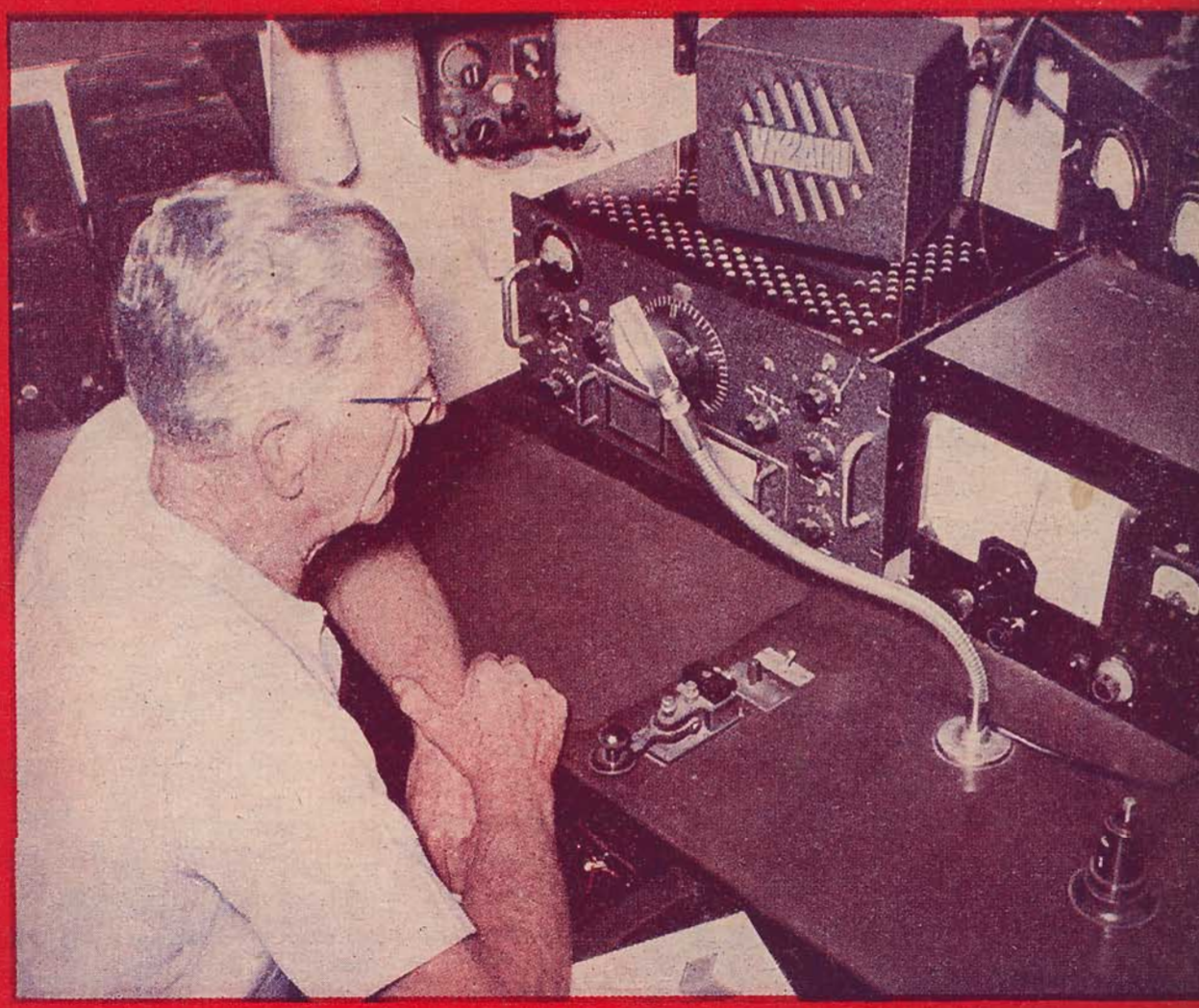
RADIO TELEVISION AND HOBBIES

2/6

Vol. 19 No. 13
APRIL, 1958

Registered in Australia for transmission by post as a periodical.



Distributed in NSW by Sungravure Ltd., 21-29 Morley Avenue, Rosebery, NSW; in Victoria by Associated Newspapers Ltd., 247 Collins Street, Melbourne; in South Australia, Western Australia and Queensland by Gordon & Gotch (A/sia) Ltd.; in New Zealand by "Truth" (NZ) Ltd.; in Tasmania by Davies Bros. Pty. Ltd. ("The Mercury" Hobart).

EDITORIAL

ATN'S coverage of the Queen Mother's visit to Canberra was more than a stunt.

It was a spectacular attempt to widen its activities beyond the primary purpose of a TV station—provision of programmes and entertainment from the local scene.

Sooner or later—I hope sooner—TV must set out to cover the continent.

ATN provided sharp proof that it can be done now, at least in part, if those who want it have enough initiative, and command equipment within the normal requirements of a well-planned station.

It was significant that the first big hop should have been to Canberra to cover an event of national importance. It was with this knowledge in mind that ATN's facilities were made available to the other Sydney stations, without prejudice to the prestige of either.

Now that the ice has been broken, is it too much to expect that strenuous efforts will be made to follow up this success?

For whether we like it or not, the stature of TV in Australia is destined to increase much more quickly than it did overseas. And the very fact that our major centres are so dispersed makes early linkage of programme material all the more urgent.

The obvious channel which should be created without delay lies between Sydney and Melbourne. It is along this line, passing as it does through Canberra, that most of our national events take place.

Later on, extensions from either end will take in Adelaide and Brisbane, and points on the way.

We have at least two important items, both first-class TV material, coming up later in the year.

One is the Melbourne Cup, which creates more national interest than any other single event.

The other is the England-Australia Test series.

We saw the impact made on viewers by Davis Cup matches. Stations used fast aircraft to fly films across the country, but how much greater was the interest in the direct telecasts.

Isn't there time for a combined effort by stations at each end and the P.M.G.? Between them they could pioneer the overland link.

I think the public is justified in hoping that they will.

John Moyle

INDEX

RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

EDITOR
JOHN MOYLE
S.M.I.R.E. (Aust.)

TECHNICAL EDITOR
NEVILLE WILLIAMS
M.I.R.E. (Aust.)

TECHNICAL STAFF
MAURICE FINDLAY
A.S.T.C.
PHILIP WATSON
A.M.I.R.E. (Aust.)
W. YASHIN
MERVYN HUDDLESTON

Vol. 20 No. 1

SUBSCRIPTION RATES

C'wealth, N.Z., N. Guinea, Fiji — £1/10/- p.a.
United Kingdom — £1/13/- p.a.
British Empire — £1/15/- p.a.
Foreign — £1/17/- p.a.

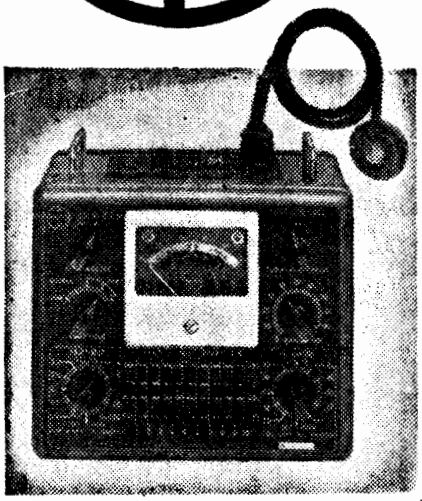
Phone ---------- BO944

OUR COVER PICTURE

Amateur radio is still one of the world's best hobbies. Harry Hatton, veteran Australian amateur, listens to the new generation on the air.

Palec

Range of TV and RADIO INSTRUMENTS



MODEL MX47

Forty-seven Range Television Multimeter. 20,000 ohms per volt.

Current: AC and DC to 10 Amp.
Voltage: AC and DC to 3000 Volts
Resistance to 50 Megohms (Int. Batteries) to 500 Megohms (ext DC Supply).
Decibels, Output etc.

METER PROTECTION

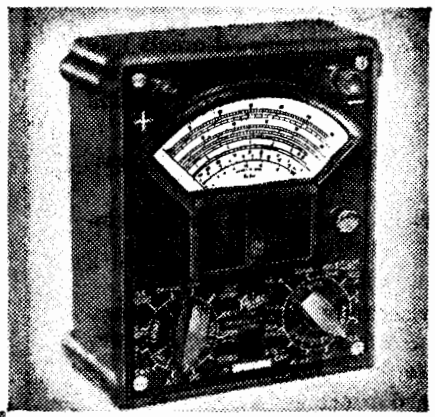
High voltage DC Probe to extend range to 30,000 volts available.

MODEL ET4A TUBE TESTER

Embodying a Self Cleaning, Flexible, Lever Action Element Switch in accordance with R.M.A. code which will completely cope with past, present and future RADIO AND TELEVISION TUBES, including PICTURE TUBES, tubes with tapped filaments or double supported elements, etc. Picture tube extension lead extra.

MODEL MX 32. Thirty-two range.
Television Multimeter:—20,000 O.P.V.
Current: AC to 10 Amp.
Current: AC 0-1 mA (for use with ext. C.T.).
Voltage: AC and DC to 1000 Volts.
Resistance: 0-10 Megohms (Int. Battery), Decibels, etc.

MODEL M32. Thirty-two range.
Radio and Electrical Multimeter:—1000 O.P.V. Ranges as MX32.



Model TV-M Vacuum Tube Volt-Ohm-meter.

This instrument is a basic necessity for Television Service.
Features; DC Volts, AC Volts, RMS, AC Volts Peak to Peak; Resistance to 1000 Megohms and Decibels, 42 ranges in all.
Extra:—Crystal Diode Probe (TVHF) extends HF measurements to 400 megacycles.
High Voltage Probe (TVP) to extend DCV range to 30,000 Volts

MODEL M52. Fifty-two range.
Laboratory Multimeter:—1000 O.P.V.
Current: AC and DC to 30 Amps.
Voltage: AC and DC to 1000 Volts.
Resistance: 0-5 Megohms (Int. Batteries), Decibels, Output, etc.

MODEL M42. Forty-two range.
General Purpose Multimeter:—1000 O.P.V.
Current: AC and DC to 10 Amps.
Voltage: AC and DC to 1000 Volts.
Resistance: 0-5 Megohms (Int. Batteries), Decibels Capacity etc.

Common Features of Multimeter Models 47, 52 and 42.
Semi-hard rubber housing. Spring loaded jewel bearing meter movement to minimise effects of shock; Range steps 1, 3, 10, 30, etc.

Send for descriptive literature.
Terms Available.

TRADE PRICE LIST

(Subject to Alteration without notice.)

MODEL	Description	Trade Price
ET4a	Tube Checker	£37 15 0
PTL	Picture Tube Extension Lead	£1 7 6
TVM	Vacuum Tube Volt-Ohm meter	£49 17 6
TVP	High Voltage DC Probe to extent range at TVM to 30,000 Volts	£9 10 0
TVHF	H.F. Crystal Diode Probe to extend TVM to 400 megacycles	£4 17 6
MX32	Multimeter (20,000 Ohms/Volt)	£25 17 6
MX47	Multimeter (20,000 Ohms/Volt)	£39 15 0
MXP	High Voltage DC Probe to extend range of MX47 and MX32 to 30,000 Volts	£9 10 0
M32	Multimeter	£17 18 6
M42	Multimeter	£32 12 6
M52	Multimeter	£43 15 0

All prices subject to 12½ per cent sales tax

SERVICE

Our Australian-built products have the advantage of being backed by local factory services.

TECHNICAL PROBLEMS

Our Technical facilities are at your disposal.

Australian Agents for
MEGATRON PHOTO-ELECTRIC CELLS.

WRITE FOR CATALOGUE TO:—

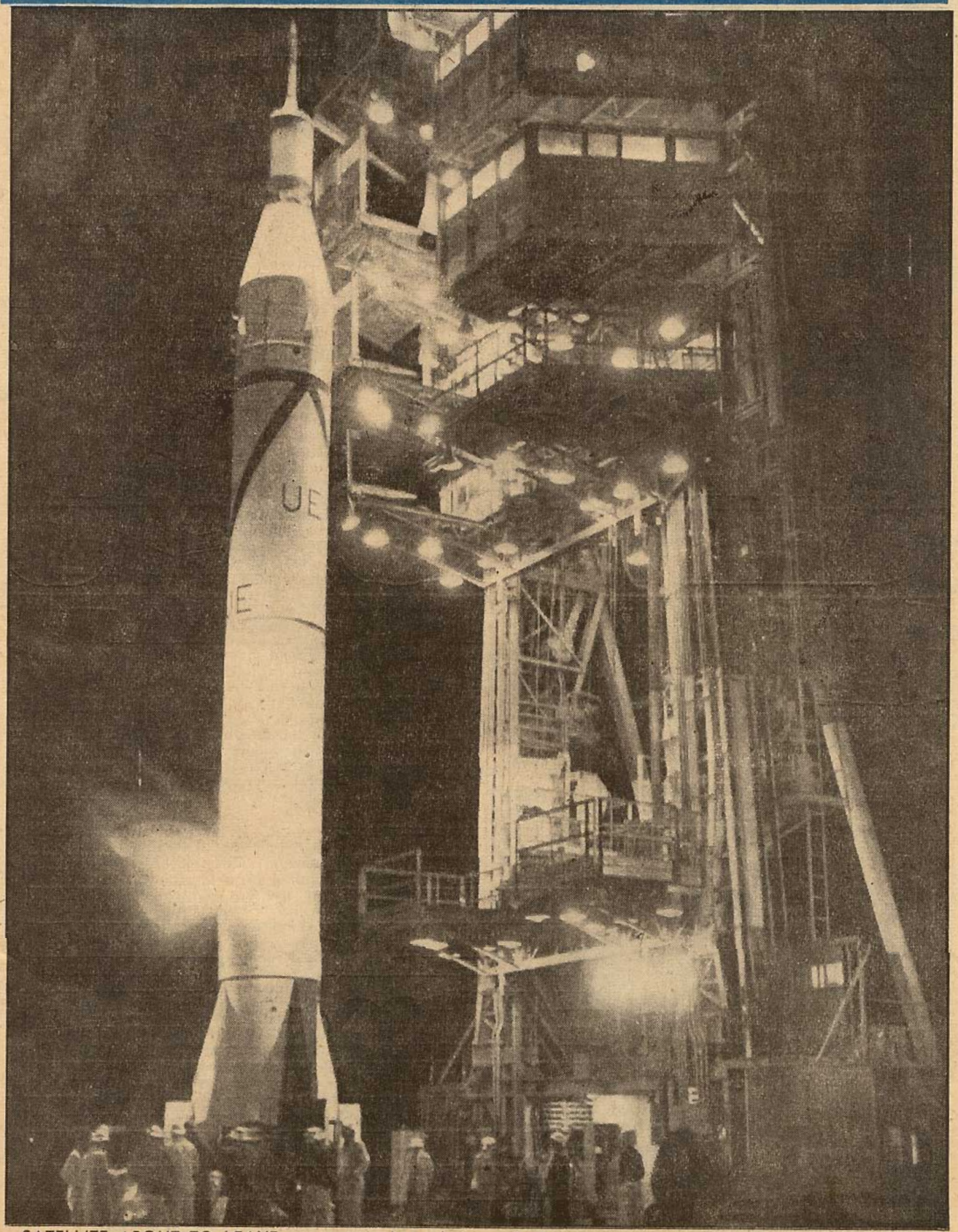
Paton Electrical Pty. Ltd.

ASHFIELD, SYDNEY • UA0381 (5 lines)

REPRESENTATIVES:

MELBOURNE: R. G. Holloway, 299 Little Lonsdale St., **BRISBANE:** K. H. Dore & Sons, 465 Adelaide St. **ADELAIDE:** Newton McLaren Ltd., 17-23 Leigh St. **PERTH:** Carlyle & Co. Ltd., 915-917 Hay St. **TASMANIA:** Gabbie Harvey Pty. Ltd., 76 Wellington St., Launceston. **NEW ZEALAND:** Carrel & Carrel Ltd., 41 Shortland St., Auckland.

THE START OF A LONG JOURNEY



SATELLITE ABOUT TO LEAVE—an outstanding photograph of the Jupiter-C missile prior to launching of the first U.S.A. earth satellite at Cape Canaveral. (See story page 16).

Solving The Riddle Of Superconductivity

By B. T. MATTHIAS

Superconductivity is the property exhibited by certain metals by which they lose all electrical resistance when cooled to a few degrees above absolute zero Although the phenomenon has not been completely explained, it has now been found to adhere to some simple rules. At the moment its main interest is academic, but it is one of those natural happenings which developing techniques could transform into an item of great importance.

IT was almost 50 years ago that Heike Kamerlingh Onnes a Dutch investigator of the behaviour of matter at very low temperatures, passed an electric current through some frozen mercury and made a startling discovery.

He found that, at a few degrees from absolute zero, all resistance to the flow of the current disappeared.

Physicists today are still hunting for an explanation of this bizarre phenomenon of super-conductivity, which seems to contradict some or our basic ideas about nature. But though we do not understand it very well, we are beginning to learn enough about superconductivity to make use of it.

This article is a report of some recent work which suggests that it may be possible to make superconductors which can be used in electrical equipment held at low temperatures.

NORMAL CONDUCTION

Let us begin by considering the normal conduction of an electric current by a metal. We know that the current is transmitted by the motion of electrons driven through the metal's crystal lattices by the applied electric voltage. The electrons collide with the atoms in the lattice; this impedance of their motion constitutes the conductor's electrical resistance.

The resistance increases as the temperature increases, because the vibrating atoms in the lattice then oscillate over wider distances from their lattice positions and interfere with the electrons' motion more strongly.

Now it is reasonable to suppose that if the atoms' vibrations were completely stilled by reducing the temperature to absolute zero, resistance to the flow of electrons might drop to an undetectable level. But Kamerlingh Onnes found that resistance vanished abruptly at several degrees above zero.

Mercury became superconducting at 4.2 degrees Kelvin certain other metals did so at different temperatures in the low range down to around one degree — the lowest Kamerlingh Onnes could reach. Later the German physicist, W. Meissner, discovered another peculiar property of metals in the superconducting state. They were impervious to a magnetic field; placed between the poles of a magnet, they completely expelled the field, so that the lines of magnetic force went around the material.

About 20 years ago Fritz London, a German-born physicist then working in England, suggested a theory about the behaviour of matter in the superconducting state. Since the free movement of electrons through a superconducting metal is analogous to the unimpeded motion of electrons in their orbits around the nucleus of an atom, London reasoned that an external magnetic field fails to penetrate a superconducting material because it shifts the large "orbits" of the electrons in the material so that they set up a counteracting magnetic field of their own.

London's concept gave an understandable picture, but, of course, it did not explain why a mass of materials should behave like a single giant atom — that is to say, why reduction of the material to a very low temperature should create unobstructed orbits for the flow of electrons.

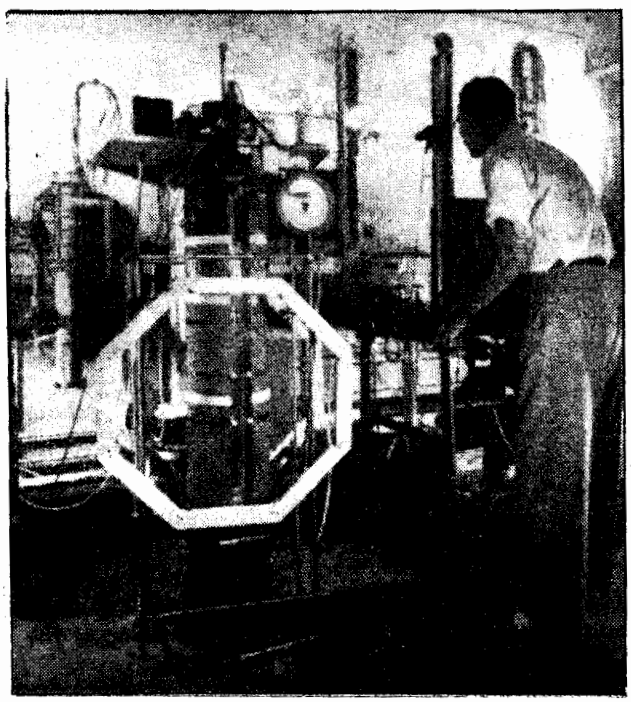
VIBRATING ATOMS

In 1950, H. Frohlich, at Purdue University, and John Bardeen, of the Bell Telephone Laboratories, attempted a more specific explanation. Their theory said that at low temperatures the vibrating atoms in a crystal lattice no longer obstruct the flow of electrons, but on the contrary, begin abruptly to conduct this flow in a wave-like way; in other words, the lattice vibration itself becomes the agent that makes the metal superconducting.

According to the Heisenberg uncertainty principle in the quantum theory, the vibrations of atoms can never die away entirely. Even at absolute zero the atoms in a lattice would retain an irreducible motion, called "zero-point vibration."

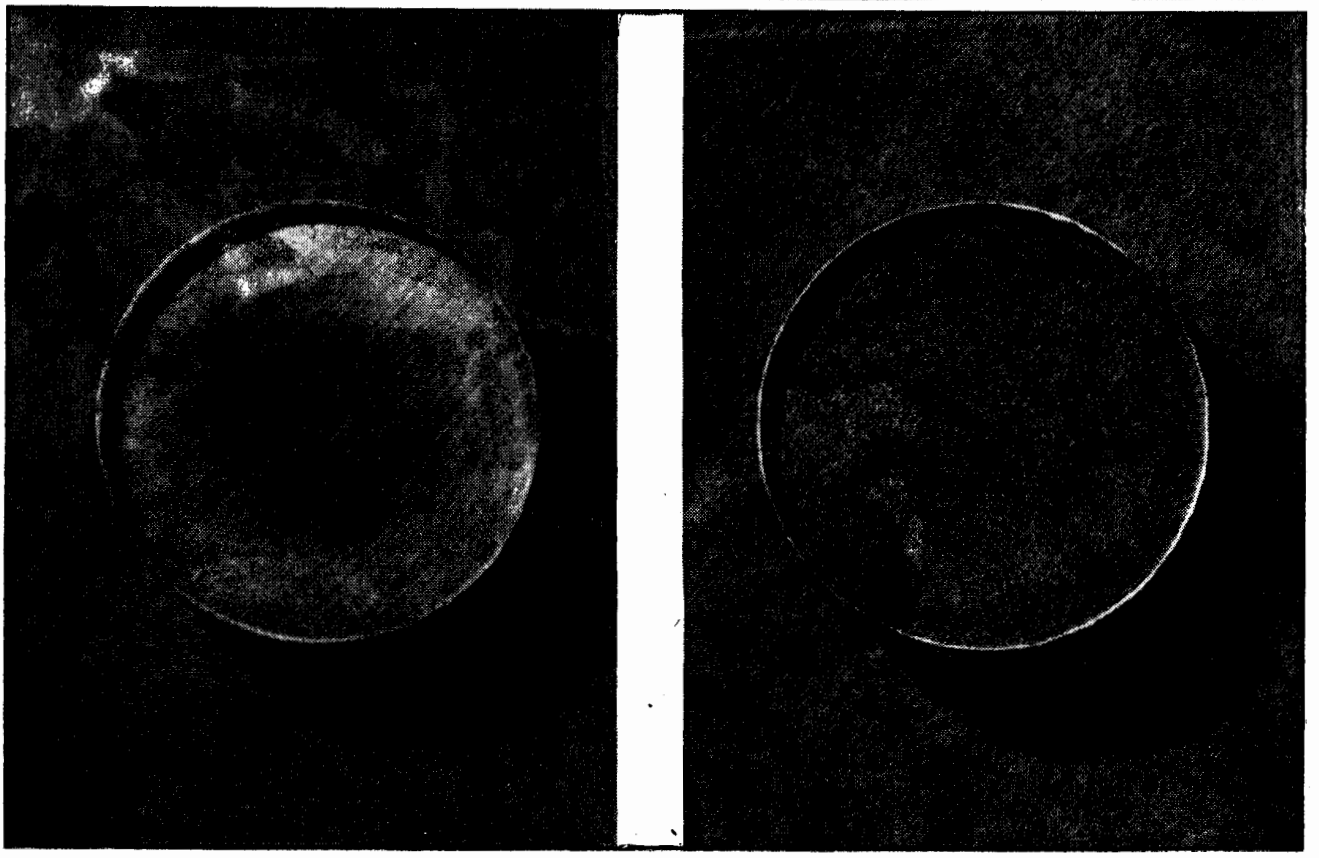
The Frohlich-Bardeen theory of superconductivity holds that, at very low temperatures, these vibrations of atoms and the motions of electrons are synchronised, so to speak. As a result of the interaction between the atoms and the electrons, the electrons reduce their energy and ride along with the lattice vibration as on a wave. Thus resistance to the flow of electrons disappears.

The theory was suggested by the fact that metals which are comparatively poor conductors at normal temperatures are most apt to be superconductors at low temperatures. Frohlich and Bardeen reasoned that since these metals have a strong scattering effect on electrons at elevated temperatures,

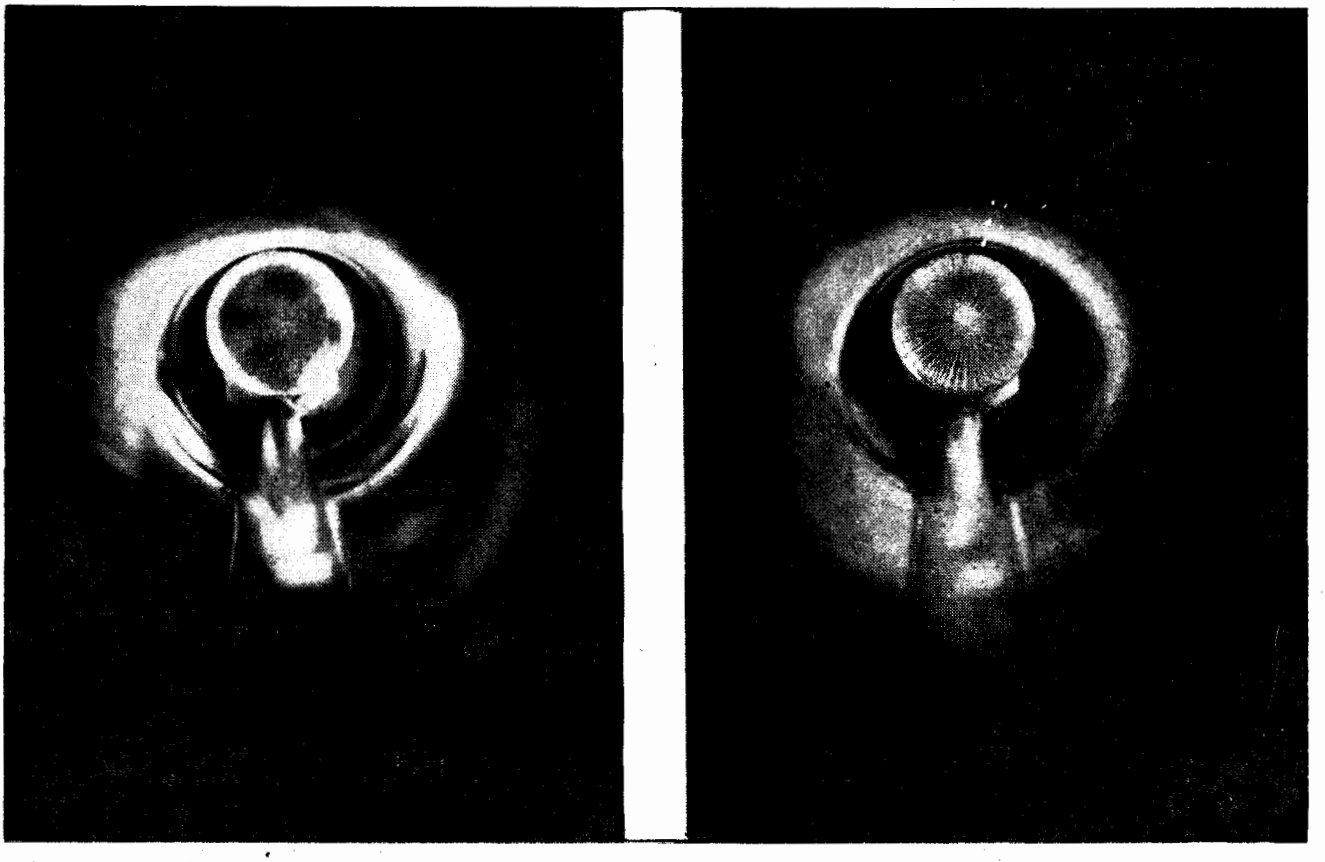


Effect of a magnetic field on superconducting metals is studied with this apparatus in the Bell Telephone Laboratories. A sample of superconducting metal is placed in liquid helium at the bottom of the cylinder at left.

TREATMENT OF SAMPLES FOR SUPER-CONDUCTIVITY



Sample is prepared for an experiment with the apparatus on the opposite page. At left is a disc of very pure tin surrounded by a low retaining wall made of paper. **At right, the surface of the** disc has been covered with a powder of the element niobium.

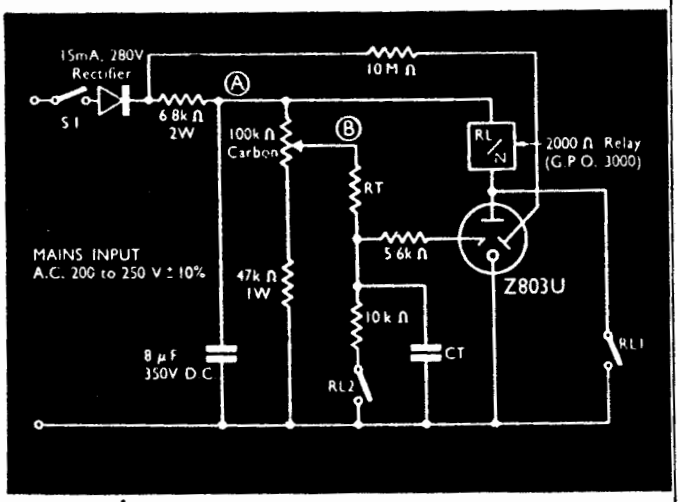


Sample is lowered into apparatus (left). Around it is the silvered wall of an insulating Dewar flask. After an electromagnet around the flask has been switched on, the particles of niobium move into superconducting and non-superconducting areas (right).

FOR TIMER SIMPLICITY AND ACCURACY

Z803U

TRIGGER TUBE



The Z803U trigger tube can be used for a variety of timer, voltage control and general relay applications. It has an extremely stable trigger voltage over a very long operating life and offers the advantages of all Mullard cold cathode tubes — no heater supply requirements, no waiting for "warming-up" and good mechanical strength.

Typical of the applications of the Z803U is the simple interval timer described here which can cover the range between 5 seconds and 10 minutes. It may be operated direct from any a.c. mains supply between 200 and 250 volts.

To start a timing sequence the mains supply is switched on (S1). The d.c. voltage at point A will then rise, in about 100 milliseconds, to between 184 and 282 volts, the actual level depending on the value of the local mains voltage. The timer capacitor CT will start to charge up through RT, the timer resistor.

When the voltage on CT reaches the critical trigger voltage of the Z803U the tube will fire, pulling in the relay, partially discharging the 8 microfarad smoothing capacitor, and lowering the voltage at A.

The relay will self lock on contact RL1 thus extinguishing the Z803U, and the relay current will then be limited by the 6.8 k Ω series resistor. Contact RL2, which should make after RL1, re-sets the timer capacitor to zero volts.

However, the relay drops out only when S1 is opened. A new sequence can then be started on reclosing S1.

The 100kΩ preset potentiometer allows the timing circuit voltage to be set up so as to compensate both for component tolerances and for the value of the local supply voltage. The pre-firing voltage at point B will be about 170 volts.

The values of RT and CT will be set by the required time interval T′, and can be determined from the fact that T′ = 1.6 RT.CT.

RT should be a high stability resistor, while CT must be a capacitor with a small power factor, e.g., a paper or plastic film capacitor. All other components are of ± 10% tolerance.

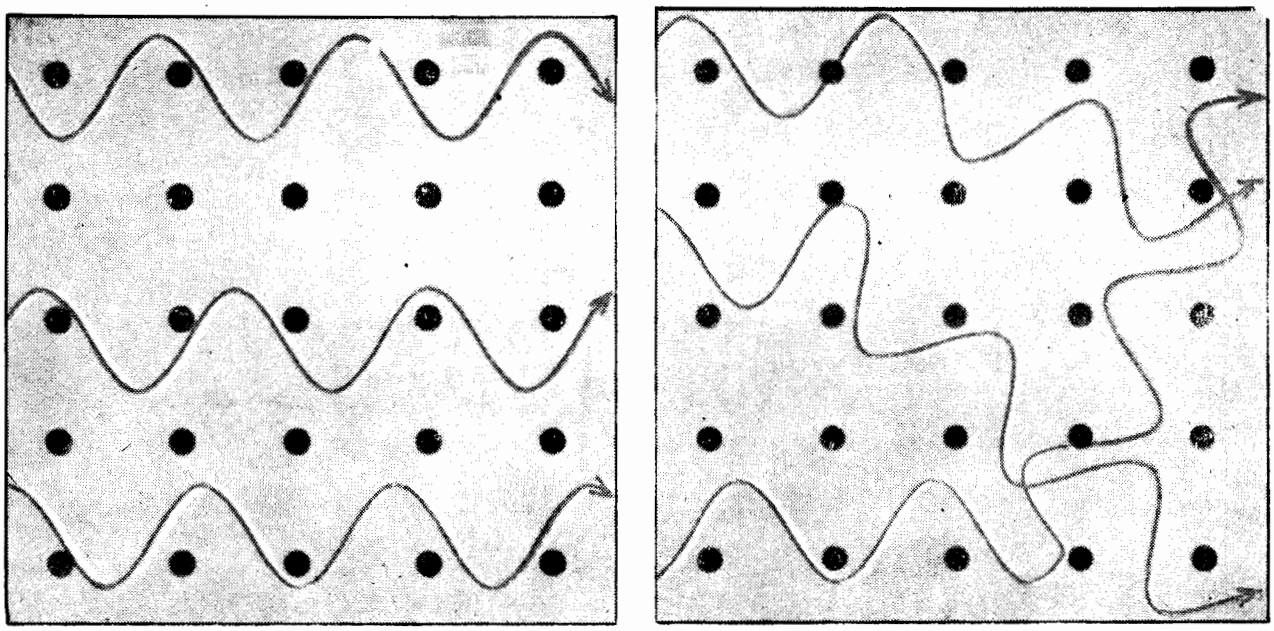
Mullard

Mullard

TECHNICAL SERVICE DEPARTMENT

MULLARD-AUSTRALIA PTY. LTD., 35-43 CLARENCE STREET, SYDNEY. BX 2006. 592 BOURKE STREET, MELBOURNE. MU 2366
ASSOCIATED WITH MULLARD LIMITED, LONDON. MULLARD OVERSEAS LIMITED

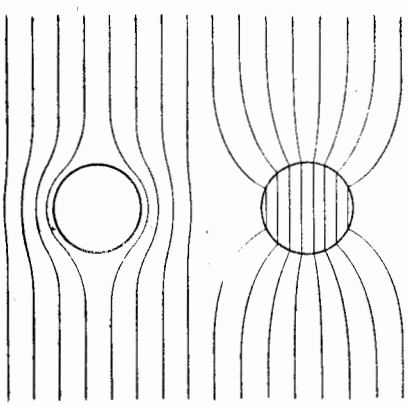
M48



Superconducting electrons (wavy lines at left) interact in an orderly way with atoms (dot) in a crystal. Ordinary conducting electrons (right) are deflected by atoms.

they should have a strong ordering effect on electrons when the vibrations of their atoms and the motions of electrons become co-ordinated at low temperatures.

On this reasoning, materials whose vibrating atoms interact strongly with electrons should become superconductors more readily (i.e., at higher temperatures above absolute zero) than those whose atoms interact weakly with electrons. As a corollary, the heavier the



Effect of superconductivity on a magnetic field is depicted in these schematic drawings. A sphere of ferromagnetic material (circle at left) concentrates the lines of force in a magnetic field. A sphere of superconducting material (circle at right) expels the field.

element, the less likely it is to become a superconductor, because its low-temperature vibrations will be comparatively slow.

Frohlich predicted that light isotopes of an element would become superconducting sooner (at higher temperatures) than the heavier ones, and this proved to be true.

Recently Bardeen, Leon N. Cooper and J. Robert Schieffer at the University of Illinois worked out a more complete new theory. It yields a correct description of properties of a superconductor, but there is still some question about the mathematical rigour of its treatment of the magnetic effect.

In 1950 John K. Hulm and I decided to try an entirely different approach. Since the theories offered no dependable means of predicting just what substances might be superconductors, or at what temperatures they would reach this state, we set out to find superconducting materials strictly by experiment.

Our hope was that after we had tested a large number of substances, we might begin to see a pattern which would identify some of the physical and chemical properties associated with superconductivity.

VALENCE ELECTRONS

Having almost no clues as to where to look, we tried one compound after another. At first we seemed to be getting nowhere. But after three years of testing a great number of compounds a crucial fact began to emerge.

It appeared that the decisive factor determining how readily a substance would become superconductive was the number of valence electrons possessed by its atoms—valence electrons being those in an outer unfilled shell.

We found that the only substances which became superconducting were elements or compounds with an average of between two and eight valence electrons per atom. And within this range the materials with an odd number of valence electrons per atom—three, five or seven—become superconducting most easily (furthest above absolute zero).

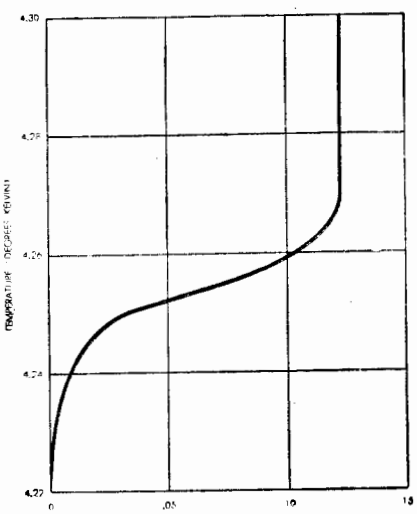
Here is the kind of rule we have been looking for. We now have a specific guide to finding or synthesising superconductors. We should seek substances with an average of three, five or seven valence electrons per atom.

To this rule we can add a few other helpful clues: it is known, for instance, that superconductivity is favoured by certain kinds of crystal structure and by the amount of empty space in the crystal (i.e., space not occupied by atoms).

With these empirical rules to steer us, we have been able to produce many superconducting materials. I shall illustrate with a few particularly striking examples.

The rare element technetium, found only as a product of uranium fission in atomic reactors, has seven valence electrons and a crystal structure favourable for superconductivity. John G. Daunt and James W. Cobble at Ohio State University had found that technetium does, in fact, become a superconductor at a relatively high temperature—11 degrees Kelvin.

Now the elements before and after technetium in the periodic table, are, respectively, molybdenum and ruthenium. Ruthenium, with eight valence electrons, has to be cooled to within half a degree above zero to become superconducting. Molybdenum, with six valence electrons, cannot be made super-conducting at all at the lowest at-



Electrical resistance of mercury is plotted against temperature. The resistance disappears entirely at about 4.2 degrees Kelvin (4.2 degrees centigrade above absolute zero).

MAGNETIC SOUND INDUSTRIES

Nothing But TAPE RECORDERS from £65 or £10 dep.

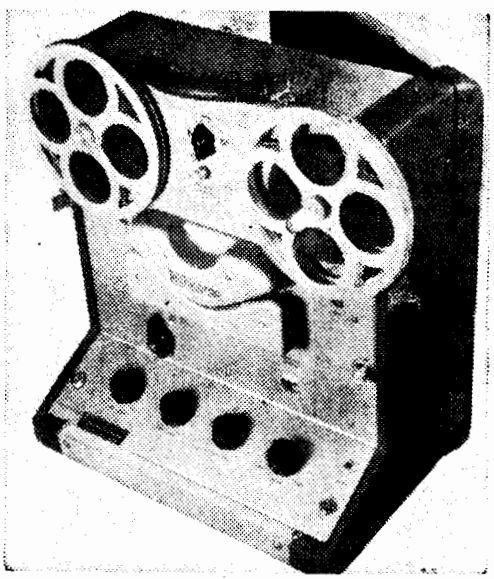
Only Magnetic Industries can offer you tape recorders from this amazingly low price. And not only is the price right, but we have the largest range of tape recorders in Australia. EVERY machine we sell, brand new or reconditioned, carries our full UNCONDITIONAL GUARANTEE

FIRST RELEASE:

NEW WALTERS TAPE RECORDER £79/10/-

De-luxe model £89/10/-

It's brand new and exclusive to Magnetic Sound Industries. The Walters is all British made and the least expensive tape recorder ever. Weighs only 19lb, frequency response 40-10,000 cycles. 1½ hours playing. It features a large inbuilt loudspeaker, single knob operation for added simplicity and a smart 2-tone carrying case. Ideal for music or speech, records from radio or microphone. Only **£79/10/-.**



TECNICORDA

SEMI-PROFESSIONAL HIGH FIDELITY MODEL UG4

Frequency range of 50-1200 cps, 3 motors, inbuilt mixing control. Carries our exclusive 12 MONTH GUARANTEE. £149/2/-. Free Microphone stand.

Guaranteed Used Tape Recorders

Magnetic Sound Industries has more than 25 makes and models —all FULLY GUARANTEED, all reconditioned in our own workroom—all at SYDNEY'S LOWEST PRICES.

A.W.A. several to choose from £65
TECNICORDERS at £75 and £85
ELCON standard model £65
ELCON complete with radio £85

THIS MONTH'S SPECIAL RELEASES:

GELOSO: world's smallest tape recorder from Italy, weighs only 8 lb. Wonderful reproduction, 2 speeds, press-button operated. Complete with tape, high-grade microphone and zip carrying bag. **£89/10/.** ACOS Crystal stick microphone, **£8/19/6.** Hear the famous Tanberg tape recorder—3 speeds, up to 8 hrs. recording.

WE SELL, SERVICE, HIRE AND BUY GOOD TAPE RECORDERS

MAGNETIC SOUND INDUSTRIES (AUST.)

STREET LEVEL, BISLEY HOUES, 387 GEORGE ST. PHONE BX4440 or BX4587

superconducting at all at the lowest attainable temperature (around one tenth of one degree above absolute zero).

But if we make an alloy composed of equal parts of molybdenum and ruthenium, so that the average number of valence electrons per atom is seven and the crystal structure is identical with that of technetium, the combination becomes superconducting at 10.6 degrees —almost exactly the same as technetium's transition temperature!

Molybdenum can be made a superconductor by dissolving in it a little rhodium, which has nine valence electrons and therefore raises the average number in the mixture to slightly more than molybdenum's six. The same is true of tungsten, which like molybdenum has six valence electrons and will not become superconducting alone. We have produced many different superconductors by alloying molybdenum or tungsten with other elements, such as columbium (niobium), phosphorus, antimony or boron.

It is even possible to make a superconductor by combining two elements which by themselves are totally unfitted for this property.

SPECIAL SUPERCONDUCTOR

A good example is the combination of silicon and cobalt. Silicon, of course, is not a metal or a conductor of electricity. Cobalt has two qualities which completely disqualify it for superconductivity, it has nine valence electrons and is strongly magnetic. Yet when silicon and cobalt are combined in a cubic crystal structure, they become a superconductor, because the silicon neutralises cobalt's magnetism and reduces the average number of valence electrons per atom to the appropriate range.

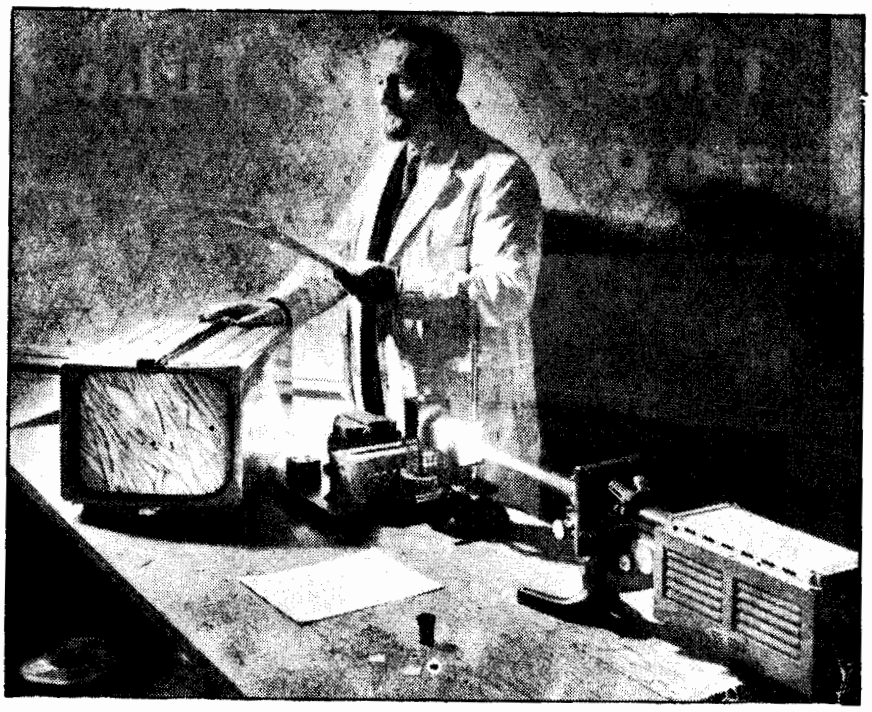
Again they can employ another type of manipulator based on the fact that crystal bulklines promote superconductivity. There is a compound of nickel and arsenic which has a favourable crystal structure and a favourable valence-electron number, yet it fails to become superconductive as we would expect. What we did in this case was to replace half the nickel with the bulkier atoms of palladium, and this mixture then became a superconductor.

We found that the most favourable crystal structure for superconductivity was the one called the beta-tungsten structure—a cubic arrangement of eight atoms which makes the crystal bulky, with considerable space between some of the atoms.

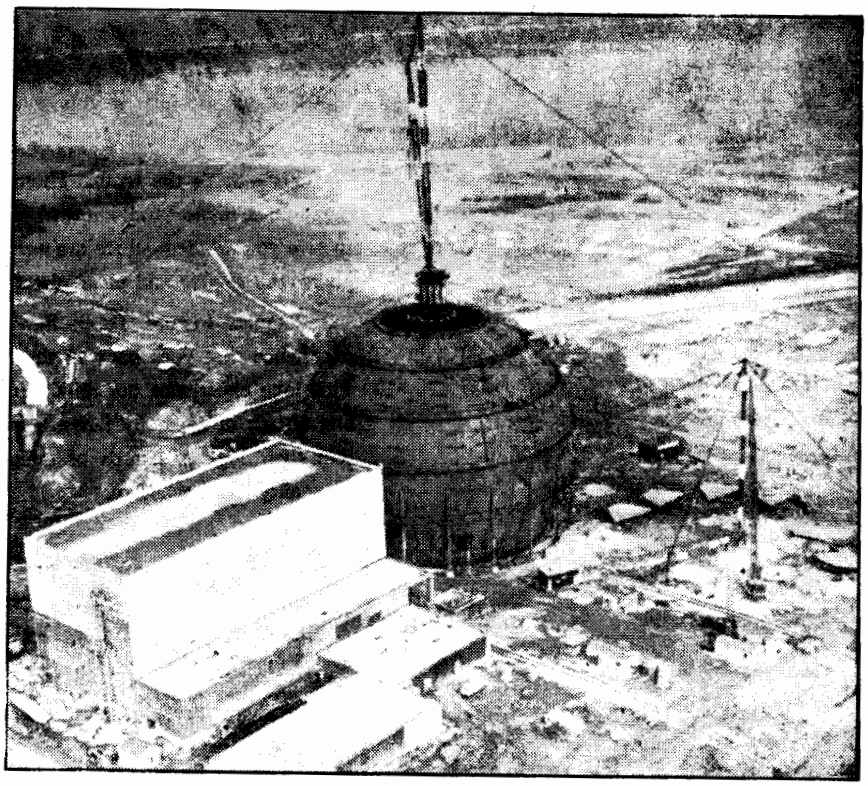
Compounds with this structure and a valence-electron average between 4.5 and 4.75 per atom proved to be particularly disposed to become superconducting. On that basis we deduced that a compound of tin and columbium should reach the superconducting state at a comparatively high temperature. It turned out that this compound could be made and did in fact become a superconductor at slightly above 18 degrees Kelvin — the highest transition temperature yet found.

We can conceive of substances that may have transition temperatures as high as 30 degrees, but so far we have not succeeded in making stable compounds with the necessary specifications. At all events, transition temperatures such as 18 degrees already bring us into a range where we can begin to envision putting superconductors to work in a practicable way.

TV AIDS IN CANCER RESEARCH

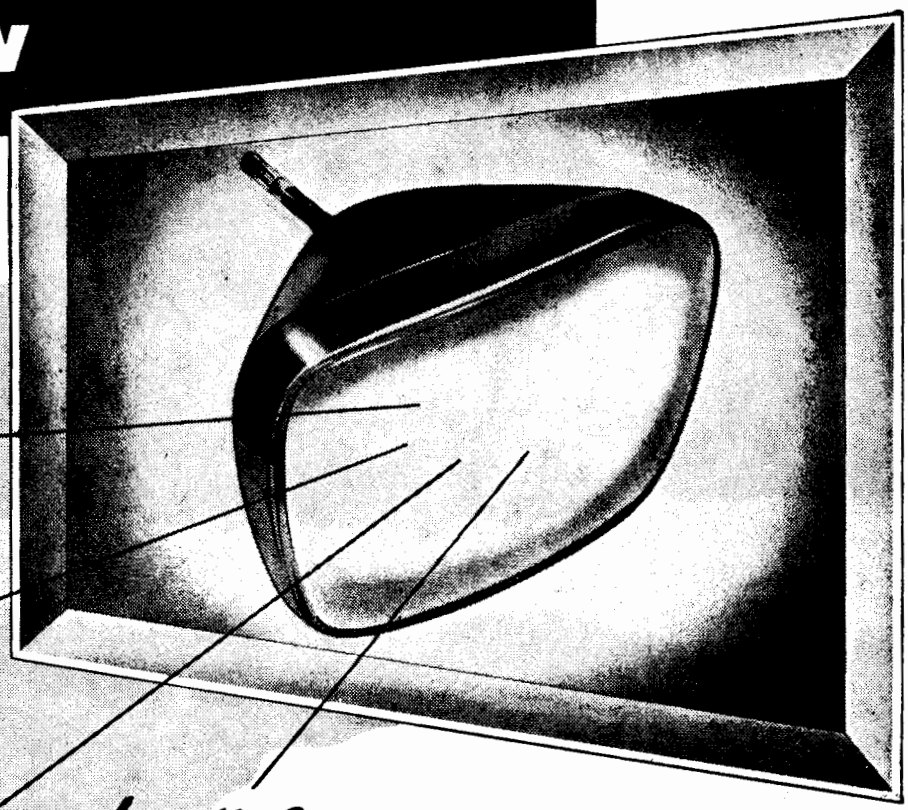


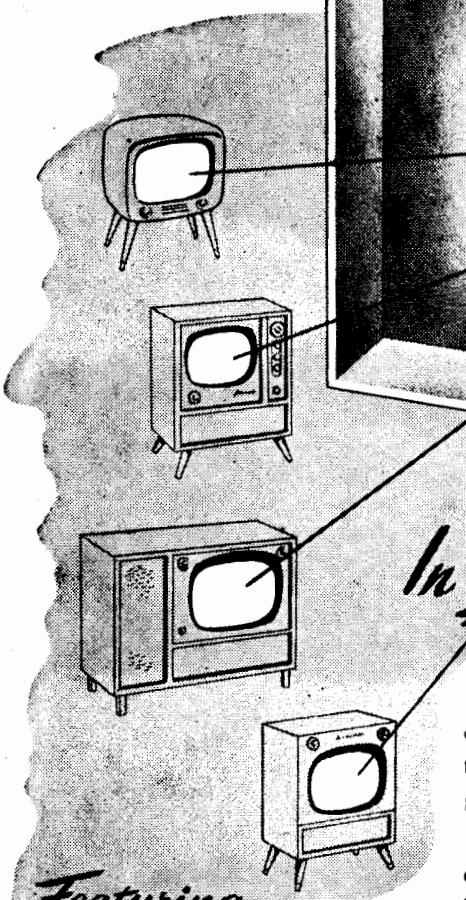
Closed circuit television for cancer research and as a medium for general research in education was demonstrated recently at the Northern Polytechnic (London). An audience of about 45 scientists, doctors and educationists saw a new £1,000 ultra-violet television microscope demonstrated for the first time. An industrial camera projects the microscope image on the screen. Picture on the screen shows crystals of ammonium platino cyanide.



Nuclear power plant at Dresden U.S.A. takes shape on the Illinois waterway, 50 miles north-west of Chicago. The steel sphere, 190ft in diameter, will house the boiling water reactor assembly supplying power for the turbines. Scheduled for 1960, the plant will produce 180,000 Kilowatts—cost 45 million dollars.

The 'Picture' Tube for TOP TV





In all Good Sets-EVERYWHERE

Yes—that's the truth. Thomas Picture Tubes occupy an honoured place in most well-known TV sets sold in Australia to-day. Just to give you an idea—there are **many, many thousands** of Thomas Tubes giving top service and clear pictures throughout Australia right now.

Thomas Picture Tubes have a manufacturing background of experience that goes back to the beginning of picture-tube history. This long experience not only explains why Thomas Tubes are the first choice of so many famous-name TV set makers, but also proves that their high standards of manufacture are your best guarantee of quality and reliability.

Featuring

- ★ Aluminised Screens
- ★ Electrostatic Focus
- ★ 90° Deflection
- ★ Short or Standard Length Necks.

Thomas Tubes for TV *TOP TV-Always*

Quality Products
manufactured by

Thomas Electronics of Australia Pty. Ltd.

Thomas PICTURE Tubes

ATN's HISTORIC MICROWAVE LINK

This picture shows the installation at Repeater No. 1 (Mt. Gibraltar). In the back of the van is a motor-generator set for power. In the foreground are seen two of the microwave parabolic aerial reflectors, units of equipment ready to be unpacked, and connecting cables. All this was later manhandled to the elevated site.

Television station ATN in Sydney performed a remarkable feat on February 25 when it televised the visit of the Queen Mother to Canberra. It covered the inspection of Duntroon Military College in the morning, and the Ball at Government House in the evening. This was done by use of a micro-wave TV link operating over a total distance of 170 miles.

THIS is believed to be the longest TV link ever attempted by a station using its own facilities.

ATN is a prolific user of these links. There is one permanently installed to carry normal programs from the studios at Epping to the transmitter at Gore Hill. The receipt of new link equipment to supplement that already in use meant that, for the occasion, ATN was able to mount two repeater points in addition to its normal OB van, and these were used for the broadcast.

The first link was established on Mt. Gibraltar between Moss Vale and Mittagong—a well known high spot much favoured for many years by amateur experimenters on VHF and used for P.M.G. telephone link equipment.

The second repeater was installed on the top of a high mountain outside Canberra in such a position as to allow a clear path back to Gibraltar, and down to the valley in which Canberra lies.

The distance between the two repeater points was approximately 85 miles, and a further 20 miles carried the signals into Canberra.

The occasion was the result of much careful planning extending over several weeks. Because of the extremely long hops involved, an initial survey of the path was made, and the probable behaviour of the equipment calculated to ascertain whether sufficient signal strength would be forthcoming.

Later, field parties went out to verify these forecasts, and the results in practice were found to tally almost exactly, demonstrating that the telecast was quite practicable.

A pilot run made about a week before the event, ironed out initial problems.

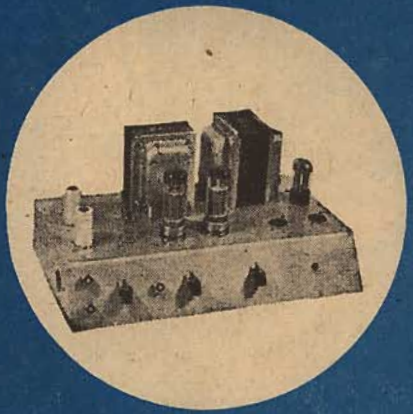
Careful co-ordination was needed between technical crews and their equipment, for some of these were required at the weekend to cover a surf carnival on the Saturday and a visit of the Queen Mother to A.W.A.'s factory on the Monday.

Immediately this was over, the crews left for their distant position, and commenced setting up the gear for the big event.

The arrangement of the links was as follows: The OB van, a completely equipped TV station in a truck, was located at a selected spot at Duntroon, and later at Parliament House. It transmitted its signal to the repeater on the mountain outside Canberra, using a frequency of 6,800 megacycles. This was Repeater No. 2.

The equipment at this point received the van's transmissions and used them

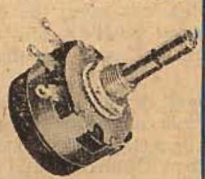
BUILDING THE 35W. P.A. AMPLIFIER?



FEATURED IN LAST MONTH'S R. & H. p. 48

Then here are the Resistors, Volume Controls, Transformer, Sockets, and Capacitors already listed for you.

JUST HAND THIS SHEET TO YOUR USUAL SUPPLIER

COMPONENT	SPECIFICATION	QTY.
INSULATED FIXED RESISTORS 	I.R.C. TYPE 4.7 Meg. ½W BTS 470,000 ohms ½W BTS 3,900 ohms ½W BTS 2,200 ohms ½W BTS 100 ohms ½W BTS 1.5 meg ½W BTS 10,000 ohms ½W BTS 82,000 ohms ½W BTS 3,300 ohms ½W BTS 1 meg 1W BTA 100,000 ohms 1W BTA 47,000 ohms 1W BTA 220,000 ohms 1W BTA	
W W RESISTORS 	I.R.C. TYPE 5 Watt Wire Wound 1000 ohm Ctg "A" AB 50 ohm 5 Watt Ctg "A" AB (Centre Tapped) 125 ohm 20 Watt Ctg "B" DG	
VOLUME CONTROL 	I.R.C. TYPE 0.5 Meg. Single Carbon Control Standard CS (Silent Spiral)	

COMPONENT	SPECIFICATION	QTY.
TRANSFORMER 	NATIONAL TYPE 325V—325V PA180/325 6.3V 4A 6.3V 4A 5V 2A	1
VALVE SOCKETS 	TELETRON TYPE Octal with mtg saddle ST48L 1 9-Pin with shield ST59G/2 2 9-Pin less shield ST29G 1	
STRIPS 	TELETRON TYPE 4- Tag SM24 1 8- Tag SM28 7	
CAPACITATORS 	A.E.E TYPE 0.1 mfd 400 Volts W48 1 .047 mfd 400 Volts W48 4 .022 mfd 200 Volts W99 2	

Also components for the associated control unit.

Wm. J McLELLAN & CO. PTY LTD.

126 SUSSEX STREET (Near King Street), SYDNEY BX 1131.

A close up of an aerial reflector at Mt. Gibraltar. John Innes is attaching the wave guide at the centre of the parabola. Radio waves emerging from the open end of the curved guide are ejected against the parabola which gathers them and radiates in a narrow "searchlight" beam.

to modulate a transmitter the output of which was beamed to Repeater No. 1 at Gibraltar on a frequency of 7,000 megacycles.

At Gibraltar, this process was repeated, and the final hop to the Epping studios was carried on a frequency of 7,100 megacycles.

After being absorbed into the normal equipment at Epping, the signals travelled over a fourth path, the fixed link used to carry programs from Epping to Gore Hill.

At the studios, the synchronising pulses received as part of the signals from Canberra were used to lock the synchronising generators at ATN, thus allowing all the normal telecasting facilities of the station to be used.

The power used in these microwave links is very small. They must depend for their operation on motor-driven generators which supply the necessary power, and because portability is largely dependant on size and weight, everything must be kept as small and as light as possible.

The radiated power of the link transmitters, therefore, is only 1 watt.

But the aerials used with them, because of their high concentration of the radiated energy into a narrow beam, effectively increase this power many times.

For instance, the large "dishes" have a gain of 11,000 times, so that the effective radiated power is increased to 11 kilowatts.

The smaller dishes have a gain of 7,000 times, which increases effective power to 7 kilowatts.

The success of the venture was illustrated by the excellence of the pictures received in Sydney, and made available to both ABN and ATN because of the national interest in the occasion.

During the telecast of the Duntroon ceremony, the signals were noticed to fade out entirely for a few seconds several times during the telecast.

Chief engineer of ATN, Mr Murray Stevenson, said that these fadeouts were not due to atmospheric conditions, but to reflections from aircraft flying in the vicinity of Canberra.

Because of the very high frequencies involved, the metal skin of the aircraft acted as a very efficient reflector, and there were times when the reflected signal cancelled out the direct broadcast from the OB van.

This phenomena is well known at these frequencies and, of course, was outside the control of the engineers on the job.

In addition to the TV link itself, a VHF telephone circuit was employed

(Continued on Page 77)

A unit in the repeater link erected at Repeater 2, somewhere outside Canberra. Here are seen the parabola and wave guide mounted on a tripod which allows the aerial to be aligned accurately to the next section of the link at the OB van in Canberra. The RF section of the equipment is mounted behind the parabola. Engineers are removing some trees which are obstructing the line of fire.

New Release

PUBLIC ADDRESS AMPLIFIERS

DUAL OPERATION mains or battery

The addition of two versatile mains and battery operated amplifiers to the extensive range of A.W.A. sound equipment provides for every requirement of mobile Public Address Operators.

Type PA828 amplifiers may be operated from 240 volt or 6 volt battery supply, changeover being effected by alternate cables which are stowed in rear of housing. A standby switch is provided to conserve battery life.

5 WATT AMPLIFIER

TYPE PA 828

20 WATT AMPLIFIER

TYPE PA 829

Type PA829 20 watt mains or 12 volt battery amplifier provides all facilities necessary for P.A. Hiring

These include two microphone channels with third optional channel for microphone or pickup. Either high or low output pickups can be used. Features include a battery saving switch and a bass cut switch to control L.F. response when using horn speakers. A plug-in V.U. meter and monitor speaker with their associated switches are ancillary units.

FOREMOST IN SOUND

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

47 YORK STREET, SYDNEY, B0233. 167 QUEEN STREET, MELBOURNE, MU9161.

Available in other States from

NEWTON McLAREN LTD., ADELAIDE NOYES BROS. (MELBOURNE) LTD., HOBART AND LAUNCESTON
CHANDLERS PTY. LTD., BRISBANE NICHOLSONS LTD. PERTH.
ALSO FROM LEADING WHOLESALERS.

WHISTLERS MAY GUIDE SIGNALS

PHENOMENA OF IONOSPHERE MAY PROVIDE NEW PROPAGATION METHOD

The ionosphere is the home of many strange radio signals whose history is largely unknown. They range over a wide band of frequencies, some of them so low as to enter the spectrum generally asociated with audio. Gradually their nature is being unravelled by research workers.

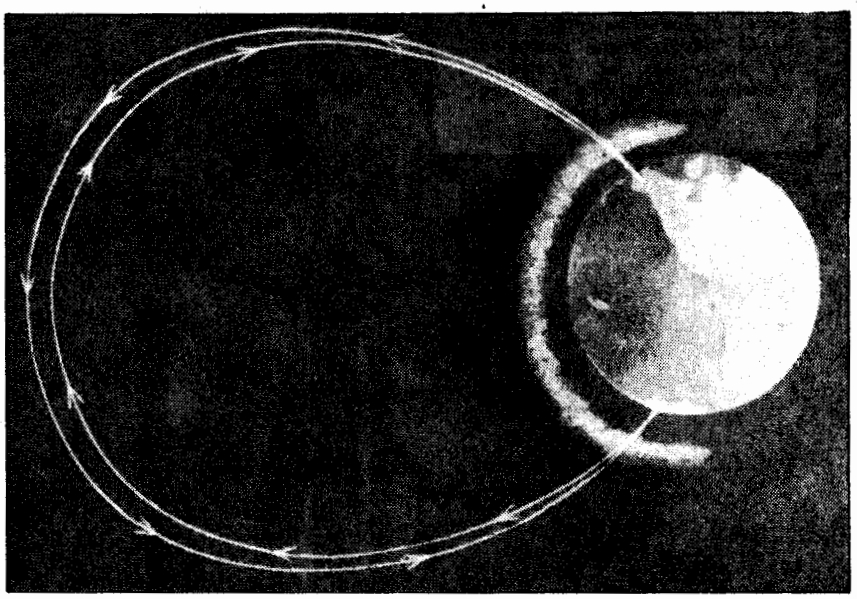


Diagram showing suspected "whistler" path as indicated by experiments at Stanford University.

THERE are signs that IGY scientists investigating natural radio signals called "whistlers" may hand us a new, reliable, long-distance method of point-to-point radio communications.

By following the paths which guide whistlers on round trips through outer space, radio signals could avoid magnetic storms in the ionosphere.

NEW LIGHT

Whistlers were first detected 40 years ago and linked to lightning discharges 30 years ago. But until six years ago, no basic understanding existed.

L. R. O. Storey postulated in 1952, at Cambridge University, that whistlers follow the earth's lines of magnetic force through ionised gases in the exosphere.

At that time there was no real proof that there is sufficient atmospheric density to support magneto-ionic ducts above the 250-mile ionospheric altitude range.

Subsequent investigations have borne out Storey's theories. Here is what is now known:

Ionized gases from the sun are formed into magneto-ionic ducts extending 25,000-30,000 miles up.

DUCT PATHS

These ducts run from a magnetic co-ordinate in one hemisphere to the comparable co-ordinate in the other hemisphere.

Whistlers bounce from hemisphere to hemisphere along one or more ducts at frequencies of 1,000 to 30,000 cycles. They are received simultaneously at points over 1,000 miles apart.

Whistler-mode propagation went beyond theory for the first time this summer when Stanford University successfully carried out a radio experiment.

A special pulse signal was sent from NSS (15.5 kc) at Annapolis to Cape Horn through the ionosphere and the exosphere. Both signals were received.

The signals over the 20,000-mile whistler path took 0.7 second longer and were 10-30 decibels weaker, but the variations in amplitude appeared systematic.

There is reason to believe that whistler-mode signals from NSS may equal or exceed the direct wave in strength at points further south (of Cape Horn), according to R. I. Helliwell, of Stanford Radio Propagation Laboratory.

If this turns out to be true, the new mode would have distinct communication possibility. New recording stations are now in the process of being readied at points in Argentina, Chile and Antarctica.

PART OF IGY

These experiments are part of a broad investigation into whistlers as part of the IGY programme in ionospheric physics. Overall results, authorities feel, will be of value to the established radio communications systems.

Whistlers provide a probe into the exosphere. Hence, they furnish data on matter in space, solar storms, magnetic storms and fields and weather causes.

One result of the IGY programme may be a map of the magnetic influences surrounding the earth — a road map for future communications.

PROGRAMME WELL ADVANCED

There are 30 whistler stations in the IGY programme. Stanford and Dartmouth College are each administering about a dozen for the U.S. National Committee for IGY and cooperating countries.

Helliwell is directing "Whistlers West" and Millett G. Morgan, of Dartmouth, is directing "Whistlers East." Both schools have pre-IGY backgrounds in whistlers.

Whistlers can be received over telephone lines or a large antenna and an ordinary audio amplifier. IGY stations use a loop antenna and specially-designed wideband equipment to achieve analytical sensitivity.

Each station makes recordings at co-ordinated times to allow world-wide comparison of signals. During IGY's 18 months, over 3,000 miles of tape will be used.

NEW ELECTRONIC DEVICE RESTORES VISION

DEVELOPMENT of a device which "sees" through fog, rain or snow was announced recently by Diamond Antenna and Microwave Corporation of Wakefield, Mass.

"Eyetron" converts microwaves into visible light, reproducing the vision of the human eye electronically.

The company claims Eyetron will permit safe landing of planes under zero visibility conditions. Other applications, the firm says, include "close navigation" for ships and harbour craft.

Eyetron is not radar, nor is its purpose to replace radar. Its chief intention is to supply the 'missing link' of present-day radar systems; that is, to fill the gap where radar is useless at close proximities and where radar-type presentation requires skilled operators.

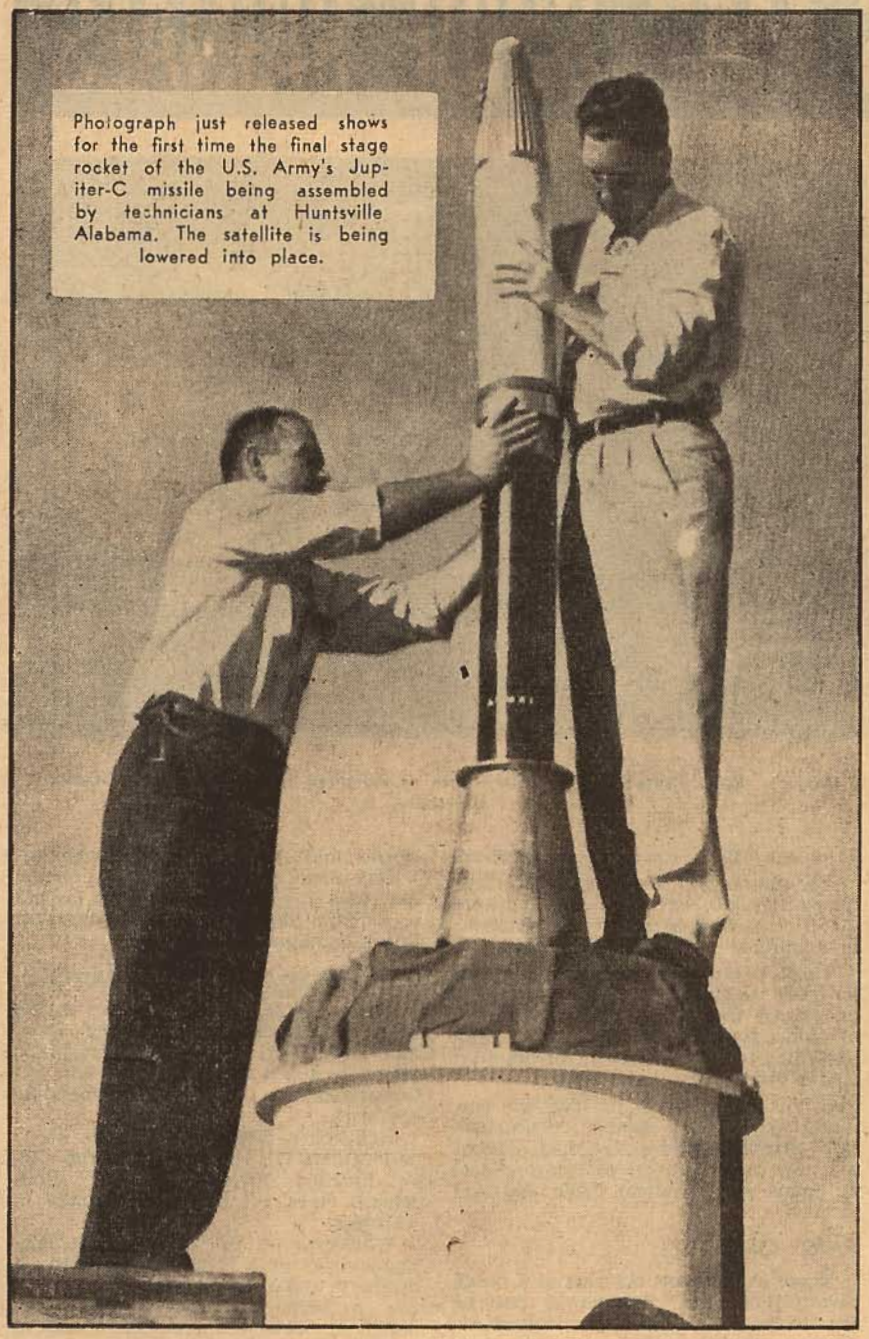
The company is withholding technical details of the device for military reasons.

Let's Look At Guided Missiles

☆

By CALVIN WALTERS

☆



Photograph just released shows for the first time the final stage rocket of the U.S. Army's Jupiter-C missile being assembled by technicians at Huntsville Alabama. The satellite is being lowered into place.

Most articles on guided missiles tend to become rather technical and specialized. This one reduces the subject to everyday language, and includes some interesting information on the histroy of missiles and rocket engines. Did you know that rockets were used at Waterloo?

WORK on guided missiles has now become a matter of the highest priority in all the major countries of the world. This is because it is realised that a guided missile is about the deadliest weapon of modern times.

Whilst it is true that the A-bomb and the H-bomb constitute the deadliest devices of destruction known to man they must be carried in some vehicle to the point where they are to be dropped.

Hitherto it has been the aeroplane which has been used for this purpose, and as the aeroplane must be manned by a crew, it is obvious that, as both man and machine are costly items to be expendable, any means of carrying and delivering the bomb without the aid of a pilot is the more satisfactory method.

A missile therefore which is guided to its destination from the ground and which can drop the bomb with accuracy is about the deadliest weapon which could be devised.

The race is on, then, for all kinds of weapons, from short and medium range missiles to the long range inter-continental ballistic types loaded with a war head.

The guided missile is a rocket. Contrary to general opinion the rocket is not a new weapon. It was used in China in the thirteenth century but not of course as a guided missile.

In 1808 Sir William Congreve first used iron war rockets which weighed about 24 pounds. These had thick iron heads and acted something like a shell from a cannon. They were fired from a tube and steadied by means of sticks attached to the sides. The fuel for these rockets consisted of saltpetre 68 parts, sulphur 12 parts and charcoal 32 parts.

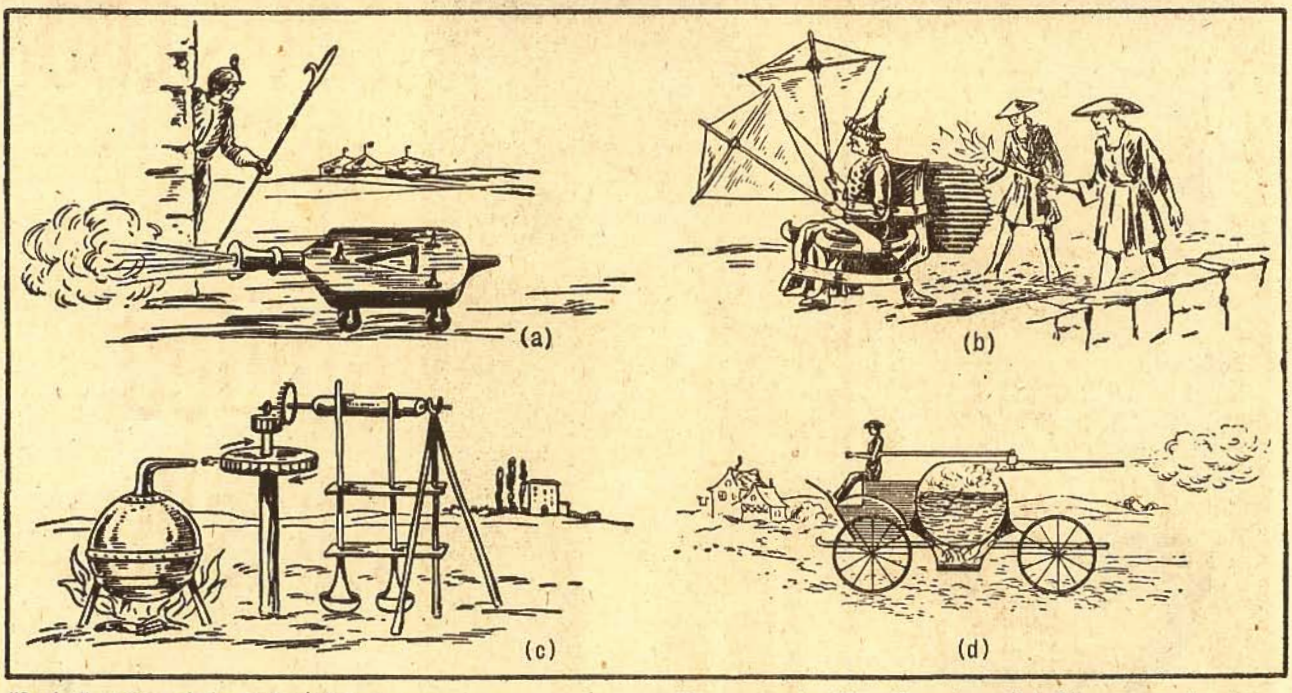
COMMENT FROM THE PAST

How far we have come from those days can be seen from the following extract from an old encyclopedia dated 1888.

"In the more modern Hale rocket a rotatory motion is given by causing the gas to pass out of vents in the base, bored between three projecting shields, shaped something like the blades of a screw propeller against which it presses. The cumbrous stick is therefore no longer used. . . .and the rocket is fired from a trough to give it the required range . . . . as much as 4,000 yards. Though extremely portable. . . . rockets are so uncertain in their flight that they are not much used except for incendiary purposes and against savages. Against cavalry they would be very useful if they could be depended upon."

Well! Well! They could be fired as much as 4,000 yards but are more useful as incendiary weapons and against savages. We have certainly come a long, long way except that I doubt that in

ROCKET ENGINES HAVE AN ANCIENT HISTORY



"Rocket" motors of the past—(a) Rocket car designed by Jones de Fontana in the fifteenth century. (b) Chinese experimenter Wan Hoo risked his life in this flying machine which did not fly! (c) Giovanni Bronca invented this jet turbine in 1629. (d) Newton's wagon, driven by the reaction of a steamjet.

many respects we are the less savages for all that.

So much has been written about the theory of rocket propulsion that I will only touch briefly upon it here in order to refresh the memories.

It all has to do with Newton's Law of action and reaction which states that for every action there is an equal and opposite reaction.

This means that if you push against the table with a given force the table will resist with the same force. Conversely if you squirt water from the rear of a cylinder with a given force there will be the same force generated in the opposite direction, namely, to the front.

ACTION AND REACTION

So that if a fuel inside a steel cylinder generates gas and shoots the gas to the rear there will be an equal thrust to the front and the cylinder will shoot forward if the force is great enough. The recoil of a gun is another example of this law as is also blowing up a toy balloon and letting it go without tying the nozzle. It will shoot all around the place.

Thus a missile is an enlarged edition of a toy balloon with many notable improvements.

The missile takes the form of a steel cylinder provided with some sort of fuel either liquid or solid and some means of guiding it to its destination but it is not my intention here to enter into the actual construction of the missile.

Rather will we have a look at the tremendous facilities which must be provided and the methods of testing missiles for performance.

The testing of a missile is quite different from the testing of an aeroplane.

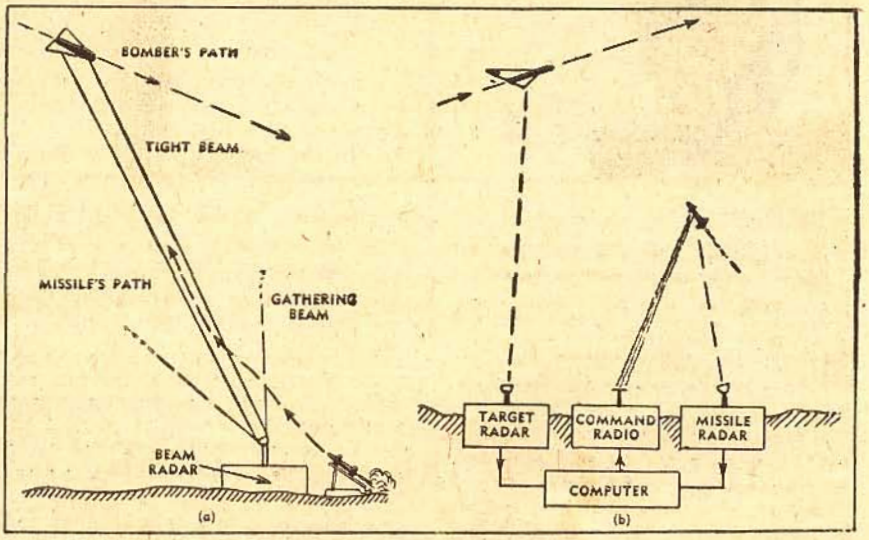
A new type of aeroplane is a piloted machine which is tested by a pilot and observed by scientists from the ground. Thus when it has been air tested the required modifications can be made and the same machine taken into the air time after time.

Not so with a missile. By its very nature it is not recoverable to any practicable extent therefore all observations must be by instruments from the ground and signals from instruments enclosed within the missile itself.

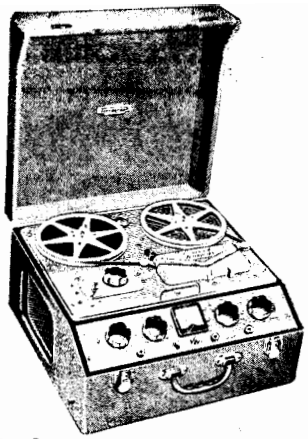
Every time a modification is made a new missile must be built, which alone makes missile testing a most expensive business.

The advent of the wind tunnel reduced considerably the number of new missiles used for testing.

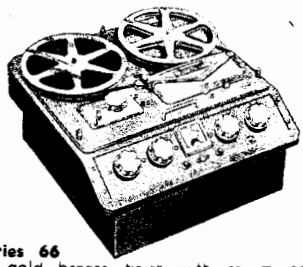
These tunnels, a few feet in diameter and may be 300 feet or so long are designed to duplicate the conditions which exist in the atmosphere during the flight of a missile. Air is driven into the end of the tunnel by means of turbines and the tunnel is provided



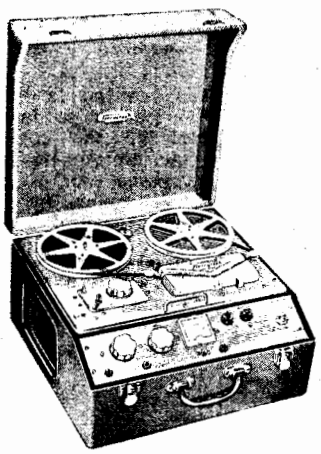
(a) Beam rider uses one radar tracker while the missile has sensing elements which enable it to fly up the beam to the target. A gathering beam is used to collect the missile after launching and to bring it into the tight controlling beam.
(b) The Command Guidance system uses two radar trackers, one to follow the target while the other follows the missile. A computer uses the data from the two tracking radars to issue instructions to the missile through a command link.



Series 3A
In black or fawn portable case with detachable lid. Grey or gold, bronze deck and amplifier panel with black controls
Model 3A/N 3¾ and 7½ i.p.s.
Model 3A/NH 7½ and 15 i.p.s.
Including 7in reel of Ferrotape.

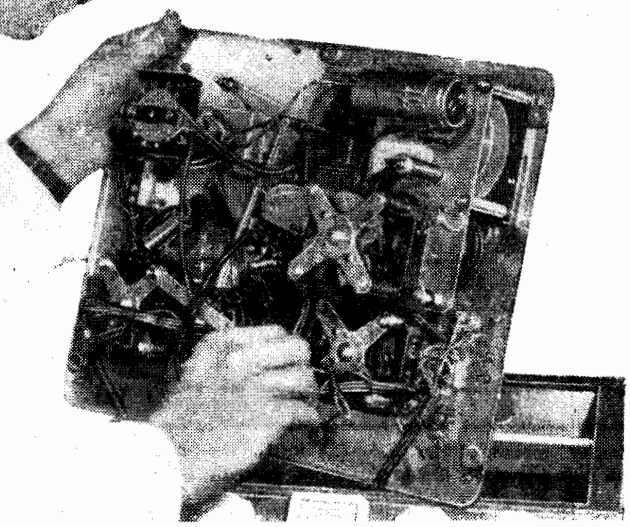


Series 66
In gold bronze finish with cream controls, for fitting to own cabinet.
Model 66N 3¾ and 7½ i.p.s
Model 66H 7½ and 15 i.p.s
Including 8¼in reel of Ferrotape.



STEREO SERIES
Model 77
3¾ and 7½ i.p.s. for normal monaural recording, and playback (with monitoring) and for reproduction of commercial stereo tapes.
Model 88,
7½ and 15 i.p.s. for full stereophonic recording and playback. Also for monaural full track recording playback.
Including 7in reel of Ferrotape.
Note: Both Models 77 and 88 require addition of external amplifiers and loudspeakers

THE MASTER TOUCH



IN THESE DAYS of impressive assembly lines—of ever-moving conveyor belts — of the advent of automation — it is well to remember that there are still products whose good name depends upon the traditional skill of the British craftsman.

Such a one is the Ferrograph — today freely acknowledged to be without equal in the field of magnetic tape recording.

In Australia, chosen by Government Departments, by the Services, by Broadcasting Stations, by Schools, by High Fidelity enthusiasts, by industry and research workers, by famous explorers and anthropologists whose sound recordings on tape are such an essential part of their work, by news commentators and those who travel the world to bring back recorded impressions, the Ferrograph owes much to those craftsmen who guard so zealously its unique reputation.

In the manufacture of a Ferrograph there is the closest control of every assembly operation. The tests to which every instrument is subjected are the most exacting that can be devised. Of course, such high standards of fidelity and performance cost money. But those who choose the Ferrograph are making a life-time purchase — they are the wise (and fortunate) ones to whom ultimate satisfaction and performance count so much more than initial cost.

THE INCOMPARABLE **Ferrograph**

TAPE RECORDERS PTY. LTD.
BOX 3456, G.P.O., SYDNEY

SYDNEY: United Radio Distributors Pty. Ltd., 175 Phillip Street. Audio Engineers Pty. Ltd., 422-4 Kent Street. **MELBOURNE:** Simon Gray Pty. Ltd., 28 Elizabeth Street C1. **ADELAIDE:** Gerard & Goodman Ltd., 192 Rundle Street **BRISBANE:** Chandlers Pty. Ltd., Cnr. Albert & Charlotte Streets. **PERTH:** Leroyo Industries Pty. Ltd., 672 Hay Street.

with many different instruments for observing the behaviour of the missile in the tunnel.

Test models of a missile are fired into the tunnel with a gun. To test the distribution of pressure on the surface of the missile small bore tubing is connected from its missile to a mercury manometer. This is an instrument consisting of a tube filled with mercury. Pressure applied at the bottom of the tube will lift the mercury. The greater the pressure the higher the mercury will rise. A scale placed alongside the column is calibrated in pressure per square inch. It is like taking the blood pressure of the missile.

During flight the mercury levels are photographed to provide a record for comparison if modifications are made to the missile.

Then there is an instrument called a strain guage which is attached to the missile. These register by means of pen recorders, the strains and stresses which are imposed on the body of the missile during flight.

SHOCK WAVES

In order to examine the behaviour of the air in the immediate vicinity of the missile, and the formations of shock waves and so on, use is made of shadowgraph apparatus.

If beams of parallel light are passed across the air stream the varying density of the air caused by the entry of the missile will cast shadows on the beam. In practice, beams of parallel light are directed across the air stream. This will throw a silhouette shadow of the missile as well as shadows representing the various graduations of pressures. These shadows are photographed for reference.

To study the problems of flight at extremely high altitudes and at high speeds, air under pressure is forced into the tunnel. This air must first be heated in order to avoid condensation at the high pressures required, and also to study the missiles heat transfer problems when entering the atmosphere at speed from great heights.

AIR TUNNELS

At one tunnel station air is contained in steel bottles which store 20,000 cubic feet of air at a pressure of 33 atmospheres. New types of devices heat this air to 540 degrees Centigrade before entry into the tunnel.

In this tunnel speeds of nine times that of sound are obtained and the missile can be tested in conditions simulating up to 200,000 feet of altitude.

Whatever is done in wind tunnels there comes a time when the missile must be finally tested in the outside atmosphere, and for this purpose a colossal amount of effort has been expended in various ways.

Testing grounds have been erected in various parts of the world, the longest land range ground being that at Woomera in Central Australia.

It stretches for 1,500 miles into the "Never Never" country, and is indeed a busy place with a township, a population of up to 5,000 people and some 500 houses.

We don't have much detail of our own Woomera testing ground but if it is anything like the American range at Cocoa in Florida it is a great venture indeed.

This Florida range is 1,000 miles long extending over the Atlantic Ocean through a chain of observation stations on the Caribbean Islands.

More than 400 personnel stand by over these stations for each firing. These take care of the recording instruments at each station which are connected together by time signals from a master clock at a control base.

The launching base is at Cape Canaveral where a concrete block house is equipped with periscopes for observation of the missile during launching.

Radar equipment for tracking and searching is installed in a control building three miles away. Here, visual trackers trace the path of flight of the missile, and if the missile goes off course a safety officer can press a button and destroy it by radio.

FLIGHT RECORDING

From the time of launching, special cameras record the flight, and radar antennae located along the predetermined track of the missile over the islands keep it under observation.

Details relating to angles and speeds are given by optical instruments. These details are later used for the study of speed and the effectiveness of the guiding device.

The apparatus within the missile transmits signals giving certain information. These signals are recorded on tape recorders which are later decoded, and the resulting information used to determine what goes on inside and outside the missile.

Perhaps that which contains the most interest for the majority is the manner in which a missile is guided in its flight.

Generally speaking there are three phases in the guidance of the missile. Firstly there is the "launching phase" where it is controlled to prevent or correct any irregularity in its path, thus preparing it for its entry into the second phase called "mid-course guidance." This carries it to close proximity of the target where it next enters the "terminal guidance phase" to direct it straight to the target.

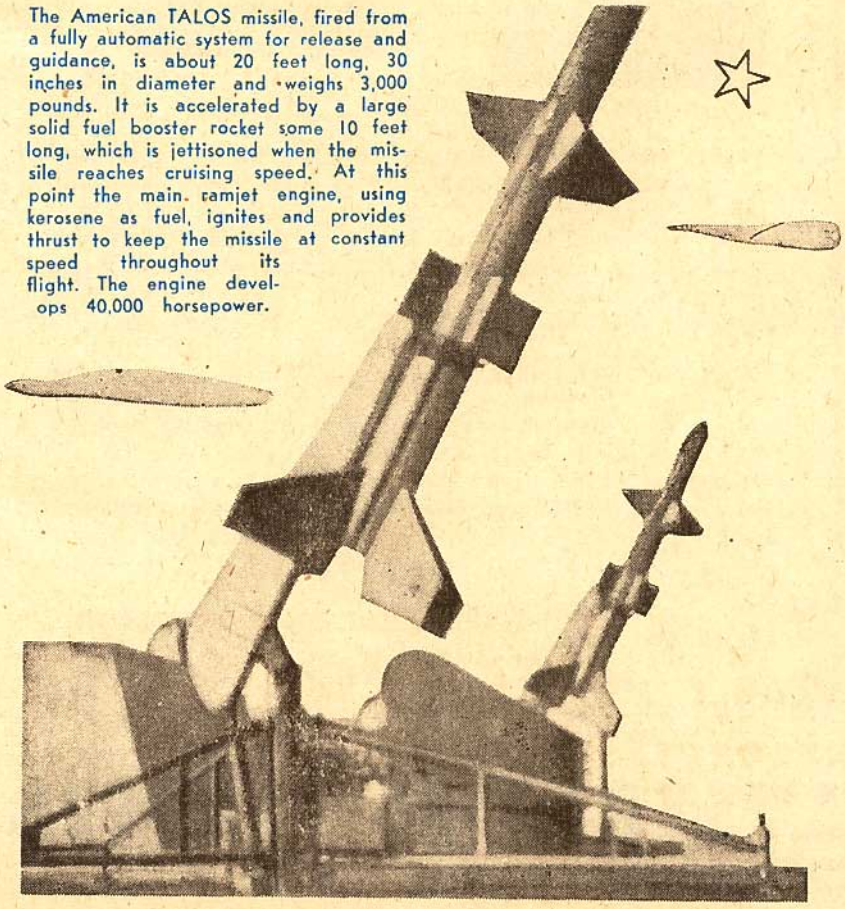
GROUND CONTROL

Whilst there is some difference in the guidance system between a missile directed from the ground to a stationery target and one directed to a moving target, we will deal only with the former as this will give a pretty good idea of the methods adopted.

Of course the missile must be provided with receiving apparatus to receive signals from radar transmitters located in the control room on the ground. These signals when received actuate relays and servo-mechanism devices which in turn actuate the steering apparatus.

At the "launching phase" the radar transmitters send out a beam with a conical form and another with a wider angle. The missile receiver is locked to the narrow beam but, immediately after launching it is gathered by the wide angle beam which directs it into the tight narrow beam where it is main-

(Continued on Page 63)



The American TALOS missile, fired from a fully automatic system for release and guidance, is about 20 feet long, 30 inches in diameter and weighs 3,000 pounds. It is accelerated by a large solid fuel booster rocket some 10 feet long, which is jettisoned when the missile reaches cruising speed. At this point the main ramjet engine, using kerosene as fuel, ignites and provides thrust to keep the missile at constant speed throughout its flight. The engine develops 40,000 horsepower.

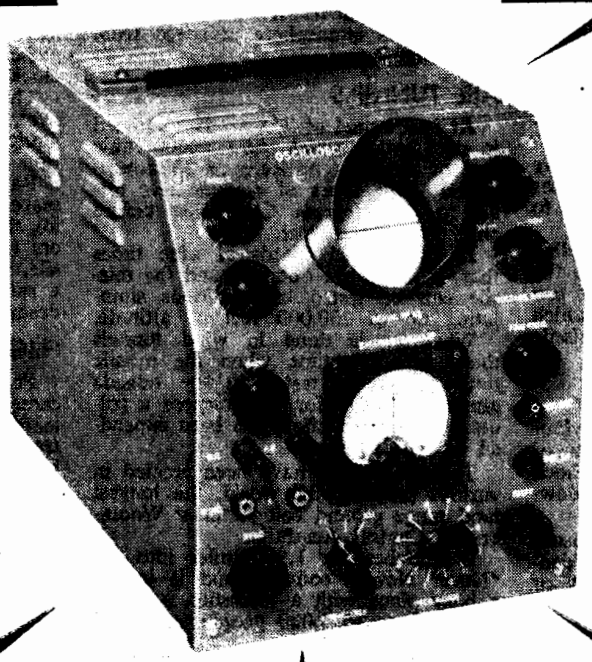
E·M·I MEASURING OSCILLOSCOPE TYPE W.M.S.

Industrial Research

Technical Colleges

Radio and Television Servicing

Production Testing



"Services" Workshop Testing

General Electronics

Dealer Servicing

A.C./D.C. Y. Amplification

Symmetrical Deflection

Visual Null Bridge Measurement

5 Range Voltmeter

Wide Range Time Base

The new E.M.I. Measuring Oscilloscope Type W.M.S. is a lightweight, general purpose D.C. coupled instrument of compact design. Incorporating exclusive features for rapid and easy measurement of voltage, it is recommended to Radio, Television and Radar technicians, to technical students and to science laboratory workers in all cases where an inexpensive instrument of wide application is required.

★ **MAX. SENSITIVITY.** 2"/Volt P-P or 0.5 volts/inch.
★ **ATTENUATOR.** X1-X2-X10. Fine Gain Control 10:1.
★ **REF. VOLTS FACILITY.** Phone jack lifts ref. level from earth to any desired value within ± 500 volts.
★ **FULL 1.3 mc/s BANDWIDTH** maintained at all gain settings (3 db down).
★ **VOLTAGE MEASUREMENT RANGES:**

5 — 0 — 5	50 — 0 — 50	500 — 0 — 500
10 — 0 — 10	100 — 0 — 100	

2" scale centre zero meter.

★ **TIME BASE FREQ. RANGE:**
7.5 c/s to 90 kc/s in 12 ranges (3:1 fine freq. control).
★ **EXTERNAL TIME BASE** requires 56 volts P-P for F.S.D. (20V r.m.s.).
★ **POWER SUPPLY.** 110, 200, 210, 220, 230, 240, 250 volts; 50 C.P.S.; 90 watts A.C.
★ **WEIGHT:** 24 lbs.
★ **INPUTS ATTENUATOR**

		INPUT R	INPUT C
A.C. or D.C.	X1	1 meg.	65 pF approx.
	X2	2 "	65 " "
	X10	10 "	35 " "

★ **DIMENSIONS:** Height, 9¼"; Width, 8¼"; Length, 13".
★ **CATHODE RAY TUBE:** 2½" diameter, type 3AFP4.

PRICE: £85/10/-, including Sales Tax

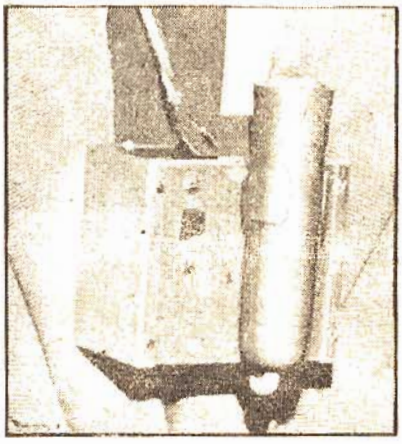
E.M.I. (AUSTRALIA) LIMITED

301 CASTLEREAGH STREET, SYDNEY — BA 2501

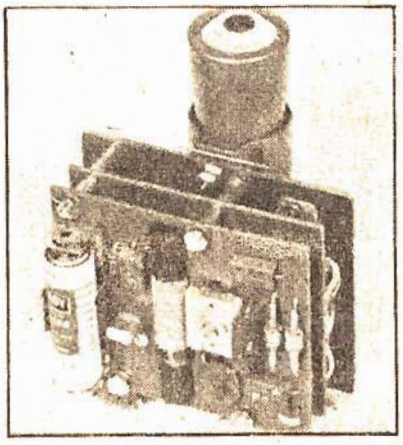
TR.32.FP

Technical Review

NOVEL WIRELESS MICROPHONE WORKS ON 460Kc



Wireless transmitter, worn as lapel microphone, permits announcer to move freely in studio or lecture hall. Transmitter operation is controlled by switch.



Interior view of transistorised microphone transmitter. Unit is compact and can be easily disassembled for repair through use of tier construction technique.

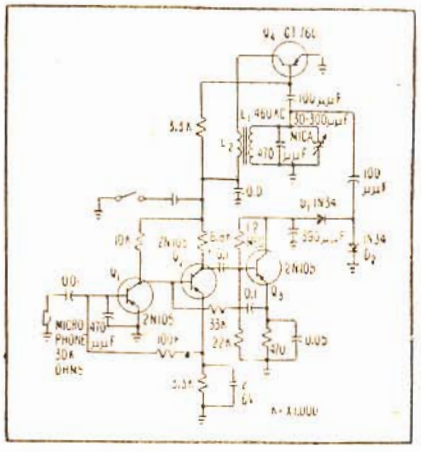


FIG 1—Circuit for wireless microphone transmitter. Operating at about 460 kc, transmitter radiates about .22 micro-microwatts directly from tank circuit.

An interesting application of transistors to a wireless microphone operating at a frequency of 460 Kc and an effective field too low to cause external interference. It establishes an induction field around the transmitter, and is received by a fixed FM superheterodyne receiver which recovers the audio signal and feeds a public address or speech amplifier. Peak deviation is about 10 Kc. (From Electronics).

WIRELESS microphones are useful in studio or lecture halls where the announcer or speaker must be able to move without being restricted by microphone cabling. The unit described here consists of a dynamic microphone with a self-contained wireless transmitter.

A fixed receiver, whose electrical output substitutes for the direct microphone output, is used to feed the public-address or speech pre-amplifier. Both the wireless microphone transmitter and the fixed receiver were originally developed for the main lecture auditorium at the National Bureau of Standards.

LIMITS OF TUBES

Wireless microphones commonly use vacuum-tube transmitters and usually operate on a frequency within the vhf band. Vacuum tube power drain often limits transmitter battery life to several hours. In addition, a troublesome bar to vhf operation is the FCC requirement that the radiation from an unlicensed transmitter be limited to a very low figure.

For a moderate distance between transmitter and receiver, a signal with an adequate signal-to-noise ratio may be impossible to transmit without exceeding such limits. The transmitter described in this article uses transistors to permit relatively long battery life and operates at 460 kc, a frequency at which an induction field can be established around the transmitter within a usable area without exceeding the radiation field limitation.

The transmitter circuit diagram is shown in Fig. 1. Frequency modulation was chosen principally because of its inherent automatic-volume-control action. The transmitter radiates a signal directly from the tank circuit which consists of coil L1, wound on a ferrite rod.

The radiated power, determined by the transmitter coil current and its radiation resistance, is about .22 micro-microwatts. Power is delivered to the tank by Q4 operating as an oscillator at 460 kc.

Diodes D1 and D2 control the r-f current through a 100 pf capacitor shunted across the tank. The direct diode current through a 100 pf capacitor shunting the r-f current delivered to Q3. A change in this direct current produces an approximately linear change in tank-circuit susceptance. The oscillator is therefore frequency modulated by the audio signal. Transistors Q1 and Q2 are audio-frequency amplifiers for the microphone output.

The coupling components were chosen to attenuate voice frequencies below about 700 cps. With the circuit shown, a normal speaking voice produces a peak deviation of about 10 kc. The total battery drain is about 15 milliamperes, so that with the single mercury cell the battery life is about 150 hours.

RECEIVER

The vacuum-tube superheterodyne receiver is shown in Fig. 2. An r-f amplifier, V1, operates at the signal frequency of 460 kc. Pentagrid converter, V2, converts the signal frequency to 50 kc and the signal is amplified and limited by V3 and V4.

The output of stage V4, a variable frequency square wave, is differentiated and rectified by the counting-detector diode D2. The audio signal is recovered by passing the diode output through a low-pass filter and amplified by V5. Peak audio output is about 0.5 volt.

Squelch action is provided by diode D1 which rectifies the received signal and unblocks the audio output stage during operation. This feature is useful in urban locations where the noise level is usually high.

The f-m superheterodyne receiver consumes little power and uses low plate and screen voltages consequently the operating temperature is low and the com-

THE WARBURTON FRANKI PAGE

ALL YOUR RADIO & T.V. NEEDS . . . CHECK IT EACH MONTH

• BARGAINS

Leatherette Mantel Cabinets—2 types—Inside Measurements 9¾in x 5¼in x 6in and 11¾ x 5¼ x 6¼in. Similar to Stromberg Carlson Types 4A17 and 4A18. To Clear: **19/11 each.**

3-Speed Record Changers—superseded models—few only. To Clear: **£11/19/6 each.** Freight forward.

CRYSTAL DETECTORS. Glass Barrel type, complete with piece of crystal. 3/8 each. Post 4d.

RECORDING TAPE: Paper Base 7in 1200ft. To Clear: 19/11 reel. Post 1/6.

MULTICORE TAPE SOLDER: Solders with the heat of a match. 1/9 card. Post 4d.

PLASTIC COIL FORMERS: ¾in diameter x 2in long. **1/3 each.** Post 4d.

POWER TRANSFORMERS: Flat Mounting—125 ma 325V a. side . . . . . 75/- } Post Vic. 3/8
—150 ma 325V a. side . . . . . 79/6 } Int. 6/-

Build your own MULLARD 5-10 AMPLIFIER . . .

Complete chassis kits available, including Main Amplifier and Pre-Amplifier. Etched Control Panel and all hardware. **£8/11/-** Freight forward.

Power Transformer to suit above **99/3** Freight Forward

Output Transformer to suit above **152/-** Freight Forward

PARTS FOR MULLARD AMPLIFIER TYPE 3-3 ALSO AVAILABLE.

Build your own TV SET

W.F. have all components necessary to make the Radio, TV and Hobbies 17in or 21in TV set.

Some of the items are:—

Punched Chassis	£5/18/-
Q+ I.F. Strip	£27/2/6
A and R Power Transformer . .	£11/15/4
„ „ Choke	48/6
Philips Tuner	£18/5/-
17in Picture Tube	£30/14/-
21in „ „	£40/-/-

Unwired R.C.S. Incremental Tuner	73/4	plus 25% S.T.
„ „ I.F. Strip 6AC7 . .	110/-	„ „ „
„ wired	£11/16/-	„ „ „
Unwired R.C.S. I.F. Strip 6BX6 . .	115/-	„ „ „
„ wired	£12/3/8	„ „ „
R.C.S. Filament Transformers 5KV Insulation 2.5-4 or 6.3 volt . .	26/8	„ „ „
R.C.S. 3KV Osc. Coil	26/8	„ „ „
A.W.A. Raster Components—		
17in.	£12/11/8	
21in	£13/19/-	
Knob for above	1/6	

(Please include postage for these items)

CONSOLE TV CABINETS

Suit any 17in Set. Well made. Polished—Light Oak or Rosewood Finish.

23gns. each.

PALEC Ohmeter type OM2

Measures from one-fortieth of an ohm to 100,000 ohms in 4 ranges.

£12/10/- plus 12½% S.T.

Post. Vic. 1/10, Int. 3/-.

Assemble your own V.T.V.M.

Complete Kit Set to build the Cossor 1044K Valve Voltmeter Price £29, plus 12½% S.T. Add 14/6 surcharge. Freight forward.

Above Instrument Completely wired and tested ready to use, £37/12/6, plus 12½%. Add 14/6 surcharge. Freight forward

LOUDSPEAKERS *select your Hi-Fi Speaker from W.F.'s Large Range:—*

			Post	Vic.	Int.
15in Wharfedale	W15/CS	£44/3/7	Freight	Forward	
12in „	12/FS/AL	£44/3/7	„	„	
12in „	W12/CS	£28/1/9	„	„	
12in Magnavox	12WR	£7/9/7	2/11	4/4	
12in Goodman	150	£28/7/6	Freight	Forward	
12in „	Audiom 60	£25/5/-	„	„	
12in Rola	12UX Hi-Fi	£28/19/6	„	„	
12in „	120X	£11/4/-	2/11	4/4	
12in „	120 De Luxe	£6/10/6	2/11	4/4	
12in Jensen Dual .	12PQCB	£19/5/-	Freight	Forward	
12in „ Woofer	12PQ/15	£6/18/-	„	„	
8in Wharfedale	8FS/AL	£13/12/4	2/11	4/4	
8in Magnavox	8WR	£7/-/-	2/11	4/4	
8in Goodman Axiette		£15/1/-	2/11	4/4	

TWEETERS

Magnavox 6WR	£6/10/-	1/10	3/-
„ HF5	£2/5/11	„	„
Rola 5FX	£2/5/6	„	„
Jensen 6PU/25	£2/6/4	„	„
Wharfedale Super 3	£13/12/4	„	„
Ibbot Crystal 360	£14/14/-	„	„
Goodman Trebax	£12/9/4	„	„
„ Midax	£27/6/10	2/11	4/4

In addition to the above, full range of Magnavox, Rola and Jensen Speakers, is always in stock.

RECORD PLAYING EQUIPMENT in stock includes:—

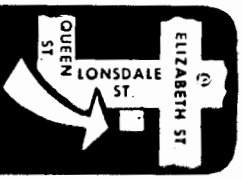
Dual 295 4-speed Players	£18/10/-
„ 1004 Record Changers	£32/8/6
„ 1005 Record Changers	£37/9/6
(Above units in attractive Carrying Cases, can be supplied at £24/15/6, £39/7/3 and £44/8/3 respectively.)	
B.S.R. HF8 4-speed Players with crystal heads	£13/5/-
or with 555 variable reluctance head	£16/5/-
B.S.R. UA8 Monarch Record Changers	£20/10/-
Garrard 301 Transcription Turntables	£46/7/6
Connoisseur Transcription Turntables	£49/10/-
Thorens Transcription Turntables, E53NPA	£35/-/-
Collaro 4-speed Players	£12/10/-
„ Transcription Turntables	£26/7/6

EASY TERMS AVAILABLE

(Freight forward on all above items)

WARBURTON FRANKI (MELB.) LTD.

359 LONSDALE ST., MELBOURNE — PHONE MU 9664



OPEN SAT. MORNINGS

•

TRADE ALSO SUPPLIED

★ **Call or write for FREE RESISTOR COLOUR CODE** ★ ***Please include postage or freight with all orders*** ★

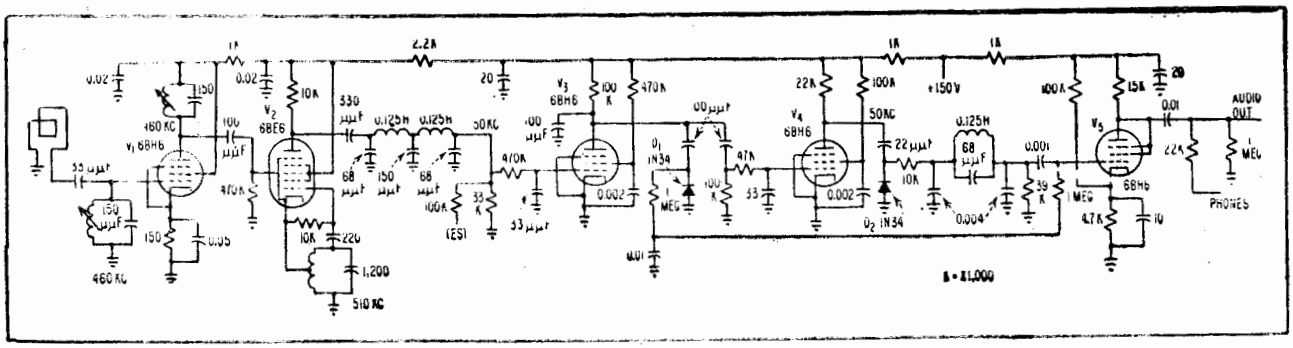


FIG. 2—Circuit for fixed receiver. Operating frequency of transmitter is converted to 50 kc by V2 and is amplified and limited by V3 and V4. Audio signal is recovered after passing through low-pass filter. Peak audio output of receiver is about 0.5 volt.

ponents should have long life.

The overall audio-frequency response of the system from microphone input to the receiver output is shown graphically in Fig. 3. No audio-gain control has been included in the transmitter but a control may be desirable to keep the deviation at maximum to compensate for differences in speakers.

The maximum size of the receiving loop depends on local noise field. A loop 5 metres square was used for this equipment. The loop could be made larger by using more transmitter power or by reducing local noise such as that generated by electrical machinery.

AERIALS

In noisy locations, it is helpful to use a shielded receiving loop made of small coaxial cable. One end of the inner conductor is connected to the ungrounded receiver antenna terminal, the other end of the inner conductor and the shield braid are connected to the ground terminal. At a point halfway around the loop, the outer braid is cut and stripped for a length of an inch or two. Shielding is effective in reducing electrostatic pickup from nearby noise sources.

PORTABLE TV RECEIVER

A portable 14in picture tube, cordless TV, powered by two 12 volt nickel-cadmium rechargeable batteries, was recently exhibited in Chicago by Motorola, Inc. The unit has 31 transistors and utilises 10 watt power consumption.

Battery life is six hours. A monopole 4½ft antenna is used.

Motorola says "the unit is not a laboratory freak. We can start building them right away if the economics make it feasible. We want to encourage component manufacturers to get behind this."

As yet, it is too costly to produce. Weight of the entire unit with batteries is 32lbs. Unit takes 17 seconds for warm-up time. Excessive power in some portions of the TV receiver have been eliminated by a "scan-magnifier," a Motorola invention kept under wraps.

Price of the unit was not disclosed. The unit will play in a plane, train, etc. Batteries will withstand 2,000 separate recharges for an estimated 12,000 hours of life. Estimated cost of operation of the TV is 4/10 of 1 cent per hour.

A 90 degree tube is used. No printed circuits are used at the moment.

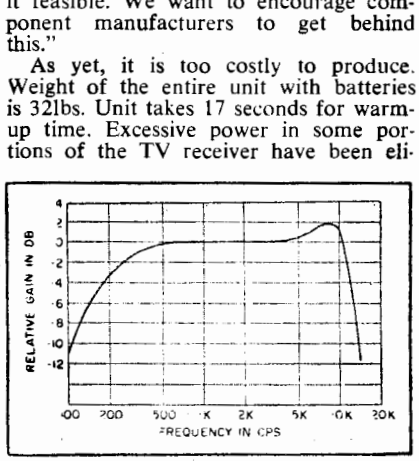


FIG. 3—Overall audio frequency response of transmitter-receiver system.

RADIO THERMOMETER FITS PENGUIN EGG

The unit uses a transistor oscillator powered by three mercury cells, and operates continually for 150 hours.

RECENTLY developed components have made possible a radio thermometer with far-reaching possibilities. Immediate application is to monitor the temperature at which the penguin keeps its eggs.

The purpose of the penguin experiments is to look for some of the reasons that make it possible for some forms of animal life to withstand extreme cold. Other forms, anatomically similar, perish under similar conditions.

A little deception of the penguins is required. The egg is opened and its contents removed. The radio thermometer and gelatin is substituted. The egg is resealed and returned to the unsuspecting penguin.

INDUCTIVE PICKUP

The radio was developed by American Electronic Laboratories for the Office of Naval Research. As well as size limitations the device had to be wireless, since penguins are inclined to carry their eggs from place to place.

Inductive pickup was used rather than conventional radiated RF energy. The salt water or flesh surrounding the egg would tend to absorb RF. In addition, designing an antenna that would fit in a penguin egg posed problems.

The unit uses a transistor oscillator powered by three mercury cells. It is said to operate continuously for 150 hours.

The use of a transistor was a natural. It is not only small, light and economical of power, but does not generate heat. In addition, being a current device, it is suitable for supplying current for the coil.

The radio thermometer has a range of 80 feet, is accurate to within 0.2 deg. F and weighs only 80 grams.

Another application of the thermometer is to test the effectiveness of survival suits. First reports from the Antarctic on these tests indicate that a man swimming in water at 25.8 deg. F increases his body temperature to 98.9 deg. F while actively swimming for the first 12 minutes. After that, while resting, his temperature decreases at the rate of about 0.3 deg. F every two minutes. The experiments last 20 minutes.

Other planned uses for the radio thermometer include studies of chickens and reindeer.

COLD LIGHT FOR FILMS

COMMERCIALLY made "cold" mirrors which reflect visible light and transmit heat rays have recently been tested in London. They are intended for use with cinema projectors in order to increase the light passing through the film without increasing the amount of heat.

The cold mirror depends for its results on an extension of the principle used in "blooming" lenses to reduce reflections from the front surfaces. To make a selective mirror a large number of coating alternately of high and low refractive index are used. The coatings slow down the light passings through them by approximately a quarter of a wavelength.

The different layers are of different thicknesses and one of the most tricky problems is calculating the exact thicknesses required to allow all the visible light but none of the heat to pass through or vice versa.

Apart from this there is the manufacturing difficulty of superimposing a large number of thin films, each of which must be accurately prepared to the thickness required. Deposition of the layers is carried out by evaporation in a vacuum. This multi-layered sandwich must be sufficiently robust and able to stand local heating if it is to be used close to an arc lamp.

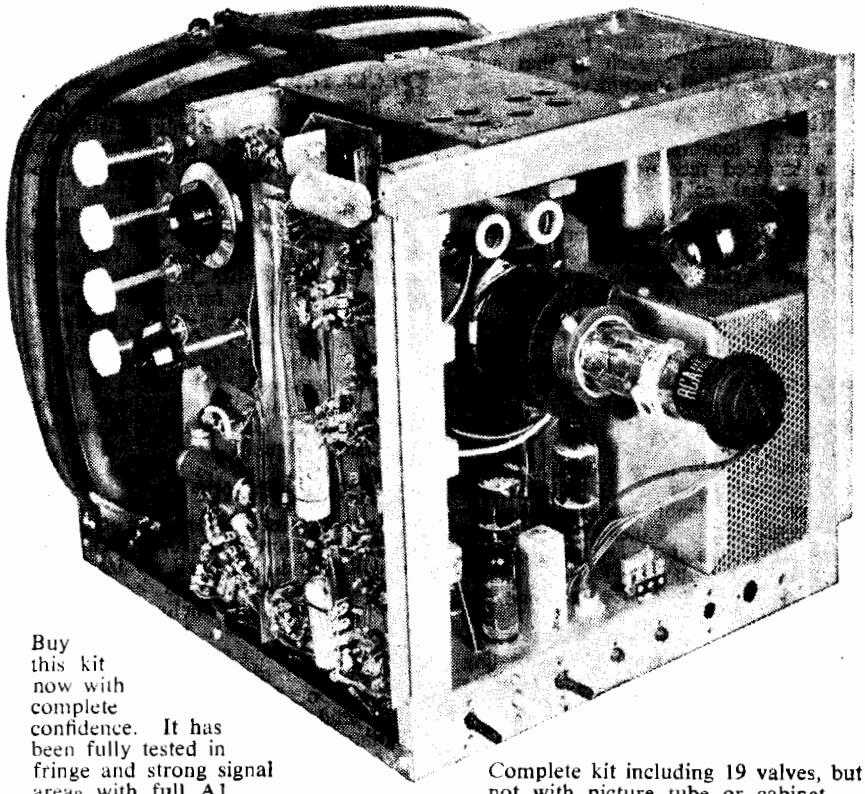
With fifteen pairs of coating 98 per cent of visible light is reflected. Most of the heat passes through the mirror.

The mirrors have such a hard surface that they are not subject to damage from the splutter from projection arcs. As the "silvering" is on the front surface special heat resisting glasses which are not available in optical quality can be used.

NOW AVAILABLE THE "Q-PLUS" TV KIT SET

COMPLETE TO THE LAST NUT AND BOLT, FULLY ILLUSTRATED CONSTRUCTION MANUAL. ALL TUNER AND IF STRIP PRE-WIRED AND PRE-ALIGNED SO

NO TEST EQUIPMENT IS NECESSARY



Buy this kit now with complete confidence. It has been fully tested in fringe and strong signal areas with full A1 performance

A SET YOU WILL BE PROUD TO OWN

Custom Builders—put your own brand on this receiver.

Complete kit including 19 valves, but not with picture tube or cabinet
. . . . . **£78/2/6**

Plus sales tax **£17/9/7** **£95/12/1**

17" 70 deg picture tube **£24/11/3**

Special Q-Plus cabinet . . **£9/7/6**
(Available shortly)

Total Price **£129/10/0**

BRIEF SPECIFICATIONS:

Circuit Function and Valve Types

Power Supply (5AS4)

Primary taps for 200, 220 and 230 V. operation, full wave rectification with capacitive input filter. A 300 mA fuse is incorporated. Mains transformer has copper shield for minimum external field.

Tuner (6BQ7A, 6U8)

Q plus type VTT/1 10 channel turret tuner featuring low noise "Cascode," R.F. amplifier and high mu mixer oscillator. Special moulded coil formers prevent cores from coming loose. Special "alkyd" low loss high stability plastic used on all coil biscuits and mouldings. Oscillator is compensated for frequency drift due to variations in temperature. This unit comes fully tested and pre-aligned.

Video and Sound I.F. Channel (4-6CB6, 2-6AL5, 1-6AU6)

The ever popular Mark III I.F. strip, four stages of video amplification using bifilar and an over-coupled stage. Video detector, with R.F. filter and video detector load, intercarrier taken from video detector. Sound amplifier limiter stage and ratio detector, fully tested and aligned

Audio Amplifier and Output (6AV6, 6AQ5)

A triode voltage amplifier with beam tetrode power output. Negative feedback is applied to the 6AQ5. F.M. de-emphasis is obtained by a simple R/C network. Frequency response 90 c/s—5Kc/s at—6 db.

Video Amplifier (12BY7)

A high gain pentode using a combination of series and shunt peaking. Video detector is directly coupled to video amplifier grid. Output is capacitively coupled to picture tube cathode. The gain (contrast) is controlled by a cathode potentiometer. Frequency response up to 4Mc/s at — 6db., and greater than 40 db., at 5.5 Mc/s.

Sync. Separator, Sync Phase Inverter (12AU7)

Sync pulses are obtained from the output of the video amplifier and applied to the sync clipper which removes most of the video content, and provides a substantial degree of noise immunity.

Frame Oscillator and Frame Output (12BH7).

A frame blocking oscillator is used. The frame output stage drives the deflector using an auto-transformer to match the output to the yoke impedance.

Line A.F.C./Line Blocking Oscillator (6SN7GTA)

The line A.F.C. is a D.C. control valve to correct the line blocking oscillator which used a "sine wave" stabilising coil. Small changes in sync control are obtainable by a pot. on the D.C. control valve. Once aligned correctly, this circuit will remain in sync. over long periods, with varying signal strength and mains variation.

Line Output, E.H.T. Supply (6BQ6-GTB, 6B3-GT, 6AX4-GT)

The line output/E.H.T. transformer (Q Plus VHOPT/1) (auto-transformer type) and the E.H.T. rectifier are shielded in a metal case and cover. Provision is made to alter this section for higher ultor voltage and drive suitable for a 90 degree 21in. picture tube.

A.G.C.

"Simple" type, supplied from video detector output. An area control is provided which uses part of the negative input to the line output grid. This negative voltage is filtered and applied via a potentiometer ("area" control) and the Tuner A.G.C.

Chassis

The main chassis comes pre-assembled, ready to take the power supply, line output/E.H.T. cage, tuner, video and sound I.F. channel, frame oscillator and output sub-chassis. The picture tube mounting, strap, etc., are screwed to the main chassis, making it one complete unit.

Controls

Channel selector and fine tuning are a dual concentric knob, volume off-on, brightness, contrast, frame hold, line hold, controls are grouped together and fitted with smaller knobs. Area (A.G.C.), frame height, frame linearity, line drive, line oscillator, line sine wave, line width controls are mounted on the rear of the main chassis. All these controls can be adjusted without removing the back of the cabinet.

R. W. STEANE & Co. Pty. Ltd.

Factory & H. O.: MONTROSE ST., AUBURN VIC.

Sydney Office: CADOW ST., PYMBLE, N.S.W.

INDUCTION PICKUP FOR DRIVE-INS

Induction pickup methods seem to be gaining ground in many fields where lead connections are a problem. Here is a novel use for the idea which has been used successfully in U.S.A.

REPRESENTING a completely new technique in drive-in theatres, the Dover (N. J.) drive-in will be equipped with portable transistor-amplifier car speakers instead of the conventional type. It constitutes what its builders hope will prove the first of a great many such transistorised drive-ins.

The Dover drive-in uses conventional electronic equipment up to the output of its power amplifier. From there on, the wiring of the area and the loudspeakers used by the patrons are altogether different.

The theatre is unique. It has no loudspeaker posts—although, of course, it has speakers. It is not located far out in the countryside, but within the shopping centre of a city of 11,000. It is located on the top deck of the shopping centre's 2-level, 1,200-car parking lot.

As this deck is used for parking during daylight shopping hours, conventional drive-in speaker posts would be objectionable. Hence the new technique in which sound is supplied to patrons, not over the usual wires, but by way of an audio-frequency magnetic field.

Underground wiring suffuses the area with this field, which corresponds to the sound to be reproduced. It can be picked up anywhere in the area by an instrument consisting of a magnetic pickup coil, a four-stage transistor audio amplifier, and a 5-inch loudspeaker.

The basic idea of using an audio-frequency field instead of wires to convey speech and music to theatre patrons is not new. It was introduced roughly 10 years ago in indoor theatres, to energise earphones which theatres loaned to hard-of-hearing.

NO WIRES

In the magnetic-field system there are no connecting wires between the output of the amplifier and the speakers. A length of No 12 wire is connected to the amplifier's output and laid about the grounds in a definite pattern.

The pattern consists of a number of loops of wire. Each loop is about 40 feet long and 15 feet wide. These loops are laid side to side and end to end in sufficient numbers to cover the area completely.

Electrically they constitute a series circuit, presenting a total af impedance of between 4 and 6 ohms, looking out from the amplifier terminals.

On entering the theatre, the patron is handed a speaker unit (approximately the size, shape and weight of a conventional drive-in speaker, but containing a pickup coil and encapsulated transistor amplifier, in addition to the speaker itself).

This he places anywhere in his car to suit his convenience. Windows can be kept completely closed. On leaving, he will be stopped at the exit and the speaker unit collected.

WILL NEED MORE SERVICING

The new speakers will need more servicing than the conventional kind. There are three reasons for this.

First, the transistor amplifier needs a battery. The condition of these batteries must be checked from time to time, and replacements made as necessary. Second, the new units are composed of a greater number of components—a greater number of things that may go wrong.

Finally, the new units are more exposed to physical injury. The conventional speaker gets some protection as it is fastened to a cord. If dropped, it may not reach the car floor or the ground.

If it is connected by a coiled cord; that acts as a tension spring and checks the force of a fall. The induction speaker-amplifier is not attached to anything. It is apt to be laid loose on the front or rear shelf of the car and may slide off or be jarred off.

Vido-Sound Corp., New York City, is the inventor and proprietor of the inductive sound distribution system. Although the basic principle of inductive distribution is not new, its current application is said to incorporate some patentable features.

ADVANTAGES

Vido-Sound claims the following advantages for its system:

1. Lower cost. They figure the cost of equipment, including wiring, at £25 per car, which they state is less than the average cost of conventional drive-in systems. The latter cost is estimated at £30 per car. Experienced drive-in engineers are not in complete agreement.

Vido-Sound claims as a further economy that less-expensive amplifiers can be used in the projection room. With this system a 75-watt output is adequate for 600 cars. The conventional requirement would be about 300 watts of audio.

2. Less maintenance. The Vido-Sound amplifier is a four-stage, printed-circuit, p-n-p transistor unit. Its gain is 37 db and the unit is encapsulated. This protected assembly rests in a chassis of silica gel. It uses a 9-volt battery, which has an estimated useful service life of six months to one year, and will cost the theatre 49 cents. 5-inch speaker completes the unit.

As already noted, this assembly obviously needs more servicing than a conventional unit, which consists only of a speaker, volume control and case. But, in conventional installations, not only the speakers, but the speaker boxes, transformers and connections need some maintenance.

3. Increased refreshment sales. The inductive speakers promote refreshment sales, since patrons can take them right along to the refreshment counter. They need not hesitate to go for refreshments out of fear of losing part of the show.

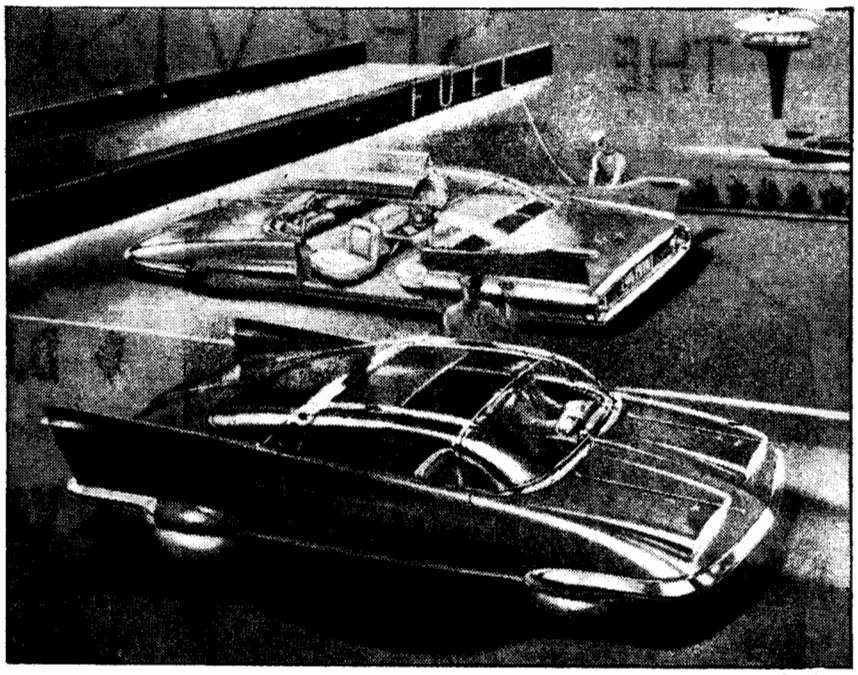
4. Less speaker theft. In the ordinary arrangements used by conventional drive-ins no excuse exists for stopping an outgoing car and asking for the return of a speaker. The speaker is supposed to have been left back at the post.

5. Fewer accidents. Speaker-post accidents cannot occur—there are none. Patrons walking from their cars to the refreshment area or rest rooms cannot be caught by or trip over speaker wires.

Engineers who do not favour the induction process look forward to possible drawbacks of one kind or another. They expect noise from car ignition systems, from sign flashers and from refreshment-room machinery such as refrigerators. They suspect the steel underbody of the automobile may in some cases shield the transmission.

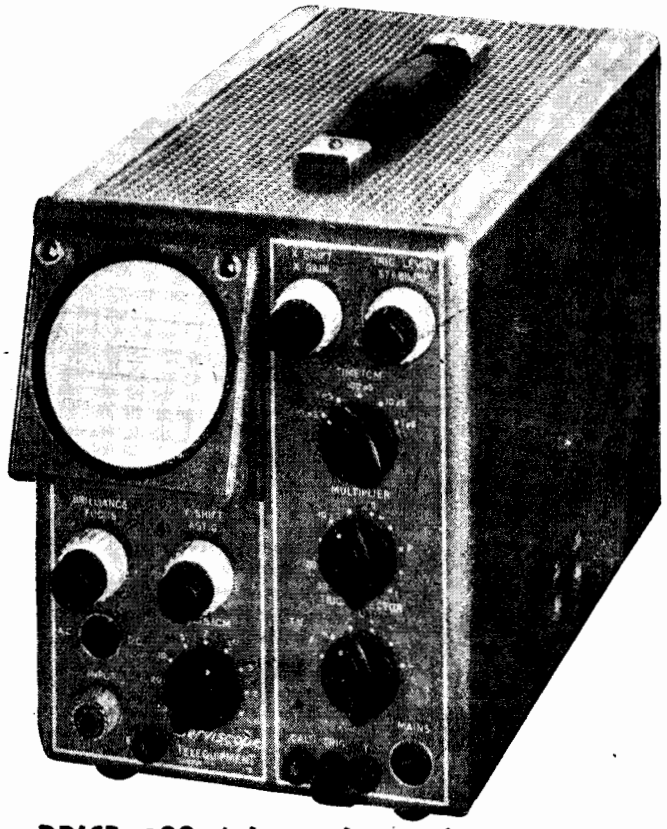
(Continued on page 127)

WHEEL-LESS CAR OF THE FUTURE



Detroit designer, Carl Reynolds, predicts this car of the future will have no wheels. It will be propelled by ducted fans, and travel two feet above the roadway. Small, light-weight engines are required. Target date—1978.

THE SERVISCOPE



- **WIDE RANGE**
- **D.C. COUPLED**
- **VOLTAGE CALIBRATED**
- **TIME CALIBRATED**
- **PORTABLE**
  (6½" x 8½" x 13½")

PRICE £99 (plus sales tax)

FREIGHT COSTS EXTRA INTERSTATE

Y AMPLIFIER

Frequency response.	D.C.—6 Mc/s (-3db)
Maximum Sensitivity.	100 mV/cm. at all frequencies.
Rise Time.	.06u/sec (less than 2 per cent overshoot).
Maximum Y deflection.	5 cms. at all frequencies.

INPUT ATTENUATOR

9-position frequency compensated, direct reading in Volts/cm.
100 mV, 200 mV, 500 mV, 1V, 2V, 5V, 10V, 20V, 50V/cm.
Input Impedance 1 megohm plus 15 pf (approx.), Voltage Measuring Accuracy plus/minus 5%

TRIGGERING.

Automatic for repetitive signals up to about 1 Mc/s.

TRIGGER LEVEL CONTROL selects any point on input signal slope for repetitive, random, or single shot triggering.

TRIGGER SELECTOR. Positive, negative, or T.V. Line or Frame (plus ve or minus ve) Internal or external.

VOLTAGE CALIBRATOR. Stabilized 1 v.p.p. 50 c/s square-wave for checking voltage accuracy.

TIME BASE. 18 preset calibrated Sweep Speeds.
500, 200, 100, 50, 20, 10, 5, 2, 1 milliseconds per cm. } at minimum.
500, 200, 100, 50, 20, 10, 5, 2, 1 microseconds per cm. } X expansion.
Slower speeds can be obtained by internal adjustment.
Time measurement Accuracy plus/minus 10%

X EXPANSION. Continuously variable up to over 10 screen diameters (50 cms.). Trace expands symmetrically about centre of screen. X-shift control positions any portion of expanded trace on screen. Direct Access to X-amp.

CATHODE RAY TUBE. 3in flat faced 3WP1 (Direct American Replacement). E.H.T. 1.4KV. Tube face tilted at convenient viewing angle. Removeable green filter fitted to improve contrast at high ambient illumination.

COOLING. Convected air thermo-syphon cooling. Fan assisted cooling available for use in extreme ambient temperatures.

SUPPLY VOLTAGE. Normally 200—250 V. 50 c/s. Or 95—115V.60c/s. Other voltages to special order.

DIMENSIONS. 6½in x 8½in x 13½ (overall).

JACOBY MITCHELL
EQUIPMENT FOR INDUSTRY AND RESEARCH

SOLE AUSTRALIAN AGENTS

JACOBY, MITCHELL & CO. PTY. LTD.

469-475 KENT ST., SYDNEY.

PHONE MA8411 (5 LINES)

PAPER WORK IS SPEEDED UP BY NUMBER READER

Machine Identifies Numbers as They are Written

This amazing machine can be used to read numbers automatically as they are written, and thus to operate teletypewriters, recording machines, etc. for computer processing. The principle is capable of further expansion to save time in accounting procedure.

HANDWRITTEN numbers can be identified by a device about the size of a portable typewriter. With modifications, the equipment can be made to read handwritten letters as they are being written.

The system has just been announced by Bell Labs and is expected to be a boon in the processing of the paper work for about two billion long-distance telephone calls a year. Bell thinks it may find applications wherever it is necessary to write and identify large quantities of numbers.

SIZE RESTRICTION

In order that written numerals may be read with a minimum possibility of error, mild restrictions must be placed on their size and form.

The constraints consist of two vertically aligned dots, around which the numerals must be formed. Three radius vectors extend out from each of these dots, a seventh joins the two.

Numerals are then sensed by determining which of these radius vectors are crossed.

Information as to which vectors have been crossed is transmitted to a translator, which contains transistorised logic circuits.

Since each numeral has a corresponding set of crossings which is unique, the translator needs only to be able to distinguish each of the sets in order to produce a different output for each numeral.

The outputs are employed in the utilisation circuit to illuminate a number, operate a teletypewriter, feed the information to a computer or perform any other desired operation.

SPECIAL PLATE

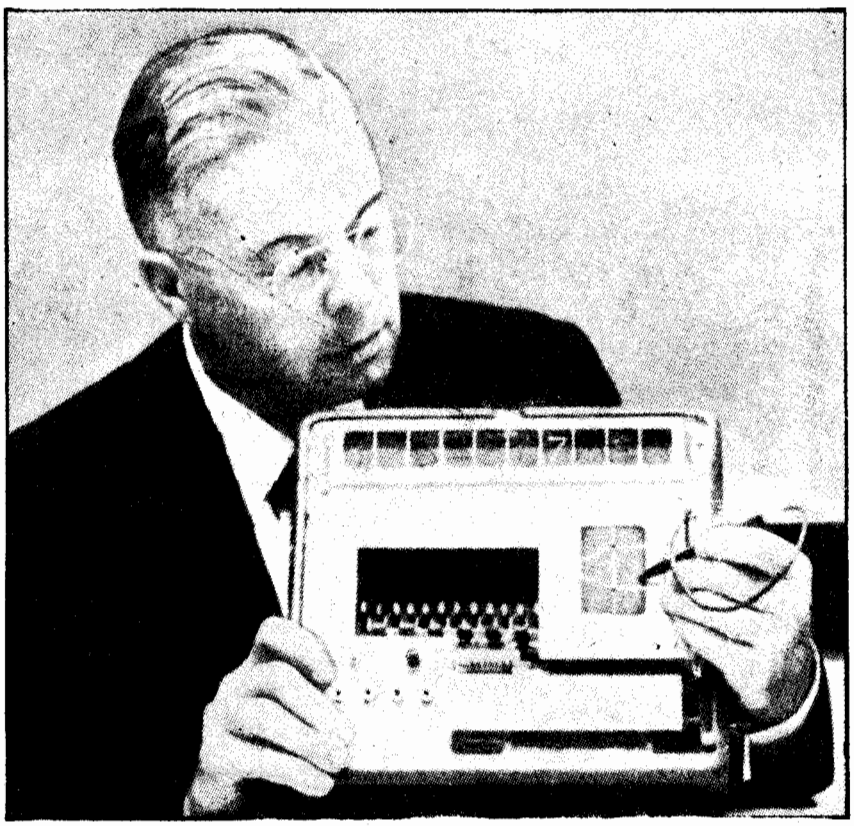
To recognise written numerals, a specially prepared plate is employed on which each radius vector appears as a closely spaced, insulated parallel set of conductors.

The numerals must be written with a conductive pencil on a sheet of paper or a card. When this writing is superimposed on the printed plate and properly oriented, the appropriate sets of conductors are shorted out.

To recognise numerals as they are being written, a writing surface is provided on which there are two guide dots and in which seven radius vectors made of conducting material, are embedded in plastic. The writing is done with a metal stylus on the writing surface.

Whenever a conductor is crossed, the information is fed to the translator and logic circuit.

As necessary crossings are made for a particular numeral, the translator again sends the proper information to the utilisation circuit. To clear the system for the start of the next numeral, a conducting plate is touched by the stylus.



Hand-written reader can operate other data-processing gear.

BIG INCREASE IN U.S. TUBE SALES

THE sale of radio valves and picture tubes in the U.S.A. is certain to rise very considerably during 1958, according to report from Sylvania.

The replacement radio and TV parts segment of the industry continues to expand while the sale of television sets is down for the third straight year. Consumer buying is slowing. Fewer people will be spending for a new TV set during 1958 but everyone who owns a TV set will want to make sure it's in top working order.

Market research experts tell us more receiving valves and picture tubes will be sold this year than during the 1957 sales year.

DROP FOR 1958

During 1957 actual television set sales were 6,604,000. The forecasts predict a drop of twenty thousand for 1958.

The great majority of them are in the portable class. Many are going into homes already equipped with a big console model as "second" or even "third" sets for the den or the children's rooms.

Black and white picture tube sales should reach the 7,000,000 mark during 1958 — an increase of 700,000 over last year's total figures. This year, one out of seven TV set owners will replace their old picture tube.

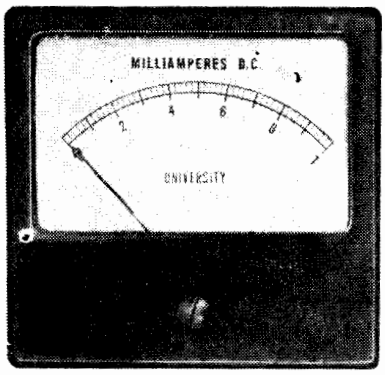
Projection figures show that by 1960, the replacement sales of black and white picture tubes will be approximately 8,300,000.

ABOVE ESTIMATES

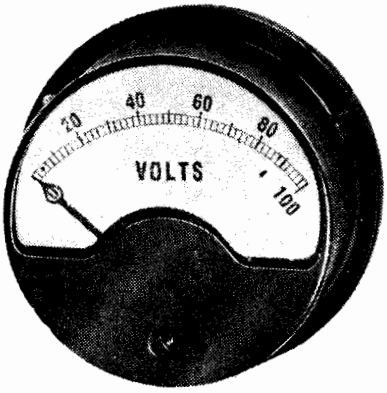
Seven million more receiving valves will be sold during 1958 than last year, when total sales reached 185,000,000 exceeding market research projection for 1957 by two million. Seventy per cent will be used in TV set replacement, thirty per cent in radio.

Keeping in mind that receiving valve sales are expected to grow by 7,000,000, the fact that the buying public paid 375,000,000 dollars for receiving tubes alone in 1957 is significant. This dollar figure is **only** for receiving valve sales, not for the total of goods and services purchased for radio and television receivers by consumers. But, a third of a billion dollars, especially when it reflects only a portion of the total amount, is certainly big.

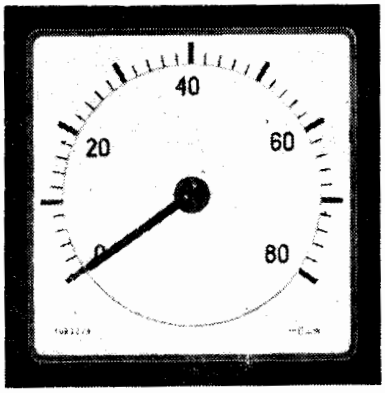
INSTRUMENTS OF QUALITY | FOR INDUSTRIAL AND LAB. USE



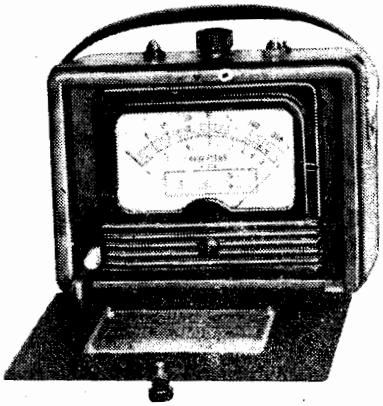
PANEL METERS. A comprehensive range of both moving coil and moving iron types are available in 2", 3", 4" round, square, rectangular and polystyrene meters. Ammeters, voltmeters, m.a. meters, micro-ammeters, VU meters, etc.



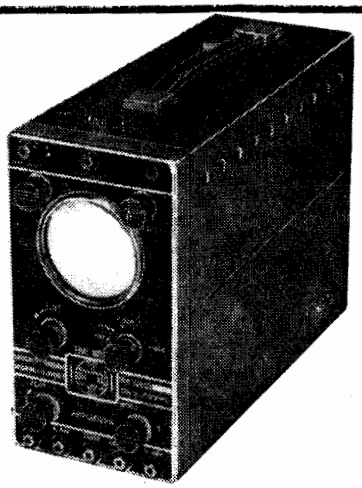
SWITCHBOARD METERS. Heavy-duty meters in nominal 4" and 6" round, flush and projection and other case types are available in all ranges of moving iron, moving coil and special types.



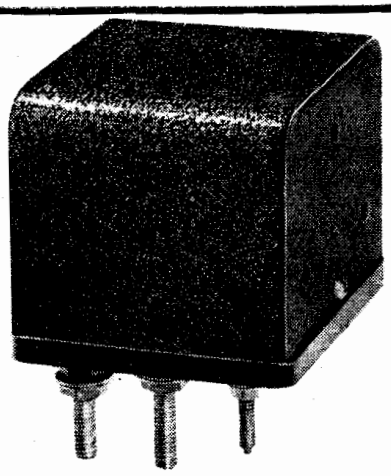
LONG SCALE METERS. Nominal 4" and 6" Long Scale Meters with 270° movement are available in moving iron, moving coil, frequency meters, wattmeters, power factor meters, etc.



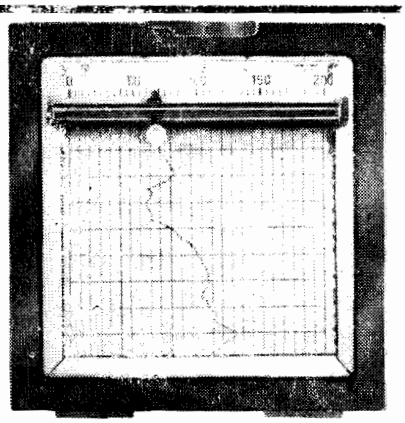
MINING TESTERS. A range of blasting circuit testers, 60-shot exploders and other approved testers are made to standards approved by the New South Wales Department of Mines.



RADIO, TV, TEST EQUIPMENT. A most comprehensive range of radio, television and industrial test equipment is available, embracing multimeters, oscillators, vacuum tube voltmeters, oscilloscopes, sweep and marker generators, battery testers, valve testers, ohmmeters, etc.



LIGHTING PLANT CUT-OUTS. These lighting plant cut-outs are designed to efficiently operate in 32 volts, 50 volts and 110 volts D.C. lighting plant equipment.



RECORDING INSTRUMENTS. For all switchboard facilities. Small and large models, embracing voltmeters, ammeters, wattmeters, etc. Wide range of chart speeds. Portable, rack or panel mounting.

The instruments illustrated on this page and briefly described are part of the University range and are manufactured in Australia. Free literature is available on all instruments. Service and technical advice is backed by our staff of sales engineers.

UNIVERSITY GRAHAM INSTRUMENTS PTY. LTD.

5 North York Street, Sydney. BU 3169

MAIL THIS COUPON NOW!

To University Graham Instruments Pty. Ltd., 5 North York Street. SYDNEY.

Please place me on your mailing list.

NAME.....

ADDRESS.....

NEWS AND VIEWS OF THE MONTH

Robots run subway

NEW York's vast subway system is to be changed to automation over the next 10 years.

The city's transport authority decided on the change after a strike by train drivers.

The change will mean cutting the staff of 38,000 by half.

Drivers will be replaced by electronic brains and gatekeepers by automatic turnstiles.

But there will be no dismissals the staff has been promised.

The changeover will be gradual and no resignations or retirements from the staff will be replaced.

When the changeover comes each train will be equiped with a master "brain-box" slung beneath the carriages and carrying a punched tape directing its speed and stoping laces.

Doors will be opened automatically and the train will be "told" by the tape how long to wait, when to sound a warning bell, when to close the doors and when to start.

A transit official said: "The subway will resemble a toy train operated completely automatically.

"Service will be faster and more reliable.

"They will also be freer of accidents because of the absence of human failure," he said.

Russia has also developed an electronic train driver.

The "train driver," known as an automatic cybernetic device, obeys all signals, chooses the correct speed and stops at stations.

It has been successfully tested on an electric train.

The "reader," built by engineers in Odessa, has a cathode ray tube similar to that in a television set, according to reports.

* * *

Atom safety gadget

EVERY Canadian soldier is being issued with a small instrument that detects nuclear radiation.

The Canadian Army said small dosimeters, which register radiation and provide information for medical authorities, will be worn around the neck like identification tags.

Army units will also be equiped with dosimeters in a fountain-pen style, survey meters to calculate how soon a contaminated area can be re-entered, and a pistol-shaped instrument to detect radiation in clothing and food.

* * *

Human spare parts

MEDICAL research workers in Boston have reported "a big step toward the creation of banks for human organs."

They are trying to develop a "deep freeze" process by which such organs as the heart and the kidney could be preserved, pending their use to replace defective organs.

The Massachusetts Heart Association said that human cells had been frozen to minus 459 degrees Fahrenheit—nearly absolute zero—then "thawed" to normal after long hibernation.

The Association said researchers may not be too far from success in deep freezing organs as well as cells.

But researchers had not found yet how to freeze a heart or kidney below minus four degrees Centigrade (28 degrees Fahrenheit)

The organs suffered damage between four and 10 degrees and would not work again.

The Association said the researchers were trying to produce a deep freezing process which would pass through the danger area before the damage was done.

* * *

Hope for heart cases

THE Heart Association also reports discovery of a mould that tracks down and destroys blood clots, thus promising dramatic and quick relief for heart patients.

The discovery is considered one of the major research developments in the cardio-vascular field in the last 10 years, ranking in importance with penecillin. The mould is completely safe for use with very sick patients, and is expected to prove helpful in relief of persons who had heart attacks, phlebitis, or other conditions connected with blood clotting.

The mould, given by injection, entered the bloodstream, and immediately sought out and destroyed blood clots.

At present the mould is scarce and its production slow.

POPULAR SCIENCE QUIZ

Q.—Is is true that when a bearing is oiled, an oil film prevents the metals from being in contact with each other?

A.—For a long time the action of oil as a lubricant was not clear and it was not unreasonable to doubt that the great pressure set up in some bearings could not allow a film of oil to remain unbroken. However, if a correct oil is used, a film does exist, and in such a case the metal surfaces are not in direct contact. Scientists have carried out many tests to prove this point, including one of electrical resistance which gave a reading much too high for metal-to-metal contact.

The oil film becomes thinner when the load on a bearing is increased, but it becomes thicker again when the speed of rotation is stepped up. At high loads, a film might be 40-millionths of an inch thick. Temperature has a big effect on the thickness of the film, and a change of a few degrees can reduce it by 50 per cent. It would seem that failure of bearing surfaces is firstly a matter of too high temperatures, and secondly too slow rotation under heavy load. Modern lubricants have been developed which show increasing adaptability to changes in operating conditions.

Q.—How much sleep do we need?

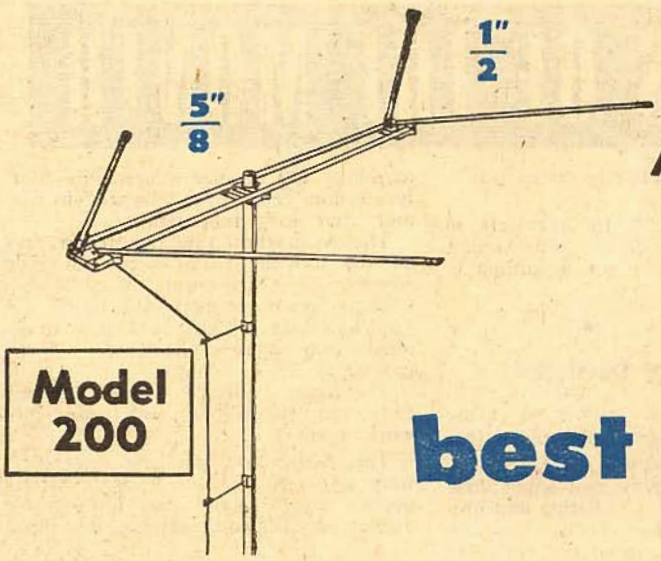
A.—Doctors disagree, but many consider we can do with less than we get. Recently a Soviet biochemist suggested that the body could be exposed to electrical frequencies which would so assist in disposing of fatigue toxins that 1-2 hours would do as well as eight hours, and even extend the life cycle by 20 years. But it is generally accepted that the full importance of sleep has not yet been understood.

Q.—Do meteors affect radio reception?

A.—Yes, scientists today are meeting with great success in using meteor trails for long-distance reception, as radio waves of appropriate frequency are reflected from them.

These trails must be correctly positioned, and lie roughly along a line joining the two stations in contact. Because of their transient nature, contact is established generally for only a few seconds at a time.

The first station transmits a steady carrier wave which is detected by the second station when the meteor trail arrives. The second station sends out automatic acknowledgment signal, whereupon the first station commences transmitting high-speed tape signals. When contact is lost, the acknowledgment signal disappears, and the first station reverts once again to standby. Distances of 1,000 miles have been used between 30 and 50 mega cycles, and radio men expect useful service from this method of transmission using quite low power



ANTIFERENCE

presents the

proved best performing

DOUBLE V

in Australia!

BEST PERFORMANCE

Practical tests in the field have proved conclusively that the Model 200 Double V, due to extensive research and design and use of large diameter rods, has an electronic performance far ahead of any similar type aerial on the market.

BEST PRICED

The resources of the Antiference organisation make it possible to produce the Model 200 Double V, even though it is far superior in quality, at a price more than comparable with any opposition model.

BEST QUALITY

$\frac{1}{2}$" & $\frac{5}{8}$" special aluminium alloy tubes

FOR BETTER ELECTRONIC PERFORMANCE

Greatest Strength—No Sagging

ANTIFERENCE

TELEVISION AERIALS

ANTIFERENCE (AUST.) PTY. LIMITED
(inc. Canberra)

VIC.: 360 Smith Street, Collingwood
JA 1303
N.S.W.: 131 Regent Street, Sydney
MX 1104, MX 1197

AUSTRALIA'S AND THE WORLD'S LARGEST TELEVISION AERIAL MANUFACTURERS

AF/39/FPC

Kids test rockets

THE U.S. Army may set up roving grounds on which science-minded teenagers can test home-made rockets.

Service and civilian authorities are becoming increasingly alarmed over the number of accidents involving children experimenting with rockets.

The rockets—some 12ft long—are powered with explosive propellants which could bring death to bystanders.

Army inquiries revealed that there are nearly 500 amateurs experimenting in or near New York City.

Pioneer rocket expert Willy Ley said he had discussed with Army officials a plan to set up roving grounds for amateur enthusiasts.

"None of the fuels these kids use is safe when used by an amateur," Ley said.

"With the amateur proving grounds, experienced adults would be around to see that nobody blows his head off."

★ ★ ★

Gas kills germs

UNITED States Army chemists have discovered a germ-killing gas with which to sterilise hospitals, the New York Times reports.

The newspaer says the gas is known as beta-propiolactone.

It is a compound used previously for sterilisation only in liquid solution.

The Times report said the Army chemists had claimed that beta-propio lactone could sterilise a room in two hours.

Formaldehyde would take 10 hours and ethylene oxide six hours to sterilise a similar area.

★ ★ ★

Machine therapy

A NEW machine to give low-frequency therapy for nerve and muscle injuries is to be installed at Royal North Shore Hospital.

The machine is an electric impulsator equipped with a CRO screen, the first of its kind in Australia.

Imported from Austria at a cost of £350, it will be installed in the hospital's physiotherapy department.

The CRO screen shows the physiotherapist the exact amount of power and the manner in which it is conveyed to the patient.

The impulsator is used to restore muscles paralysed by nerve injuries, and will help paralysed patients to regain the use of their limbs.

★ ★ ★

Man of the future

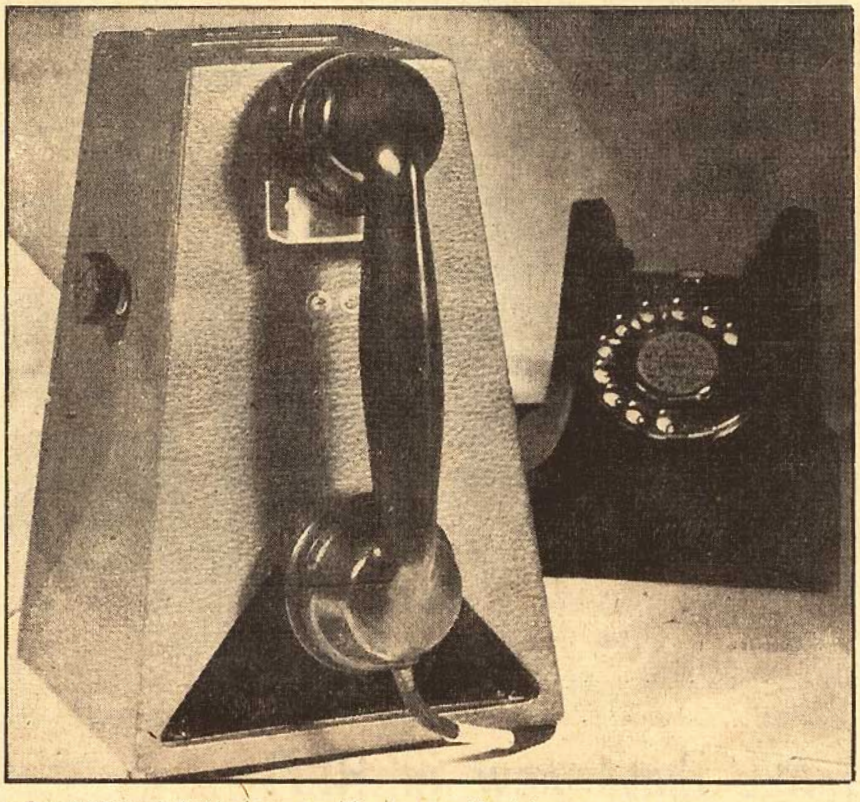
MAN'S appearance would undergo a substantial change within about 65 centuries, according to Jay Savage, an American scientist.

He thinks earth's inhabitants of that period will have a hairless head, spindly legs, and no toes.

Houses, headgear and umbrellas will have removed the need for hair. Baldness in both sexes is now increasing.

Mechanism would mean that we would use our legs a great deal less in the future.

And footwear would make toes unnecessary. Already the human little toe has almost disappeared, and has no function.



The transistorized telephone amplifier in use. Headpiece is held close to magnetic pickup coil, the output of which is amplified and fed to the speaker mounted in top of case. Volume control is at the side. The horn at the bottom of the case helps to reinforce outgoing speech.

A Transistorized Telephone Amplifier

Here is a new version of one of the handiest gadgets we have ever described. It has a place in every business office where the phrase is so often heard . . ."Just hang on a minute, please." Our telephone amplifier will save you "hanging on", will let you get both hands free to turn up lists and copy down information.

by Maurice Findlay

THE original version was described in the February, 1954 issue and was an immediate success. This new version has all the features of the original with the difference that an extremely economical and reliable transistor amplifier is substituted for the valve amplifier.

RESTATEMENT

The idea behind the new version is just the same as for the original and we can do no better than repeat some of the introduction to the original article. This started off with a discussion about the time wasted per day waiting on one end of a telephone while someone at the other end searches for a wanted party.

Anyone who has worked in a business office will readily appreciate the problem. The routine goes something like this:

You wish to ring Brown and Co. and speak to Mr. Smith, but the first couple of attempts to dial their number results in an engaged signal. (After all, Brown and Co. are a busy firm).

Eventually, having already wasted much precious time, you succeed in making contact and ask for Mr. Smith.

Then the fun starts. Mr. Smith is either engaged on another line, busy with a client, or just cannot be found for the moment. "He will probably be available in a few minutes," says the switch girl. "Will you wait on?"

Remembering the difficulty you have already had getting this far, you decide to wait on. The minutes drag by. There are many things which you could be doing while you wait, but with only one hand free you are practically incapacitated. You try to make a few notes about something you just remembered, but the paper slides all over the desk.

You try to refer to a catalogue but find it almost impossible to keep it open at the page you want. Eventually you resign yourself to sitting and waiting until Mr Smith is available, which may render you immobile for up to 10 minutes.

WORTH HOUR PER DAY

By the time this procedure has been repeated several times a day it is quite easy to waste an hour or more, simply because one must hold the telephone to one's ear while waiting for someone to answer it.

It is obvious enough that, if one could couple a simple amplifier to the phone to raise the incoming signal to loudspeaker level, it would be possible to monitor the circuit while continuing with other work.

From this thought was born the idea of a "telephone minder." After a practical test it became apparent that such a set-up was capable of working in both directions, at least under favourable conditions, due to the high sensitivity of the modern telephone transmitter.

By adding a simple horn, which would collect the sound more efficiently, it was possible to improve results enough for a "loudspeaking telephone" to become a real possibility.

Apart from its use as a telephone-minder, it is extremely valuable when notes have to be made from information received by phone, since it leaves both hands free while still providing talk-back facilities to permit checking.

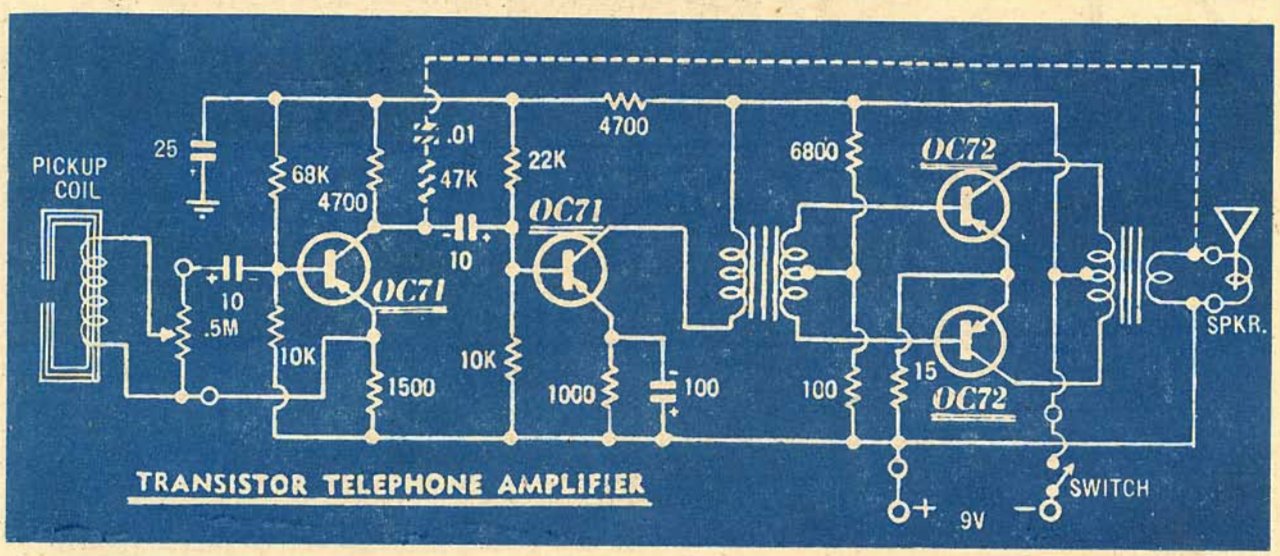
Similarly, when data have to be given over the phone, it is frequently necessary to refer to books or thumb through files, a process which can be extremely difficult with only one hand.

A good idea of the device in its present form can be obtained from the photographs. It consists of a pyramid-shaped case occupying no more desk space than an ordinary telephone and which houses the amplifier, battery, speaker, horn, etc., making the unit completely self-contained.

SIMPLE IN USE

In use, the handset is simply hung on the front of the case, which action operates a simple gravity switch and turns on the amplifier. At the same time the handset rests in such a position that the receiver couples automatically to the pickup coil while the mouthpiece rests in the throat of the horn.

CIRCUIT OF THE NEW TRANSISTOR AMPLIFIER



The amplifier includes circuits to ensure stability of operation at any likely temperature. Maximum power actually delivered to the speaker is about 250 mV (greater than in the case of the original valve amplifier) and there is a reserve of gain. The feedback circuit is optional.

Signals from the receiver will be heard through the loudspeaker in the top of the case while speech may be directed at the transmitter horn.

The distance at which one may work from the transmitter depends on several factors, including the efficiency of the particular telephone channel, but it will usually be quite satisfactory up to 12 inches.

This is quite enough to allow a notepad or other data to occupy the desk between the operator and the instrument.

Under more favourable conditions greater distances may be possible.

There is one question which we know our more technically-minded readers are just itching to ask, namely, "What about feedback?"

FEEDBACK

This is quite a reasonable query because, at first glance, it would appear that the set-up is a "sitter" for such a complication. The main reason for this is the fact that in any ordinary telephone circuit the one pair of wires carries the signals in both directions and the receiver in any telephone is therefore connected across its own transmitter.

For this reason there is always an echo of one's own voice in the receiver, as well as considerable pick-up of the general noise level in the vicinity. This is known in telephone parlance as "side tone" and it can cause serious interference to the distant signal when one's own phone is being operated in a noisy location.

In an effort to overcome this problem, P.M.G. engineers developed what is known as an "anti-side tone circuit."

This is an ingenious arrangement whereby the local receiver is effectively isolated from the local transmitter, though still in circuit as far as the distant transmitter is concerned.

For various reasons the isolation is not made complete (though it could be) but is sufficient to improve performance considerably in noisy locations.

What is more important as far as we are concerned is the fact that the possibility of feedback is reduced in direct proportion to the degree of isolation between the two halves of the circuit and, since most phones are now fitted with this circuitry, the problem is much easier than otherwise.

PLENTY OF VOLUME

It must not be inferred that feedback will not take place, because it certainly will if the gain is high enough, but it does mean that, by careful placing of the speaker and horn, it is possible to operate the speaker at a perfectly satisfactory level without trouble.

So much, then, for the general considerations. Now let us consider the practical unit in detail.

To ensure efficient operation of the microphone insert, we designed the unit to hold the handset in an upright position and, because there appears to be an even chance that a user will want to hang it on either the right or left-hand side, we hung it on the front.

This also makes the design of the horn much simpler. Bringing the received sound out the top helps to isolate it from the horn, this being further assisted by the shelf holding the amplifier.

Since it is an offence under P.M.G. regulations to make any physical connection to the telephone circuit, connection to the receiver is made magnetically.

There are many ways of doing this, and practically any iron-cored winding will provide some measure of pickup. However, a reasonably efficient system is desirable if the amplifier is to be kept simple.

For the pickup coil, we used a pair of headphone bobbins. These are available from disposals headphones or, alternatively, could be obtained new from one of the manufacturers of telephone equipment. Each coil has a nominal DC resistance of 100 ohms.

The core is made from a few pieces of stalloy such as can easily be obtained from a discarded transformer stack. Following the design of the tape heads, we bent two "U" shaped pieces, one slightly smaller than the other and designed to fit inside it, to form one half of the core.

MAGNETIC HEAD

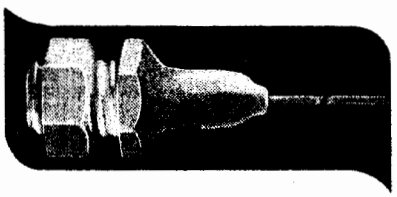
The coils are mounted side by side, one on each leg of the "U", and a strip of stalloy inserted in the opposite side of each to form the actual pickup poles of the system.

The coils are mounted behind the front panel of the case and the pickup poles of the core are brought out to the front through two narrow saw cuts in the panel.

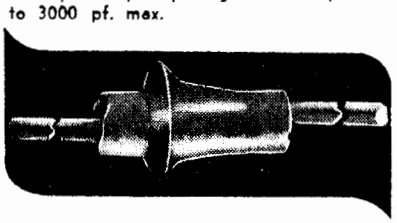
PARTS LIST

1 case (see diagram)
1 bakelite panel 5¼in by 2¾in
1 3in permag. speaker
2 OC71 transistors
2 OC72 transistors with heat sinks
RESISTORS all half watt. 1 15 ohm, 1 100 ohm, 1 1,000 ohm, 1 1,500 ohm, 2 4,700 ohm, 1 6,800 ohm, 2 10K, 1 22K, 1 47K, 1 68K and 1 0.5 meg pot.
CAPACITORS 1 0.01 uF 200V, 2 10 uF 12V, 1 25 uF 12V, 1 100 uF 3V.
1 special output transformer (300 ohms to 3.5 ohms)
1 special driver transformer
1 600 type relay with 1 normally open contact complete with yoke and armature but minus coil.
2 500 ohm headphone bobbins
Strips of stalloy for pole pieces
1 276P 9V battery
Plug for battery, hook-up wire, nuts, bolts, tinplate for horn, scrap aluminum &c.

DUCON MINIATURISED RADIO & TV Components

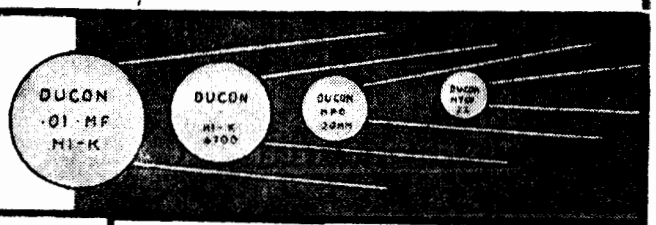


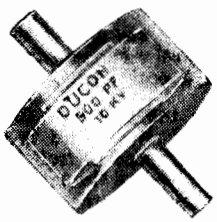
TYPE CAE—Screw mounting stand-off variety in capacity ranges of 100 pf. min. to 3000 pf. max.



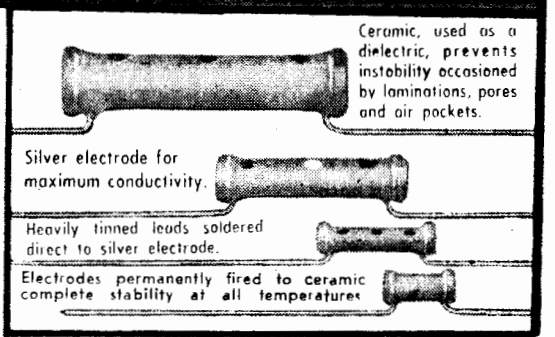
TYPE CAC 100—Feed-thru flange mounting type can be soldered direct to the chassis or shield plate in tuner units. From 50 pf. min. to 1500 pf. max.

The disc ceramic, with its short rf current path, when soldered direct to the tube terminals, reduces the inductance to very small values.





Type TV high voltage disc capacitors encased in "DURITE" for T.V., and other high voltage applications.

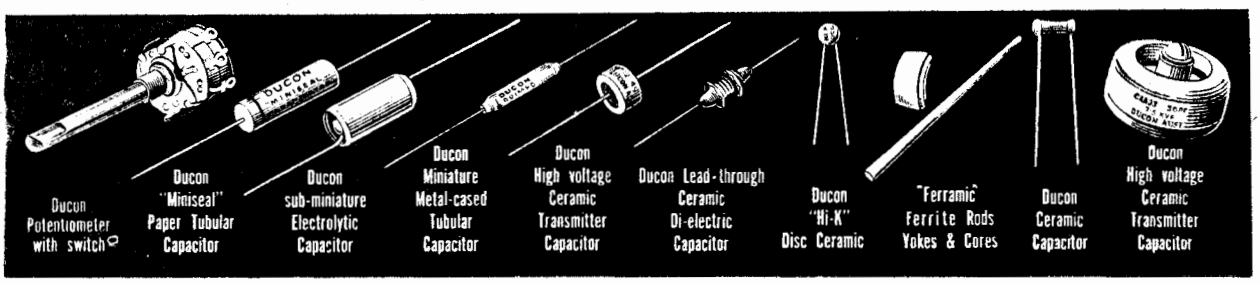


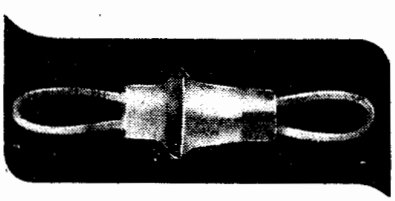
Ceramic, used as a dielectric, prevents instability occasioned by laminations, pores and air pockets.

Silver electrode for maximum conductivity.

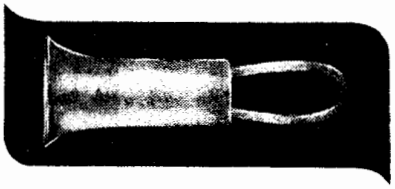
Heavily tinned leads soldered direct to silver electrode.

Electrodes permanently fired to ceramic complete stability at all temperatures





TYPE CAC—Feed-thru flange mounting type can be soldered direct to the chassis or shield plate in tuner units. From 50 pf. min. to 1500 pf. max.



TYPE CAE 100—Stand-off flange mounting style mounted by soldering to the chassis. From 50 pf. min. to 1500 pf max.

New modern Leightonfield Works provide further expansion for Ducon manufacture and expedience of delivery.

DUCON CONDENSER LIMITED

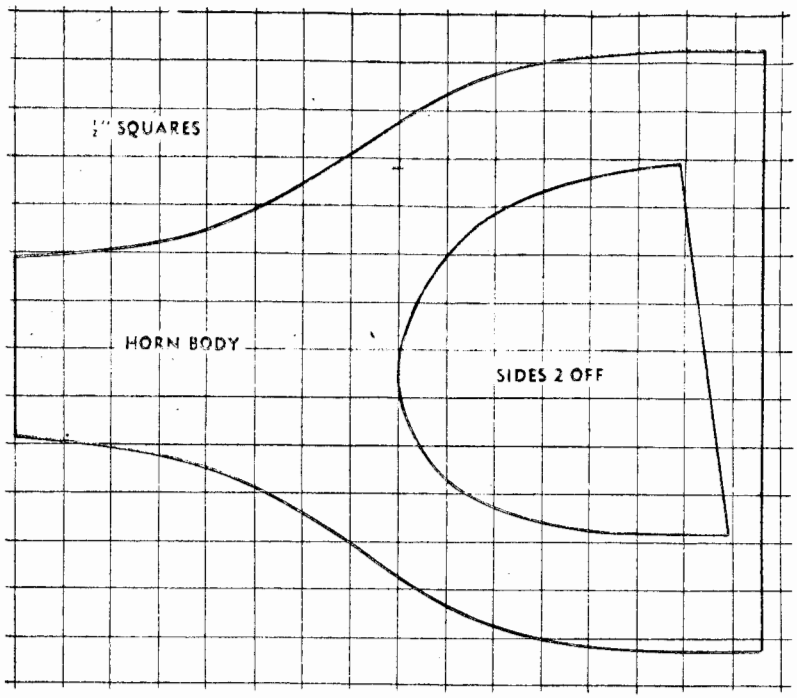
Christina Rd. and Birmingham Ave., Villawood, N.S.W UB0133.

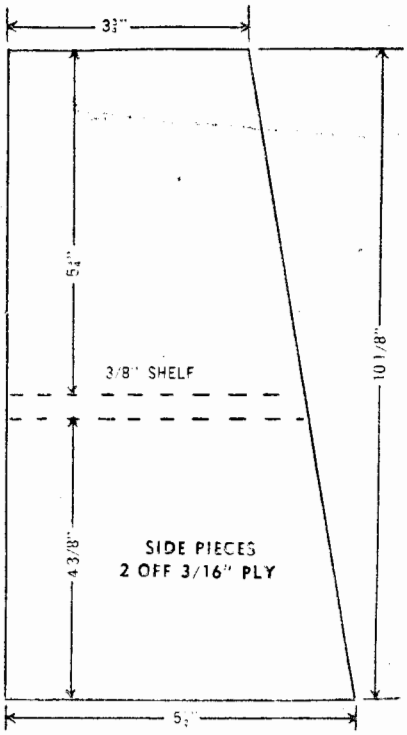
SUBSIDIARY COMPANIES:
Simplex Products Pty. Limited.
Mica Products Pty. Limited.
Ducon General Ceramics Pty. Limited.
Ducon (N.Z.) Limited, 21 Grey St., Wellington. 42-411.

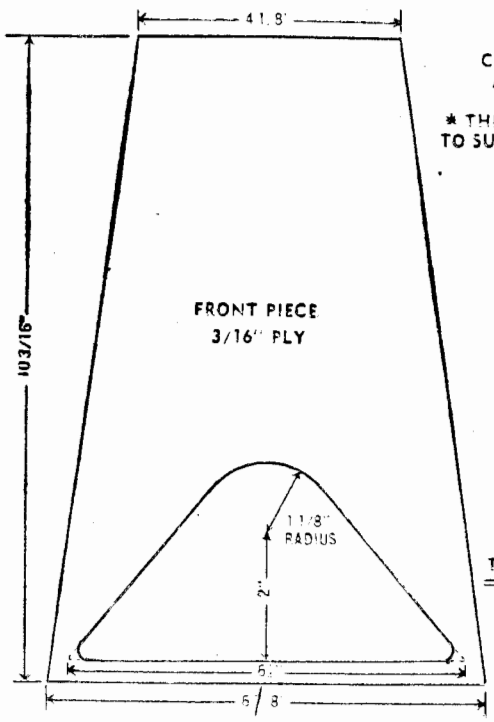
VICTORIAN OFFICE:
Ducon Condenser Limited, 83 William St., Melbourne. MB4471.

INTERSTATE AGENTS:
Wm. T. Matthew Ltd., 95 Grenfell St., Adelaide. W3361.
P. H. Phillips Pty. Ltd., 458 Brunswick St., Brisbane. LW2011
H. T. McQuillan Pty. Ltd., 1 Queen's Place, Perth, W.A. BA8911

ASSOCIATE COMPANY: P. R. Mallory & Co. Pty. Ltd.

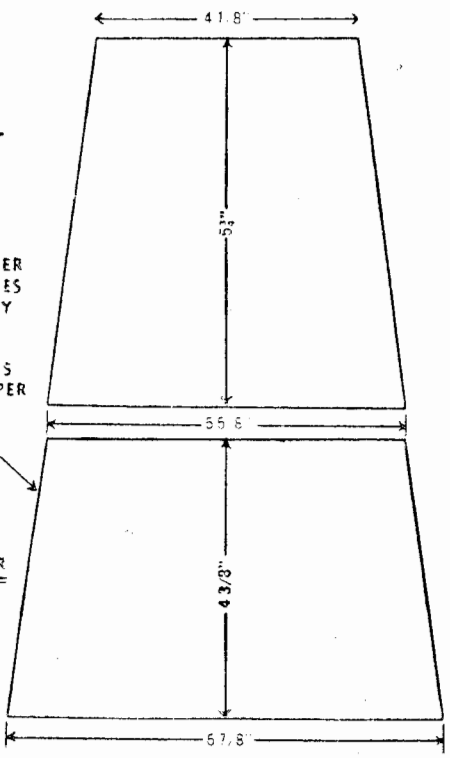




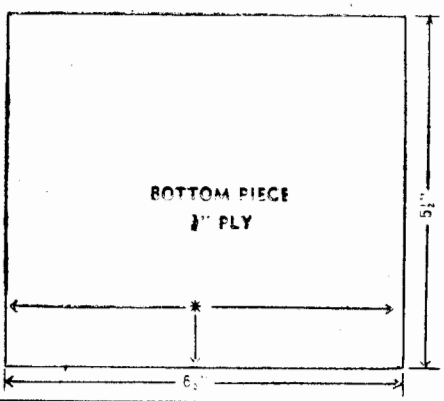


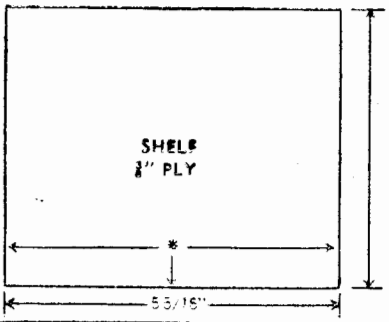
CABINET DETAILS
ARE 1/3 SCALE

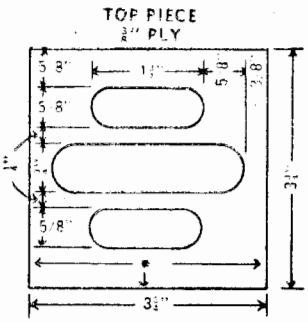
* THESE EDGES ANGLED
TO SUIT TAPER OF CABINET



RADIO AND HOBBIES
TELEPHONE AMPLIFIER



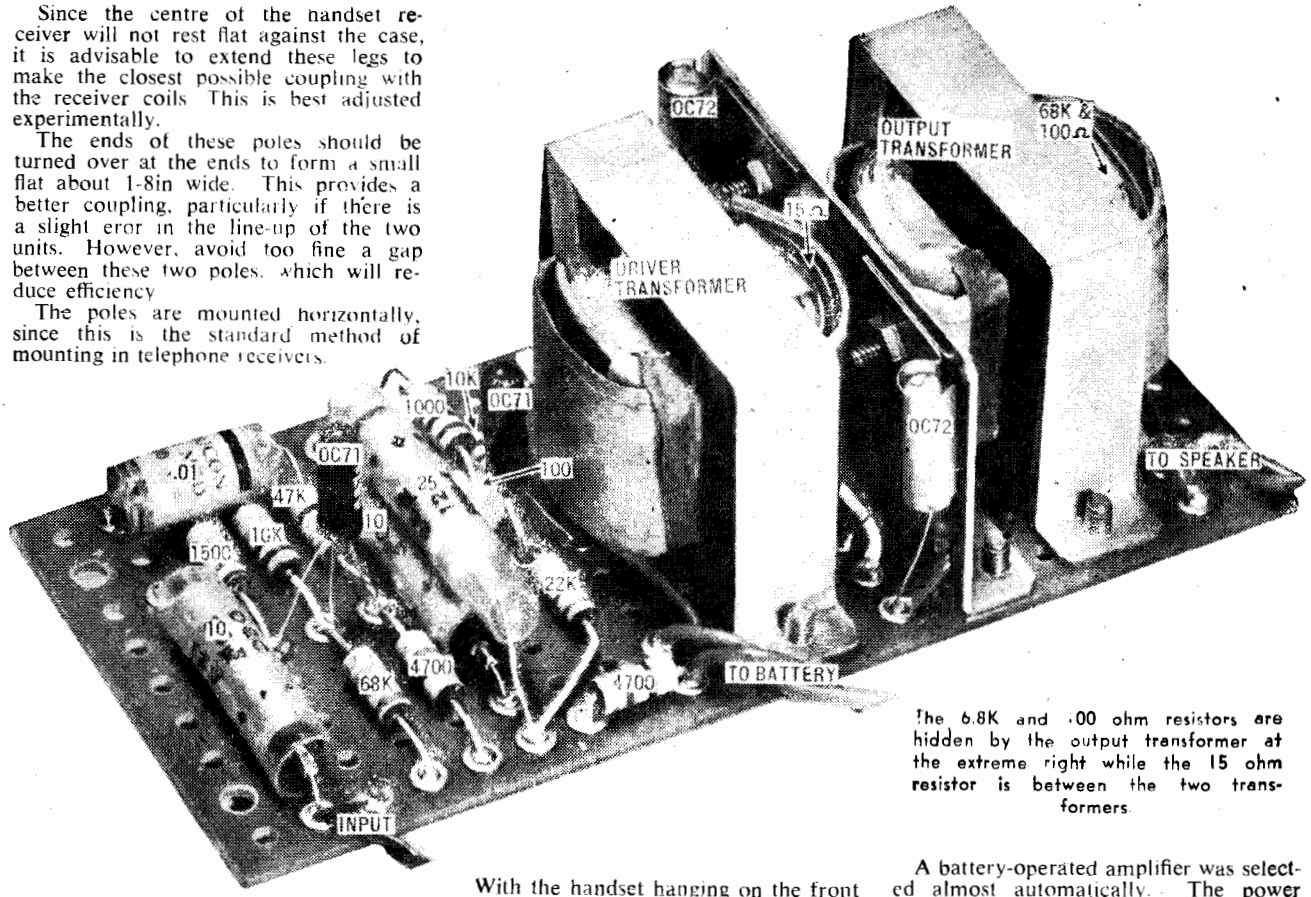




Since the centre of the handset receiver will not rest flat against the case, it is advisable to extend these legs to make the closest possible coupling with the receiver coils. This is best adjusted experimentally.

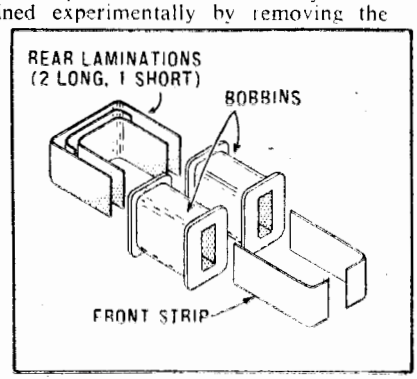
The ends of these poles should be turned over at the ends to form a small flat about 1-8in wide. This provides a better coupling, particularly if there is a slight error in the line-up of the two units. However, avoid too fine a gap between these two poles, which will reduce efficiency.

The poles are mounted horizontally, since this is the standard method of mounting in telephone receivers.



The 6.8K and 100 ohm resistors are hidden by the output transformer at the extreme right while the 15 ohm resistor is between the two transformers.

In our case, the top pole was mounted 7-8in from the top of the case (outside) and the spacing between the slots 7-16in. These figures are only given as a guide and the position should be finally determined experimentally by removing the cover of the receiver and noting the position of the poles.



The magnetic pickup head.

We tried mu-metal in place of the stalloy, and this does give slightly better results, but it is not essential and hardly worth chasing if it is not readily available.

A two-terminal tag strip is mounted alongside the coils, held in place with a countersunk screw through the side of the case. It provides a termination for the fine leads from the coils.

The coils should be connected in series aiding and this is achieved by connecting the two outside leads together and taking the two inside leads to the amplifier.

With the handset hanging on the front of the case the mouthpiece will be facing away from the user and speech pickup under these conditions is poor. The horn is, therefore, designed to collect the sound from the speaker, and turn it through 180 degrees into the mouthpiece, as well as increasing the area of sound pickup.

We conducted several experiments with various shapes to determine a suitable one and finally reached the conclusion that a simple design is practically as effective as a more complicated one.

MAKING THE HORN

The final design consists of a simple elliptical fold with sloping sides, and a good idea of it can be obtained from the scale drawing.

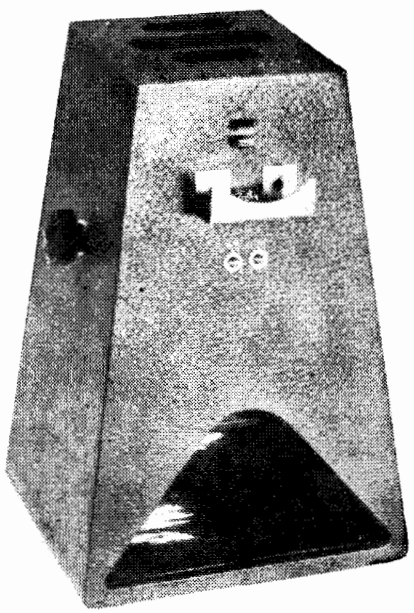
The original was made from 22-gauge tinplate and it should not be difficult for the home constructor to duplicate our effort by scaling up the drawing to full size.

If tinplate is not readily available in sheet form it should be possible to obtain enough material from a couple of discarded jam tins, or similar containers. All that is then required is a pair of tin snips and a soldering iron. When finished it can be given a coat of black lacquer and its humble origin will never be suspected.

The horn is mounted against the front of the case behind the triangular cutout and is held in place by means of two 1-8in machine screws through the bottom near each front corner. This should force the top of the horn against the front of the case. The heads of the screws should be given a dab of black lacquer also, to match the horn.

A battery-operated amplifier was selected almost automatically. The power available is quite adequate for applications of this kind, and the intermittent nature of the operation ensures long battery life.

The original telephone amplifier described in the February, 1954, issue, used two valves. However, in the intervening four years transistors have been developed to the point where they offer advant-



The position of the magnetic head clearly visible in this photograph without the handpiece.

ages over valves in the present application.

All things considered, the average power consumption of a transistor amplifier is likely to be only about 1-10th or less the power consumption of a valve amplifier with the same maximum capabilities.

The supply position of transistors is gradually improving and it is probable that readers wishing to build the new telephone amplifier will have no difficulty in buying all the transistors over the counter. However, there may be odd occasions when it will not be possible to buy the OC72's we have chosen for the output stage and we would advise readers to buy their OC72's before any other components. The supply position for the OC71's should not present any difficulties.

While it is not appropriate in a practical article such as this to take too much space discussing the electrical design of the amplifier, there are a few remarks which are appropriate.

First of all, transistors are sensitive to temperature. Their characteristics change, particularly with high temperatures, and it is necessary to take special precautions in the design to ensure that the amplifier will operate successfully over the entire temperature range.

The most suitable temperature stabilising arrangements takes the form of a resistive network. All values are capable of calculation to give a desired degree of stability. Greater temperature stability than has been designed into our amplifier is possible, but we believe that we have chosen the best compromise between several conflicting factors.

HIGH EFFICIENCY

The output transistors are operated under class B conditions. This means that the base bias current is adjusted so that the collector current is almost zero with no signal. When drive is applied, the collector current of the opposite transistors increase alternatively with successive half cycles of the signal. The average current drain is nearly proportional to the amplitude of the signal.

This type of circuit is very efficient by comparison with other circuits and even taking into account the various losses which occur in a practical amplifier, efficiencies of the order of 70 per cent are not unusual.

The detail of the design of the ouput stage is closely dependent on the battery supply voltage. From the point of view of the transistors it would have been quite practical to have designed the output stage to operate on any one fixed voltage between about 4 and 12 volts.

However, inquiries revealed that there is a tendency among manufacturers of transistor portables and transistor amplifiers to standardise on a nine volt supply. Batteries of this voltage will eventually be available in at least three different sizes.

With the nine volt supply a suitable collector to collector load resistance is 300 ohms when the transistors will develop a power output of about 350 mW. Loudspeakers commonly available have voice coil impedances of a few ohms only and therefore a matching transformer is required.

We used the Rola 3C speaker which has a nominal voice coil impedance of 3.5 ohms in conjunction with the Ferguson OP370 transformer designed to match 300 ohms to 3.5 ohms.

The driver transformer used in the original amplifier is the Ferguson MT355. The ratio of this transformer has been designed specially to fit in with the operating conditions for the OC71 driver stage and has a slightly different ratio to other designs for the same voltage. The basic thinking behind our design has been to supply a slight reserve of drive at the expense of slightly increased driver current drain.

The whole matter of transistor transformer design locally is only in its initial stages and there is no doubt that there will be improvements in time to come. The most obvious room for improvement is in the matter of size. The volume of iron could be much less than that in the present transformers while still maintaining excellent characteristics.

The remainder of the amplifier follows fairly conventional resistance capacity coupled design and includes circuits to maintain the operating point fairly stable with changes in temperature.

Miniature low voltage electrolytic capacitors are expected to be available in several brands before too long but you may find that your usual supplier will not have exactly what you require in stock. In general, you could use a larger value for the electrolytics, provided the voltage rating is adequate. Units which are larger physically could also be used but with the obvious disadvantage of spoiling the layout. You will note that the need for the electrolytic across the emitter resistor of the first transistor has been avoided by returning the input circuit direct to the emitter.

FREQUENCY RESPONSE

For the amplifier without feedback, the minus 3 db points occur at about 250 cps at the low end and 5 Kc at the high end of the range. It will be found to have a reserve of gain with most magnetic pickup heads and negative feedback of about 6 db can be applied with advantage.

Approximately this amount of feedback will be obtained by connecting a 47,000 ohm resistor between the collector of the input transistor and the voice coil winding of the output transformer. (The correct polarity should be found experimentally by reversing the VC winding connections.) With feedback, the minus 3 db points will be found to be at 100 cps and 8 Kc.

In practice the limit to the volume that you can use, depends on the amount of gain which can be obtained with stability. Telephone circuits generally tend to have a rising frequency response and greater effective volume from the transistor amplifier may be obtained by boosting the bass with respect to the higher frequencies.

Considering all factors, a .01 uF capacitor in series with the feedback resistor appears to give the best results and the output rises gently with diminishing frequency until it reaches a peak at about 200 cps.

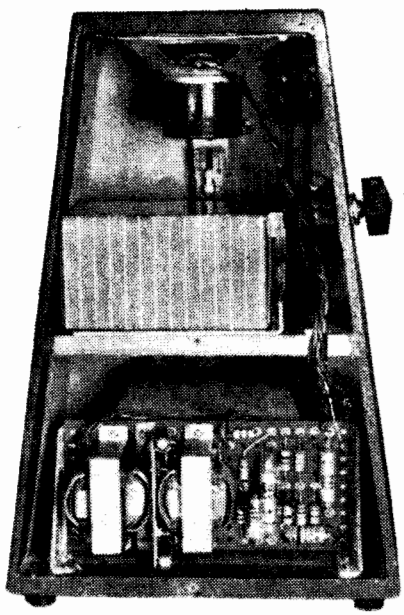
The main points which remain to be discussed concern the mechanical construction of the amplifier and the case. All components can conveniently be mounted on a piece of bakelite with appropriate holes or a piece of matrix board. This form of construction is far more suitable than a conventional chassis, and there is no serious danger of feedback in the case of unshielded circuits because of the low impedance.

It is necessary that the output transistors be mounted on a heat sink. In our case, this takes the form of aluminium sheet 2¼in by 1½in, with one of the 2¼in sides bent up ⅜in to form a mounting foot. The transistors are normally supplied complete with specially shaped mounting pieces which contain and permit them to be attached to the heat sink with a single bolt.

Small eyelets make convenient tag points in the bakelite. They are quite easily secured by tapping on the reverse side with a cone-shaped punch which spreads the body.

The general plan of the layout follows the theoretical diagram with one or two exceptions which have been included to make the amplifier more compact. The location of most of the parts can be judged from the coded photograph.

From the mechanical features of the amplifier we can now go on to talk about



A rear view of the unit

making the case and the on-off switch which is actuated by the telephone hand set.

There are many possible arrangements for the actual switch hook and the reader with a well-stocked junkbox and a little ingenuity will probably be able to evolve a scheme to suit his own requirements. However, the scheme which we have worked out appears to be as good as any and has the advantage of using standard components which, while not usually available from a radio dealer's shelf, can be obtained on special order.

We found it most satisfactory to provide a rigid bracket to take the weight of the handset, thus ensuring that it always rests in the correct position relative to the horn. This consists of a "U"-shaped bracket, approximately ⅜in on all three sides and 2in long. One side, which mounts against the front of the case, is cut out to allow the arm of the switch hook to pass through to a point where it will be operated by the lower edge of the receiver case.

The opposite side has a curved cutout to suit the curve of the handset, and a good idea of the arrangement can be obtained from the photograph of the finished unit. The details of the bracket

(Continued on page 127)

VALUE!

a complete series of top quality city aerials priced so low that it becomes pointless to even consider aerials of questionable quality.

CHANNEL MASTER

presents

"MAVERICK" series

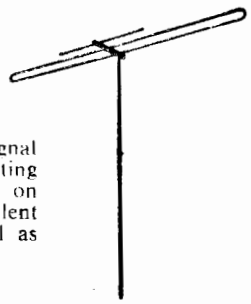
5 NEW MODELS—mechanically superior to any other aerials in their price range.

Fully pre-assembled snap lock swings all elements open. Secured in seconds.

In the entire TV industry, only CHANNEL MASTER has the technical resources and productive capacity to produce a low-priced quality aerial like the "MAVERICK."

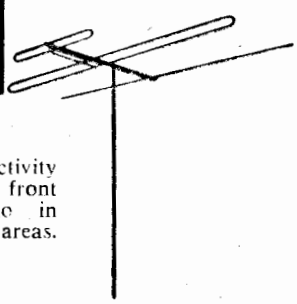
The "MAVERICKS" are unquestionably today's outstanding buy . . . for low price . . . for quality and for really fast assembly. Fully pre-assembled in aluminium alloy with elements that swing into position and "snap-lock" securely in a matter of seconds. Tested rigidly by the Channel Master field technicians and perfected to this series which will give excellent performance in the metropolitan area. Each features the newly developed ghost rejection coupling system.

RETAIL £5



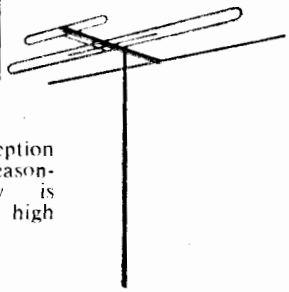
For primary signal areas where ghosting is no problem on high band. Excellent loft fitting as well as outdoors.

RETAIL £6/17/6



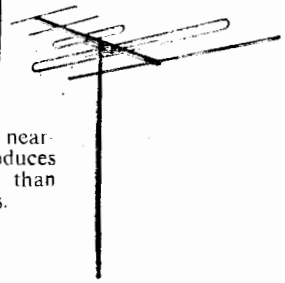
Excellent directivity and maximum front and back ratio in medium prime areas.

RETAIL £7/17/6



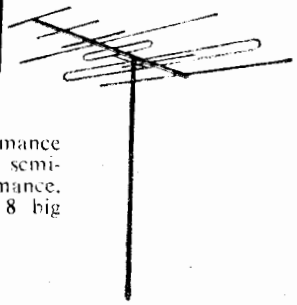
For good reception areas where reasonable directivity is needed for both high and low bands.

RETAIL £9/7/-



6 elements for near-fringe use. Produces clearer pictures than any in this class.

RETAIL £11/11/-



High performance aerial featuring semi-fringe performance. At city prices 8 big elements.

THE NEW MAVERICK – ACCLAIMED BY THOUSANDS – "A QUALITY AERIAL"

EASY TO INSTALL

AND THE PRICE IS RIGHT!

CHANNEL MASTER

PTY. LTD.

FIRST IN PREASSEMBLED AERIALS

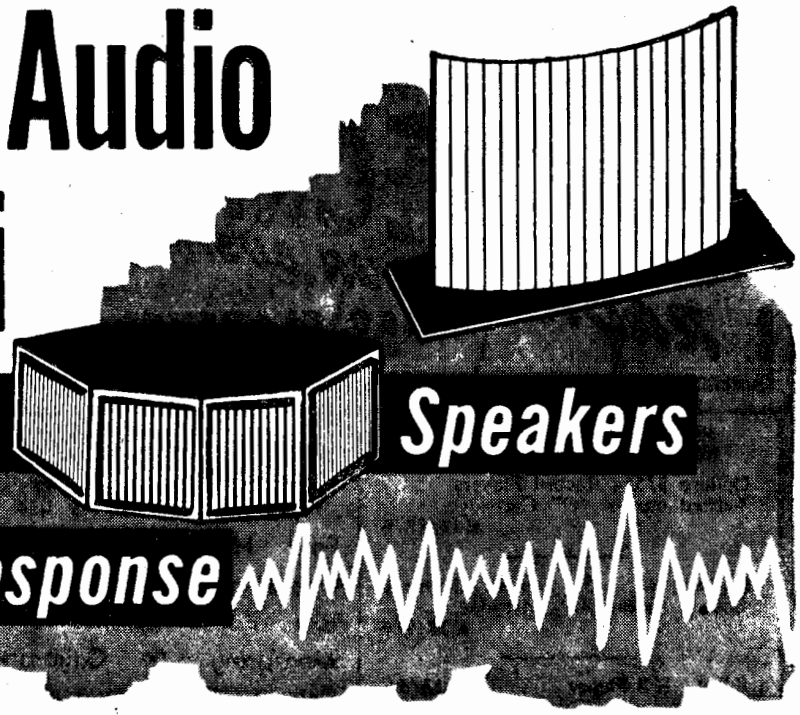
752 Pittwater Road, Brookvale, N.S.W. XF0221

576 Elizabeth Street, Melbourne. FJ6634

Contact your CHANNELMASTER wholesaler

All About Audio and Hi-Fi

Electrostatic Speakers & Transient Response



By G. A. BRIGGS

(Managing Director Wharfdale Wireless Works Ltd.)

PART 6—Matching electrostatic tweeters to amplifiers and factors that affect transient response of speakers.

THE question of load matching between amplifiers and electrostatic speakers is rather involved and the problems are not yet generally understood. Mr R. E. Cooke, our technical director, has been making an investigation into what happens, and I do not mind admitting that I read his findings in statu pupillari (as a student); he admits with becoming modesty that he learned quite a bit himself. Here is the report in Mr Cooke's own words. (As this is the sixth article in the series, it is time he showed his hand).

For the sake of simplicity we usually refer to impedance by its numerical value alone but, as the term implies we are really dealing with a complex mixture of resistance and reactance. Reactance is the technical term for the blocking action due to an inductor or capacitor and the amount of reactance associated with a given impedance is often expressed as a phase angle. The sign of the phase angle, i.e., plus or minus, indicates whether the reactance is inductive or capacitive in nature, as the case may be.

PHASE ANGLES

For the purpose of simple discussion we can say that a phase angle of plus 90 deg. corresponds to pure inductance and minus 90 deg. corresponds to pure capacitance, while zero angle indicates pure resistance. Intermediate values relate to mixtures of resistance and reactance which may be inductive (positive) or capacitive (negative) in character.

Fig. One shows the phase angle and impedance characteristics of a 10 inch moving-coil loudspeaker with foam suspension when mounted on a plane baffle 2½ feet square. The measurements were carried out using a Muirhead impedance and phase angle meter Type D-728A in conjunction with a b.f.o. and standard resistance box.

The impedance curve is quite ordinary and shows the usual peak at the fundamental resonance frequency, with a gradual rise above 400 cps due to voice-coil inductance. The phase angle curve is relatively unfamiliar, however, and shows that this typical unit behaves like a pure resistive load at two frequencies only. The lower one corresponds to the fundamental resonance at 31 cps, and the upper frequency is 300 cps which occurs in the region of the lowest impedance value normally used for matching purposes. Between these two frequencies the loudspeaker is capacitive in its behaviour, while outside that region it behaves inductively.

We know from experience that most power amplifiers are quite happy when feeding loads of this type but it is generally accepted that electrostatic speakers present some new load matching problems; so we cannot do better than start by inspecting the phase-angle and

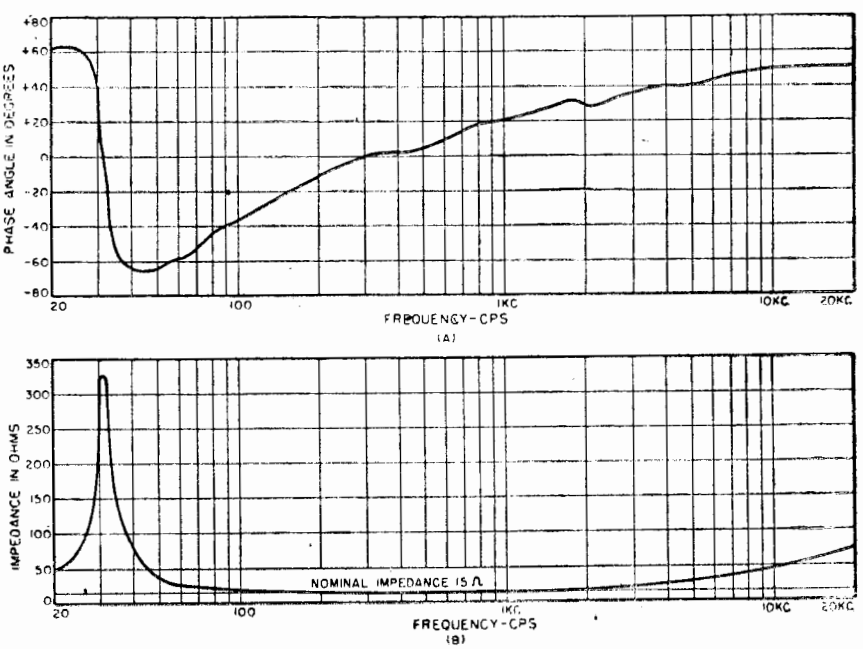


Fig. 1 — Phase angle and impedance of 10-inch moving-coil speaker on a flat baffle.

impedance curves of a typical push-pull electrostatic tweeter of the latest type.

These are shown in Fig. 2, and we can see at once that electrostatics behave quite differently from moving coils. This particular electrostatic unit contains a built-in high-pass filter incorporating an inductor, which accounts for the peak in the impedance curve as well as for the positive phase angle below 2,000 cps.

Although the operating range is from 500 cps upwards, the interesting part of the curves is in the region above 3,000 cps, where the impedance falls rapidly to 5 ohms at 15,000 cps although the unit is nominally rated at 16 ohms.

Over a large part of the working range the phase angle is around minus 80 degrees which approximates to a pure capacitance. This contrasts sharply with the moving-coil unit, which is inductive in the upper frequency range.

Many power amplifiers employ overall negative feedback taken from the secondary of the output transformer. The loud-speaker load is therefore included as part of the feedback loop and its phase characteristics must be taken into account. In order to maintain stability, the phase of the feedback voltage must remain within certain limits and some amplifiers which have been designed to work with moving-coil loud-speakers may become unstable when faced with electrostatics.

STABLE AMPLIFIERS

However, there is no fundamental difficulty in building an amplifier which will remain stable while feeding this type of load and in course of time all high-quality power amplifiers will be designed with such operating conditions in view.

The real snag in matching an electrostatic loud-speaker to its driving amplifier is the problem of developing an adequate voltage across the loud-speaker terminals over the whole operating frequency range. The trouble arises because vacuum tubes are voltage amplifying devices which do not like working into low impedances. Consequently, although the average amplifier is not unduly worried by loads greater than the nominal matched impedance, the onset of distortion is usually serious if the load impedance falls very much below the nominal matched value, and the same power output is expected.

In order to obtain some factual information, tests were carried out on a good quality power amplifier of reputable vintage.

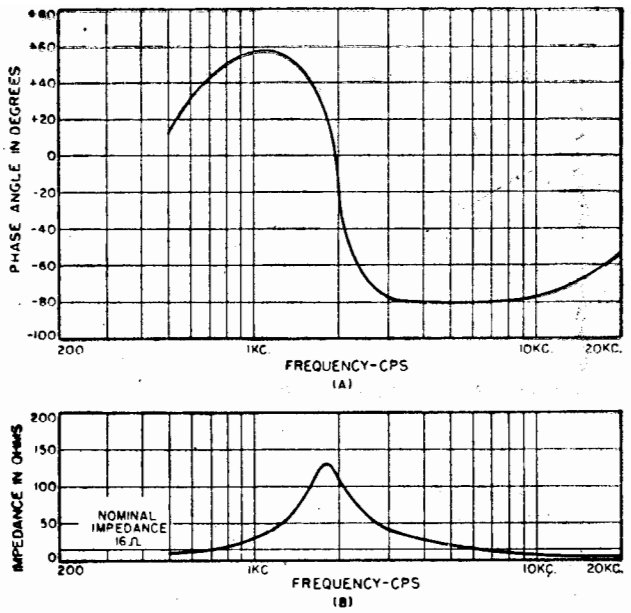


Fig. 2 — Here are shown the phase angle (upper curve) and impedance (lower curve) of a push-pull electrostatic tweeter. Note that, as is to be expected, phase angle is in the order of minus 80 degrees, which approximates a purely capacitive circuit.

Its power output was rated at 12 watts and its nominal matching impedance was 16 ohms.

Fig. 3 shows the effect of varying load resistance on the maximum output voltage at 15,000 cps. Similar results were obtained at other frequencies in the working range; 15,000 cps was adopted here because we happen to be interested in high-frequency performance for purposes of this discussion.

The curve shows that the maximum voltage available, just short of clipping, falls away drastically as load resistance is reduced. For example, with a resistance of 5 ohms only 4.5 volts were available as compared with 15 volts across 16 ohms, corresponding to a drop of 10.5 db in maximum output voltage.

In other words, when faced with a load resistance of 5 ohms the output of this amplifier is only equivalent to 1¼ watts related to its matching impedance of 16 ohms.

REACTIVE LOADS

Fortunately, most practical amplifiers seem to have a slightly better performance as regards distortion and overload when working into reactive loads, and it appears that the resistance load is the worst case. When the electrostatic unit was connected to the amplifier used for the previous test, a maximum voltage of 5.7 was obtainable at 15,000 cps which, although better than the 4.5 volts obtained with a resistive load of the same value (5 ohms), is still 9 db below 15 volts.

This drop of 9 db does not mean that the output will be 9 db down at 15,000 cps during normal operating conditions. What it does mean is that this particular amplifier/loudspeaker combination will handle 9 db less input at 15,000 cps without distortion relative to the mid-range input.

Thus if the amplifier is fed with a 15,000 cps signal and the level gradually increased, it is obvious that distortion will occur earlier than would have been the case with a load impedance of 16 ohms or more. The position could of course be eased by treating the loudspeaker as a 5-ohm unit and rematching with a suitable transformer, but this would result in a loss of sensitivity amounting to 5 db which would be unacceptable, especially in view of the fact that the electrostatic unit is already less sensitive than high-flux, moving-coil types.

Full-range electrostatic loudspeakers behave in a similar fashion at high frequencies, but the impedance can be prevented from rising too severely at middle frequencies by crossing over to an electrostatic bass section at a carefully chosen point. Clever circuit design also helps matters here, an artifice not open to the tweeter manufacturer because he has no control over the type of bass speaker with which his unit may ultimately have to work.

NOMINAL IMPEDANCE

As the frequency goes down, the impedance continues to rise, as one would expect with a capacitive device. In a typical case the impedance of a nominal 15-ohm electrostatic unit reaches 30 ohms to 40 cps.

This is actually a benefit because the electrostatic is a voltage-operated device and the rising impedance ensures that the amplifier can maintain its drive down to the lowest frequencies.

On the other hand, the operation of a moving-coil speaker depends upon current, so that an impedance rise at low frequencies results in more difficult conditions for bass reproduction.

The question which now arises is whether this falling high-frequency impedance will cause the amplifier to run into distortion on speech and music, and

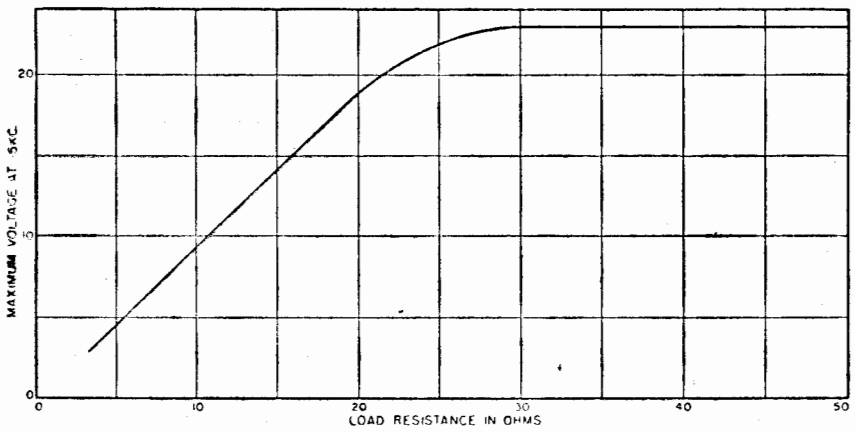


Fig. 3 — Effect of varying load resistance on maximum output voltage at 15,000 c.p.s.

ORYX

(LOW VOLTAGE)

MINIATURE SOLDERING INSTRUMENT

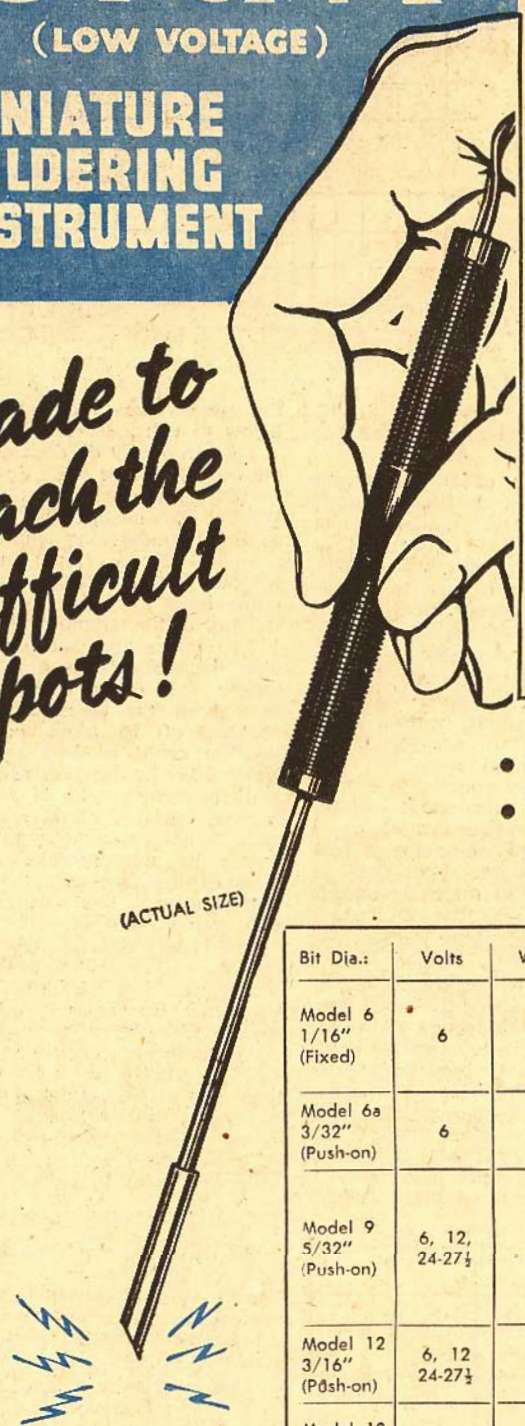
cut TIME and LABOUR with ORYX

The Oryx is an amazingly light-weight soldering instrument with which the operator can reach INSTANTLY even the most awkward spots in assemblies. It weighs less than 1 oz., yet is robustly constructed for long life. It operates on low-voltage, thus is completely safe. There are no ceramic formers to break, no mica to flake.

The ORYX long life element will outlast several bits which are of tight push-on fit. NINETY PER CENT. of instrument makers in Britain use the ORYX. Cut down time and expense by using the ORYX in YOUR laboratory or assembly department.

Take the OLD out of Soldering with ORYX

Made to reach the difficult spots!



(ACTUAL SIZE)

- *Fast heating element, ready for operation in less than one minute.*
- *Exclusive design features resulting in universal acceptance of ORYX as the standard miniature soldering instrument.*

Bit Dia.:	Volts	Watts	Nett Weight	Length	Recommended Use
Model 6 1/16" (Fixed)	6	6	0.25 oz.	6"	Electrical measuring instrument fine assemblies, hairsprings, R.F. pick-up & speech coils, hearing aid sub-assemblies, etc.
Model 6a 3/32" (Push-on)	6	6	0.25 oz.	6"	As for Model 6 (for extremely delicate work only)
Model 9 5/32" (Push-on)	6, 12, 24-27½	8.3	0.25 oz.	6"	Hearing Aids, Midget Radios, Personal Receivers, Radio and T/V Sub-assemblies, Coils, Electronics, Instruments, Model Construction, Electro-Medical, etc.
Model 12 3/16" (Push-on)	6, 12 24-27½	12	0.5 oz.	6.25"	Radio, Television and Telecommunications assemblies.
Model 18 3/16" (Push-on)	6	18	0.75 oz.	7½"	For heavier work, heat capacity equivalent to that of most 80 watt soldering irons.

Australian Agents:

MANUFACTURERS SPECIAL PRODUCTS PTY. LTD.

47 YORK STREET, SYDNEY — B 0233 — EXT. 279

here the usual crop of If's and but's begins to sprout.

Certainly there is a tremendous amount of energy in sounds such as a cymbal crash, which make heavy demands upon the power amplifier, especially if recorded out of balance and reproduced at high level. It is therefore likely that electrostatic speakers will require the use of amplifiers in excess of 15 watts rating if full-blooded reproduction is required.

This increase in power is necessitated partly by the lower sensitivity of current electrostatic designs as compared with moving-coil types and partly by the mismatch referred to previously. It seems likely that 30-50 watt amplifiers will become more common as the electrostatic era dawns and develops.

Now that we have reached the subject of loudspeaker watts, this seems a good place to point out a few common fallacies. With the moving-coil loudspeaker most of our calculations are based on the nominal impedance at around 300-400 cps where we see from Fig. One, the load is almost a pure resistance. In these circumstances it is permissible to calculate the power absorbed by the speaker from the formula:

$$Power = \frac{V^2}{Z} \ watts$$

where: V = voltage across voice coil
Z = loudspeaker impedance in ohms.

Thus in the case of the unit of Fig. One for 4 volts across the voice coil the power input would be:

$$\frac{4^2}{15} = 1.07 \ watts$$

At all other frequencies, variations in impedance and phase angle must be taken into account by inserting phase angle into the formula, thus:

$$Power = \frac{V^2 \cos \phi}{Z} \ watts$$

where: ϕ is the phase angle.

Hence for the same 4 volts at 31 cps, the power input has fallen to 0.05 watt. Although the power input to the unit has fallen so drastically, it must be remembered that the efficiency has increased enormously, due to the fundamental resonance which occurs at 31 cps. The actual sound power output is therefore maintained to a great extent. Similarly, at 15,000 cps the input power is 0.16 watt, but here there is no resonance to boost efficiency so that the output falls accordingly. (Hence the importance of avoiding the impedance rise as much as possible, as already pointed out in Part 5.).

It is interesting to look at the electrostatic tweeter from the point of view of power absorbed for the same input of 4 volts. At 1950 cps where the phase angle is zero, the power absorbed is 1/8 watt, while at 15,000 cps the power is 1½ watts.

VOICE CURRENT

These few figures should suffice to show how meaningless it is to talk of loudspeaker watts by merely considering voltage and rated impedance.

Generally speaking, however, we are not concerned with the actual power absorbed by the loudspeaker, but by the voice-coil current in the moving-coil type and the voltage across the plates in the electrostatic type. Thus we strive to keep the impedance from rising in the case of the moving-coil and from falling in the case of the electrostatic. With typical contrariness, nature opposes our efforts.

Here ends the first lesson by Mr Cooke.

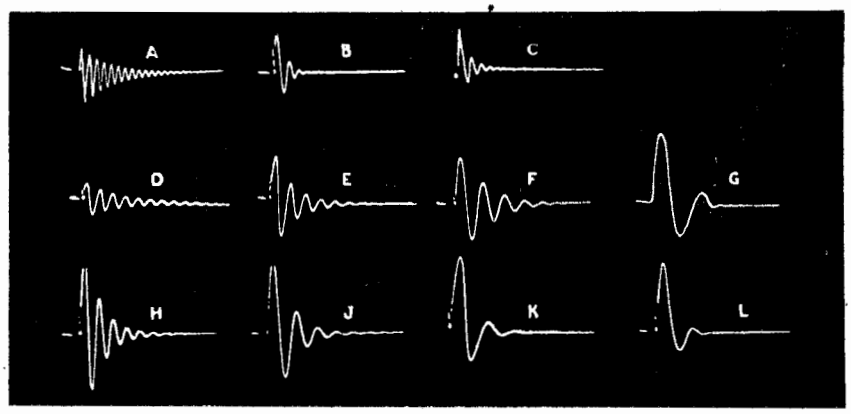


Fig. 4 — Actual photographs of oscilloscope records of the shock effect on various speaker/cone/coil/magnet assemblies. (A) A 6-inch unit with low flux density, corrugated cone suspension. Note "ringing" with exponential decay rate and 22 vibrations before cone comes to rest. (B) A 5-inch unit with high flux density, cloth suspension, and a finer spider. Note big improvement over part A. Input at 0.5 volt. (C) Same as part B, but magnet reduced from 13,000 gauss to 5,000. Note the 7 or 8 oscillations instead of previous 4 or 5. Input increased to 1.5 volts to make up for loss of sensitivity. (D) An 8-inch speaker with 8,000-gauss magnet. A corrugated cone suspension is used. (E) Same as for part D but speaker uses a 13,000-gauss magnet. Note the greater sensitivity and better damping shown by the rapid rate of decay, with fewer oscillations. (F) Same as for part E but with cloth suspension, which lowers the frequency of the cone resonance and, in addition, reduces the number of vibrations. (G) Goodmans 8-inch unit with free-edge cone and saturated pole. Low resonance frequency and rapid decay rate is shown. (Note: The unit was referred to in previous article.) (H) A typical 12-inch unit with corrugated cone and a 13,000-gauss magnet. (J) Same as for part H but with cloth surround. Note the obvious improvement. (K) Same as for part J but magnet improved to 17,000 gauss. Again there is an obvious improvement. (L) A 15-inch unit with a large magnet. There is little or no ringing here.

Fig. 5 — Shock tests show effect of magnet. (A) A 10-inch loudspeaker unit with a 10,000-gauss magnet. (B) Same as for part A but with a 14,000-gauss magnet.

TRANSIENTS & RESONANCE

These qualities are taken together because one is dependent on the other. Absence of resonance (or ringing) **ipso facto** results in good transient response provided a sufficiently wide frequency range is covered.

The basic difference between a loudspeaker and a musical instrument is that in the one all resonance should, in theory, be avoided like the plague, whereas in the other maximum resonance is the objective.

Piano makers strain at the leash to increase the effectiveness of the soundboard or resonator, but the worst loudspeaker I ever heard was the result of fixing a moving-coil driver to a point on the soundboard of a piano. (It is impossible to make speakers for 25 years without trying a few silly ideas.)

The main resonances in a moving-coil unit are due to (a) fundamental cone resonance; (b) cone break up; (c) surround resonance; and (d) resonance of spider or centering device.

In so far as the electrostatic speaker avoids these pitfalls it can be said to have a better transient response, but it must not be assumed that moving-coil design remains stagnant. The main cone resonance is virtually damped out by the modern amplifier and by high flux density in the magnet. The effects of cone texture in large speakers, and stiffer diaphragms in small units. Surround resonance is avoided by using soft cloth of foam plastic surrounds or by completely free suspension

CENTRING

The centering device is still a necessary evil with moving-coils, but its resonance is the least objectionable of those cited. In small units limited to frequencies above 1,000 cycles, the conventional spider or corrugated disc can be dispensed with and the coil can be

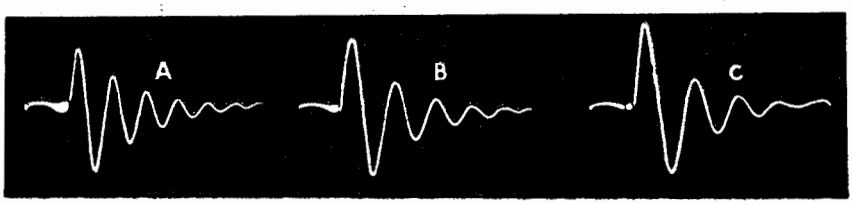
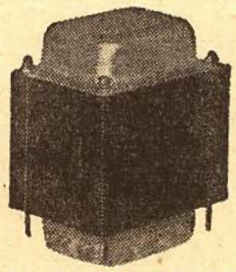


Fig. 6 — Shock tests showing the effect of various cone suspensions. (A) A 10-inch unit with corrugated cone surround. (B) Same unit with cloth and (C) foam surround.

FERGUSON



PREFERRED RANGE

First introduced by FERGUSON early in 1955, the PREFERRED RANGE of transformers and chokes covers the most popular types, selected from the vast FERGUSON range. Production is concentrated on these types to ensure prompt delivery.

The PREFERRED RANGE is now being revised, and the new PREFERRED RANGE of POWER TRANSFORMERS is listed below. Filter chokes, output transformers and vibrator transformers will also be revised.

Types not listed as PEFERRED are still available but delivery may not be as prompt as PREFERRED types.

POWER TRANSFORMERS — PREFERRED RANGE

TYPE No.	PRIM. VOLTS	H.T. VOLTS	H.T.M.A.	L.T SECONDARIES
PF545	240	350-0-350 650V	20 2	6.3V-3A,6.3V-0.6A 4V TAP 2.5V-2A
PF619	240	150-0-150	30	6.3V-1.8A
★ PF299	240	285-0-285	40	6.3V-2A, 6.3V TAP 5V-2A
PF300	240	325-0-325	40	6.3V-2A, 5V-2A
PF201	240	225-0-225	50	6.3V-2A
PF151 PF151F	230-240	285-0-285	60	6.3V-2A, 5V-2A
PF166	230-240	325-0-325	60	6.3V-2A, 5V-2A
PF165	230-240	385-0-385	60	6.3V-2A, 5V-2A
★ PF170	230-240	285-0-285	80	6.3V-2A, 6.3V-2A, 6.3V TAP 5V-2A
PF1073	230-240	300-0-300	80	6.3V-2A, 6.3V-1A
★ PF169	230-240	325-0-325	80	6.3V-2A, 6.3V-2A, 6.3V TAP 5V-2A
PF168	230-240	385-0-385	80	6.3V-2A, 6.3V-2A, 5V-2A
PF130	230-240	285-0-285	100	6.3V-2AC.T., 6.3V-2A, 5V-2A
PF164	230-240	325-0-325	100	6.3V-2AC.T., 6.3V-2A, 5V-2A
PF160	230-240	385-0-385	100	6.3V-2.5AC.T., 6.3V-2A, 5V-2A
PF1072	230-240	300-0-300	120	6.3V-4AC.T., 6.3V TAP 5V-2A
PF152	230-240	285-0-285	125	6.3V-3AC.T., 6.3V-2A, 5V-2A
PF163	230-240	325-0-325	125	6.3V-2.5AC.T., 6.3V-2A, 5V-2A
PF181	230-240	385-0-385	125	6.3V-3AC.T., 6.3V-3A, 5V-2A
PF174	230-240	285-0-285	150	6.3V-2AC.T., 6.3V-3A, 5V-3A
PF142	230-240	325-0-325	150	6.3V-2AC.T., 6.3V-2A, 5V-3A
PF175	230-240	385-0-385	150	6.3V-2AC.T., 6.3V-2A, 5V-3A
PF173	230-240	425-0-425	175	6.3V-3AC.T., 6.3V-2A, 5V-3A
PF1067	230-240	400-0-400	180	6.3V-4AC.T., 6.3V-2.5AC.T., 5V-3A
PF1193	200-220-240	295-0-295	275	6.3V TAP 5V-3A, 6.3V-9A
PF1265	240	—	—	6.3V-2.25A
PF162	240	—	—	6.3V-3A, 6.3V-3A
PF265	230-240	—	—	17V. TAPS 11.5V. 10V. 8.5V-4.2A

★ *L.T. windings now amended for use with either 5V or 6.3V rectifier.*

Manufactured by

FERGUSON TRANSFORMERS PTY. LTD.

FERGUSON LANE, CHATSWOOD, N.S.W. JA8491

held in centre with a simple cloth disc which is entirely resonance-free. (We adopted this arrangement on a 3in unit several years ago with complete success.)

There can be little doubt that a really perfect loudspeaker would be massless. The "Ionophone," as it is known in England, seems to be the nearest approach to date, but its development has been bedevilled by distortion troubles and all the old problems of horn loading, plus radiation which interferes with TV reception within a small area, probably not exceeding a radius of 50 feet.

The diaphragm in a moving-coil speaker is receiving shock after shock and it is this state of affairs which colours the reproduction.

Pictures of the effect of shock treatment are therefore not without interest, and a few are reproduced in Fig. 4. The voice coil is held off its central position by applying a suitable value of direct current.

When the circuit is interrupted the voice coil moves and the e.m.f. generated in it as the vibrating coil cuts the magnetic field operates the oscilloscope by the triggered time base, the result being photographed.

In all cases shown in Fig. 4, wider spacing between vibration peaks indicates a lower resonance frequency of the cone. The benefits of high flux density, non-resonant surrounds, and free suspension with low cone resonance are clearly shown. The cone assembly in examples A and D is obviously behaving like a drum and is typical of the cheap, mass-produced speaker.

PHOTO TESTS

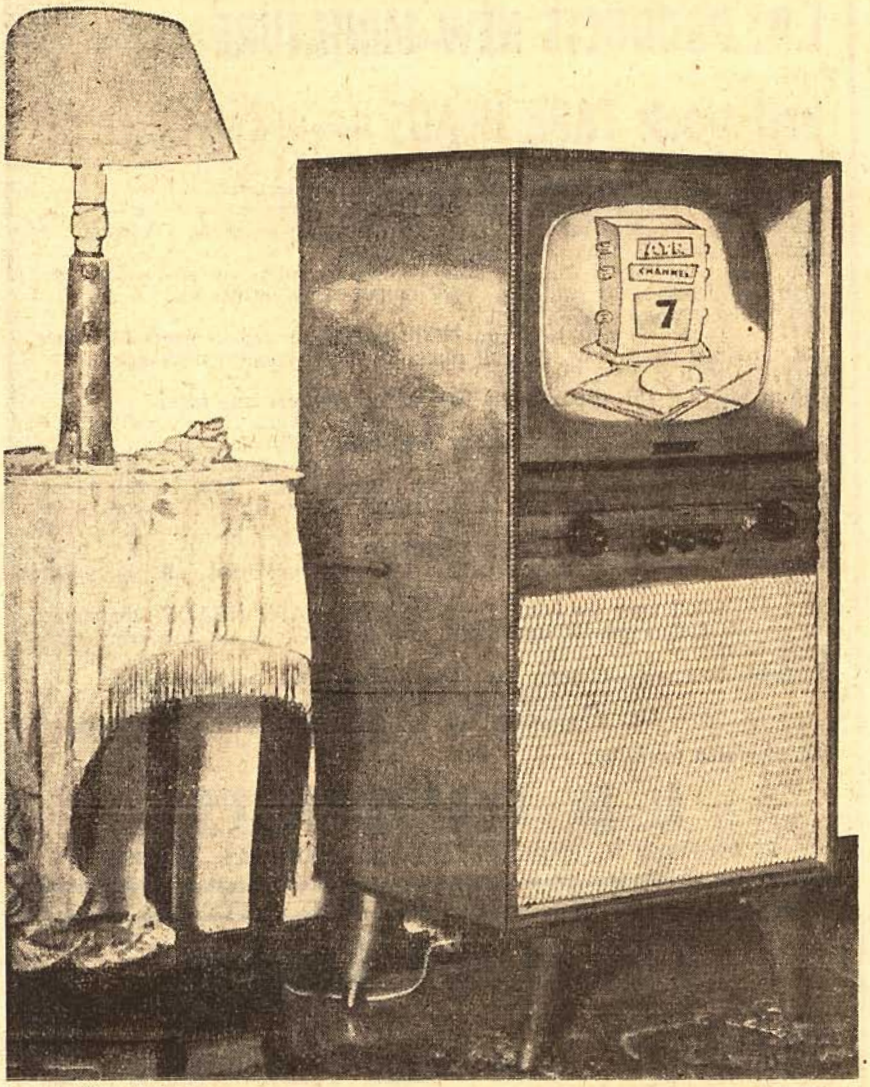
The tests just described were made about five years ago. This (or any other) method of photographing what takes place always appeals to me strongly because the results are theory-free and enduring. Given an accurate statement of conditions of test and a carefully considered interpretation, the findings will be as true in a hundred, or even a thousand, years as they are today.

Quite recent tests on 10 inch units are shown in Figs. 5 and 6 and again confirm the virtues of soft surround and high flux density.

The results shown in Fig. 6 speak for themselves.

It will be seen from Fig. 5 that with the same input voltage and identical cone and coil assembly the deflection of the voice coil is almost three times as great with the higher magnetic flux, but the coil comes to rest with half the number of oscillations. Translated into speaker performance, this means much higher sensitivity (or fewer watts from the amplifier) plus cleaner reproduction and superior transient response. In fact, the virtues of high flux density—or in other words expensive magnets—are beyond dispute and are confirmed by the most primitive listening test.

(To be continued)



Here is the complete console cabinet which our contributor built to house the 17-inch TV Receiver. It is proportioned to bring the centre of the screen to eye level, when seated on conventional lounge furniture. The height can be reduced, however, without changing the basic design concept of the cabinet.

Console Cabinet For Your TV

Here is a console style cabinet design suitable for TV SETS with chassis-mounted picture tubes. It can be built cheaply without any special skill or special tools and should be completed in one weekend. While the measurements relate to our 17-inch version, there is no reason why they cannot be modified to suit the 21-inch set.

In July,1957, the construction of a modern-style cabinet for a 17-inch television receiver was described.

This was primarily intended for sets using cabinet mounting for the picture tube, a home-constructed picture mask playing the dual role of supporting the tube as well as framing the picture.

Many readers, alternatively, have decided to mount the picture tube on the chassis itself, as for the 21-inch version. Full details of such mounting can be found in the December, 1957, issue.

With the release, in fair quantity, of moulded plastic picture masks, the method of mounting the picture tube on the chassis has gained considerably in popularity and, in no small manner, simplifies the construction of the cabinet.

We decided that the cabinet produced should be of the utmost simplicity so that it could be duplicated by anyone using the humblest of equipment. With that object in mind, the writer limited himself to the tools most likely to be found in the average handyman's home —hammer, panel saw, small plane and punch, and screwdriver.

Some panel pins, screws, sand-paper, wood glue and filler are the only other accessories required.

By COLIN JONES

Most TV receivers on the market today are somewhat small in stature and, as a result, sales are gradually increasing of "TV stools" and "TV cushions," not to mention the low "TV lounge suites."

As it costs quite a small fortune these days to re-furnish a complete room to suit just one piece of furniture, we decided to take the opposite approach.

It was envisaged that the set would stand in a "standard" domestic lounge setting and to get the "correct" level for the TV screen, the writer sat in one of the chairs in a relaxed position and dropped a tape measure from eye level to the floor.

CHECK ON HEIGHT

This distance was taken to represent the height, from ground level, of the centre of the screen, in our case, 36 inches. So, we have the basic measurement of a tailored-to-measure television receiver.

Whether you care to follow this method, however, is a matter of personal choice, and you may vary the dimensions from the shelf level to the floor to suit your own requirements.

We reversed the procedure with this cabinet by building it to fit the safety glass instead of the other way round. This was because sheets of this special glass have been made available, although, at this stage, not in large quantities, ready-cut to fit either 17in or 21in sets.

In our case the dimensions of the glass are 19¼in by 14in. We would advise intending constructors to endeavour to obtain such a sheet before building the cabinet as the careful use of it during construction will assist considerably in "squaring up" the cabinet.

In order to keep the cost of this cabinet to a minimum, we decided to reduce the depth to 18in, building a small box on the back coverplate to protect the end of the picture tube which projects beyond the back edge of the chassis. This is in line with many commercial models on the market today.

To enhance its appearance, we purchased a set of small round tapered legs, some 6in long. This meant that, in order to have the centre of the screen at the

previously determined height, the woodwork (ignoring the legs) would have to be 36in long.

This proved to be the ideal measurement because it was found that the ¼in plywood is available, ready-cut to these dimensions.

The accompanying diagram shows the dimensions of the original cabinet and the manner in which the various pieces are put together. Two 3ft lengths of plywood were carefully chosen, making sure that they were free from defects, and these were lightly planed along their edges.

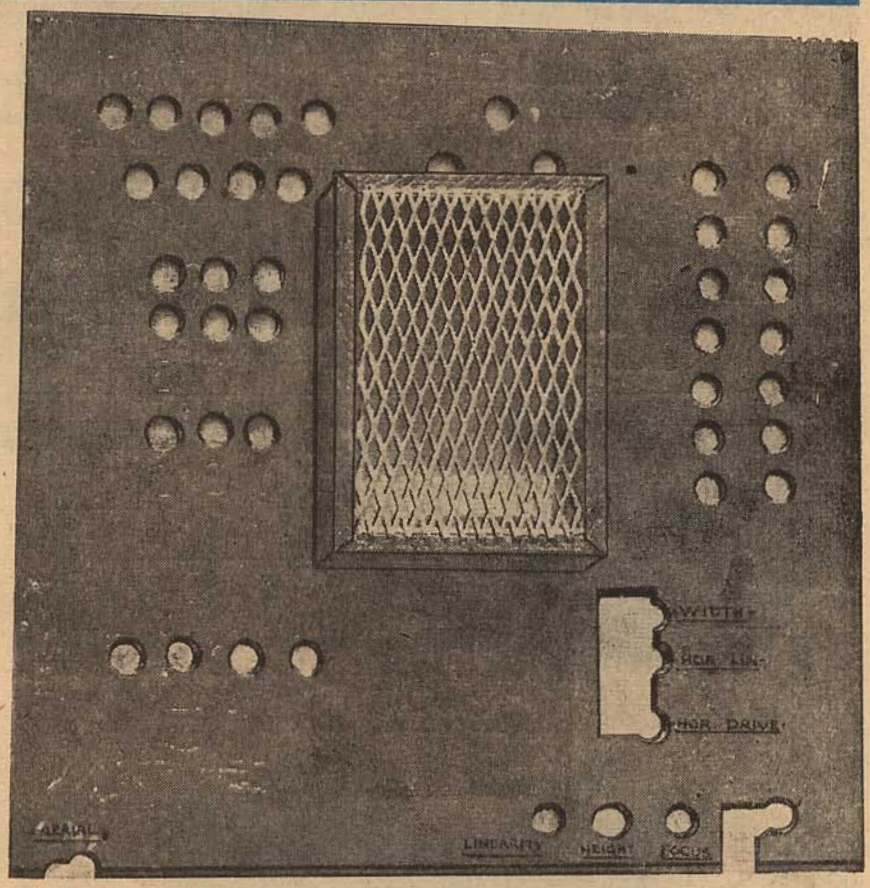
When planing edges such as these, it is imperative that you work from both ends toward the centre to avoid the risk of chipping the corners. Three more lengths of plywood are required for the top, shelf and bottom of the cabinet, dimensions of which are outlined in the diagram.

GUARD AGAINST SCRATCHES

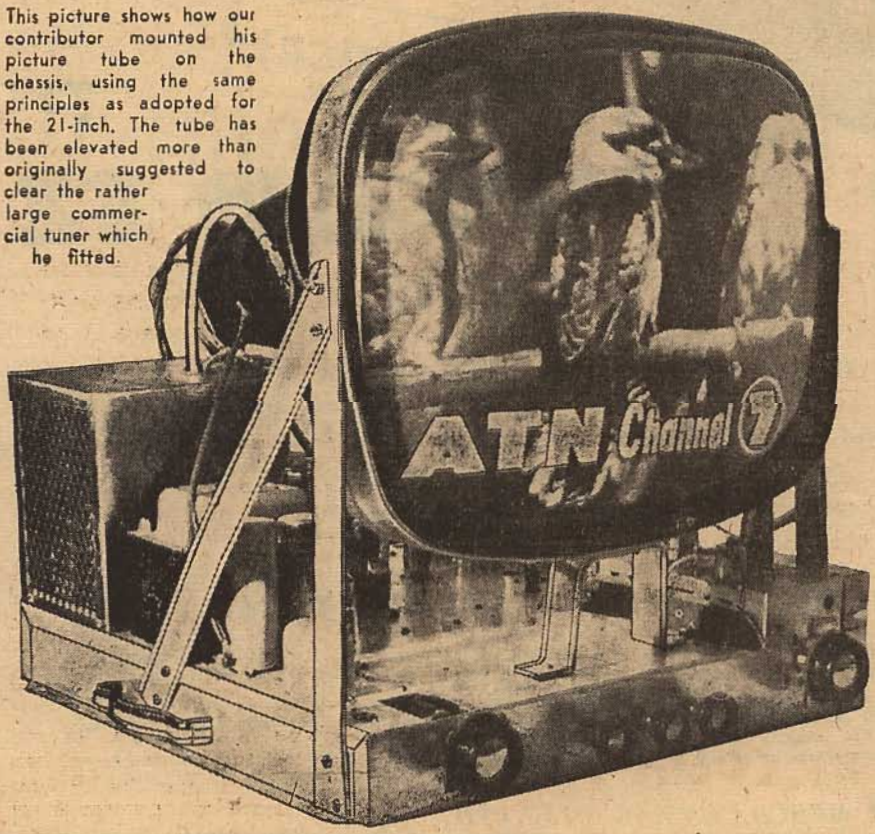
It is a good idea to spread a bag or two on the floor of the workshop to prevent the surface of the ply from being damaged or soiled during construction.

Cut four cleats from either 1in square or "quad" dressed stock and drill three holes through them each way and countersink. These are used to strengthen the butt joints between the sides and the top and bottom.

To assemble, commence with the bottom panel and coat the relevant surfaces with some casein or other carpenter's glue. Secure the sides to the bottom by driving half a dozen long panel pins through each side, punching the heads below the surface for subsequent filling.



An important part of the cabinet is this rear cover which protects the internal "works" and particularly the end of the picture tube, while permitting some ventilation. Note the access holes for the picture adjustments.



This picture shows how our contributor mounted his picture tube on the chassis, using the same principles as adopted for the 21-inch. The tube has been elevated more than originally suggested to clear the rather large commercial tuner which he fitted.

Stand the now partly assembled cabinet on its base and secure the top to the sides, using the same procedure as before. Now coat the cleats and internal surfaces of the joints with glue and screw the cleats firmly into position, making sure that the screws are long enough to hold the two surfaces strongly together, yet not too long, where they would penetrate the top or sides and ruin the surface.

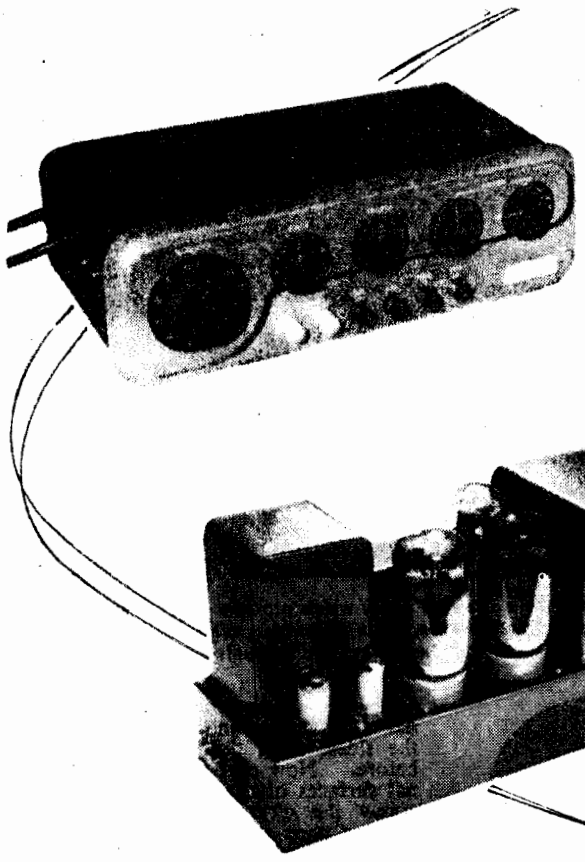
Note that the cleats should end approximately 1½ inches from the front of the cabinet and are flush with the back. This will allow the safety glass and speaker baffle to be positioned later from the rear.

Test the unit now for squareness using either a T-square or the safety glass, then nail several short lengths of timber or aluminium moulding across all corners at the front and back to ensure that the "squareness" of the cabinet is maintained during subsequent operations. These are removed later on.

To hold the safety glass and expanded aluminium speaker grill in position, ¼in picture framing is used. Select the type of moulding which has the side at right angles to the back otherwise difficulty will be experienced in attaching it to the cabinet.

This is cut to the dimensions shown and fastened with glue and panel pins (through the edge on which the glass will stand) to the inner front edge of the cabinet so that the outer edge of the

for the closest approach to the original sound



ACOUSTICAL

QUAD II

AMPLIFIER

The criterion, as always, is that the reproduced sound shall be the closest approach to the original — that the enjoyment and appreciation of music may be unimpeded. This is reflected throughout the design of the QUAD II. It is reflected, too, in the straightforward and logical system of control, achieved without the sacrifice of a single refinement or adjustment capable of contributing to the final objective.

DEMONSTRATIONS AND SUPPLIES AVAILABLE FROM

- SYDNEY: United Radio Distributors Pty., Ltd., 175 Phillip Street; Audio Engineers Pty., Ltd., 422-4 Kent Street.
- MELBOURNE: Homecrafts Pty., Ltd., 290 Lonsdale Street.; J. H. Magrath & Co., Pty. Ltd., 208 Little Lonsdale Street; Radio Parts Pty. Ltd., 157 Elizabeth Street; Warburton Franki (Melbourne) Ltd., 380 Bourke Street.
- ADELAIDE: Gerard & Goodman Ltd., 192 Rundle Street; Newton McLaren Ltd., 17 Leigh Street; Radio Electric Wholesalers, Ltd., 26 James Place
- BRISBANE: Chandlers Pty. Ltd., Cnr Albert & Charlotte Streets.
- PERTH: Atkins (W.A.) Limited, 894 Hay Street; Carlyle & Co., Ltd., 915 Hay Street; Leroya Industries Pty. Ltd., 672 Hay Street

A BRITISH MERCHANDISING PTY. LTD., AGENCY

frame is flush with the outer edge of the cabinet.

The safety glass can now be tested against the back of the frame to ensure that everything is in order.

With the glass held in the position it will eventually occupy, place a pencil mark on the cabinet frame at the bottom of the glass and then put the glass away to avoid accidental damage.

CONTROL PANEL

The control panel used in this particular set was a short length of pre-shaped pelmet moulding, ¼in at its greatest thickness and six inches wide.

This is cut to fit behind the "picture-frame", the edges being filed flat to fit well into the frame. The top of the control panel is planed down to fit into the bottom edge of a piece of aluminium moulding, or "H" cross-section, the safety glass and plastic picture mask resting together in the top of the "H."

The thickness of the glass and plastic combined is slightly more than the space allowed by the aluminium so that the BACK of the moulding has to be opened up a little with a pair of pliers, but be very careful not to deform the front of the aluminium when doing this.

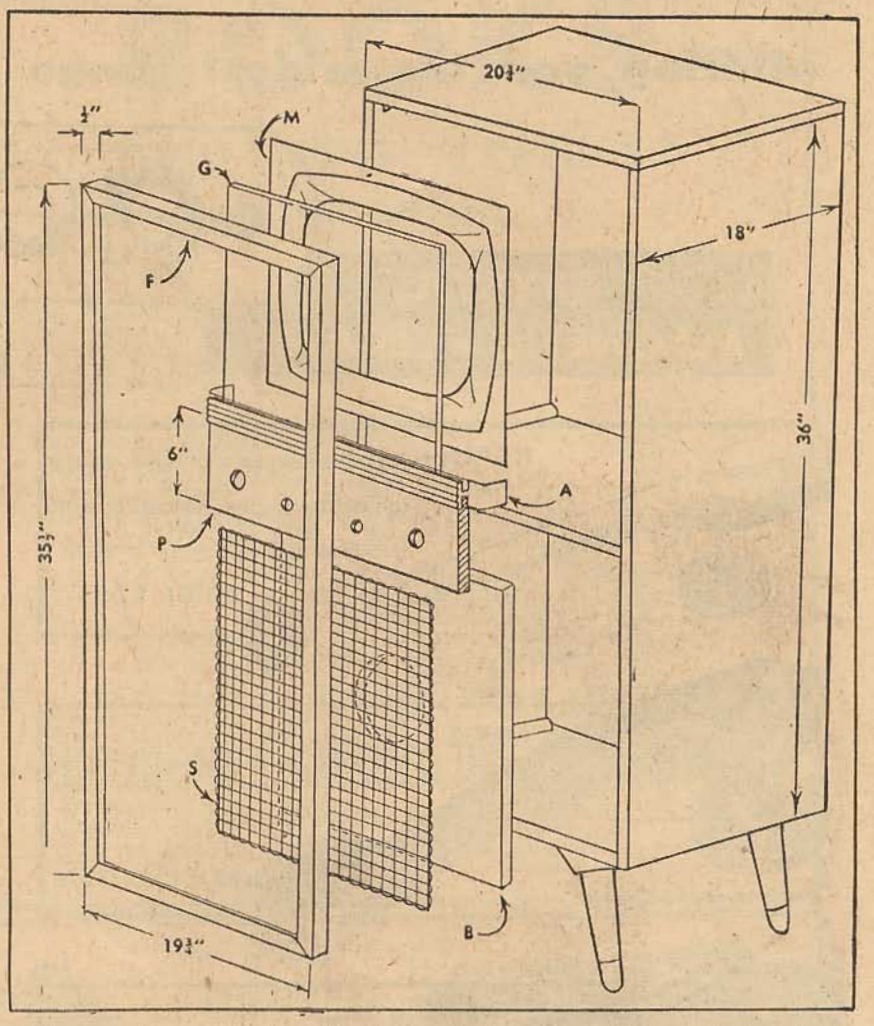
When cutting the aluminium moulding to size, allow about 1in on each end to bend at right angles for attachment to the inner sides of the cabinet.

The panel is then drilled for the holes for the control spindles, allowing sufficient distance for the picture tube and mountings to clear the tuner and tops of valves or other components on the chassis.

Fasten the panel with glue and panel pins into position inside the cabinet and screw the aluminium to the sides. Two 6-inch lengths of ¾-inch quad are glued and screwed into the cabinet at each end of the panel for extra support.

The shelf is the next item to secure and this is made to fit approximately 1½-inches between the centres of the control spindle holes (depending on your own layout) where it is fastened to the sides by glue, panel pins at various angles, and two lengths of 1-inch stock beneath it for support, these lengths ending 1½-inches from the front. Two panel pins and a screw through the control panel into the shelf will stop any "play" in this direction.

The holes in the panel are covered by a short length (5-inches) of picture frame moulding on which are inscribed the various functions of the three smaller controls.



Here are the assembly plans for the console TV cabinet. Some details have been exaggerated for clarity. Key to the diagram is as follows: A, aluminium moulding B, speaker baffle; F, frame moulding; G, safety glass; M, picture mask; P, control panel; S, expanded aluminium speaker grille.

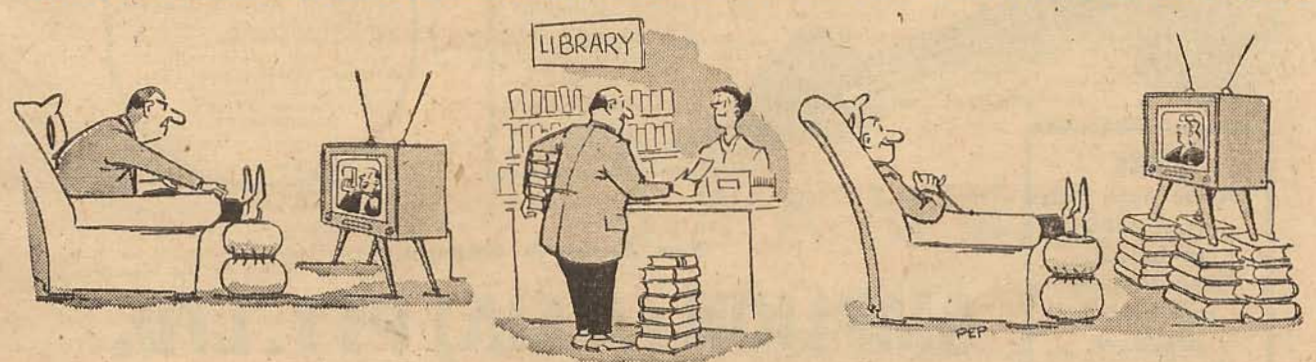
The plastic picture mask can now be carefully cut to fit snugly in the cabinet, resting in the aluminium moulding and holding the glass within the frame. Note that the picture mask is cut ½-inch wider than the glass on all sides except the bottom. Two pieces of ¾-inch dressed quad screwed (not glued) behind the mask to the sides of the cabinet is all that is required to hold the glass and mask in position.

When all is in order in this section of the cabinet, take the mask and glass out of the cabinet and remove the angle strips that had been pinned in place to hold the cabinet "square."

Because of the thickness of the frame moulding and the control panel, the chassis will project beyond the back of the cabinet by almost ½-inch.

To overcome the difficulty in positioning the back cover plate and at the same

(Continued on Page 117)

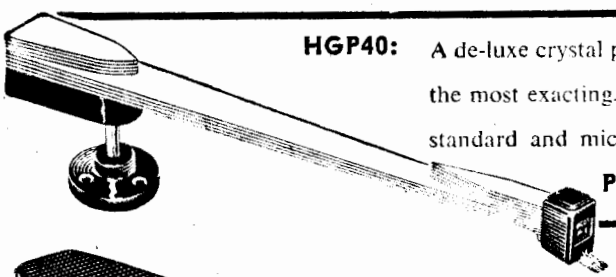


"Most TV receivers on the market today are somewhat small in stature . . . . . "

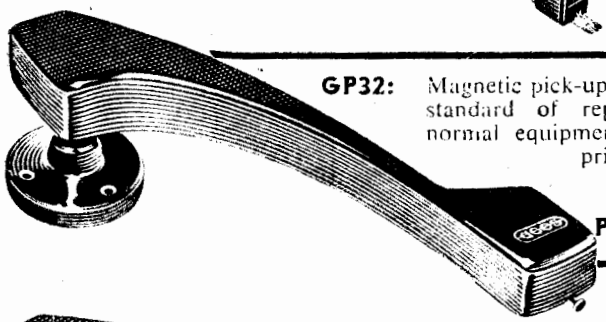
offering you the widest range of pick-ups . . .

acos

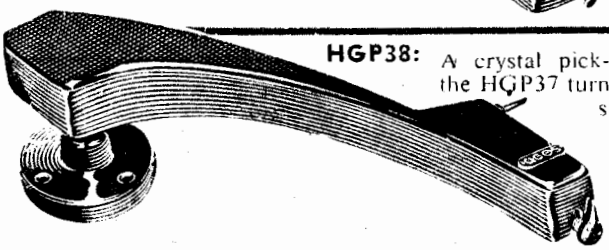
CRYSTAL MAGNETIC • CERAMIC



HGP40: A de-luxe crystal pick-up to satisfy the most exacting. Complete with standard and microgroove heads **PRICE, £9/15/-**



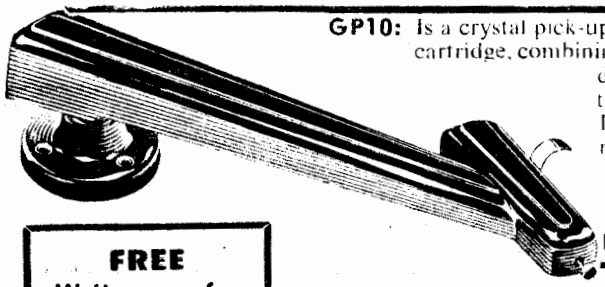
GP32: Magnetic pick-up provides a good standard of reproduction with normal equipment at reasonable price. Output voltage, ½ volt at 1,000 c.p.s. **PRICE, £2/12/6**



HGP38: A crystal pick-up. Incorporates the HGP37 turnover cartridge for standard or microgroove recordings with cantilever stylus **PRICE, £5/15/-**

GP50: Is a HIGH-OUTPUT crystal pick-up suitable for reproducing standard and microgroove records through *low-gain* amplifiers as used in small record players and some radios **PRICE, £4/19/6**

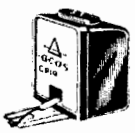
GP60: Incorporates the latest-type CERAMIC cartridge—unaffected by heat or humidity. For use in tropical areas **PRICE, £6/16/-**



GP10: Is a crystal pick-up utilising the GP9 cartridge, combining purity of reproduction with extreme reliability. Resonance-free response from 50/8,000 c.p.s. Output, 1.5V at 1,000 c.p.s. **PRICE, £3/12/6**

FREE
Write now for illustrated technical literature on any of the products shown on this page.

plus these acos replacement cartridges



HGP39 CARTRIDGE
Designed to meet the most exacting requirements of modern recordings — low element mass and very high compliance enables the heaviest modulation possible to be traced with a minimum of record wear. Both standard and L.P. heads available **PRICE, £3/12/6**

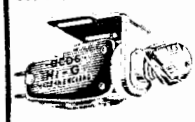
GP9 CARTRIDGE

Now famous as the cartridge with the unbreakable crystal. Takes standard steel or fibre needles for 78 r.p.m. records **PRICE, £1/11/6**

GP59 CARTRIDGE
A HIGH OUTPUT cartridge suitable for reproducing standard and microgroove records through low-gain amplifiers **PRICE, £2/3/-**

CARTRIDGE GP61

A CERAMIC cartridge that will withstand the rigours of a tropical climate and is, at the same time, very robust **PRICE, £3/19/6**



HGP37 CARTRIDGE
A TURNOVER cartridge with cantilever stylus that utilises a new method of crystal drive, a bisectional control element that achieves independent characteristics for standard and microgroove. **PRICE, £2/18/6**

Sole Agents in Australia:

AMPLION (A'SIA) PTY. LTD.

101 Pyrmont Bridge Rd., Camperdown. Sydney, N.S.W. Phone LA6124

HOW TO GET YOUR AMATEUR LICENCE

In last month's issue we detailed the requirements for obtaining an amateur transmitting licence, and told you how to make preliminary applications. This month we are concerned specifically with the technical examination, thy application. This month we are concerned

After some months of study, you finally face the great moment. You feel that your knowledge is sufficient to enable you to pass. But will you miss out simply because you didn't tackle the paper in the most efficient way?

Every student knows the importance of "examination technique," and while you can't pass unless you know your work, the way you tackle the paper can make a big difference to the ease with which you do it.

Most important is the matter of reading the instructions at the top of the paper and noting **exactly** what is required.

ONLY 7 ANSWERS NEEDED

If you read the heading at the top of the October 1957 paper given here, you will see that you are asked to do seven of the nine questions listed. You won't get any extra marks for doing eight questions. You would probably earn fewer marks, because the time wasted on the extra question may have been better spent on gaining more marks on the questions which count.

At the other extreme, you have to attempt at least five questions in order to pass. But if you did five questions only, you would have to gain practically full marks for each, which is unlikely. Six questions answered are necessary for a reasonable chance of getting through.

The best approach, is to aim at seven questions, and even if you don't know a great deal about one of them you have a chance of gaining at least a few extra marks by making an attempt.

Knowing that you have 2½ hours, you can allow yourself 20 minutes for each question. Try to keep closely to this schedule. Watch the time, and check as you finish each question to see whether you are ahead or behind schedule. Unless you are really smart, it is most likely to be the latter.

ORDER OF WORKING

If you know your work reasonably well, you will find two or three questions which can be answered without hesitation. Do these first. They are marks "in the bag" and there is an incalculable psychological advantage in knowing that so much of the paper is behind you.

Handle your best questions carefully. Be meticulous about numbering each, together with its separate parts, especially when you are working through them in an order other than that of the paper. You should be able to complete them in a little less than the allowed 20 minutes, giving yourself extra time to think about the tougher ones.

Answer the question. If it asks for a diagram of the voltage distribution on the feeders of a particular type of aerial, don't write a treatise on transmission lines. Perhaps you are an expert on the subject, but it won't earn you any extra marks in this case—it may even cause you to fail.

If the question asks for typical circuit values, don't forget to include them. The examiner probably allots a proportion of marks for each section of each question. If you miss out on something he definitely asks, he simply can't credit you with the marks, no matter how much you write about the rest of the question.

BLOCK DIAGRAMS

There are some questions where a block diagram tends to help your own thinking although not strictly necessary to the answer. If you were asked to show the essential stages of a superhet receiver and explain what each does, a block diagram would help. It would not be necessary to draw a complete circuit.

Suppose that, after 1½ hours, you have two questions to go. In one case you can answer most of what is asked, but of the three remaining untouched questions in the paper the best offers faint hope.

This is a case when the correct decision could gain you just enough marks to get over the pass line. It may even be best to write something on the really tough one first and earn at least a small proportion of the marks. You could then go back and dig into the one you think likely to gain you the more marks for the remainder of the time.

Of course, it's best to be so sure of your work that you can answer seven questions fully. But sometimes luck is not with the best of us and the examiner just doesn't ask the questions we have studied.

If you check through a few past examination papers you will find that there is a sameness about the questions. This is because they are designed to test your knowledge of certain aspects of radio, and there is a limit to the variety of questions which can fairly be asked. With some judicious guessing you can often approximate the questions which will appear in the next paper.

At any rate, here are the answers which we feel would earn high marks for the October, 1957, paper. We have set them out just as you would in answering the paper yourself.

★ ★ ★

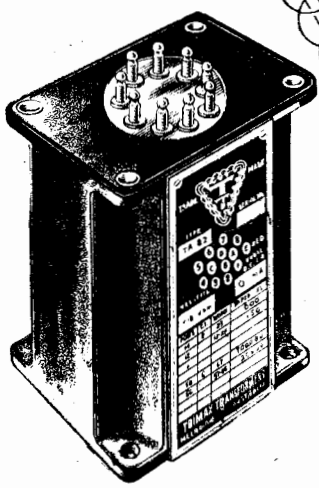
QUESTION 1: Key clicks are caused by transient voltages set up in the transmitter each time the contacts of the transmitting key make and break the keyed circuit. These transients represent a wide band of frequencies which may be radiated by the aerial and/or the power mains to interfere with other services. They may be eliminated by connecting suitable components in the keying circuit to delay

A.O.C.P. THEORY TEST, OCTOBER, 1957

SEVEN QUESTIONS TO BE ATTEMPTED—EQUAL MARKS FOR EACH

1. What causes "Key Clicks"? Describe, with the aid of diagram, how this type of interference to broadcast reception may be reduced or eliminated.
2. (a) Explain, using sketches, two methods of matching a half wave, centre fed aerial to a transmission line. Show the current and voltage distribution.
   (b) Why is it important to correctly match line to aeria impedance? What effects can result from mismatching?
3. Having a zero to 1 milliampere meter with internal resistance of 100 ohms describe how you would adapt this instrument to read the following:—
   (i) up to 500 volts d.c.:
   (ii) up to 100 milliamperes d.c.

   Show component values in both cases.
4. What do you understand by the followinu definitions relating to Frequency Modulation:—
   (i) Modulation Index, (ii) Deviation Ratio, (iii) Frequency Deviation (iv) Frequency Swing?
5. (a) Draw circuits of a crystal oscillator and a variable frequency oscillator capable of being used by an amateur station.
   (b) Explain the theory of operation of each type and state what particular advantage and disdvantage each possesses.
6. What are lecher wires? Describe, with the aid of a diagram, how you would use these to measure the frequency of a transmitter operating on 144 megacycles.
7. (a) Usinq diagrams, explain the principle of operation of a crystal microphone. Show how you would connect this to the input of a microphone amplifier. Give resistance values.
   (b) Why is it necessary to carefully shield the microphone leads and transformer used with a moving coil or ribbon microphone?
8. Explain with the aid of a diagram how high tension supplies for a receiver or a transmitter may be obtained from a battery and a vibrator.
9. What do you understand by the following terms used in ionospheric investigations:—
   (i) Critical Frequency. (ii) Maximum Usable Frequency (iii) Optimum Working Frequency. (iv) Sporadic E. Layer.



Behind THIS SYMBOL...

LIES A WEALTH OF EXPERIENCE IN THE MANUFACTURE OF UNIFORMLY RELIABLE TRANSFORMERS & ALLIED TECHNICAL COMPONENTS, ETC.

Whatever you build you need a foundation. The basic designs and necessary research for TRIMAX quality products come from our fully equipped Laboratory with its complete technical library. Our products include POWER TRANSFORMERS air-cooled to 10 KVA, POWER AND AUDIO CHOKES, AUDIO TRANSFORMERS of all types, CURRENT TRANSFORMERS, AUDIO AND POWER AMPLIFIERS, special high-quality TEST EQUIPMENT, custom-built SHEET METAL, and the latest additions to our range, SOLENOIDS, IGNITION TRANSFORMERS, IGNITION COILS, FADERS and GAIN CONTROLS.

OUR RANGE COVERS ALL TYPES AND ENSURES THAT THE RIGHT TRANSFORMER IS AVAILABLE FOR THE RIGHT JOB

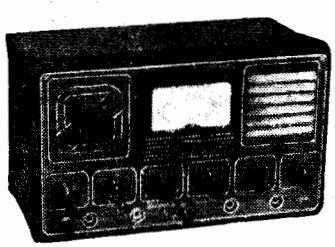
TRIMAX TRANSFORMERS PTY. LTD.

CNR. WILLIAMS RD. & CHARLES ST.,
NORTH COBURG, VIC. PHONE: FL1203

We issue regular details of new transformers or improved existing types. Register your name and address with us now!

TRADE IN YOUR OLD INSTRUMENT

Test instruments have advanced greatly in recent years, so why not trade in your old instrument on a new more comprehensive model. You will receive a good price for your old instrument (regardless of manufacture) which will pay much towards the cost of your new instrument.



Experienced Radio men know the value of the AST Signal Tracer and VTVM. Rapid Location of faults in receivers, amplifiers, etc., is easy with this instrument. A goodwill earner and big profit maker. Service organisations need this instrument. Rf tuning range 175KC-18MC. VTVM to 500v AC/DC.

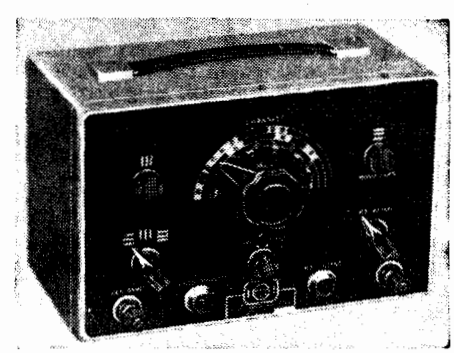
£60 Plus Tax 12½%

Service Organisations and servicemen are welcome to try the instrument which interests them in their own workshop for one week, free of charge. You are thus able to test the instrument under conditions peculiar to your service requirements. No obligation to purchase, just a service we expect to give.

- Literature available on all instruments. A.W.A., Paton, etc.
- Easy terms available on ALL test equipment. All N.S.W. and certain towns in Victoria and Queensland.
- Trade-in service applies to all States. Attractive freight conditions.
- If you have a test instrument requirement let us know. Demonstrations of equipment may be arranged at any time, day or night, Monday to Saturday, at your workshop or home. You are under no obligation whatsoever to purchase.
- Reliable after sales service always.

City — Country — Interstate

THYRON RADIO SUPPLIES
233 VICTORIA ROAD,
GLADESVILLE, N.S.W. WX3428

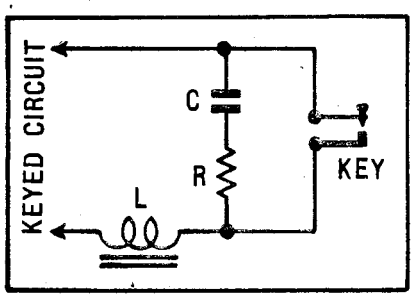


The University Pattern Generator is a basic instrument required for testing and adjusting TV receivers and produces RF and IF carrier waves, AM modulated by video signals to produce horizontal or vertical bars or a pattern of horizontal bars and vertical rows of dots. These patterns enable vertical and horizontal linearity, height, width, centering and focus adjustments to be carried out. These adjustments, even when a station is on the air, are not readily carried out, due to unsuitable programme material. Number of bars in vertical and horizontal patterns are variable as well as the number of dots, by means of controls on the front panel. This instrument is attractive technically in its advanced features and physically in size and appearance. Price of TVR.PG, £60. Plus tax 12½ per cent.

Preset Radio Clocks. Able to set switch on—switch off time. Ideal for tape recorders, TV displays, radios, etc. £6 complete.

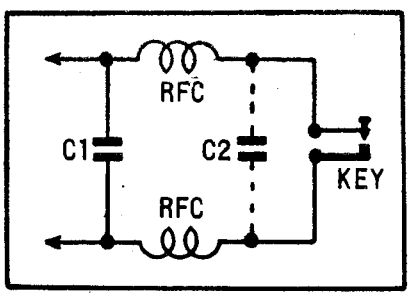
the rate at which voltages and currents rise and fall in this circuit as the transmitter is keyed.

The diagram of a typical key-click filter is shown herewith.



Q1 — Diagram of typical key-click filter.

In this diagram, the inductor L delays the rise of current as the key is depressed, and the capacitor C delays the rise in voltage as the key is opened. Resistor R, a peak current limiting resistor, prevents an arc at the key contacts when these are closed, discharging capacitor C.



Q1 — Simple filter to reduce radiation due to sparking at key contacts.

Radiation due to sparking at the key contacts can also cause interference to nearby broadcast receivers. The interference can usually be eliminated by connecting a filter using a pair of RF chokes and a small capacitor right at the key terminals in accordance with the circuit given. A second capacitor C2 is sometimes included.

Exact values in these diagrams are generally determined by experiment.

★ ★ ★

QUESTION 2 (i): The impedance looking into the centre of a half-wave aerial in free space is approximately 72 ohms. It may be fed by breaking such an aerial at its centre (with an insulator) and connecting any length of 72 ohm balanced cable to the ends of the wires. In practice, co-axial cable can also be used without serious unbalance effect if the aerial is reasonably high.

(ii) Any constant impedance line may be used to feed a half-wave aerial at the centre if the line is an electrical half-wavelength long. The impedance presented at the transmitter end will also be 72 ohms because the half-wavelength is a 1-1 ratio transformer. The feed line may therefore be any number of half-wavelengths, and its characteristic impedance within reason is not important.

(b) A correctly matched feed line is important to ensure the most efficient transfer of power from the transmitter to the aerial. Mismatching will cause reflections along the line. These will set up standing waves which cause points of high and low voltage and current values to appear. High voltage can cause losses at points of insulation and high current can cause losses due to the resistance of the feeders. Standing waves can also cause losses due to radiation of energy from the transmission line.

★ ★ ★

QUESTION 3—(i): The meter can be used as a voltmeter reading 500 volts full scale deflection by wiring a resistor in series with the movement. The total resistance must be such that 1 milliamp flows with 500 volts applied. By Ohm's Law, the value of this resistor will be equal to the voltage, 500, divided by the current flow, .001 amps. This works out to 500,000 ohms.

Subtracting the meter resistance, the required multiplier is 499,900 ohms. In practice 500,000 ohms would be near enough.

(ii) A resistor can be connected in parallel with the meter movement to allow it to measure 100 mA on full scale deflection. The value of the resistor must be such that, with 1 mA passing through the meter, 99 mA pass through the shunt. This value is equal to 1-99th the meter resistance. The meter resistance is 100 ohms. Therefore the required shunt is 100 x 1-99 equals 1.01 ohms.

★ ★ ★

QUESTION 4 (i): The Modulation Index is the ratio of the carrier frequency deviation to a specific modulating frequency.

(ii) The Deviation Ratio is the ratio of the maximum carrier frequency deviation to the highest modulating frequency.

(ii) The Frequency Deviation is the maximum change in frequency from the carrier frequency during modulation.

(iv) The Frequency Swing is the total change in frequency during modulation and is equal to twice the Frequency Deviation.

★ ★ ★

QUESTION 5:

(a) See circuit diagrams.

(b) CRYSTAL OSCILLATOR.

In the circuit of the crystal oscillator shown, the crystal (x) is the equivalent of a high-Q parallel tuned circuit. The circuit LIC1 connected to the plate of the valve is tuned to a frequency slightly higher than the crystal frequency. Energy having an in-phase component is fed to the grid from the plate of the valve via the inter-electrode capacitance C2. If the gain of the valve is high enough for the feedback energy to overcome circuit losses, the circuit will oscillate at the parallel resonant frequency of the crystal.

The oscillating frequency is determined by the size and orientation of the quartz crystal, which physically vibrates when the circuit oscillates. The crystal is generally mounted between two metal plates, often with an air gap. Output may be taken from the plate via a small capacitor or coupled inductively from coil L.

Advantages:

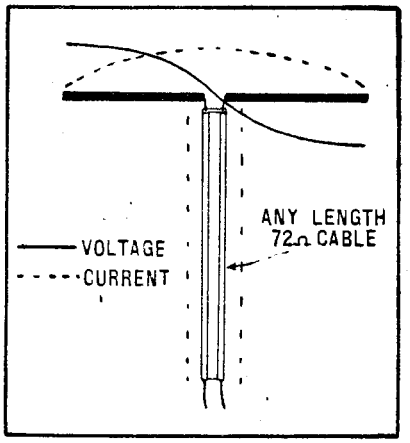
(a) The circuit arrangement is very simple.

(b) Stability of oscillation is very good, affected only slightly by variations in circuit constant and supply voltage.

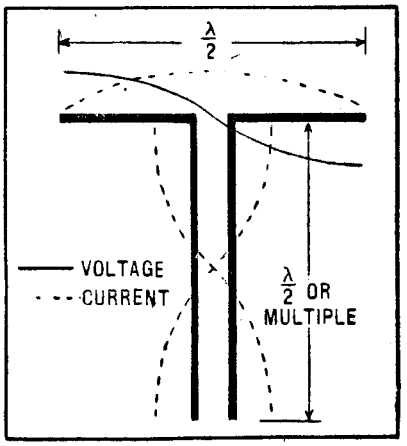
Disadvantages:

(a) Not suitable for variable frequency operation without multiple crystals.

(b) Crystal can be shattered by high crystal current if incorrectly adjusted.



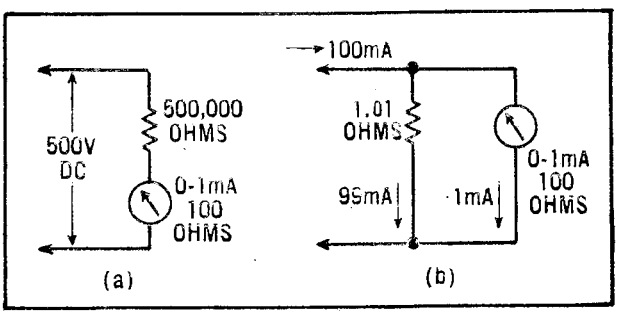
Q2 — Half-wave aerial fed with 72 ohm line



Q2 — Half-wave aerial fed with length of constant impedance cable in multiples of half-wave length.

☆

Q3 — (a) Use of multiplier to convert meter circuit to read 500 volts (b) Use of shunt resistor to convert to read 100 milliamps.



☆

SELF-EXCITED OSCILLATOR

In the self-excited electron-coupled oscillator shown, the screen grid operates as an anode so that the valve oscillates as a triode.

Part of the grid coil is included in the cathode-ground circuit. As this portion of the coil is common to both grid and screen circuit, an in-phase component will be fed from the screen to the grid. The circuit will oscillate when this component and the amplification of the valve are sufficent to overcome circuit losses. The flow of grid current which takes place when the grid is positive with respect to the cathode builds up a negative charge at the grid to provide automatic grid bias.

The grid capacitor C2 avoids short-circuiting the grid to the cathode through the coil. The oscillation frequency is set by the values of L and C1 plus stray circuit values.

Output may be taken from the plate of the valve which is coupled to the oscillator through the common electron stream. The RF choke is the plate load. If the valve has a suppressor, this should be earthed.

Advantages:

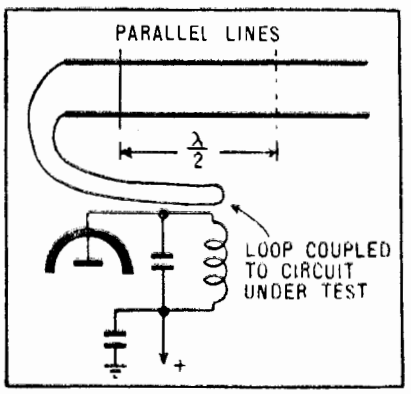
(a) The circuit may be set to any frequency within the tuning range of L and C1.

(b) Generally cheaper than a crystal oscillator with multiple crystals.

Disadvantages:

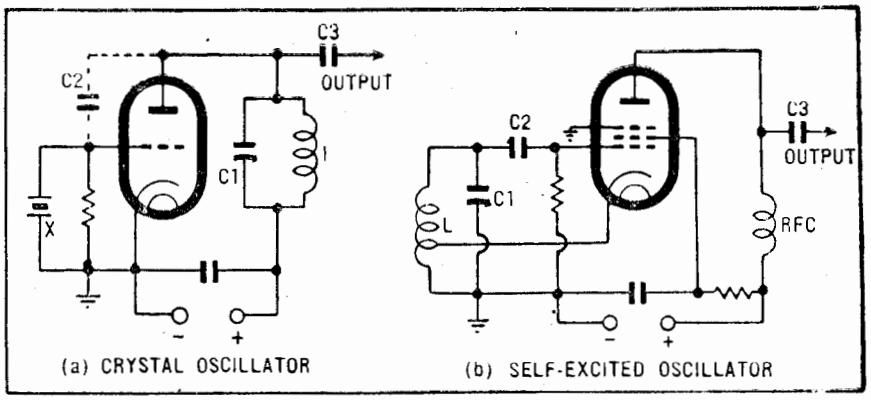
(a) Physical or electrical variation of the components or surrounding objects may cause unwanted variations in frequency. A high-C circuit is desirable.

(b) Variations in supply voltages may cause appreciable variations in frequency.



Q6 — How Lecher lines are connected to an RF output stage to measure frequency.

QUESTION 6: A two-wire parallel transmission line used to measure directly the length of radio waves particularly at ultra-high frequencies is said to consist of Lecher wires. In use, they are loosely coupled at one end to the output stage of a transmitter tuned to resonance. When energised, a shorting bar containing an indicating device is slid along the wires to indicate successive points of high voltage or current. The distance between successive points of either represents quite accurately a half-wavelength of the frequency being measured. The indicating device may be an RF ammeter, RF voltmeter, or even a small torch globe to indicate by its brilliance successive repeat points. If the half-wavelength in inches is divided into 5905, the result is the frequency in megacycles.



Q5 — (a) Circuit of a simple crystal oscillator. (b) Circuit of a simple self-excited oscillator.

QUESTION 7: The crystal microphone operates by virtue of "piezo-electric effect." This phenomenon produces potential differences on opposite side of slabs of certain crystals, notably Rochelle salt, when these are subjected to mechanical strains.

In the diaphragm type crystal microphone, a square slab crystal is supported at three corners but the remaining corner is connected to a diaphragm. When the sound waves cause the diaphragm to move, the crystal is subject to minute mechanical strains and potentials in sympathy with the original sound are developed.

Connections to the external circuit are made via conducting layers fastened to opposite surfaces of the crystal and leads connected to them.

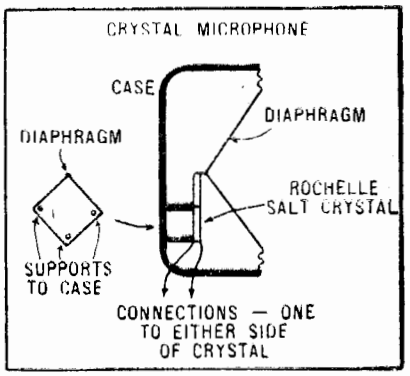
Being a high impedance device, the microphone is generally connected into the grid circuit of a valve with a load resistor of from 2 to 5 megohms or as specified by the manufacturer. A blocking capacitor is desirable in the active lead to prevent any DC voltage appearing across the element.

(b) Shielding is desirable around connecting leads and coupling transformers of ribbon or moving coil microphones in order to prevent hum pickup from external electric fields. It is also effective in avoiding RF feedback.

Hum due to electric fields may be removed from the leads by enclosing them in copper braid.

The microphone transformers, and certain low impedance leads, may pick up hum due to magnetic coupling. This can be avoided by surrounding the affected parts with magnetic material. High permeability iron such as Mu-metal or Permalloy is frequently used.

QUESTION 8: A vibrator is used to interrupt and reverse the direction of the primary current of a transformer. It thus supplies the changing magnetic field needed for transformer action and the initial low voltage DC supply can be stepped up to a high voltage alternating current. The alternating current is applied to a rectifier which delivers pulsating DC to a filter circuit. Alternatively,

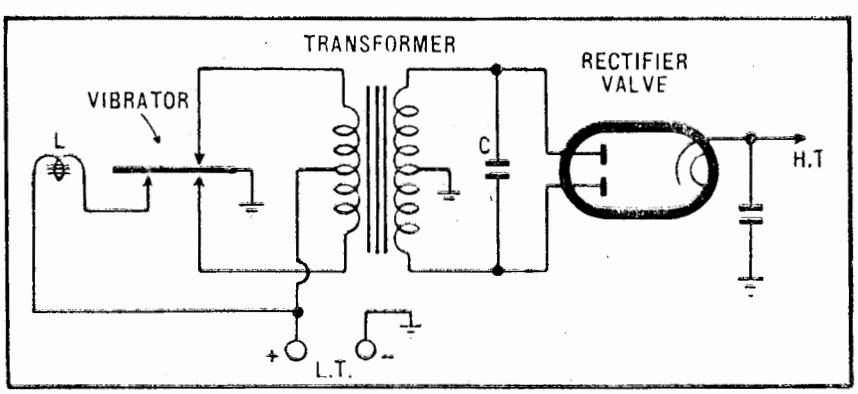


Q7 — Diagram of a diaphragm type crystal microphone.

an additional set of contacts, synchronised with the primary contacts, can be used in place of the rectifier. Action is initiated by a starting coil L and its contact. Vibrator design may vary on this point.

The capacitor C is chosen to resonate the transformer at the natural frequency of the vibrator. This has the effect of reducing sparking at the vibrator contacts and reducing current drain. In a practical transmitter supply, a high fre-

(Continued on Page 77)



Q8 — Diagram of a vibrator power supply using a rectifier.

Connoisseur

Pick-up and Transcription Motor

Fine Equipment For Reproducing Sound On Disc

Pick-Up (Mark II)

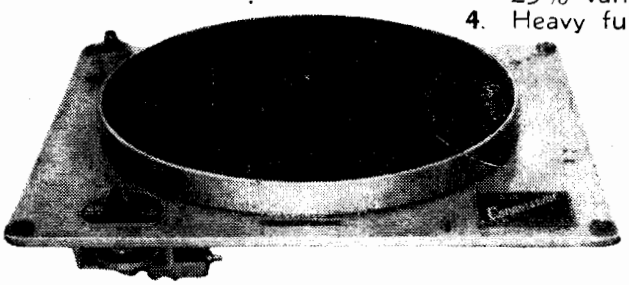
The Connoisseur Pick-up has a downward pressure of only 5 grams and has a frequency range from 20 c/s to 20 kc/s plus or minus 2 dbs on soft vinolite discs at 33⅓ r.p.m. This is distinguished by its supreme quality and high class finish. This is the unit for Hi-Fi enthusiasts

1. 15 mV. obtained off a standard L.P. disc
2. 100% screening of coil by magnet system
3. Easily replaceable armature system.

Variable 3 Speed Motor

This is a hand-built product which meets with the most stringent requirements

1. Three speeds with 4% variation by mechanical means. No braking action applied to motor.
2. The motor is a synchronous hysteresis type, running in substantial phosphor bronze bearings.
3. The motor will remain in synchronisation with 25% variation of line voltage.
4. Heavy full-sized die-cast platform, 15¾ in. x 13½ in. This unit is being used in considerable numbers by Recording Studios and Sound Installations.



Demonstrations and Supplies Available from

NEW SOUTH WALES:	United Radio Distributors Pty. Ltd., 175 Phillip Street, Sydney.
	Audio Engineers Pty. Ltd., 422-4 Kent Street, Sydney.
VICTORIA:	Homecrafts Pty. Ltd., 290 Lonsdale Street, Melbourne.
	J. H. Magrath & Co. Pty. Ltd., 208 Little Lonsdale Street, Melbourne.
	Radio Parts Pty. Ltd., 157 Elizabeth Street, Melbourne.
	Warburton, Franki (Melbourne) Ltd., 380 Bourke Street, Melbourne.
SOUTH AUSTRALIA:	Gerard & Goodman Ltd., 192 Rundle Street, Adelaide.
	Newton McLaren Ltd., 17 Leigh Street, Adelaide.
	Radio Electric Wholesalers Ltd., 26 St. James Place, Adelaide.
QUEENSLAND:	Chandlers Pty. Ltd., Cnr. Albert & Charlotte Streets, Brisbane.
WESTERN AUSTRALIA:	Atkins (W.A.) Ltd., 894 Hay Street, Perth.
	Carlyle & Co. Ltd., 915 Hay Street, Perth.
	Leroya Industries Pty. Ltd., 672 Hay Street, Perth.

Australian Agent:

BRITISH MERCHANDISING Pty. Ltd.

BOX 3456, G.P.O., SYDNEY.

FROM THE SERVICEMAN WHO TELLS

At various times in the past, I have read and told stories about faulty coupling capacitors and here's another one with a different slant. It might possibly provide a lead for someone else who has come up against the same set of symptoms.

OF course, by introducing the story this way, I have been guilty of the same thing as many womenfolk who say, typically: "Dear, tell Mrs So-and-So the story about the window that you couldn't see through because it was so dirty."

Having thus identified the joke by its "punch line," no amount of artistry thereafter in the telling can make it funny. Nor is it funny either, if you refuse to tell it.

Well, as I said, this is a story about a coupling capacitor.

It started one day, when I received a call from a very good friend who could variously be described as a "Hi-Fi Crank" or an "Audiophile." He isn't in the game professionally but has picked up a good deal of knowledge from long association with amplifiers.

Quite perturbed, he told me that his amplifier seemed to be on the fringe of motor-boating but nothing he could do would cure it.

NO CURE!

Every time he moved the volume control too rapidly, the speaker would emit a double "plop-plop" sound. This was unpleasant in itself but he was worried that such near-instability would "mess up" the low frequency reproduction.

"Sounds like electrolytic trouble," I said. "Have you tried new ones in parallel, or extra decoupling?"

He gave me a somewhat disgusted look, apparently for making such an obvious suggestion.

"Listen mate, I've put so many electros into the thing, they're hangin' out the bottom. They don't make a scrap of difference."

"Has the amplifier always been like this?"

My friend said not—or at least he didn't think so—although the recent substitution of a low output pickup meant that the volume control was now used over a wider sweep than formerly. The effect could conceivably have been present earlier without his noticing it.

"What about the coupling capacitors in the control unit?" I asked. "Some of these overseas capacitors aren't so hot, you know."

He said he'd checked these and they seemed to be okay.

TV ELECTROLYTICS

"Have you tried bigger electros? I see the R, T and H boys are suggesting TV types for amplifiers . . . 50 and 100 mics."

Again that look of disgust, or something. Apparently he had tried them.

"Then what about high frequency instability? Have you changed your speaker set-up lately? Some amplifiers will oscillate with long leads or filters connected to their output circuits."

Again I drew a blank. My friend said he had no C.R.O. but a multimeter on the 10-volt AC scale, and connected across the voice coil winding, showed no deflection without signal. No, he didn't think the amplifier was oscillating.

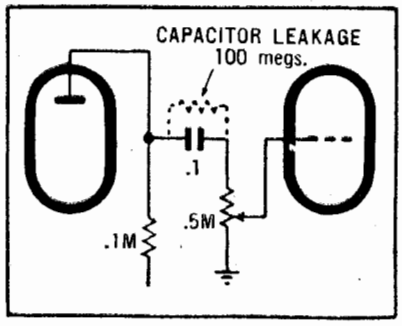
Since there appeared to be nothing else for it, I suggested that he bring the amplifier and control unit over the following evening and we could run through it on the test bench. This he did.

When duly connected up to the bench speaker, it looked very much as if the amplifier was going to play the familiar trick of behaving itself, under observation. Swinging the volume control gave no plop-plop effects whatever.

COULD BE FELT

Leastwise, it didn't seem to, until I touched the speaker cone with a finger tip. I could then feel the plop-plop without hearing it, which seems to point to some moral about bass response in test-bench speakers.

However, not wanting to spend the rest of the evening with one finger on the cone of a speaker, I connected the C.R.O. across the output and tried again



When an output valve cathode resistor open circuits, the bypass electrolytic may open circuit or break down. In this rare case it almost tricked the serviceman by developing enough leakage to maintain about the correct bias for the valve.

This time, the effect was quite evident as a slight up-and-down movement of the C.R.O. pattern.

At least we had something to work on. What about the feedback factor? Perhaps it was too high. Possibly a resistor had drifted in value.

To check this, I duly connected my output meter across the voice coil leads and set it to 10 volts AC. Then, feeding a signal through the amplifier, I shorted out the feedback circuit and set the control to give an output of 10 volts across a 15-ohm resistor, which incidentally, I had substituted for the speaker voice coil.

There's no point in blasting one's ears, if you don't have to.

At the same time, a quick glance at the C.R.O. pattern showed me that the amplifier was not being overloaded with 10 volts across the load.

On removing the short, the output voltage dropped to 1-volt, indicating 10 times gain reduction or 20db of feedback. Without knowing what the exact figure should be, it was at least a likely one. Nor was there any sign of instability in the C.R.O. pattern, with or without signal.

What then? I checked through things in my mind.

Electrolytics apparently OK! Decoupling more than adequate by all appearances. Feedback factor high but not suspiciously so. No sign of high frequency instability.

What about those coupling capacitors? Ignoring my friends' protestations, I stripped the control unit from its cover and identified the coupling capacitor between the pickup preamp. stage and the gain control.

On one side, the plate voltage was evident, on the other side, nothing. Or was it nothing?

Peering in myopic fashion at the meter needle, I detected just a trace of forward movement as the test prod touched the grid side of the capacitor.

DEFINITE LEAKAGE

It didn't take long after that to strip the capacitor out and check it on the V.T.V.M. Leakage resistance . . . 100 megohms.

That's a lot of megohms but not enough for a coupling capacitor. Assuming a 0.5 meg. potentiometer, it means that 1/200th part of the plate voltage is present across the volume control. And 1/200th part of 100 odd volts is 0.5 volt.

Therefore, swinging the volume control through its travel with no signal applied, would put a voltage on the grid varying from 0 to 0.5 volt at an apparent frequency determined by the rate of rotation of the pot.

In a system which is probably flat down to a few cycles per second, a low frequency impulse of near "overload" proportions, fed right through the amplifier, could so disturb the voltage levels that the poor thing could hardly be blamed for giving a couple of plops in the process of recovering.

As I had hoped, a new coupling capacitor (600-volt type this time) wiped the trouble like magic.

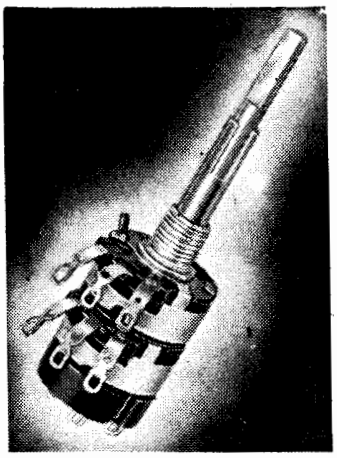
PRECAUTIONARY STEP

But here's the unkind cut.

My friend revealed that he had replaced the "overseas" coupling capacitors some time previously as a purely precautionary measure. The one which had now developed leakage and caused him so much heartache was very much Australian made.

Who said hooray for direct coupling?

My second story for the month is only

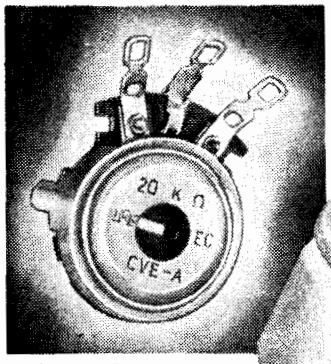


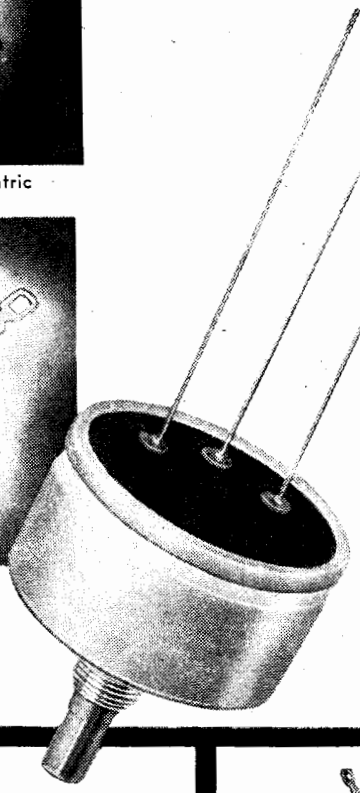
IRC Type Q Concentric Control

4 NEW VOLUME CONTROLS ADDED BY . . .

IRC AUSTRALIA

to their unexcelled range!





Above: IRC Type EC Tab-mounted Trimmer or Preset Control. At right: IRC Type Z Volume Control & Type ZW Rheostat Potentiometer.

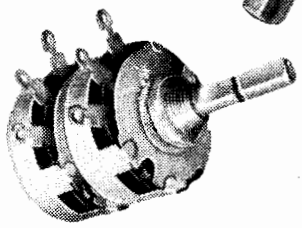
1 **IRC TYPE Q CONCENTRIC DUAL CONTROL.** Available with or without taps and switches. Panel and rear sections can be oriented so centre terminals are located at any multiple of 15° from each other. Standard RMA shaft dimensions with or without slots 180° apart in outer shaft, with or without flat or slot in outer shaft

2 **IRC TYPE EC TAB-MOUNTED TRIMMER OR PRESET CONTROL.** A new low cost control designed for circuits requiring only occasional adjustment by factory or service personnel. The control is adjustable with any instrument having a screwdriver tip and is accessible front or rear of control

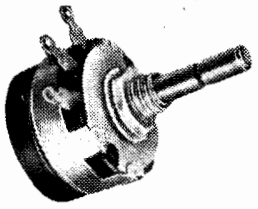
3 **IRC TYPE Z VOLUME CONTROL** is the tropicalised form of carbon volume control, and is completely sealed in a metal housing. The spindle is fitted with a pressure gland to maintain the seal in operation

4 **IRC TYPE ZW RHEOSTAT POTENTIOMETER** is similar to Z in appearance, only it is a sealed wire-wound potentiometer. The spindle also is fitted with a pressure gland to maintain the seal during operation. Ohms range standard values between 2 ohms and 10,000 ohms.

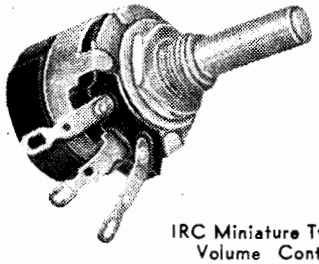
WRITE OR 'PHONE YOUR USUAL SUPPLIER FOR FULL DETAILS



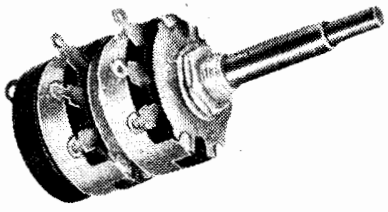
IRC Ganged Type Controls, in 2, 3 and 4 Gangs



IRC Type CS Metallised Control

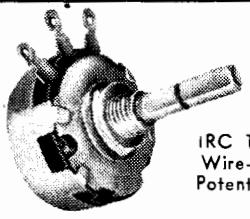


IRC Miniature Type Q Volume Control

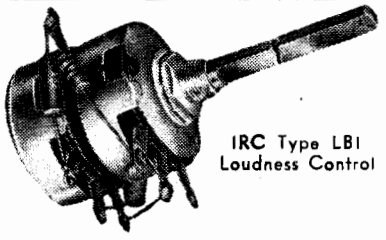


IRC Type CS Concentric Dual Control

Ask your Supplier for full details



IRC Type W Wire-Wound Potentiometer



IRC Type LBI Loudness Control

Sole Australian Agents:

Wm. J. McLellan & Co. Pty. Ltd.

126 SUSSEX STREET, SYDNEY • BX1131

(50 yards from King St.)

BACKED BY OVER 20 YEARS'

AUSTRALIAN VOLUME CONTROL MANUFACTURING EXPERIENCE

brief but it serves to show how easily a serviceman can be caught out, even an old greybeard like yours truly.

It was just an ordinary old set, of the type which still "graces" many suburban homes—a five valve superhet with valve equipment of the 6A7, 6D6 variety. As received, it played stations all right, but in a very weak and distorted fashion.

I took one look at the 6B7S "detector" and guessed that the screen supply resistor was open circuited. In my book, there are few more unsatisfactory components than the high value resistor which feeds a pentode audio screen.

Accordingly, I turned the receiver over, checked the screen and found, as I had expected, no voltage whatever. A continuity check showed the capacitor to be in order, so it was simply a case of wiring in a new 1.5meg. resistor to replace the original one.

This done, the set played quite loudly again and I was almost ready to reach for the charge docket.

However, since I had spent next to no time on the chassis, I decided to give it a bit of a "birthday" and a general check for good measure. Accordingly, the valves were removed and cleaned one by one, the chassis wiped down as well as possible and the dust blown out of the capacitor plates.

A SPOT OF OIL

A spot of oil on the dial mechanism and pot. shafts improved their operation, the pointer was straightened and the dial glass cleaned. Lastly, a quick check over all wiring and components, a similar check of the alignment and the customer had his money's worth.

But wait, that old 10mfd. electro across the output valve cathode had probably not been replaced since the set was built even though it looked respectable enough. It probably didn't have much capacitance left and it might be affecting gain and tonal balance. Better put in a new one, even though it was a bit hard to get at.

This done, the set sounded suspiciously distorted and a check showed something like 30 volts of bias on the output valve. A further check revealed the reason—the cathode bias resistor was open circuited.

Tracing back, I found that the old electro had conditioned itself somehow to passing about the right cathode current and developing about the right bias. It had neither open circuited nor short-circuited, as one might have expected in the circumstances.

The new replacement electro wasn't so accommodating and immediately revealed the faulty resistor.

But how easy I could have been caught. The set could have been returned quite innocently with an O/C bias resistor, to play for months in that condition—or to fail almost immediately.

A NEAR THING

It's disturbing to realise that one's reputation as a serviceman can hang on so fine a thread but it's also reassuring to know that the Gremlins are sometimes on your side.

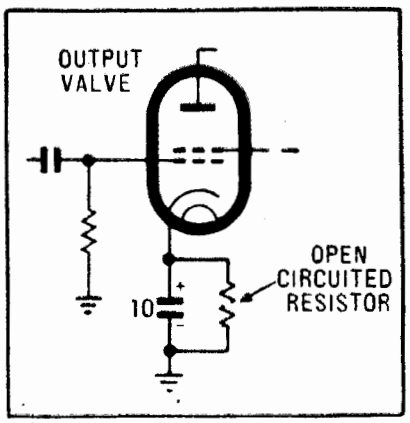
A TV job which I ran across during the month was simple but well worth a mention, because it sets the pattern for many similar complaints from now on, as valves begin to age.

There I go again, giving the show away before I've begun the story.

The set was of well-known make and the complaint was to the effect that the picture tended to shrink in height after a few minutes of operation. When switched off, it would apparently recover so that the picture was normal at next use—but it would inevitably begin to shrink shortly afterwards.

When I arrived on the scene, the set duly misbehaved in the manner described—or nearly so. In point of fact, there was evidence of the picture shrinking almost immediately from switch-on but it didn't become obvious to the casual viewer until the limits of the scan had crept from behind the mask.

It seemed fairly clearly to be a fault in the frame circuitry because any general trouble as, for example, reducing H.T. voltage would have affected the picture width and brightness to some degree at least. As it was, the picture seemed to get brighter as the scanned area decreased.



A leaking coupling capacitor in an amplifier control unit put a slight positive voltage across the volume control pot, causing a "plop" when the control was swung through its travel.

The trouble could have been due to a resistor or electrolytic somewhere in the frame circuit but I was inclined to think not. Their pattern of failure is scarcely as regular as this one appeared to be, besides which faulty electros often emit a quite tell-tale odour.

My pick was a valve, probably the frame output valve. This has to work fairly hard in the average TV set and a failing cathode with possible gas leakage could explain the trouble.

Apparently I picked it in one, because a new 6AQ5 restored law and order, the picture no longer attempting to take on the proportions of Cinemascope in miniature.

NO PICTURE!

The present activity in television has resurrected an old cry, to judge by two or three tales of woe which have been related to me during the past month.

The most eloquent was from an acquaintance who installed a TV set just before last Christmas. He kept it through the trial period, was apparently satisfied, despite a couple of minor faults, and duly paid for it in spot cash.

No sooner had the amount been deducted from his credit balance by the banking eagles, than the set blacked out completely. It was picked up, repaired under guarantee and returned.

It played for another week, then began to emit smoke from the little holes in the back cover. Another complaint, another service call.

So the tale continued, ending with the information that the picture was now horribly "tall and skinny" and the people who had originally sold him the set didn't seem to be in too much of a hurry now to fix it.

"It's the old story," he complained. "Pay cash for a thing and you can't get any service."

Having had this said to me at least twice in the one week, I'm beginning to wonder how many other people have similar feelings. Or how many fellow servicemen have the same idea thrown at them.

The customer reasons that, if he pays cash for a receiver, the retailer has his money and can thereafter offer as many excuses as he likes for withholding or delaying service. On the other hand, if time payment is involved in one form or another, the customer can simply stop payments until satisfaction is given.

He reasons that, since he has the set and the outstanding money, he holds the whip hand.

PAID ANYWAY

In actual fact the position is anything but that. Most retailers don't handle their own terms at all but simply act as agents for a separate finance company. They make the sale and complete the necessary papers. They accept the deposit and later accept the instalments.

In the meantime, however, the retailer has been paid his price in cash by the finance company, so that the set is paid for anyway, as far as he is concerned.

If the purchaser tries to bring pressure to bear by witholding payments, the most likely result will be a letter from the Finance Company, signed by a gentleman who is far more interested in books of account than the technicalities of a client's television receiver.

In the ensuing exchange of letters some question may be asked of the Retailer as to what this is all about but any pressure on him which results, is only of a very secondary order. After all, he has sold the set and been paid for it and is bound only by whatever service undertakings he gave at the time of sale.

He will be generous or otherwise in the matter of after-sales service, according to the type of person he is and the way he runs his business.

The real fact of the matter is that Retailers who want to stay in business meet all their obligations—and sometimes more—primarily to build and keep goodwill. The routine by which they receive payment for the set is incidental.

GOOD AND BAD

But I'm not so naive as to assume that everyone in the television selling business is quite so concerned about long-term goodwill. There are doubtless those who cannot or will not give more than a minimum of technical service.

If the case arises where a set is obviously faulty and the Retailer is obviously avoiding his responsibilities, the best party to contact is the receiver manufacturer. He knows only too well that a dissatisfied owner can lose him a lot of sales and he is likely to be

(Continued on Page 63)

I'm a perfectionist!

I'M ALWAYS SURE OF JOINTS SOLDERED WITH . . .

ERSIN Multicore 5 CORE SOLDER

PACKED IN A CONVENIENT DISPENSER PACK

I know Multicore. I know leading radio and television manufacturers in most countries of the world, including U.S.A. use it exclusively. For Multicore is the only solder with more than one core of flux built right in to the solder itself. Multicore has five!

This is complete protection against dry joints and as Multicore uses only virgin metals, every inch is top quality.

I like the dispenser pack — the wire draws from the top without twisting or damage.

I like the fact that you use far less Multicore on every joint. Top quality convenient, economical and now made right here in a modern Australian plant. What more could you want?

HOW TO USE MULTICORE—apply Ersin Multicore Solder simultaneously with the iron or other means of heat to the clean components to be soldered. No additional flux is required. Only apply solder direct to the iron for tinning. Do not carry solder to the joint on the iron.

MULTICORE SOLDERS (AUST.) PTY. LIMITED

43-51 Nelson Street, Annandale, N.S.W. LA 3666

AVAILABLE FROM ALL LEADING ELECTRICAL WHOLESALERS AND HARDWARE AND RADIO SERVICE STORES

LET'S LOOK AT GUIDED MISSILES

(Continued from page 19)

tained until mid-course guidance takes over.

For long range missiles, mid-course guidance often takes the form of a built-in navigational system.

This is an electronic computer into which all the information required by the missile is recorded prior to launching.

Connected to this device is a system of accelerometers. One form of this instrument is a condenser type of pick-up. It has a suspended mass which has only one degree of freedom. This mass actuates a diaphragm which is part of the condenser and the variation in the capacity caused through movement or acceleration will measure the acceleration of the missile.

Another type is merely a mass supported by a spring. The movement of this mass actuates the arm of a potentiometer which registers the variation of current as a measure of the acceleration.

ACCELEROMETERS

Several types of accelerometers may be installed in the missile which together register the acceleration in every direction. Thus if the accelerometers give information to the internal computer which is different from that to which the latter was set the computer will automatically make the necessary correction. Error signals are transmitted from it to the servo mechanisms which will then make the necessary changes in power thrust, angle or control devices.

With atomic war heads it is, of course, not necessary that the missile should hit the target directly because the effects of an atomic explosion are widely dispersed.

Thus the final stage of "terminal guidance" need not be as accurate as might be imagined. It is only necessary that the missile reach within a few miles of the target.

"Terminal guidance" or homing has only a very short range and may be brought about by infra-red rays from the target actuating the devices in the missile.

ACTIVE HOMING

The ultimate in terminal guidance is "active homing" where the missile emits its own radar impulses which search out a target and direct the missile to it.

A missile which is being tested is fitted with apparatus called telemeters which are electronic devices. These collect the data to be measured and convert it so that it can be superimposed on a radio carrier, after another instrument encodes it for transmission.

These encoded signals are then transmitted to the control station on the ground. Here it is recorded on either a low speed record where any channel can be recorded separately or on a high speed record which can give all the information transmitted by the missile, by subsequent analysis.

Information is analysed by electronic computers. These computers are so fast that one type can give the sum of the squares of all numbers from 1 to 10,000 in 60 seconds.

The information is fed into the computer on high speed tape on which the information is impressed as punched holes. As the tape passes through the machine light passes through the holes and actuates photoelectric cells which in turn pass on the coded information to the valves of the computer.

Storage banks in the computer consist of either drums of magnetic tape or spots of light on cathode ray tubes. Then there are magnetic drums which store countless items of information on the magnetic surface.

These drums are continually revolving and information can be taken off at any required time.

The processed information is then automatically printed by high speed printing machines which can print 600 lines each of 130 characters per minute.

BRITISH COMPUTER

One of the largest computers in the world is at Farnborough, England. It occupies 6,000 square feet of floor space and has 8,000 radio valves in its circuits.

This particular instrument can simulate the entire operation of a missile.

Even parts of missiles can be connected into the machine and tested in such a way as if they were parts of the actual missile itself. With its aid it is possible to test missiles without firing them, thus saving a tremendous amount of time and money and human effort.

This short discussion will, it is hoped, help the uninitiated to more fully understand the tremendous effort which goes into the testing and manufacture of a guided missile. Information of the subject is necessarily limited because of the secrecy which surrounds the projects. No doubt by the time this is printed more advanced techniques will have been developed, so fast does science advance.

THE SERVICEMAN WHO TELLS

(Continued from page 61)

most interested in any Retailer who is doing a disservice by selling his product.

And, of course, if the receiver is really "jinxed," there is no one in a better position to produce cosmos out of chaos than the manufacturer's own service department.

Don't be alarmed if, in saying this, I seem to be talking independent servicemen out of a job. Most of them are pretty canny, anyway, about buying into arguments between owner, Retailer and Finance Company.

Oh yes, back to technical matters for a moment.

Ladies, you do not re-set a dial pointer by winding it hard against the end of its travel. The idea works occasionally but, as often as not, you just succeed in bending the pointer or breaking the dial cord.

My most tedious job of the month was a dial cord which had to be replaced for just this reason.

The worst part of it is that the lady who was sufficiently "technical" to work out the process, was also sufficiently technical to know what had happened. And you try to convince a lady that she owes you a regular service fee for just replacing a piece of string.

PART TWO

A view of the completed amplifier. Controls from left to right are, two microphone input sockets, the microphone channel volume control, the pickup input socket, the combined pickup volume control and master control for the mixer unit, the tone control, and the on-off switch and indicator bezel.

A 35-Watt Amplifier With Control Unit

Here is part two of our article on a 35-watt public address amplifier. It describes construction of the amplifier on a new, smaller chassis, then introduces a completely new preamplifier-mixer unit for use where multiple input channels are required.

by

Wes Yashin

As described last month, the basic amplifier is adequate for most P.A. needs, having a twin microphone and one pickup channel, mixing facilities, a treble-cut tone control and ample power output.

FUNCTION OF UNIT

The new preamplifier-mixer unit is intended to supplement these basic input facilities for stage or other specialised work, requiring several microphone and pickup input channels. While intended primarily for our 35-Watt P.A. Amplifier, the mixer unit can obviously be used with other existing amplifiers, to increase their usefulness. It will be described fully in the latter portion of the article.

The developmental work on the circuit of our basic amplifier left us little time to consider an ideal physical layout and we were more or less forced to compromise by showing it built up on the previously available 40-watt amplifier chassis.

However, as we intimated in the article, we have since had opportunity to review the position. The result is the same amplifier, built on a chassis of smaller dimensions but having an almost identical component layout. Only the rectifier and the associated wiring has been shifted.

The new chassis was hand-made from 16-gauge aluminium, measuring 13¼ x 7¼ inches across the top and 13¼ x 9 inches across the bottom, the difference being due to the sloping front.

The original depth of 3 inches was maintained.

While readers could likewise make up their own chassis, a blueprint will be released and a ready-punched steel chassis should therefore become available through trade houses in the normal way.

We went a step further and had a chassis manufacturer make up a perforated metal cover. As the photograph shows, the result is a very neat and attractive piece of equipment.

METAL WORK

The sides of the cover are of sheet metal and overlap the chassis sides by a half inch or so. Nuts and bolts through the overlapping portions hold the cover in place. A pair of handles on the top of the cover facilitate handling and add to the appearance.

The addition of a label to the front panel will also enhance the appearance and facilitate use of the controls. Our original label was made from white card with Indian ink lettering and protected by celluloid sheet. Should the demand prove sufficient, at least one manufacturer plans to make an etched label available.

A glance at the front view of the chassis will reveal that the layout is essentially the same as that of the original, the difference being in the closer grouping of the components, a more forward position for the rectifier socket and the addition of the "on-off" switch and indicator bezel on the front panel.

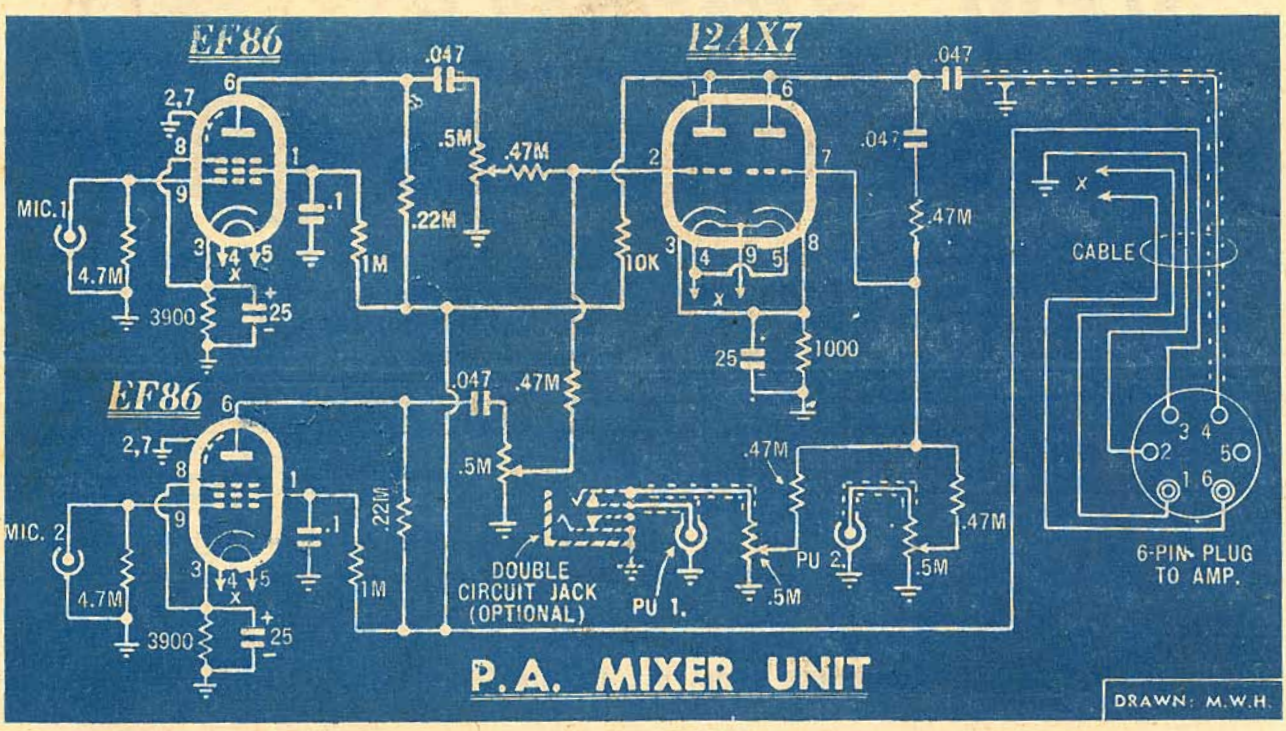
Some of the under-chassis wiring has been altered to suit the altered grouping, but the rest of it remains unaltered. In fact, in rebuilding the amplifier we were able to transfer whole sections of the wiring onto the new chassis.

EARTH POINTS

As with the original amplifier, certain precautions should be observed when wiring. A common earth point for each of the voltage amplifier stages is essential, if hum due to earth loops is to be avoided. The input connectors must be insulated from the chassis and connected to their respective common earth points near the relevant valve sockets.

It is a wise precaution to connect the remaining earth points together with a common run of heavy tinned copper wire, to guard against poor contact with

CIRCUIT DIAGRAM OF THE PRE-AMPLIFIER UNIT



The circuit of a suggested mixer unit. Note that feedback is used to control the gain of the pickup section of the mixer valve.

the chassis in the future, due to rust or corrosion.

A further critical piece of wiring involves the two .47 meg isolating resistors in the grid circuit of the second stage. These must be mounted as close to the grid pin as possible, with no more than about half an inch of attaching lead. Two lugs of an eight-lug mounting strip are used to support their free ends while the common end is anchored directly at the grid pin of the valve socket.

The method of terminating the output transformer secondary leads is also worthy of mention. In the new version, the secondary leads are terminated at a seven-lug bakelite strip equipped with screw terminals. This arrangement is ideal for temporary installations. An octal socket is wired in parallel with the bakelite strip and provides an alternative means for connecting to the speaker system.

INPUT REQUIREMENTS

Although the amplifier is quite versatile as it stands and is likely to cover most situations met with in public address work, we felt that a separate mixer unit with a number of extra channels was warranted. We have certainly had numerous requests for such a unit.

After some consideration the present design was evolved. It consists of two microphone and two pickup channels feeding into the grids of a twin triode mixer. The mixer output is then fed into the pickup channel on the main amplifier, the gain control of this stage becoming the master gain control.

The net result is that three microphone channels and two pickup channels are now available with mixing facilities for each.

The number of mic. and pickup channels in the mixer unit need not be limited to two as a slightly longer chassis than specified could quite easily accommodate three of each. Alternative schemes to suit unusual situations may be quite readily introduced.

A possible modification may consist of an amplifier valve in each pickup channel designed for low level pickups and with suitable compensation for recording characteristics. A suggested circuit is reproduced and consists of a high gain pentode, with a compensating network in the plate circuit. The constants chosen are for the R.I.A.A. curve, which has now become standard with practically all recording companies.

Also included by way of interest is a double circuit jack, connected into one pickup channel. It was not physically wired into the mixer unit and can be treated as entirely optional. However, telephone jacks, wired as shown into one or more channels, provide an extra input facility and also allows rapid interchange from one programme source to another.

Referring to the circuit, you will note that mixing of each pair of channels is accomplished by simple resistance networks feeding the respective grids of a twin triode. The output from all four channels finally come together in a common plate load.

The gain of the pickup section of the mixer valve is deliberately kept low by the use of a small plate load and, plate-to-grid feedback through an isolating capacitor and a .47 meg resistor. Feedback around this stage does more than reduce the gain; it also reduces distortion by an appropriate amount and any residual treble loss due to smaller effect.

PARTS LIST

For parts lists of amplifier see March issue.

1 Chassis with sloping front panel (10in x 3½in top, 10in x 4½in bottom.)
1 Top cover to suit above.
1 Bottom cover to suit above.
2 Noval sockets with shields.
1 Noval socket.
1 6-pin plug with cover.
4 Single contact microphone connectors.

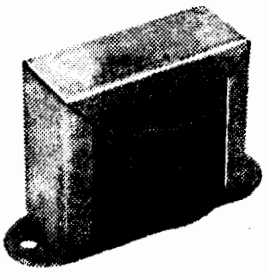
VALVES.
2 EF86, 1 12AX7.

CAPACITORS.
3 25 mfd 40 volt electrolytics.
2 .1 mfd 400 volt paper.
4 .047 mfd 400 volt paper.

RESISTORS
2 4.7 meg ½ watt.
2 1 meg ½ watt.
5 .47 meg ½ watt.
2 .22 meg ½ watt.
1 .01 meg ½ watt.
2 3900 ohm ½ watt.
1 1000 ohm ½ watt.
4 .5 meg potentiometers.

SUNDRIES
1 8-lug strip, 1 6-lug strip, 1 3-lug strip, 2 2-lug strips, hookup wire tinned copper wire, coaxial cable, spaghetti, nuts and bolts, solder lugs, knobs.

NEW FERGUSON FILTER CHOKES



FERGUSON announce the release of a new series of small economical filter chokes for use in radio and T.V. sets, amplifiers, etc.

These new chokes are fitted with robust cadmium plated steel wrap-over brackets firmly crimped to the core. They are thoroughly impregnated, and fitted with solidly anchored connection leads.

Type Number	Ind. Henries	Current D.C.M.A.	D.C.Resis. Ohms	Dimensions—inches				Approx. Weight
				Height	Width	Length	Mounting Centres	
F14-60	14	60	550	1-¾	1-¾	2-⅛	2-½	14 oz.
F6-100	6	100	210	1-¾	1-¾	2-⅛	2-½	14 oz.
F12-100	12	100	265	2-¼	2-¼	2-¾	3-⅛	2 lb.
F1-285	1	285	48	1-¾	1-¾	2-⅛	2-½	14 oz.
F1-325	1	325	27	2-¼	2-¼	2-¾	3-⅛	2 lb.

AVAILABLE FROM ALL LEADING SUPPLIERS

Manufactured by

FERGUSON TRANSFORMERS PTY. LTD., CHATSWOOD, N.S.W.

ACOS CRYSTAL STICK MICROPHONE (Type Mic 39)

Illustration shows microphone on desk stand

PRICE, £8/19/6

Available from leading radio houses

A new and beautifully styled microphone for use as a hand, desk or floor unit.

A special liner in the case eliminates hand-capacity effects. Special screening gives greatly increased signal to noise ratio and FEED BACK IS REDUCED TO A MINIMUM. Designed especially for high-quality recording, public address, dance bands and broadcasting work.

- **Frequency response flat 50 c.p.s. to 10 K.c.s.**
- **Omni-directional.**
- **Overall length, 4½ inches.**
- **Maximum diameter, 1¼ inches.**
- **Minimum diameter, ¾ inch.**
- **Supplied with 8 ft. special noise-free screened cable.**

TECHNICAL DATA SHEET POSTED FREE ON REQUEST

AMPLION (A/sia) PTY. LTD.

101 PYRMONT BRIDGE ROAD, CAMPERDOWN, SYDNEY, N.S.W.

The actual gain of this stage is a little over two times to offset the two-to-one loss introduced by the mixing circuit in its grid. The input sensitivity of the pickup channel on the mixer unit thus remains equal to that of the pickup channel on the main amplifier, being something over 100 millivolts for full output.

Although we did not draw up a set of frequency response curves for the unit, we checked to see that the response was flat to at least 10Kc and therefore adequate for PA work. The overall response of the amplifier, too, is quite good, being level to well beyond 10 Kc, depending on the secondary tap in use.

No effort has been made to reduce the gain of the microphone section of the mixer valve, as this extra gain in the mic. channel is of no consequence.

PREAMPLIFIERS

The mic. preamplifier stages use EF86 (or Z729) pentodes, whose low noise and rigid construction show to good advantage in this application. Under normal operating conditions the noise is quite low and microphony problems of no consequence, allowing the use of standard socket mountings.

Common earth points are not essential in the mixer unit since there are no low frequency chassis currents to cause hum through earth loops. However, if a steel chassis is used, the precaution of joining all the earth points with a run of heavy tinned copper wire is advisable.

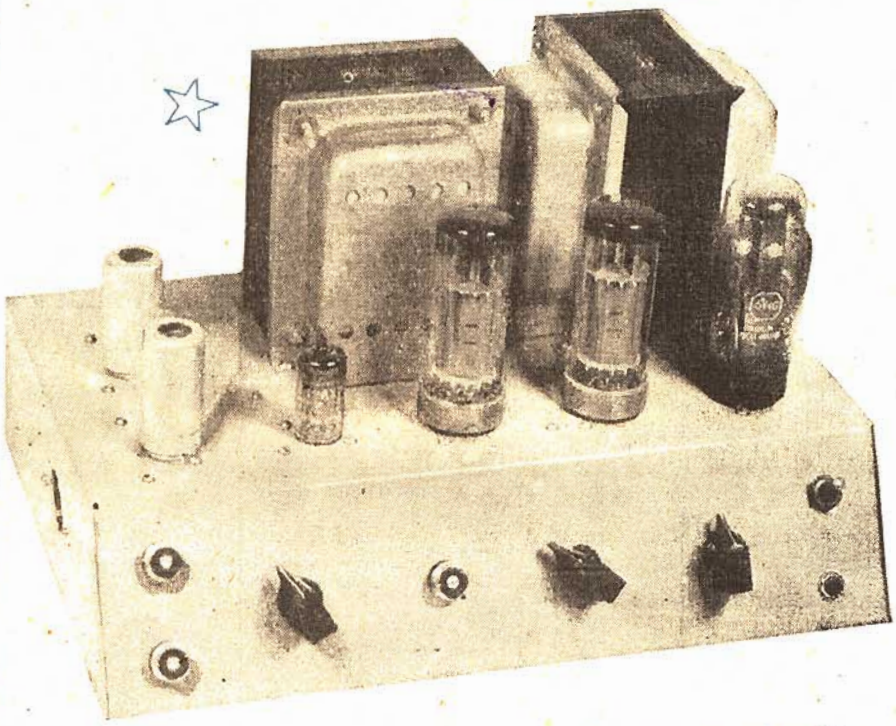
The HT supply to the mixer unit is taken from the main amplifier through a 6-pin plug and socket arrangement. Two high tension points are available at the 6-pin socket on the amplifier, one connects directly to the main HT line, while the other is taken from the de coupled point feeding the microphone preamplifier tag. This latter point was also used to supply the HT to the mixer the decoupling being quite adequate.

The extra drain of the mixer unit lowers the HT at this point and consequently the gain of the stages feeding from this point. However, the decrease in gain is not substantial and in practice would not be missed, since there is plenty to spare.

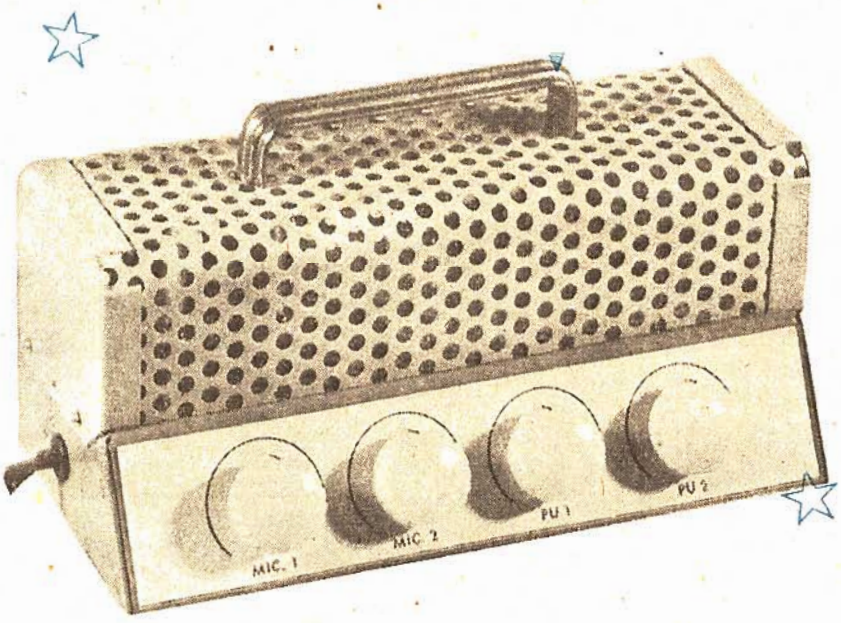
At no time did we experience instability even with all the gain controls turned full on. Operated in this manner the noise level is naturally fairly high, but this is a completely unrealistic situation, since the unit is not likely to be operated with more than two gain controls turned partly on at any one time.

The input sensitivity of the mic. channel is very high requiring less than one millivolt input for full output. In practice it is possible to obtain satisfactory operation from a low impedance microphone, even without an input transformer. Although this again is an unlikely situation, it gives a good idea of the overall performance.

We constructed the mixer unit on a chassis measuring 10in x 3½in across the top and 10in x 4½in across the bottom, due to the sloping front to match that of the main amplifier. A perforated metal cover was also made to match.



The amplifier with cover removed. A considerable saving in space was achieved by the closer grouping of components. The GZ34 is at the extreme right, the EL34s top centre, the 12AX7 and the EF86 to the left. The microphone preamplifier directly behind the first EF86.



The mixer unit matches the main amplifier. Knobs left to right are, wo microphone volume controls and two pickup volume controls.

LAYOUT

A suggested valve layout is to place the preamplifier stages along the rear of the chassis while the mixer valve may be placed forward in the centre of the chassis. The controls may be grouped and spaced to suit the number of stages used. The input connectors are placed along the rear edge of the chassis, resulting in very short leads to the grids of the mic. preamplifiers.

Liberal use is made of tag strips in mounting the various minor components, although a number of these are suspended by their pigtails.

Looking over the rear edge of the chassis, the 8-tag terminal strip, parallel to the left edge of the chassis, supports the outgoing power supply and output leads. It also provides anchor points for the screen dropping resistor and bypass of the nearer mic. stage and the bias resistor and bypass of the same stage.

A 6-lug strip directly in front of the

Homecrafts PTY LTD

FOR RADIO PARTS BARGAINS GALORE

290 LONSDALE STREET, MELBOURNE — FB3711

COLLARO-TRANSCRIPTION TAPE RECORDER DECK
£52/19/6

LENCO-GOLDRING 4-Speed Transcription TURNTABLES
£30/-/-

BASE RECORDING TAPE

213ft 3in Reel	15/
300ft 3in Reel	21/
400ft 4in Reel	26/
600ft 4in Reel	33/
600ft 5in Reel	35/
850ft 5in Reel	44/
850ft 6in Reel	48/
1200ft 6in Reel	56/9
1200ft 7in Reel	59/6
1800ft 7in Reel	79/6

PARTS FOR R&H TV

CHS1 Horizontal Sine Wave Coil	8/7
CHW1 Horizontal Width Coil	11/
CHW2 Horizontal Width Coil	12/1
CHL1 Horizontal Linearity Coil	9 6
THB1 Horizontal Blocking Oscillator Transformer	12/4
THO1 E.H.T. Transformer.	£3/7/1
THO2 (90 deg.). E.H.T Transformer	£3/9/9
Y70D1 70 deg. Deflection Yoke.	£4/12/5
Y90D1 90 deg Deflection Yoke.	£5/17/2

And all other parts, including Chassis and E.H.T. Boxes.

Aluminium Chassis Blank:

5 x 3 x 2	8/
6 x 4 x 2	9/1
8 x 5 x 2½	12/3
10 x 6 x 2½	14/8
13 x 7 x 2½	21/9
11 x 8 x 2½	17/6
13 x 10 x 2½	21/9
17 x 8 x 3	27/
17 x 10 x 3	30/
17 x 12 x 3	32/7
C8/1 14H 60mA	22/9
C5/1 20H/100mA	44/
C3/1 20H/100mA	59/6
C1/3 20H125mA	76/6
C1/1 20H/150mA	92/10
C6/1 20H/200mA	126/

FRENCH POLISHED TV CABINETS IDEAL FOR R. & H. 17in TV SET ONLY £12/10/-

CAPACITORS

Ceramic HI-KI Disc (Subminiature) 2.2 pf.—400 pf.	2/1
401 pf.—10,000 pf	2/5
Ducon TV Capacitors	
500 pf./15KV	34/6
50 x 50/350V	21/6
200 MFD./350V	24/3
100 MFD.350V	19/9
U.C.C. Special "Dectroflash" 650 MFD. 250V W.	46/7
Ducon Paper Capacitors	
.001—.006 600 Volt	1/2
.01/600	1/3
.02/600	1/5
.03/600	1/6
.05/200	1/2
.05/400	1/4
.05/600	1/7
.1/200	1/2
.1/400	1/9
.1/600	2/
.25/200	2/
.25/400	2/5
.25/600	2/11
.5/200	2/7
.5/400	3/11
.5/600	4/1
Variable Tuning Capacitors	
A.W.A. Miniature (12.450 mmfd.)	
2 gang	28/6
3 gang	37/6
A.W.A. Standard (11—430 mmfd.)	
1 gang	22/
2 gang	29/3
3 gang	39/
Roblan Midget type—	
1 gang	21/
2 gang plain	33/6
2 gang with Vernier	40/3
3 gang plain	43/9
3 gang with Vernier	50/2
Label 7-plate	3/2
Label compression trimmers.	1/6
Philips Air trimmers (3-30 pf.)	4/6
M.S.P. Air trimmers (2-28 pf.)	4/6

THE AMAZING TANBERG Hi-Fi TAPE RECORDER NOW AT HOMECRAFTS ONLY £198/-/-

RECORD PLAYER & RECORD CHANGERS

B.S.R HF 8 4-speed player.	£13/5/-
Dual model "295" 4-speed record player	£18/10/-
Collaro 4-speed record changer.	£22/7/6
B.S.R. 4-speed record changer.	£20/10/
Philips 3-speed record changer.	£25/18/-
Dual 1004 automatic record changer, 4-speed	£32/8/6
Philips AG 201 "Disc Jockey" in portable case	£21

PICK UPS:—

Goldring L.56 Transcription arm	
Goldring L.556 P/UP with variable reluctance cartridge	£13
Acos GP 10 Std. P/Up.	£3/12/5
Acos HGP 40 P/Up with 2 heads.	£9/15/
Acos HGP 50 P/Up turn over.	£6/16/
Ibbott crystal P/Up, 2 heads.	£14/10/-
Ronette crystal P/Up, 12in or 16in arm	£7/10/
Garrard P/Up. needle pressure gauge	£1/5/-

PRECISION ZEPHYR MICROPHONES

3XA Crystal Hand Mic.	£4/8/7
4XA Crystal Hand Mic	£6/7/7
8XA Crystal Hand Mic.	£7/14/3
10XA Crystal Hand Mic	£7/3/6
12XAB Lapel Mic.	£3/16/
30RA HI-Fi Ribbon Mic.	£16/17/4
18XA Hi-Fi Crystal Mic.	£18/10/
65 MA Dynamic Mic.	£10/17/10
Floor Microphone Stand	£5/6/-
Oval 4in Desk Stand with Press to Talk Switch	£5/9/9
9in Desk Minitristand	16/10
Adjustable Banquet Stand	£4/2/6

A&R Hi-Fi OUTPUT TRANSFORMERS

No. 916	
12 watts. 8500 ohms. PP U/L. 30-30.000 cps.	£8/18/4
No. 921	
20 watts. 6600 ohms PP U/L. 30-30.000 cps.	£10/19/16
No. 931	
20 watts. 4500 ohm PP U/L. 30-30.000 cps.	£10/19/6
No. 870	
6 watts. 10.000 PP (for 120X). 20-40.000 cps.	£5/5/6
No. 871	
12 watts. 10.000 PP/2 or 8 ohm. 20-40.000 cps.	£8/8/3
No. 872	
12 watts. 10.000 PP/3.7 or 15 ohm. 20-40.000 cps.	£8/8/3

SOLDERING IRONS

Scope "6 seconds" soldering iron.	50/-
Transformer for same for 240V operation	49/7
Birco D.9 40 watts, 3/16in bit.	34/9
Birco D.8 60 watts, 3/8in bit.	40/3
Birco D.1 80 watts, ½in bit.	47/6
Ersin Multicore solder 40 tin 60 lead 12/6 1lb reel	
Ersin Multicore solder 60 tin 40 lead 14/- 1lb reel	
Coraline 2oz tin soldering paste.	2/9

15 Ohm.	Woofer	Tweeter	Comb.
A.W.A.	20928	12in	Woofer. £6/6/
A.W.A	20766	6in	Tweeter. £2/9/6

ROLA LOUDSPEAKERS

3C	£1 12 0
4C	£1 11 6
4F	£2 1 0
4-5C	£1 17 6
4-5F	£2 8 0
5C	£1 13 6
5CX	£1 18 0
5F	£2 2 6
5FX	£2 5 6
5-7H	£2 8 0
5-7L	£2 8 0
6H	£3 3 6
6M	£2 5 0
6-9H	£2 18 6
6-9L	£2 15 0
8H	£3 9 6
8K	£2 10 0
8M	£2 12 6
8MPP	£3 3 0
12K	£3 3 0
12M	£3 6 0
12-0	£4 1 0
12-0 Deluxe	£6 0 0
12-0x	£6 10 0
12Ux Hi-Fi 15 ohm. V.C.	£11 4 0
	£28 19 6

Ironcore Transformers
All prices subject to sales tax 25 per cent.

T5/14 30 mA/150 V6.3	33/
T3/22 40 mA/285 V/6.3 5V	41/10
T1/16 40 mA/385 V/6.3 5V	46/2
T5/102 50 mA/225 V/6.3 V	39/7
T1/4 60 mA/285 V/6.3 V 5V	46/2
T1/18 60 mA/285 V/6.3 V 5V	55/
T1/8 80 mA/285 V/2 x 6.3 V 5V	85/
T1/20 80 mA/385 V/2 x 6.3 V 5V	61/7
T6/18 100 mA/285 V/2 x 6.3 V 5V	61/7
T6/26 100 mA/385 V/2 x 6.3 V 5V	66/
T6/20 125 mA/285 V/2 x 6.3 V 5V	66/
T6/28 125 mA/385 V/2, 6.3 V 5V	74/10
T6/22 150 mA/285 V/2 x 6.3 V 5V	79/2
T6/24 200 mA/285 V/2, 6.3 V 5V	101/2
T6/32 200 mA/385 V/2 x 6.3 5V	114/5

HI-FIDELITY ELECTROSTATIC TWEETERS 4000-19000 CPS ONLY 32/6

THE WORLD'S BEST! COLLARO 4 SPEED RECORD PLAYERS £12/10/-

OAK ROTARY WAVE CHANGE SWITCHES

1 x 11 x 1	11/10
1 x 11 x 2	18/4
1 x 11 x 3	25/7
1 x 12 x 1	13/10
1 x 12 x 2	23/10
1 x 12 x 3	31/4
2 x 4 x 3	24/10
2 x 5 x 1	11/7
2 x 5 x 2	17/10
2 x 5 x 3	24/10
3 x 3 x 1	11/7
3 x 3 x 2	17/10
3 x 3 x 3	24/10
4 x 2 x 1	11/7
4 x 2 x 2	17/10
4 x 2 x 3	24/10
6 x 2 x 1	13/10
6 x 2 x 2	23/10
6 x 2 x 3	31/4

PRECISION BUILT HEADPHONES S. G. BROWN High Impedance Type F 60/- plus 25% Tax

RADIO PARTS BARGAIN

18, 20, 22, 24, 26, 28, 30, 33 B and S Wire. 4oz Reels	10/6
12 SK7 Valves	5/
12 SJ7	5/
12 SQ7 Valves	5/
32 L7 Valves	5/
25 L6 Valves	5/
13 x 7 x 2½ Aluminium Chassis	10/
.25/400 Paper Capacitors	1/6
1600 '22 Speaker Transformer	2/6
.0005 Mica Capacitors, doz.	6/
Little General Chassis	5/6
Senior Portable Chassis	5/6
Fireside five Chassis	7/6
5-pin Plugs with covers, doz.	6/
.25/600 Paper Capacitors	1/
5-pin Ceramic Sockets	1/
25A6 Safety Valves	5/
Assorted Knobs, doz.	3/
12v Synch. Vibrators	5/6
New 3-speed Players	£10/10/
Rola 12 MX Twin-Cone Speaker	£6/16/
Brown Moving Coil Mic. Inserts	39/6
5-Valve Black Crackle Finish Chassis	9/11
7-Valve Black Crackle Finish	11/6
6-Valve Black Crackle Finish Chassis	10/6

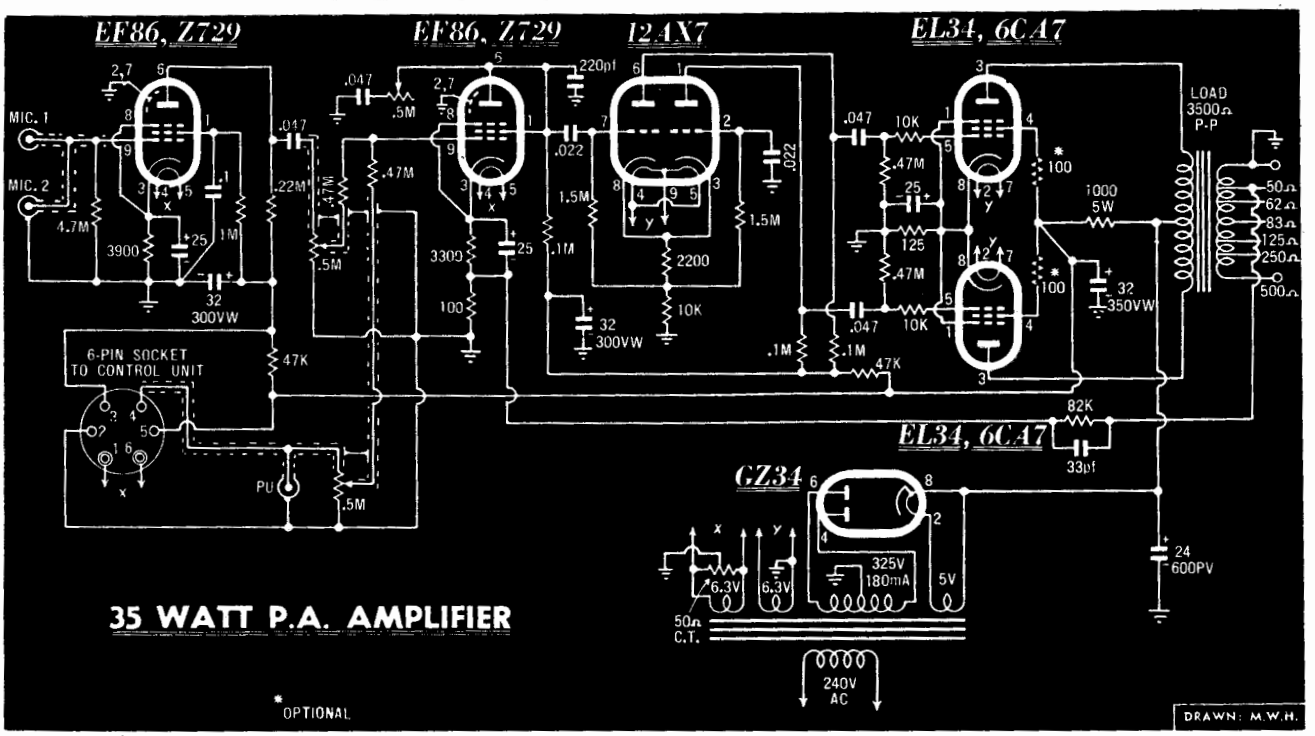
SOCKET PUNCHES
(Hammer or Screw type)

1—3/16 STD	43/4
1in Carr Octal	39/4
¾in Inoval	30/3
5/8in Button Case	23/3
½in for pots, bezels, etc.	23/3
"BIB" Wire Strippers	6/9

EXTRA SPECIAL
Genuine Connoisseur MK1 P-up with Diamond Head, £12/10/- ea.

Call in and see our Mr. S. Hurrey. Let him solve your HI-FI problems for you! We are suppliers of LEAK, QUAD, WHARFEDALE, ORTOFON, FERROGRAPH (etc., etc.) equipment.

CIRCUIT USES EL34'S IN CLASS AB OPERATION



The amplifier circuit is quite straight-forward and identical with that published last month. Should it be necessary to control the high tension due to the use of a different power transformer, a GZ32 or 5V4 rectifier may be substituted. Alternatively a wire wound resistor wired between the centre tap and chassis will also reduce the voltage to the required figure.

second mic. stage supports the plate and screen resistors for that stage as well as the plate load for the adjoining microphone stage and the mixer stage. The coupling capacitors to the volume controls are suspended between points on this strip and the appropriate lugs on the volume controls.

A two-lug strip directly in front of the 5-lug strip and at right angles to the front edge of the chassis supports the isolating resistors for the two mic. stages and the connecting lead to the grid of the mixer valve.

The coupling capacitor to the mixer plates and the outgoing output lead are anchored at another two-lug strip, which is betwen the second and the third potentiometers and is held by one of the mixer valve socket mounting bolts.

MIXING CIRCUIT

A 3-lug strip to the right of this supports the isolating resistors in the pickup mixing section, as well as the feed back components around that section of the mixer.

Any additional stages could follow the same order of component layout which is not extremely critical provided the usual precautions pertaining to grid and plate leads are adhered to.

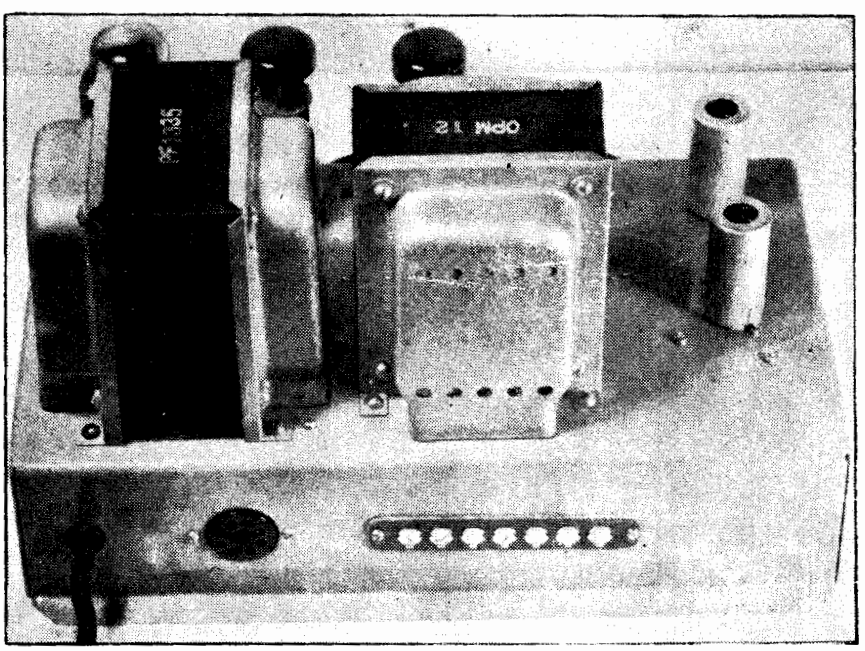
Finally, a few words about the various types of PA microphones may be of value.

Crystal microphones are probably the most popular types in use to-day, mainly because of their low cost. (Some of the cheaper inserts are available for less than £2.) This, coupled with fair average performance and reasonably high output makes them an attractive proposition

At the same time these units have their limitations, and an appeciation of these may help the reader to make a better choice when he considers his own particular requirements.

The very cheapest inserts have a marked peak in the response around the "speech region": a characteristic which can be quite useful in some communications systems, but which can seriously aggravate the feedback problem in PA systems. Better quality inserts, costing a little more, have much smoother response curves and are definitely to be preferred. In fact, the best crystal units are capable of excellent PA performance.

Crystal devices are, by their very nature, fragile in some respects, and need to be treated with a certain amount



This rear view of the amplifier chassis shows the terminal strip on the rear edge, a useful feature for temporary installations. For a permanent installation the octal socket would be used The power and output transformer placement is clearly indicated The power transformer is to the left while the output transformer is to the right.

AUDIO ENGINEERS ANNOUNCE...

THE NEW

"Grampian" famous 5-10BU power amplifier

Now available with the NEW Type 56 Pre-amplifier and Control Unit. This 2 stage Pre-amplifier allows the connection of low output magnetic type pickups. Tape record and "Playback" facilities available at front panel. Only 10 mv required at pickup input to realise full 10w output. **Price Complete £58/16/**

THE NEW

G. E. VRII Variable Reluctance Pickup cartridge!

Features Increased compliance—4 gram tracking weight—frequency range 20—20,000 cycles—nominal output 22mv.
NEW 'clip-in-tip' stylus assembly for quick and easy replacement of worn tips Price **£8/14/6.**

THE NEW

The entirely New and revolutionary THORENS MODEL TD124 Transcription Turntable.

Important Features:

1. Wooden board for pickup mounting made integral with strongly ribbed cast aluminium frame.
2. Spring suspension of whole unit.
3. Special inbuilt levelling device.
4. Inertia controlled drive system; relatively light, precision 4-pole motor associated with very heavy turntable (1,1½ lb).
5. Two step speed reduction.
6. Single control knob operation for 4-speed selection with "OFF" position between each two speeds.
7. Variable speed control (plus/minus 3%) acting on all four speeds.
8. Precision inbuilt stroboscope for 4 speeds.
9. Two-part turntable with clutch action.

Dimensions
Length, 15½"; Width, 12¾"; Depth—below mounting board—3"; Height—above mounting board—2½"

PRICE £73/15/-

SARLON PLASTIC GRILLE CLOTH

Now available in five different weaves and colours. 36in x 27in neatly packed in cardboard tube container at only **42/6.** Limited quantity; odd sizes available in all types for as low as **17/6** per piece.

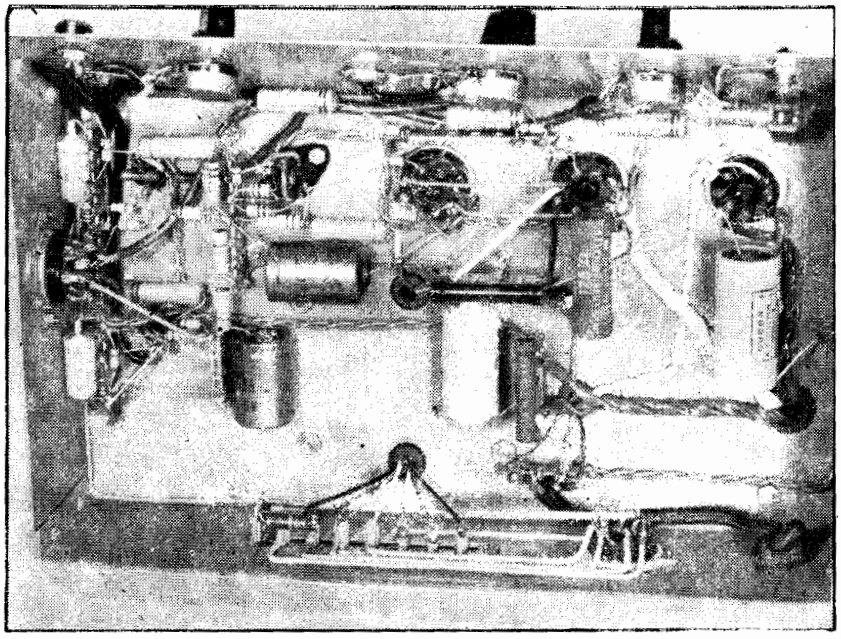
PRICE LIST Write now, enclosing stamp, for comprehensive Price List, or call at our showroom.

VISIT OUR SHOWROOMS
"Sound is our business"

Fidelity AE
Audio Engineers PTY. LTD.

PHONE BX6731

422-424 KENT STREET SYDNEY



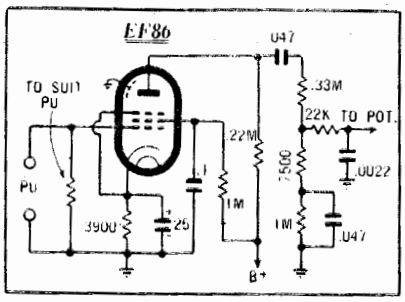
This picture gives an excellent idea of the wiring and minor component layout

of commonsense. Their two greatest enemies are humidity and heat. The makers can guard against most humidity problems by careful sealing techniques, but precautions against heat are up to the user

HIGH TEMPERATURE

At temperatures around 120F and higher a crystal can be completely destroyed, no matter how well it is sealed. Temperatures of this order are easily produced inside a microphone case left in bright sunlight for any length of time, making this type unsuitable, in general for exposed daytime outdoor work.

Crystal microphones have a high impedance output, meaning that losses can be quite severe if long lengths of shielded cable have to be used However, due to the high capacitance of the crystal itself, these losses are essentially constant at all frequencies, so that the problem is



A suggested circuit for a low level pickup input channel. Compensation is for an RIAA characteristic

mainly one of providing sufficient reserve of gain in the amplifier to take care of this. Usually, this is not a difficult requirement to satisfy, for lengths of cable up to, say, 30 ft

Probably next in popularity is the dynamic type, again due to the fact that their cost is reasonable, though usually greater than the crystal types. Some of the cheaper types suffer from peaky response in much the same manner as the equivalent crystal types, and are thus equally undesirable.

However, assuming a smooth response, this type has much to recommend it. It is robust, being ruggedly constructed and immune to heat and other weather conditions, and therefore well suited for outdoor use.

Its natural output impedance (the "voice call" impedance) is generally 50 ohms. This is a useful figure and a line operating at this impedance may be almost any length without introducing serious losses, and need not be shielded. In fact almost any form of twin cable may be employed, such as twin lighting flex etc.

It may even be possible to couple the microphone directly into the amplifier at this impedance if the gain of the latter is high enough, but it is more usual to provide a transformer close to the main amplifier to convert to a high impedance. This transformer will be quite prone to hum pickup from the power transformer and will need to be mounted several feet from it, or employ expensive mu-metal shields.

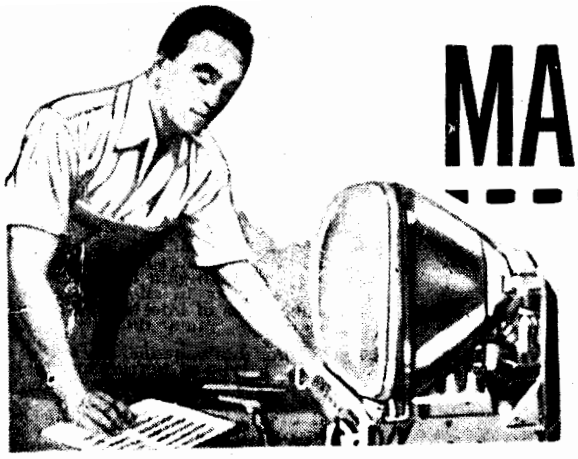
RIBBON TYPE

Two types are normally available. One is the true "velocity" type having the ribbon open to sound on both sides, and the other a modified version, with one side of the ribbon closed off.

The velocity type has a "figure 8" pattern, being equally sensitive back and front, but quite insensitive on each side. This feature is sometimes useful in controlling feedback if the speakers can be located in the "dead" regions.

Due to the "velocity" characteristic, the bass response tends to rise if the source of sound is closer than about two feet. This may be a serious restriction in PA work if the bass boost cannot be tolerated

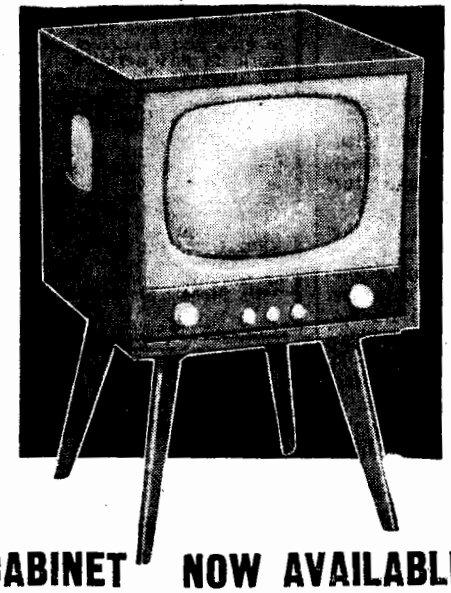
The other type has no appreciable pickup from the rear and, because it is no longer a "velocity" type, has no bass boost problem and can be used for close talking. In fact, the response favours the high note region, making the repoduction rather high pitched and tending to aggravate the feedback problem, in spite of its more restricted pickup pattern



MAKE IT YOURSELF

Your own TV set or HI-FI outfit....

NOW...17in or 21in TV KIT!

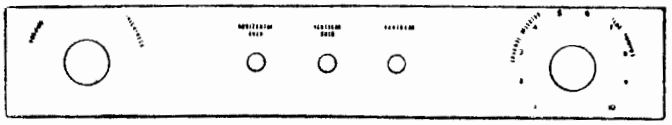


CABINET NOW AVAILABLE

Yes! We can supply a craftsman-built version of the "R. T.V. and H." cabinet (17in and 21in) in walnut or maple.

KNOB ESCUTCHEONS

Made of strong, transparent celluloid, these control knob escutcheons enhance the finished appearance of your T.V. set. The layout is to suit the standard "R.T.V. and H." chassis. Description of each control is clearly lettered and channel positions are to suit the Philips or Mullard tuner Price 11/6 post free.



Both the 17in and 21in R.T.V. and H. Television sets are winners. We have built them and can testify that picture clarity is better than most and equal to the best commercial sets These outstanding designs offer the hobbyist a remarkable opportunity to make a first-class T.V set at extremely low cost. All parts for both 17in and 21in models are available.

IT'S EASY WITH AN E.P. KIT

Kits are complete with all high grade materials, right down to the last nut and bolt Chassis is ready drilled, cadmium plated, and complete with E.H.T box To spread the cost, the kit may be purchased in four separate sections, and the picture tube left until later if required Individual components such as power transformers, chassis, I.F. strips, tuners, etc always available ex stock.

OUR CHECKING & ALIGNMENT SERVICE GUARANTEES FIRST CLASS RESULTS

Clients are guaranteed a first class picture The moment you purchase an E.P. kit, either complete or in sections, we guarantee to see you through with the job to a successful conclusion. Ready wired chassis are on view for clients' reference, and our technical advisory service is available at all times. When you have completed your wiring, we will check and align your set and make certain that you receive first class results for a very small additional charge

If you are interested in saving half the cost of T.V. set for **your** home, send now for the descriptive T.V kit price list.

Send for details NOW
TO ELECTRONIC PARTS PTY. LTD.

Dear Sirs,
Please forward descriptive list of the TV Kit Sets

NAME _____

ADDRESS _____

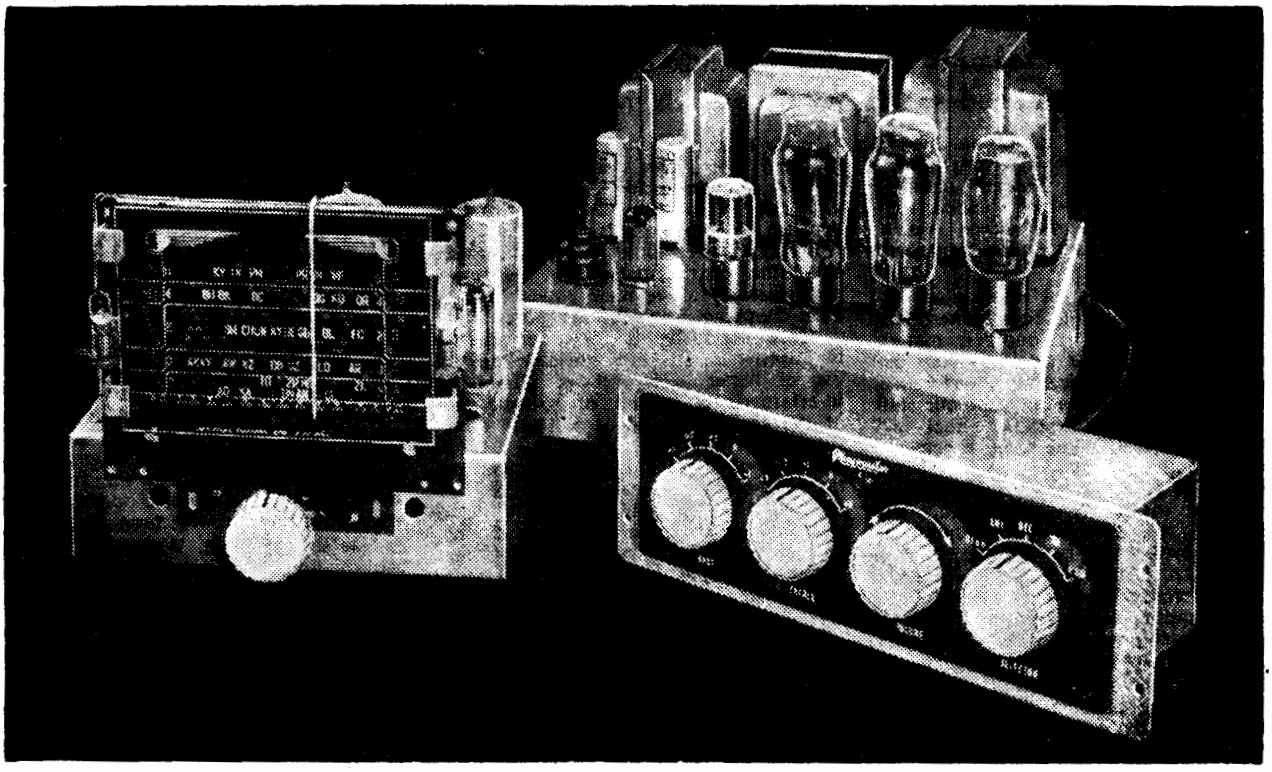
_____

ELECTRONIC

THE T.V. KIT SET SPECIALISTS

E. S. & A. BANK BUILDING
(opp. Grace Bros.)
Corner Broadway & City Rd., Sydney.
Phone: BA4891-2-3

. . . . AND SAVE MONEY



Build your own Hi-Fi outfit!

PLAYMASTER HIGH FIDELITY AMPLIFIERS TUNERS CONTROL UNITS

Designed by 'Radio, Television and Hobbies" this high-grade equipment offers combinations of units to suit every requirement. Quality of reproduction on performance and figures is amazing. Furthermore, the cost is much lower than that of similar powered imported units. If you prefer to build your own hi-fi gear, we can supply the kit of parts containing precisely the same high-grade components as are used in the completely built unit.

The range includes high quality amplifiers from 20 watts to 5 watts, control units, and a complete range of tuners (including the latest F.M. tuner). You are invited to write, phone or call for illustrated descriptive catalogue.

PARTS Pty. Ltd.

THE HI-FI SPECIALISTS

E. S. & A. BANK BUILDING
(opp. Grace Bros.)
Corner of Broadway & City Rd.,
Sydney, N.S.W. PHONE BA4893

SPECIAL! **A COMPLETE HIGH-GRADE PLAYMASTER OUTFIT FOR UNDER £50**

If you are keen to obtain hi-fidelity reproduction, something much better than could be expected from even the more expensive radiograms, this genuine hi-fi outfit will appeal to you. It comprises Playmaster 5/6 watt-amplifier (available as a kit or completely built), the sensational Magnavox 12 WR twin cone speaker and latest Dual record player. Operated from a suitably designed cabinet, it gives truly superior quality reproduction of your recordings. Send now for Playmaster catalogue.

Send for details NOW
TO ELECTRONIC PARTS PTY. LTD.

Dear Sirs.

Please mail me your free catalogue describing Playmaster Hi-Fi equipment.

NAME _____

ADDRESS _____

_____

Here's your answer, Tom!

This month Tom seems to have fired a bundle of television receiver problems at us. Perhaps his amplifier is finished and his new interest is Mum's television receiver. Look out, Mum!

Since the recent heavy rain my TV receiver has been completely free from a "two banded" snow-like interference which tended to roll up or down the screen. Can you offer a possible explanation for this?

We make a point of offering an explanation for anything Tom. Whether it is the right one is another matter. Seriously though, we think we can explain this rather puzzling interference, particularly as two members of our staff have experienced the same effect and have both arrived at the same conclusion independently.

The vital clue was the "cure" brought about by the rain. Anyone who has ever had to suffer radio reception in outlying areas will be familiar with a similar effect. During dry spells electrical interference from H.T. power lines can be quite severe, blotting out all but the most powerful local signals.

The trouble appears to be due to leakage across the insulators, caused in turn by layers of dust which settle on them. When such a leakage path is multiplied by the several hundred insulators in a few miles of power line, it is easy to appreciate how it can create such a racket.

NATURAL CLEANING

Yet, within a couple of minutes of a downpour of rain, the hissing and frying will vanish as though turned off at a master switch. Nature has done what man could not hope to attempt—washed each insulator clean and free from the noise producing dust.

This condition may last from a few hours to several weeks, depending on the weather conditions, but sooner or later there will be heard a few tentative splutters; a crackle or two—and within a few hours the whole broadcast band will be cluttered up again.

I understand a lot of research has been devoted to the problem, mainly in trying to develop an insulator which would minimise the effect of dust deposits, but with little success. Now, it seems, we are to be faced with the same problem in our TV systems.

The two bands per picture, and the slow rolling of the pattern, both tie in with a 50 cps interference. A 50 cps supply will produce 100 voltage peaks per second (one positive, one negative) resulting in two interference bars per field. If the bars are quite narrow, as is usually the case, it suggests that the major leakage occurs only during the peak voltage period.

The rolling is simply due to the difference between the nominal 50 cps of the mains, and which may vary considerably, and the more accurate 50 cps frame frequency transmitted by the station.

Since it was only an explanation you required Tom, this could well be the end of our discussion. It was kind of you not to mention the word "cure" because that's another story.

Off-hand, we could suggests moving to another district, persuading the supply authorities to move their power line, or even chopping down the HT poles.

More seriously, it may be possible to improve results in some cases by the use of better aerial set-up. Where the interference is behind or to one side of the aerial, the use of a highly directive aerial may help.

If the power line is between you and the station, you may be really "up against it." The only chance of relief would seem to be in finding a higher, or in some other way better, position for the aerial, where it would get more TV signal, if not less actual noise pickup.

"Albert! The line hold's gone!"

A friend informed me that when I switch my television receiver off I should wait approximately thirty seconds before switching on again. He said that the fuses would blow if I switched on again immediately. Is this correct?

Generally speaking Tom, it isn't essential to wait 30 seconds before switching your television receiver on again, but it may be desirable. If you do not, it is possible that you may blow the receiver's fuse or fuses as the case may be.

When switching a receiver on from cold the rectifier valve heats up and supplies H.T. to the electrolytic capacitors before the other valves in the receiver are hot enough to draw current. Thus the current rises to its normal operating value without serious surges.

On the other hand if the receiver is switched off, the electrolytics (which are of large capacitance ranging from about 40 mfd. to 200 mfd. giving a total of about 580 mfd.) give up their charge to supply the still hot valves.

When the receiver is quickly switched on again the power supply has to feed the hot valves and supply the charge current for the electrolytics as well. This could overload the fuse or fuses and so cause a breakdown.

The manufacturers try to overcome the possibility of this surge interfering with the fuses, by using anti-surge type fuses. These do not always handle this surge, unfortunately, and so a breakdown may result. At this stage a good point to mention is that the fuses are rated fairly close to their operating current in most manufactured receivers.

Not so fast Tom. We can guess you are thinking— "Why do the manufacturers rate their fuses so close to the operating current?"

The manufacturers wish to protect the rectifier valves and the power transformer. If a stage is drawing more current than it should, the fuse will melt rather than damage the rectifiers which are probably passing close to their maximum rated current anyway.

This fuse protection was incorporated in early broadcast receivers but caused more trouble than it was worth so it was not carried on. It will be very interesting to see if in another five years television receivers follow the same pattern.

★ ★ ★

Why is the volume level affected by the contrast control in my TV receiver?

Unfortunately, Tom, we do not know what type of set you are using, so we cannot give an exact answer. However, two possibilities occur to us, and one of them may apply to your set.

The first, and most likely, is that the contrast control is in the form of gain control in the IF and RF sections. We know of at least one commercial receiver that employs such an arrangement, the control simply varying the bias applied to these stages, much as was done in early broadcast receivers.

Since these stages handle the sound and vision signals in composite form, it is obvious that any adjustment of the contrast can also affect the sound level, particularly if the limiter stages in the sound channel are not doing their job effectively. Fortunately, the conventional volume control is always available for the final adjustment of sound level.

The other possibility is that the circuit uses a trick which we mentioned in conjunction with our own 17 and 21in TV receivers. This was to pick up the 5.5 Mc sound IF from the 5.5 Mc trap circuit in the cathode of the video amplifier.

Adherents of the scheme claim that this provides a worthwhile gain in the sound system, while it certainly makes adjustment of the 5.5 Mc trap easy and positive. However, since the contrast control varies the gain of the video amplifier, it may also affect the sound level, again depending on the limiters. Fortunately, the degree of change is not great, and a touch of the volume control is all that is needed to correct it.

★ ★ ★

In a TV set, what causes the picture to appear minutes after the sound?

That's easy, Tom. The set is obviously an English model, steeped in the traditions of "Much Binding in the Marsh," where the radio sets invariably took ". . . . a very long time to warm up."

No?

Oh well, let's try another approach.

First of all, might not that word "minutes" be just a slight exaggeration? Admittedly, when one can hear the dialogue and not see the action it may easily seem like minutes, but it is probably only about an extra half minute one has to wait. It must also be pointed out that not all sets take this long, some producing a picture within a few seconds of the sound.

The major factor controlling this time is the type of EHT rectifier valve used. Because the cathode of this valve will be at the EHT potential above chassis, it is difficult to operate it from the normal filament line. Instead, it is operated from a winding of one or two turns on the EHT transformer, the energy being supplied by the line output stage at 15,625 cps.

TWO STAGES

This means that a TV set comes into operation in two stages. First we switch it on and apply heater voltage to all the valves, except the EHT rectifier. These warm up in the normal way, taking about 30 seconds, and the line output stage comes into operation.

It is only now that we commence to supply energy to the EHT rectifier. If this is a directly heated type it will take only a few more seconds to reach operating temperature and deliver EHT voltage to the final anode.

However, if it is an indirectly heated type, it will take at least another 30 seconds to warm up, or even a little more if the filament supply regulation is poor. We imagine the set you describe is of this type.

Meanwhile, you sit biting your nails wondering whether the "goodies" are beating the "baddies" or vice-versa. No wonder it seems a long time.

★ ★ ★

Is a TV set dear to run?

Depends whether you've paid your licence Tom. If you haven't you will probably find yourself involved with the law, be hauled up before the beak, and have to part over many pounds before you regain your liberty. In this case, a TV set would be very dear to run, probably dearer than going to the pictures.

However, if you are a law abiding citizen, you are more likely referring to the amount of power a TV set consumes. If so, we can be rather more specific.

Whereas a radio set consumes something between 40 and 60 watts for average models, the TV set is rather greedy by comparison. It will take between 200 and 250 watts, meaning that it will operate between four and five hours for one kilowatt (unit) of power.

A kilowatt may cost you anything from 1½d to 6d, depending on your supply authority and customer rating. Taking 2d as an average figure, we can operate our TV set for about one halfpenny per hour—which is still pretty cheap pictures.

★ ★ ★

I am quite puzzled by differing opinions on Bradley oscillators for FM demodulation. Some claim that this circuit is not capable of demodulating AM signals such as noise and static, while others claim that this is impossible. If the first opinion is correct, then why is this circuit not used more in FM receivers, as it would be ideal in reducing ignition interference, which is very bad at the higher frequencies.

We must admit that you've got us with this query, Tom, because we are not familiar with the name "Bradley Oscillators." We rather gather from your letter, however, that the circuit may be similar to the Foster Seeley discriminator.

Perhaps one of our readers may be able to offer some comment regarding the application and features of this circuit.

★ ★ ★

In your articles you sometimes refer to gain controls. Are these the same as volume controls?

In either case, Tom, the control mentioned varies the amplification or gain of the equipment in question but, in the case of a receiver, a variation in gain results in a variation in volume so that either description may be applied with equal justification.

Communications receivers often have several controls which directly affect the volume and, as it would be confusing to label them all volume controls, we usually distinguish them by, RF gain, IF gain, audio gain, etc.

There are also cases where it would be incorrect to talk about volume controls. As an example, a cathode ray oscilloscope does not make audio sounds so that it is only correct to talk about its vertical gain control or its horizontal gain control as the case may be.

★ ★ ★

How dangerous is the EHT voltage in a TV set? I have been told that this may be as high as 20,000 volts.

The final anode circuit of the picture tube, which requires this voltage, would pass a current in the region of 100 uA, or about .1 mA. Mainly in the interest of safety, but also for economic reasons, the EHT power supply is designed to deliver just this small amount of current and no more.

If we attempt to draw appreciably more current than this we find that the voltage available immediately drops to a much lower value. Since it requires much more than this — several mA at least — before a shock becomes even mildly dangerous, such a power supply will do no more than deliver a nasty "bite."

NO WRIST FATIGUE WITH

SCOPE

SOLDERING IRON

WEIGHS 3½ OZS. ONLY

. . . yet will perform the function of irons rating to 150 watts.

NO HEAVY CABLE

The Scope Iron is fed from a low voltage transformer or 4-6V. accumulator via a special multi-strand 2-wire cable that gives maximum flexibility.

NO DANGEROUS VOLTAGE

The Scope Iron gives maximum safety in that it operates from extremely low voltage. The National Scope Transformer available with the iron has an output voltage of 3.3V. and is especially designed for maximum protection on the mains input side The National Scope Transformer is fully approved under Prescribed Articles of the Electricity Authority. Approval No. N/156.

NO WASTED TIME IN HEATING

The Scope Iron heats instantly, attaining full operating temperature in 6 seconds.

NO EXPENSIVE REPLACEMENTS

The only "consumable" parts in the Scope Iron are the copper tip and small element, both of which can be replaced easily by the owner at a cost of a few pence.

SEE . . . TRY . . . COMPARE

the Scope Soldering Iron at all leading electrical and hardware stores.

Prices { Scope Soldering Iron 50/-
National Scope Transformer .. 49/7

Australian and Overseas Agents:

Wm. J. McLELLAN & CO. PTY. LTD.

126 SUSSEX ST. (near King St.), SYDNEY. BX1131.

N.Z. Distributors: H. W. Clarke, Auckland and Wellington.

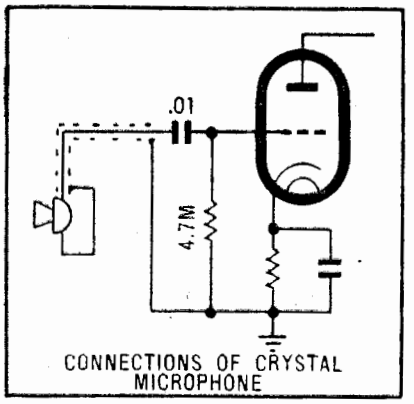
HOW TO GET YOUR AMATEUR LICENCE

(Continued from Page 57)

quency filtering system is often required in addition to the low frequency filter in order to prevent spurious signals being injected into the equipment.

QUESTION 9.

(1) The Critical Frequency is the highest frequency which, when transmitted vertically upwards, will just fail to be reflected from the ionised layers above the earth.



Typical connection for a crystal microphone.

(2) The Maximum Useable Frequency for a specific distance is the maximum frequency which can be used to transmit over that distance.

(3) The Optimum Working Frequency is that frequency which gives the greatest field strength consistent with reliability over a specific distance. It is usually calculated as 15 per cent lower than the MUF.

(4) At times, generally during the summer period, clouds of intense ionization appear in the E-layer, and these can cause extended reception paths at frequencies approximately between 25 and 100 Mc. On nature they are highly variable and are known as sporadic E-layer ionisation.

Microwave Link

(Continued from Page 13)

between repeat points, using standard FM equipment on a frequency of 165 megacycles. This enables technicians to communicate without interference to the TV picture.

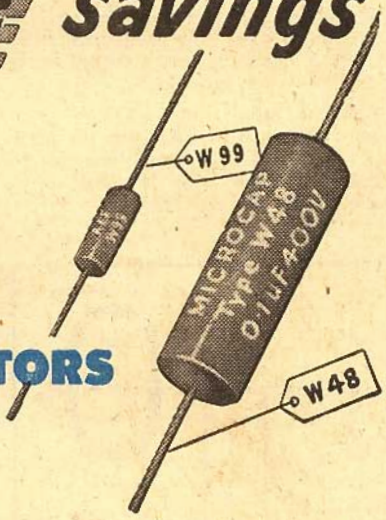
Because of the narrow beam radiated by the dishes, careful lining up with successive repeat points was needed. This was carried out initially using compass bearings, and once communication had been established, final adjustments were made by normal methods.

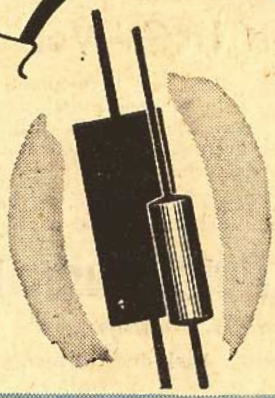
The importance of this telecast does not stop at the success achieved. It demonstrates the practicability of such links to extend the range of TV networks throughout the country, something of vital importance in the development of the art.

It demonstrates, too, that Australian engineers are not lagging behind the rest of the world in their ability or initiative.

You'll make DOUBLE savings

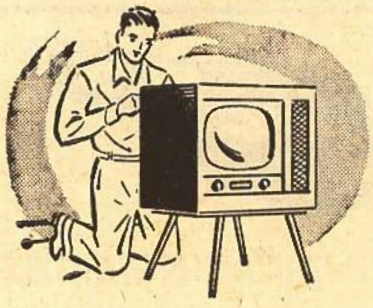
WITH **Microcap** CAPACITORS





SAVE ON SPACE

MICROCAP'S exclusive metallised paper construction results in a lightweight ultra-miniature space-saving capacitor, which can be fitted in a fraction of the space required for ordinary units of the same rating. Resultant overall savings in space mean worthwhile savings on cost.



SAVE ON SERVICING

Outstanding "self-healing" feature enables MICROCAP to sustain accidental over-voltage. This results in long, stable life in miniature form, reducing servicing problems, greatly overcoming the bug-bears of "intermittent" and open or short circuits.

Wide range covers requirements of modern design

A.E.E. TYPE W99

Available in working voltages of 200, 400, 600 V. D.C. and 300 V. A.C. In values up to .04 uF.

A.E.E. TYPE W48

Covers range .05 uF to 2.0 uF in working voltages of 200, 300 and 400 V. D.C.

*Registered Trade Mark

Microcap CAPACITORS

M12.

Manufactured under licence from A. H. Hunt Capacitors Ltd., London, by

Australasian Engineering Equipment CO. PTY. LTD.

476 LATROBE ST., MELBOURNE. FY 2638

N.S.W. Agents:—Wm. J. McLELLAN & Co. Pty. Ltd., 126 Sussex St., Sydney. BX 1131

NEW LIGHT ON THE VCR97 CR TUBE

Recent experiments in our laboratory indicate that many VCR97 cathode-ray tubes, hitherto written off as "duds" may, in fact, be just the reverse, and capable of giving very bright six-inch television pictures. This should be good news for many TV set builders.

THE facts of the case were unearthed recently, more or less by accident, when a tube which we had every reason to think was good, failed to operate satisfactorily in our prototype 6-inch receiver. By the time we were finished with it, however, it was producing sharply focused pictures, bright enough to watch in a well lighted room.

All published data we had been able to find on the VCR97 showed it as a conventional 6in electrostatic tube, identical or very similar to the Mullard ECR60. Typical tubes from disposals sources seemed to confirm this information, since they operated with the same base connections and the same applied potentials as the above mentioned commercial type.

The only complication was a vague reference in an English magazine to a connection for "Internal Coating" alongside the Y2 deflector plate. This was inconsistent with the ECR60 and sample tubes on hand, where the internal coating was tied apparently to anodes 1 and 3. Connecting a potential to the supposed "Internal Coating" certainly made no visible difference to the trace.

Accordingly, in the data published in our November, 1957 issue, we made no special provision for the internal coating, although it was shown as a possible connection to the socket.

"POOR" TUBES

Another pin, alongside the heater lug, was shown as vacant and we suggested that it could conveniently be used as an anchor point for the heater dropping resistor. The prototype receiver was wired this way, the sample tubes worked and all seemed well until this supposedly good VCR97 failed to focus.

It recalled immediately other VCR97's we had heard about which likewise failed to focus, or were variously written off as "low emission" or "out of line."

As a purely exploratory measure, we lifted the heater junction off the anchoring pin and were immediately rewarded by seeing the beam brighten and jump almost into focus. Very obviously, the supposedly vacant pin was occupied. Nor was it merely an internal tie-point, because there was no sign of any initial potential on it.

Applying a proportion of the EHT voltage brought a further improvement in the trace, showing that an active electrode of some description was involved.

Precisely the same thing happened for the other supposedly vacant pin, but which had been hinted as a connection for the internal coating.

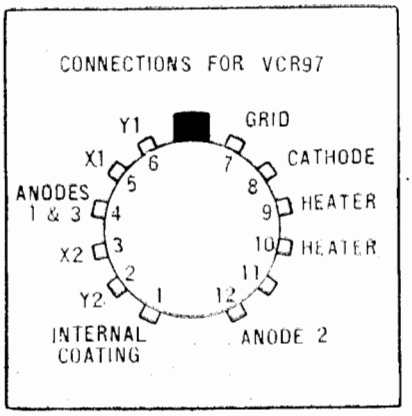
By the time the full EHT was applied to both pins, the focus was good and the beam brighter than any VCR97 or 5BP1 that we had previously seen.

Faced with this rather surprising result, we proceeded to collect a number of VCR97's for closer examination. By undoing the two screws holding the base cover plate, it became quite evident that there were two distinct versions of the tube, one with two completely blank pins as per the ECR60 and the other with internal connections to all pins.

Further investigation brought to light someone who had worked in a local laboratory on radar equipment. He recalled that later versions of the VCR97 did have amended base connections but no data for them had ever arrived. The standard amendment was to tie both hitherto vacant pins to the EHT point, along with anodes 1 and 3, just as we had done.

The rest of the story was revealed when we came across a tube in which the internal coating covered little more than the glass flare, leaving most of the gun and deflection structure visible.

The newer tubes have a completely different and well-finished electrode



structure. The vacant pin alongside the heater is a separate connection for A1, while the pin alongside Y2 goes to internal coating and a post deflection anode.

All samples of the newer tube in our possession are distinguished by the fact that the neck is 2-13/16in wide against 2¼in for the earlier type. Also the additional leads to the hitherto vacant pins can be seen by removing the base cover plate at the end of the tube.

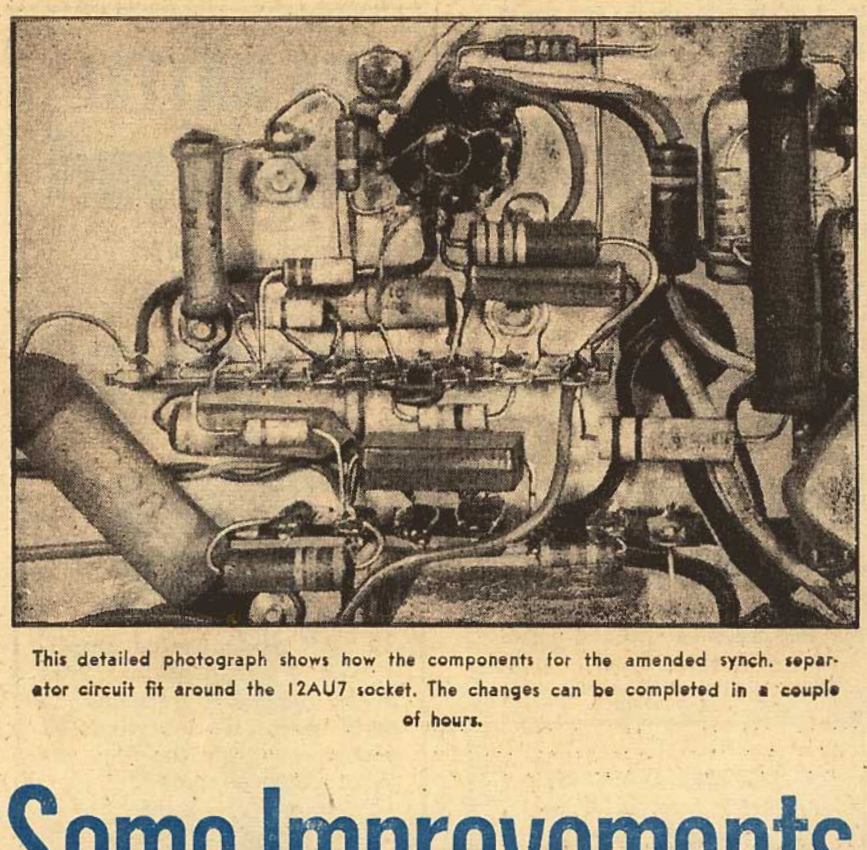
Whereas the older tube has simple flat deflector plates, the newer version has formed plates shaped rather like shallow dishes.

The accompanying diagram shows the base connections for the earlier VCR97, as given in our November issue.

For the newer tube, the internal coating should be tied to anode 3, shown in our diagram as pin 4. We have reservations about connecting A1 to this same point because, even though it gives a very bright picture, it may prejudice tube life.

Lacking definite information, it may be safer to apply not more than 1,000 volts to it, picked off about halfway along the divider system.

By wiring the socket as indicated, either version of the tube can be plugged in, the additional leads being simply redundant for the earlier type.



This detailed photograph shows how the components for the amended synch. separator circuit fit around the 12AU7 socket. The changes can be completed in a couple of hours.

Some Improvements to Synch. Separators

Recent work by the Applications Laboratory of the Amalgamated Wireless Valve Company has shed some interesting light on the operation of synch. separation stages. An amended circuit resulting from this work shows advantages over the previous arrangement and details are given for those who may care to try it in the R. TV. & H. 17-inch and 21-inch TV receivers.

IMMEDIATE object of the research was to investigate reasons why some television receivers tend to show a slight bend in vertical lines near the top of the picture.

The possibility also existed that generally better synchronising characteristics could be obtained for both frame and line oscillators, without sacrificing the essential simplicity of the earlier arrangement, suggested by the laboratory and adapted for use in the R. TV and H. receivers.

OPERATES AS CLAIMED

The new circuit has been checked in the original 21-inch receiver and operates almost exactly as claimed. It can be substituted quite simply for the original wiring and is well worth a trial in special cases where picture bending is evident or where some improvement may be sought in picture interlace.

We shall have more to say later about the necessary wiring changes, but some preliminary discussion of the problem as a whole may be helpful.

To understand the significance of synch. separation to vertical edges, interlace and other picture details, it is necessary to recall the relationship of the synch. pulses to the operation of the scanning oscillators in a TV receiver.

At normal settings of the "Vertical Hold" and "Horizontal Hold" controls, the vertical and horizontal oscillators have a natural period of oscillation which is slightly longer than the standardised frame and line intervals. Thus, when the receiver is tuned to a blank channel, the raster contains less than the normal 50 fields and the total number of lines per second of display is somewhat less than 15,625.

When a station is tuned in, the synch. pulses trigger each oscillator slightly before the end of its natural forward stroke, thereby reducing the period of each cycle and increasing the numbe of cycles per second to 50 and 15,62 respectively. Synchronism is thus estab lished between transmitter and receive

Two situations can arise to upset thi proper state of affairs:

(1) Any spurious signal reaching a oscillator before the regula synch pulse, can trigger the oscillator early so that it commences its retrace and the following forward trace too soon. The picture information which belong to the forward trace is therefore dis placed in relation to the picture as whole.

(2) If a synch. pulse is lost for an reason, the oscillator does not trigge till the end of its natural period. Th retrace and the following forward trac therefore occur too late and the relevan picture information is once again dis placed.

Very slight irregularity of the fram oscillator and consequent displacement of information is evident as a lack of or variation in interlace. More seriou irregularity can cause frame jitter where by, even though the picture is locked as a whole, it appears to jitter up and down by a distance equal to several lines.

NO GREAT HAZARD

By and large, external interference signals do not present any great hazard to the frame oscillator, because the circuits which separate and amplify the frame pulse tend automatically to discriminate against transient interference pulses arriving via the regular signal circuits.

However, as we have pointed out in other articles, the chief hazard to the frame oscillator arises within the receiver itself, when high amplitude pulses from the line deflection circuits penetrate the frame oscillator and cause it to trigger at irregular points along the slope of the frame pulse integration curve.

A small amount of line frequency penetration will prejudice the interlace so that it can only be maintained by careful adjustment of the Frame Hold control. More penetration than this may make it impossible to observe any interlace effect, no matter how critically the Frame Hold is adjusted

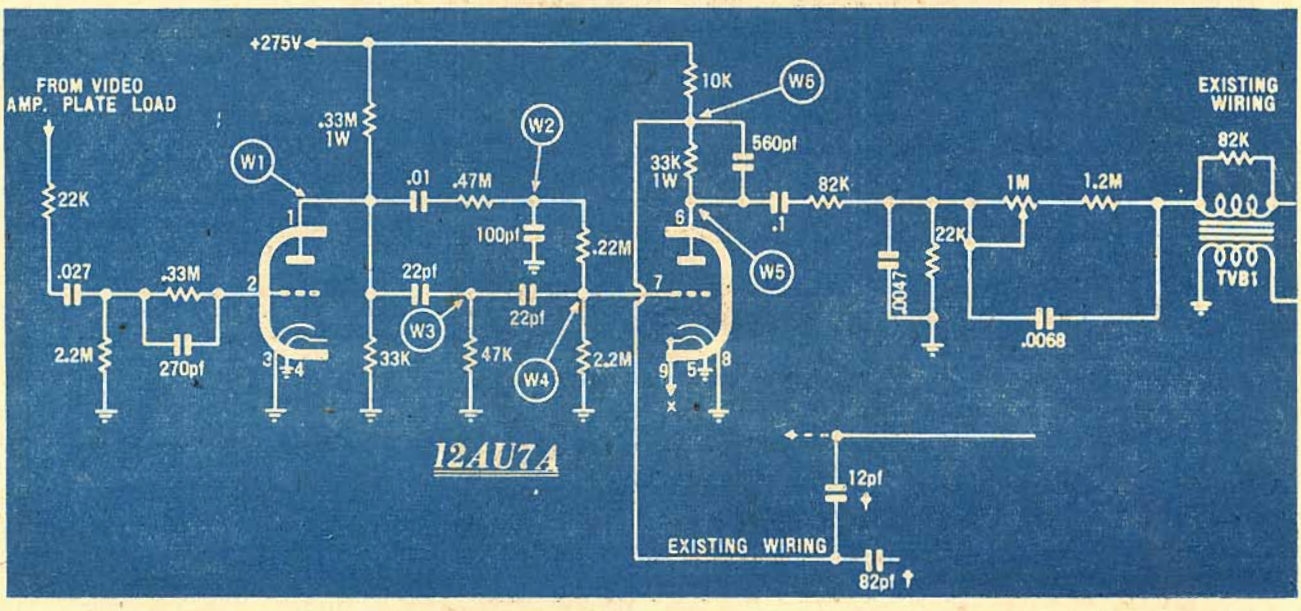
Gross leakage of line energy into the Frame Oscillator can cause the frame jitter referred to earlier, because the frame oscillator tends to trigger on any one of the line flyback pulses occurring adjacent to the frame synch. block. Such jitter is affected but not prevented by critical setting of the Frame Hold control.

The obvious step, in either case, whether jitter or merely poor interlace, is to examine and rearrange the wiring and components to minimise the leakage of line deflection energy into the Frame Oscillator. This is a first and essential requirement.

BETTER FRAME PULSE?

If, as a second step, the nature of

AMENDED SEPARATOR CIRCUIT FOR 17, 21in RECEIVERS



Here is the amended circuit diagram. The second triode section needs to be completely rewired, also the input circuit to the frame oscillator. The input circuit to the first 12AU7 grid need not be altered, apart from the substitution of a larger coupling capacitor (.01 to .03 mfd) from the .0022 used in the original 17-inch receiver.

the Frame Synch. pulse can be improved, so much the better.

From a simple integrator, the pulse has a relatively slow build-up time extending over possibly 2½ lines and there may be some doubt as to the exact point on the slope on which the frame oscillator will trigger. Under these conditions, slight additional voltage due to line synch. or line deflection may influence the exact triggering point.

Any provision which will steepen the slope of the integration curve must render these spurious voltages of lesser consequence and therefore contribute to good interlace.

So much for the frame circuit. Because the line oscillator must respond to the very brief line synch. pulse, it is equally likely to respond to transient noise pulses or even to be affected by the background noise behind weak signals.

Any noise which thus affects the line oscillator may cause it to trigger before the synch. pulse proper, displacing the subsequent forward trace and/or the picture information distributed along it. The effect on the picture is something like the familiar noise "snow" but more serious in that, along with any noise content which the picture may contain, there is a random sideways jitter of some or all lines.

Whereas noise can cause premature triggering of the line oscillator, the accidental loss of one or more synch. pulses can delay triggering and again produce displacement of lines and/or picture information.

The problem is so serious in relation to the line circuits that all but the most elementary receivers, these days, use some form of automatic frequency control for the line oscillator.

DC CONTROL VOLTAGE

Systems vary but the general idea is to compare the repetition frequency of the incoming line synch. pulses with the line scan circuits in the receiver and produce a dependant DC voltage. This involves a gating or discriminator system.

The DC voltage serves to vary the frequency of the receiver's own oscillator, so that it automatically remains in step with the incoming synch. pulses.

The control circuit is deliberately given a fairly long time constant so that the oscillator cannot change frequency in response to a single spurious impulse. Random noise voltages are largely ignored or averaged out, the control circuit deriving its voltage almost exclusively from the regular train of line synch. pulses.

Even the loss of a line pulse makes little difference, because the influence of a single pulse on the control voltage is slight and the oscillator maintains almost exact synchronous frequency, ignoring the lost pulse just as readily as a spurious one.

But—and here is the vital point—if a succession of line pulses should be lost, the control voltage will inevitably change and the oscillator begin to drift to its free-running and normally slower frequency. Picture information will be progressively displaced as the line frequency drifts from synchronism, causing vertical lines in the picture to bend.

Conversely, when the line pulses reappear after such lapse, the control voltage gradually changes to restore the line oscillator to correct frequency, again producing picture bend.

LINE HOLD CONTROL

The amount of picture bend which becomes evident in these circumstances is dependent to a degree on the Line Hold control setting, which influences the frequency to which the oscillator drifts, when the synch. pulses disappear and the control voltage alters.

Thus, in many cases, the Line Hold control can be manipulated to reduce picture bending by the simple device of bringing the oscillators' natural period very close to the synchronous frequency. However, in this condition, the oscillator's natural flyback may easily anticipate the line sych. pulse, making sychronism uncertain as the bend disappears.

Again, even though the oscillator may remain locked on a given Channel, it may not readily lock when switched from Channel to Channel, if the Line Hold control is set too critically, to maintain vertical lines.

With a system employing negative modulation, line pulses can be lost or drastically reduced in amplitude by an overload condition in the receiver and a good many picture bending and tearing troubles are traceable to this cause.

Because it involves a sustained period of high signal amplitude, the frame synch. and retrace portion of a television signal is particularly critical and may emphasise any marginal condition likely to affect synchronisation.

Work by the A. W. Valve Applications Laboratory has shown that, over and above effects elsewhere in the receiver, line synch. information can be lost or diminished in the synch. separator itself during the frame pulse block.

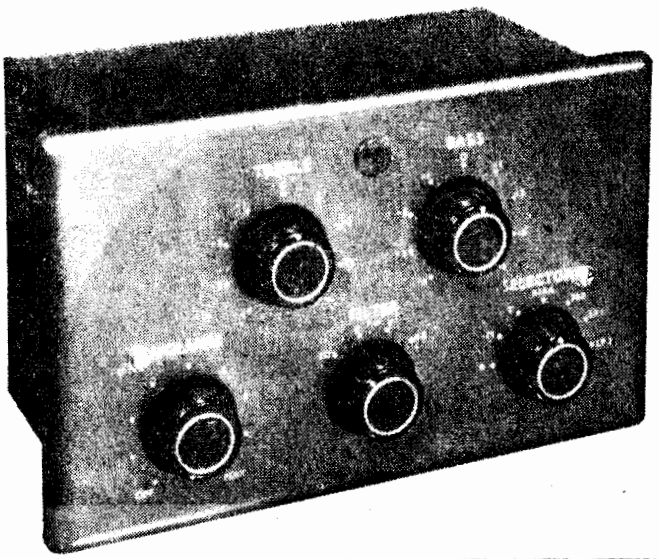
The loss is particularly likely to occur where extreme clipping action has been sought and is further affected by the time constants around the circuit and the pulse separation networks.

It may not be readily visible—if at all—on ordinary TV oscilloscopes but can readily be seen on elaborate types where segments of line information can be selected from a total field and viewed in detail.

Under such scrutiny, as the frame integration curve builds and collapses, the line pulses may be seen, in some cases, to reduce in height or even disappear temporarily.

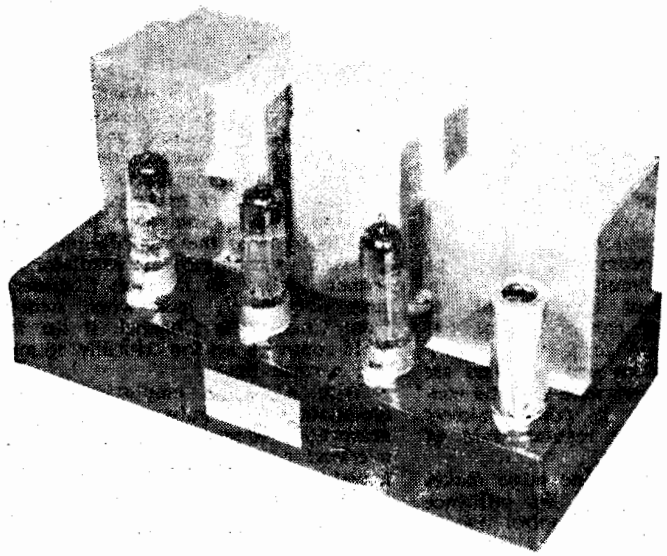
NEW RD JUNIOR

High Fidelity System



AMPLIFIER

- "Ultra Linear" output stage (Mullard EL84.s in push-pull).
- Output Transformer with grain orientated laminations.
- Exceptional power/frequency response curve.
- High margin stability.
- Unique "Impedance Plug" speaker matching.
- Ample Spare Power.



CONTROL UNIT

- Four Record Characteristics.
- Two Radio Inputs.
- Provision for microphone.
- Simplified pick-up matching.
- Tape Record and Replay sockets.
- Switched Bass and variable Treble controls.
- Ultra Compact.
- Independent continuously variable low pass filter.

TECHNICAL SPECIFICATIONS

Frequency Response:	+ or − 1 db 30-20,000 cps. 10 watts 12% at 1 kcs 12 watts .2% at 1 kcs
Hum and Noise:	−85 db below 8 watts
Output Impedance:	12-16 ohms 6-8 ohms 2-3 ohms
Spare Power:	285V. at 40 m/A. 6.3V. 2.5A.
Overall Dimensions:	11" long, 6" deep, 5¼" high.
Weight:	15 lbs.
Operating Voltage:	200-230-250V. 50 cps.

Demonstrations and Supplies Available from

- NEW SOUTH WALES: United Radio Distributors Pty. Ltd. Audio Engineers Pty. Ltd.
- VICTORIA: Homecrafts Pty. Ltd., J. H. Magrath & Co. Pty. Ltd., Radio Parts Pty. Ltd. Warburton, Franki (Melbourne) Ltd.
- SOUTH AUSTRALIA: Gerard & Goodman Ltd. Newton McLaren Ltd. Radio Electric Wholesalers Ltd.
- QUEENSLAND: Chandlers Pty. Ltd.
- WESTERN AUSTRALIA: Atkins (W.A.) Ltd. Carlyle & Co. Ltd. Leroya Industries Pty. Ltd.

Sole Australian Agent:

BRITISH MERCHANDISING PTY. LTD.

BOX 3456 G.P.O. SYDNEY

Robbed of synch. pulses in such a case, the line frequency control circuit allows the oscillator to drift, then restores it to synchronism when the pulses reappear. The initial drift is not visible on the screen because the spot is blacked out, but the recovery may not be complete before the next picture begins—hence the bending at the top of the picture.

It would appear that the effect in the original 12AU7 synch. separation circuit is quite marginal, because picture bend has only been evident in a minority of cases. Presumably the circuit tolerances in such cases have conspired to render it so.

THE MODIFIED CIRCUIT

The modified circuit suggested by the Applications Laboratory is aimed at removing this hazard and ensuring that line synch. pulses will always be present. Additionally, the frame pulses have been improved, so that some benefit can also be expected in relation to interlace.

In the modified circuit, the first triode section of the 12AU7 operates as a clipper/amplifier, being almost identical to the original circuit.

From the plate circuit, the synch. information is passed without further clipping into separate integrating and differentiating networks. The time constant, in each case, has been chosen carefully to give the best possible separation and pulse shape.

In a more complex system, the pulses might thereafter be fed into quite separate valves for further amplification and/or clipping. However, it has been found possible to arrange the operating conditions of the second 12AU7 triode such that the two sets of pulses can be applied to its grid and amplified without serious overload, so that both appear in the plate circuit.

TWO LOAD RESISTORS

The plate load involves two resistors in series, one of them bypassed by a 560 pF. capacitor.

At the line frequency the resistor/capacitor combination has very low empedance, so that line frequency energy is developed only across the remaining 10,000 ohm resistor.

Both resistors are effective for the frame pulse, however, allowing a much higher pulse voltage to be developed, with a sharply rising front. The value of this was explained earlier in the article.

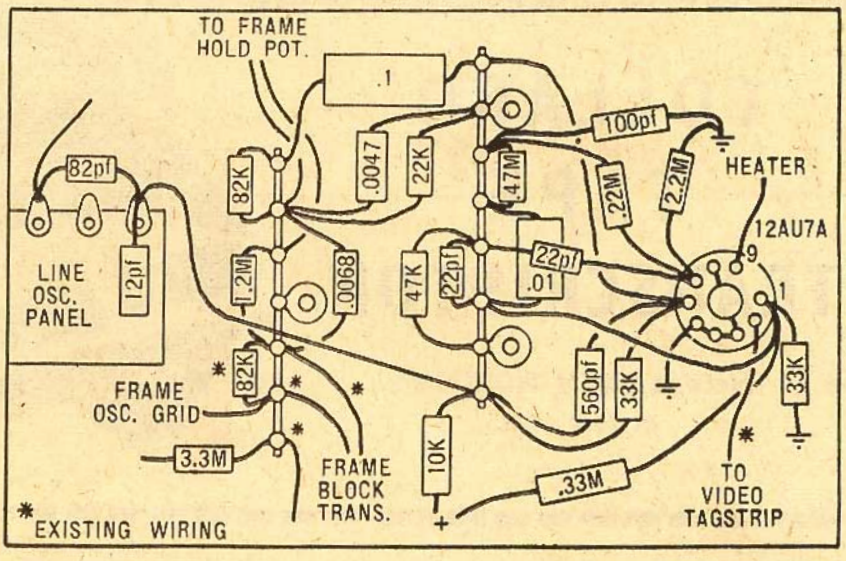
Oscillograms copied from the original Valve Co. data show that, under typical conditions, the frame synch. pulse has a peak value of 95 volts and the line pulse 36 volts.

From the take-off points in the output plate circuits, the signals are diverted through simple coupling networks to the frame and line oscillators, as shown.

To substitute the amended circuit for the original in the R. T. and H. receivers is a relatively simple matter and a suggested component layout is shown in the accompanying diagram.

The integrating components can be removed from the first three lugs on the relevant 7-tag strip, together with the leads to the Frame Hold potentiometer. Remove the 3-tag strip supporting the 0.47meg resistor in series with the pot. and all the components attaching to the second triode of the 12AU7 synch. separator. Some of these can be used again.

WIRING OF THE NEW SEPARATOR



The components can be arranged neatly and systematically if wired as shown above. The 7-tag strip to the left should already be in the chassis. The 8-tag strip needs to be added in the approximate position shown.

NEW TAGSTRIP

A new 8-tag strip should now be mounted in the vacant space alongside the 12AU7 socket and the wiring and parts put in as shown.

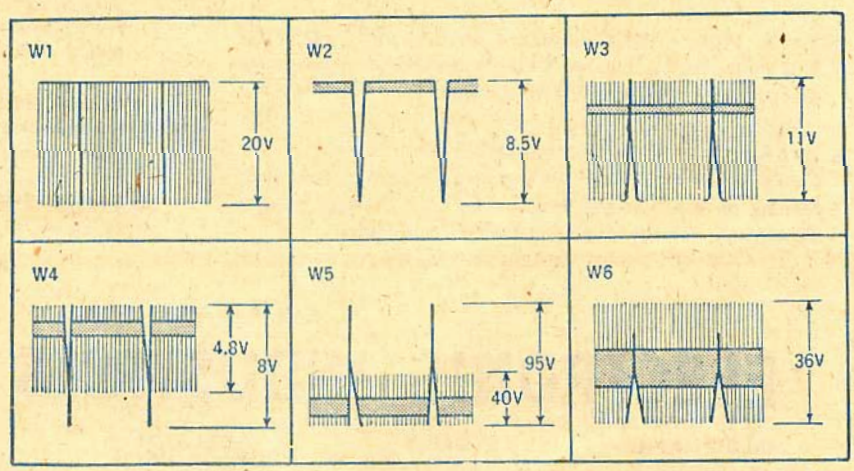
There is no need to disturb the video input wiring to the first 12AU7 grid. The sequence of components feeding the grid is different but this will not affect the end result and there seems to be no point in disturbing the present wiring.

Note that the main blocking capacitor is now shown as .027, as compared with .0022 in the 17-inch receiver and .01 in the later 21-inch version. It was suggested at the time that this latter value be used in all receivers and it would still appear to be adequate. However, the larger value could be substituted for another .01mfd wired in parallel, if readers so desire.

As we said earlier in the article, the circuit appears to work well and deliver the kind of pulses claimed for it. As it happened, neither of the receivers available for immediate test has suffered to any degree from picture bending or lack of interlace and therefore offered little indication as to the potential value of the circuit in a receiver where these things are a problem.

Individual readers may, however, welcome the opportunity to try the circuit and it is offered for this reason. We would likewise welcome any reports regarding the result of such trial.

(Continued on Page 121)

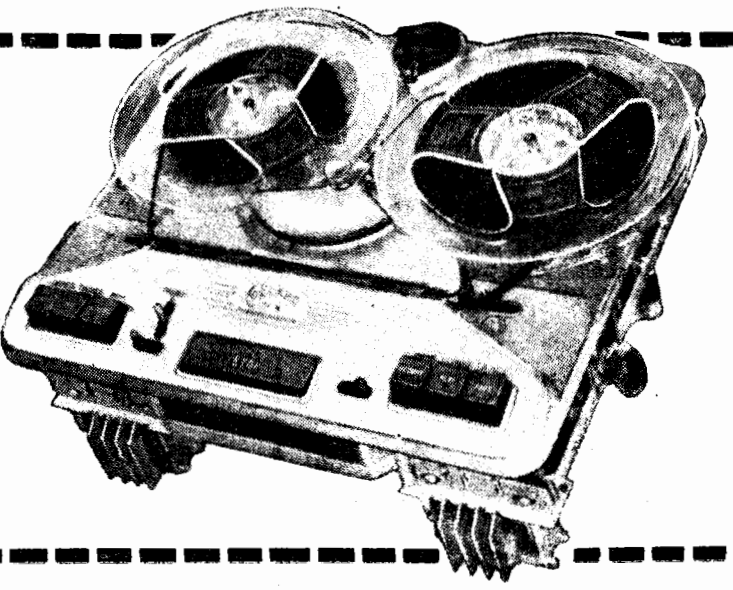


Typical waveforms at various points as marked throughout the circuit, taken with the receiver in normal operation and with a picture on the screen. The waveforms were copied from original Valve Company data but were duplicated fairly closely in our own receiver.

NOW AVAILABLE

COLLARO TAPE TRANSCRIPTOR

Here is HIGH FIDELITY at low cost



- **FOUR HEADS**
  Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halved for any given length of track.

- **TWIN TRACK OPERATION**
  One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.

- **SWITCH MECHANISM**
  Separate banks of switches are used for each track and are ready for wiring to pre-amplifier and recording heads.

- **PAUSE CONTROL**
  This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools whilst leaving all switches and mechanical functions in their selected position. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.

- **TAPE MEASURING AND CALIBRATING DEVICE**
  This simple **but exclusive Collaro feature** determines the exact position of a recording on the tape.

- **TRANSCRIPTION TECHNIQUE**
  A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of a long bearing, reduces friction and virtually eliminates "wow" and flutter.

- **TWO MOTORS**
  Each dynamically balanced motor does only one job at a time. Motors never act against each other and are of low wattage input with consequent reduction in heat and wear

- **HIGH FIDELITY**
  Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both high impedance "record" and "play-back" heads. Output of heads is approximately **5 milli-volts at 1 Kc at 7½ inches** per second.

- **INSTANTLY REVERSIBLE**
  Instantaneous changes can be made from one track to the other. Fast re-wind in either direction.

- **CONSTANT TAPE TENSION**
  A special **Collaro** device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.

- **RETRACTABLE DRIVE**
  The drive on both capstan and spool is disengaged when the machine is switched off — thus eliminating flats on the drive pulleys and contributing towards elimination of "wow", flutter and rumble. **The "wow" and flutter content is less than 0.1 of 1.0 per cent.**

- **FULLY MECHANICAL**
  No solenoids or rubber belts are used in the construction of this Transcriptor. The braking is entirely mechanical.

- **THREE SPEEDS**
  3¾, 7½ and 15 inches per second.

Sole Australian Agents

ELECTRONIC INDUSTRIES IMPORTS PTY. LTD.

MELBOURNE	SYDNEY	ADELAIDE	BRISBANE	PERTH
139-143 Bouverie St., CARLTON	713 Parramatta Rd., Leichhardt, N.S.W.	90 Grote St., Adelaide, S.A.	52 Bowen St., Brisbane, Qld.	68 Railway Pde., West Perth, W.A.
Phone: FJ 4161	Phone: LM 6327	Phone: LA 5295-6-7-8	Phone: B 7161	Phone: BA 9686; BA 8587

4359

A COURSE IN TELEVISION

PART 29 — SAWTOOTH OSCILLATORS (Cont.)

This is a continuation of the article in last month's issue on sawtooth deflection oscillators. Having discussed basic principles and the operation of gaseous discharge valves, we pass to a discussion of the various "hard valve" oscillator circuits, with particular reference to the Miller-transitron oscillator.

MENTION was made in the last article of the linearising pentode, commonly used in association with gas discharge oscillators, and a brief explanation of the idea may be appropriate at this point.

Actually neither the gas discharge valve nor linearising pentodes find much application—if any—in modern television receivers. However, they appear frequently in test oscilloscopes and could conceivably be used in elementary receivers using oddment valves and electrostatically deflected cathode-ray tubes. Some mention is therefore warranted, for the sake of completeness.

NON-LINEARITY

The gas triode oscillator circuit shown last month as figure 159 is subject to the same basic non-linearity as any simple charge-discharge circuit. The reason for this, as explained by figure 158, lies in the fact that the charging current into the storage capacitor tends to decrease as the stored potential rises towards the supply potential.

Linearity can be improved by restricting the voltage excursion across the storage capacitor, or by using a very high supply potential or by connecting some device into the charging circuit which will maintain the charging current substantially constant.

This statement is quite fundamental and, although associated here particularly with gaseous circuits, applies with equal force to other charge-discharge circuits producing sawtooth waveforms.

Figure 161 shows a typical combination of gas triode oscillator and linearising pentode.

Here the pentode, which can be an ordinary RF amplifier type, is connected in series with the cathode return of the gas triode. Either the negative or the positive side of the supply can be earthed, as required, but due care is necessary in either case to avoid applying an excessive peak voltage across the heater-cathode insulation of the individual valves.

TUBE IONISES

During the initial cycle of operation, V2 draws plate current and, by so doing, builds up a voltage across the timing capacitor "C" and therefore across the gas tube VI. In other words, the lower plate of "C" in the drawing is made gradually negative with respect to the upper plate.

When the potential across the capacitor and across V2 reaches a certain critical value, the tube ionises and abruptly discharges the capacitor. This action carries the plate of V2 once again to a high positive potential and the charging action commences once again, the cycle of events being repeated infinitely.

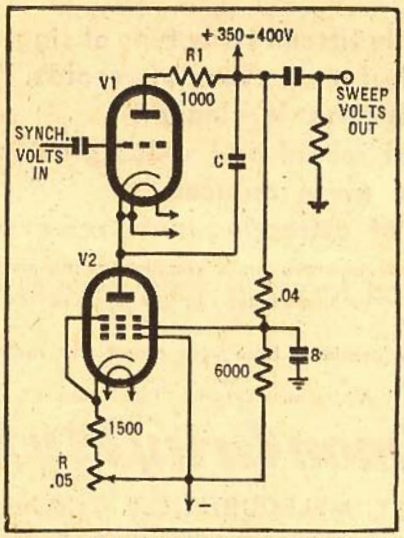


Figure 161: Typical interconnection of a pentode and gas triode to give a more linear sweep. The same principle can be applied to other oscillators.

The rate of charge into the capacitor "C" is actually dependent on the plate current of V2, since V2 provides the negative return path for the whole gas triode circuit.

It is characteristic of a pentode that the plate current is largely independent of plate voltage, being governed more by the standing screen and bias potentials.

In this circuit, the screen potential is held steady by a divider network across the high tension supply. The bias is adjusted in the cathode circuit, the two quantities together setting the plate current of the tube.

As already stated, this remains substantially constant at the preset figure and maintains a fairly constant charging current into capacitor "C." As a result, the build-up of voltage across "C," representing the forward timing trace, is made more linear.

While the pentode can thus contribute materially to linearity of the forward trace, it can effect no improvement to the rather poor retrace characteristics of the gaseous oscillator, due to the latter's rather uncertain ionisation and deionisation and its significant internal impedance.

As a result of these limitations, gaseous oscillators find little or no current application in modern television receivers, preference being for so-called "hard-valve" circuits—those using conventional vacuum types.

Such valves lack the inherent ionisation characteristics of the gaseous types and therefore the ability to function as a simple relaxation oscillator. Special measures are normally necessary to bring about an abrupt change in valve impedance sufficient to discharge the associated timing circuit.

SYNCH. PULSES

Possibly the most elementary form of hard valve time base is illustrated in figure 162.

Here the valve is supplied with appropriate plate and screen potentials, but with a standing bias sufficient to maintain it beyond plate current cut-off.

In this condition, capacitor C is charged through R, the rate and degree of charge depending on the circuit constants.

When the synch. pulses are applied to the grid, each positive-going pulse causes a burst of plate current to flow, or, put another way, it momentarily lowers the impedance of the valve. This discharges C at each pulse, the charge tending to build up again during the intervals.

The system was used in a few early overseas receivers, but it suffers from certain very serious limitations.

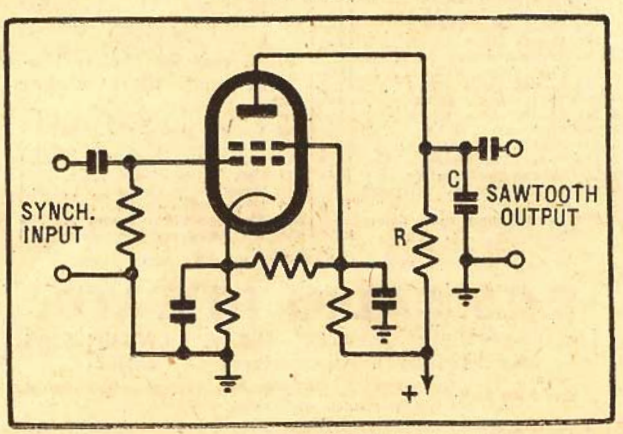


Figure 162: An elementary sawtooth generator actuated by the synch. pulses. It ceases to operate in the absence of signal and may cause damage to the screen of the picture tube with a set designed for negative modulation and having a mains type for RF EHT supply.

A MILLER-TRANSITRON OSC.-AMP.

In the first place, the synch pulses must be of large and consistent amplitude, since they control the whole discharge period of the tube rather than merely acting as a trigger. The complication of supplying such pulses may well be greater than that of installing a more elaborate timing circuit.

A further point is that the oscillatory effect and therefore the whole scanning action depends entirely on the presence of an input signal. A break in transmission or detuning the receiver would remove all deflection, allowing a stationary spot to rest in the centre of the screen. This assumes, of course, that the EHT voltage is obtained, as was the case in old-style receivers, from a mains transformer or RF supply.

MODERN SYSTEM

In point of fact, modern receivers invariably secure their EHT supply from the line scan circuits, which are driven in turn by a continuously running frequency controlled oscillator. This secures an overall economy of design, ensures that the screen area is scanned at all times and also renders the line-scan circuits, at least, less liable to interference from noise pulses.

The idea of pulse-operated scanning circuits is quite foreign to this modern approach.

In order to meet modern requirements and to make a hard valve (i.e. a normal vacuum type) act as a self-excited sawtooth oscillator, it is necessary to provide a positive feedback path around it. This can be done in a variety of ways, including the use of a feedback transformer, a phase-reversing valve, or network, or the use of some negative transconductance characteristic.

Having induced a self-oscillation, the nature and frequency of the output waveform can then be modified by the insertion of resistance-capacitance networks at appropriate points in the circuit.

This last statement may seem so general as to mean very little, but the force of it should emerge as the discussion continues.

Figure 163 shows the frame oscillator/amplifier for a five-inch electrostatic receiver, as described some months ago in this journal. Significant portion for the present discussion is the 6AC7 and the adjacent half of the 6SN7-GT, which together form a Miller-transitron oscillator and discharge valve.

The term "transitron" occurs in the title because the circuit makes use of the transitron or negative transconductance effect between the suppressor and screen of a pentode valve.

RESTRICTED USE

The circuit is not commonly used in commercial television receivers, but it does lend itself to simple home-constructed electrostatic sets and it is also used in test oscilloscopes.

Operation of the circuit is rather involved, but the broad principles can be explained as follows, using the simplified basic circuit of figure 164:—

A pentode valve, connected as in this diagram, will generate continuous output of approximate sawtooth waveform.

Consider the condition at an instant during the cycle when the plate current of the valve is cut off. No current flows through resistor Ra, there is no voltage drop across it and the valve anode, along with one plate of capacitor C, is at the same potential as the high-tension line.

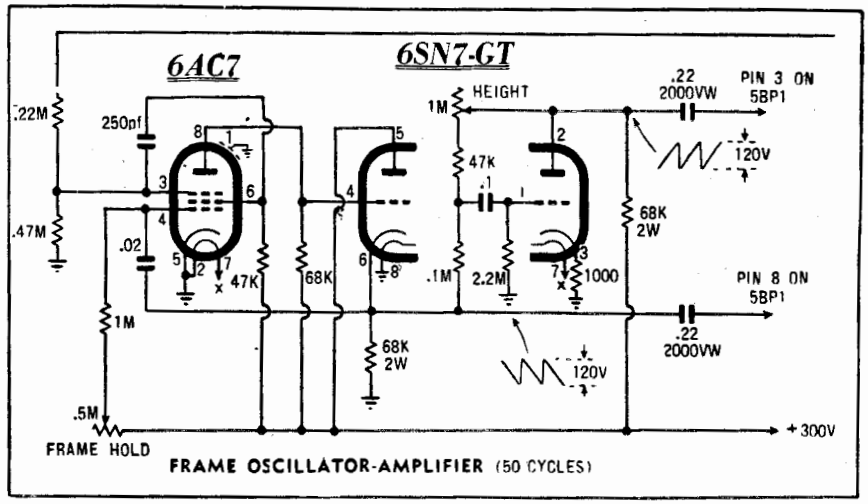


Figure 163: This circuit, extracted directly from our 5-inch electrostatic television receiver (September 1957), shows the basic Miller-transitron oscillator (6AC7) associated with a cathode follower to shorten the retrace period and a triode phase-inverting deflection amplifier.

The other plate of capacitor C is held very close to earth potential due to the diode action between grid and cathode of the valve. Conditions therefore exist for a maximum charge to be present across C.

MUST DRAW CURRENT

The condition just described obviously cannot be sustained because a valve with potential on plate and screen and near zero volts on the grid must draw plate current. Assume, therefore, that plate current begins suddenly to flow, as one would expect.

Immediately it does, a voltage drop occurs across the load resistor Ra, causing a negative-going shift in anode voltage. This shift is not confined to the anode, however, because the coupling capacitor C communicates it also to the grid, driving the grid sharply negative.

Fairly obviously, this abrupt negative excursion of plate and grid cannot have an amplitude of more than a few volts because any greater negative grid excursion would interrupt plate current and terminate the effect.

What happens, rather, is that the grid potential falls abruptly to a point just short of cut-off, after which further changes in bias and plate current take place much more slowly.

Another important point is that, with the grid now negative, there can be no grid-cathode conduction and resistor R is the only path through which capacitor C can discharge.

This it proceeds to do, immediately following the brief transient just described. As C discharges, the junction of C and R tends to move towards the B-plus line potential, carrying the grid from near cut-off towards zero bias.

OPPOSING ACTION

However, the grid cannot be subject to a positive-going signal without increasing the current through Ra, therefore tending to lower the plate voltage. This downward movement of plate voltage is naturally communicated to the grid through the reactance of C, opposing the tendency of the grid to move in a positive direction.

The ultimate rate at which the potentials can change is therefore dependent on the storage effect (i.e., the capacitance) of C, the resistance of R, and the modifying effect of the valve as just described.

The effect of the valve is quite profound, the natural discharge curve of R and C being subjected to what might be regarded as a "negative feedback" effect. As a result, the discharge curve becomes a substantially linear function.

Furthermore, while the discharge rate can be controlled by varying either C or R or both, the order of values required may differ from other circuits because of the modifying effect of the valve.

The gradual and linear discharge of C through R, and the dependent shift in plate potential, is commonly referred to as the "rundown" period and would provide the forward scanning trace in an oscilloscope or TV receiver.

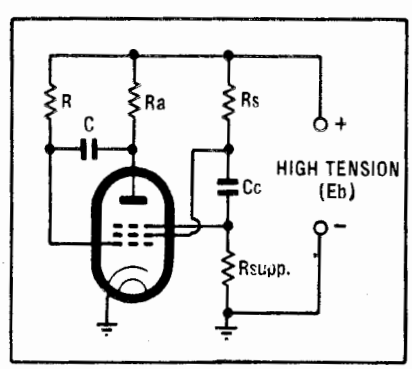


Figure 164: To assist in understanding the Miller-transitron oscillator, this diagram should be studied in conjunction with the text and the waveform diagram overleaf

MASTER ELECTRICS PTY. LTD.

A WHOLLY OWNED SUBSIDIARY OF MOTOR SPARES LTD.

Record Player Amplifier

very compact and light weight. This unit combines a 4½ watt amplifier with two inputs, one for the built-in 3-speed Philips record player and one for a crystal microphone. Each input has its own volume control. Also two outputs, one connected to the built-in speaker and one for a separate extension speaker. Also an on-off switch and tone control is provided. The cabinet is finished in two-toned leatherette. Ideal for parties or for playing records in the home.

Well worth 35 gns.

Price only 27 gns.

6-inch extension speaker in leatherette covered box worth £5. **Our price 69/6.** Crystal microphone to match this unit, **45/.**

3 speed record player in leatherette covered case, automatic stop, turnover head, 2 sapphire needles, plays standard and microgroove recordings. Colours: Fawn and Brown. Worth 18 gns.

Our Price, £13/19/6

SPRING GRAMOTORS, wind-up type suitable for replacement in portable gramophones, etc. Complete with turntable and fittings.

Price only £1/15/

3-speed Record Player Units consisting of motor and turnover head crystal pick-up, 2 sapphire needles, ideal for both standard and microgroove recordings, automatic stop. English make.

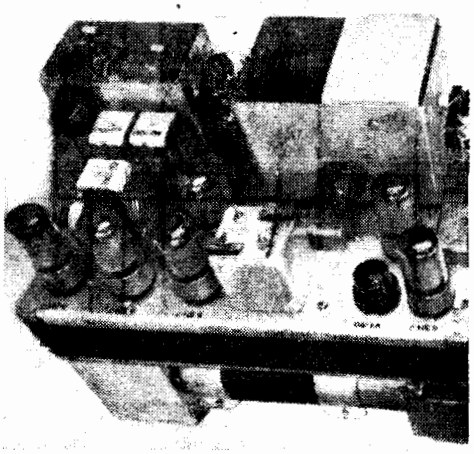
Price only £9/19/6 each

Single Speed Record Changers. Reconditioned and guaranteed in working order, well-known makes, Garrard, Collaro, Plessey, H.M.V., Stromberg Carlson, etc.

Price only £4/10/ ea.

4 Speed Record Player Units consist of motor and turnover head crystal pickup with 2 sapphire needles, ideal for playing microgroove and standard recordings. Automatic stop. English make.

Price only £10/19/6 each



IFF Set Type B.C. 966

Brand new with 3-7193, 7-6SH7 and 3-6H6 valves, and 18 volt to 450 volt at 50mA genemotor and blower, carbon pile regulator, 3 multi contact relays and dozens of resistors and condensers of all types.

Price only £5/10/

CATHODE RAY TUBES AND RADIO VALVES

Type VCR 138 3½in diameter cathode ray tube. Ideal for oscilloscopes, etc. Characteristics:

Filament Volts 4.
Filament Current 1 amp.
Anode 2-200 volts
Grid 1-50 volts.
X plate sensitivity .14.
Y plate sensitivity .33.
Anode 3-1,200 volts
Electro-static deflection.
Color green.

Socket connections can be supplied to each purchaser. **Price 25/ each.**

Type 902 2in Cathode Ray Tubes, ideal for instruments, etc. Brand new and boxed. Well-known make. **47/6 each.**

Type 815 Push Pull RF Beam Power Amplifier. Used as class AB2, A.F. power amplifier and modulator. Max. output 75 watts. Class C Telegraphy max output 75 volts Class C Telephony max. output 60 volts Filament volts 12.6 or 6.3.

An excellent valve for H.F. work. Brand new and boxed. **Our price. 35/- each.**

EL50 Power Output Pentode.

6.3 volts filament with P type base. 2 of these valves in class B will give 80 watts output. This is also an excellent single end tube which will give in class A about 8 watts output and high gain. Well worth 30/. **Our Price only 7/6.**

954. Det. Amp. Pentode 6-3 volts filament only **5/9 each.**

★ SPECIALS ★

1. **Carbon Microphones.** Hand type with switch. **Price only 5/ each.**
2. **230 to 110 volt Auto Transformers.** 400 volt-amp 50 C.P.S. Ideal for adapting 110 volt equipment to operate off 230 volt AC mains. Made in U.S.A., brand new and boxed. Worth £2½. **Our Price £5 each.**
3. **50ft Outdoor Aerial wire.** waterproof ideal for any radio. **Only 3/6 each**
4. **100ft Aerials as above. Only 5/ each**
5. **4-volt Vibrator Power Supply** will give 100 volts DC, and bias for output tube on battery sets. Neat and compact job. Brand new. Worth £6/10/. **Our price £2/17/6.**
6. **Magnetic Pick Ups.** English make with bakelite arm for 78 R.P.M. records Lightweight. **Price 7/6 each.**
7. Few only Honeycomb-wound Mains filter chokes. **Brand New Price for pair of chokes on one former 7/6**
8. **T.V. Aerial.** Rabbit ear indoor aerials. Well-known make, brand new and packaged. Worth £3/15/. **Our Price £2 each.**
9. **Heavy Duty Galvanised steel Chimney Bracket for T.V.** Aerial complete, with strapping, hook, bolts, etc. Worth £2/10/. **Our Price 35/ each**
10. **Dural Tubing.** 6ft x 1 1-8in for T.V masts. **Price only 15/ each.**
11. **PM 957 Ferrocart Vibrators,** 12 volt synchronous, split reed, with octal base. Socket connection diagrams available. **Price only 10/ each.**
12. **2 Gang Variable Condensers.** .0005 capacity brand new and cartoned. Worth £1/10/. **Price only 12/6 each.**
13. We have available the following condensers: all are brand new and in perfect condition.

Capacity	Voltage	Type	Price
.00017	4000	Mica	4/
.0002		Mica	2/
.001	5000	Mica	5/6
.003	3500	Mica	2/6
.005	2500	Block	2/
.01	2000	Mica	2/6
.01	5000	Block	4/9
.01 and .01	2000	Block	3/
.01 — .001 + .005	600	Block	1/6
.015	2000	Mica	2/6
.02	1000	Mica	2/
.02	2000	Mica	3/
.025	2000	Mica	3/
.1	500	Block	1/3
.1	1500	Block	2/6
.1	2000	Block	3/
.25	1500	Block	/9
.25	3000	Block	3/3
.5	750	Block	2/
.5	8000	Block	4/9
1	400	Block	2/3
2	400	Block	3/3
2	2000	Block	6/9
4	750	Block	6/6
4	400	Block	4/
5	400	Block	7/9
3-5			

SPECIAL NOTICE

All parcels sent Registered Post unless otherwise stated. Postage or Freight must be included with order.

547 ELIZABETH STREET, MELBOURNE – Phone FY0271

Branches throughout Victoria and Riverina

What of the automatic recovery and retrace action necessary to make the effect repetitive? This involves the negative transconductance property previously referred to.

During the run-down period the screen potential does not undergo any important changes. However, when the plate potential falls to something equal to or less than the screen potential, screen current increases sharply, resulting in a sudden downward movement of screen voltage.

This is communicated to the suppressor via Cc, the suppressor therefore being driven negative, further increasing screen current and decreasing plate current. The effect is cumulative and quite abrupt, so that plate current is suddenly and substantially cut off.

CONDITIONS MUST CHANGE

For a brief interval, therefore, the valve is left in a condition of very low screen voltage and a substantial negative bias on the suppressor, these conditions needing to change before plate current can commence to rise again.

During this delay period, C has an opportunity to charge via Ra and the grid-cathode conduction path, the plate voltage rising simultaneously toward the full supply potential. When plate, screen and suppressor voltages are such as to permit plate current once again to flow the whole cycle repeats itself.

Figure 165 shows the voltage waveforms throughout the cycle. In the "Ea" curve, representing plate voltage, note the initial brief transient, the rundown slope and the charging curve as the anode voltage rises again toward the B-plus potential.

The time constant of the screen and suppressor circuit, involving particularly Cc, must be chosen with due respect to the designed operating frequency. If Cc is too small, plate current will flow before anything like the full charge has appeared across C, thereby reducing effective output. If Cc is too large, the charge-recovery time will be unnecessarily long.

In point of fact, long flyback time is a weakness of the Miller-transitron circuit, and a cathode-follower discharge valve may be used in association with it to overcome this difficulty. This function is performed in figure 163 by the triode section adjacent to the 6AC7

The plate of the pentode is coupled directly to the grid of the triode, which has a load resistor in its cathode circuit. By ordinary follower action, the cathode at all times assumes a potential close to that of the grid, and therefore to the 6AC7 plate.

LOW IMPEDANCE

The important difference is that the cathode circuit has very low apparent impedance, so that, during the recovery or flyback period, the capacitor C is not charged through a 68K resistor in this case, but from the very low effective output impedance of the 6SN7-GT cathode, amounting probably to less than 1,000 ohms. This makes the flyback time extremely short.

Quite a substantial sawtooth voltage is available across the cathode circuit, being almost equal to the plate excursion which may, in turn, have a peak-to-peak value only slightly less than the HT supply voltage

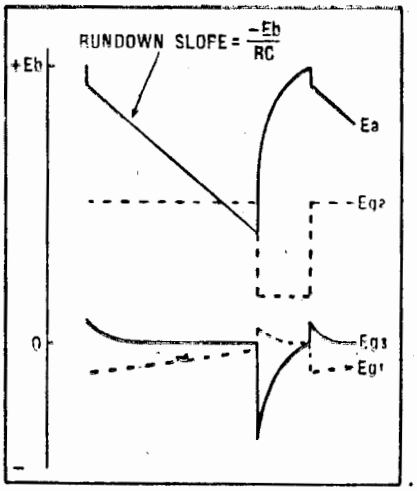


Figure 165: This diagram illustrates fairly closely the change in potentials of the Miller-transitron oscillator, plotted against time. Note the transient at the start of the run-down slope (Ea) and the following rise in plate voltage preparatory to the next cycle.

receiver to swing one deflector plate directly, the other plate being fed with an out-of-phase signal provided by the second half of the 6SN7-GT in figure 163.

Summing up, the Miller-transitron oscillator is characterised by excellent forward linearity, a very fast retrace if used with a cathode follower and high peak-to-peak output volts

The constants can be proportioned readily to allow operation at either frame

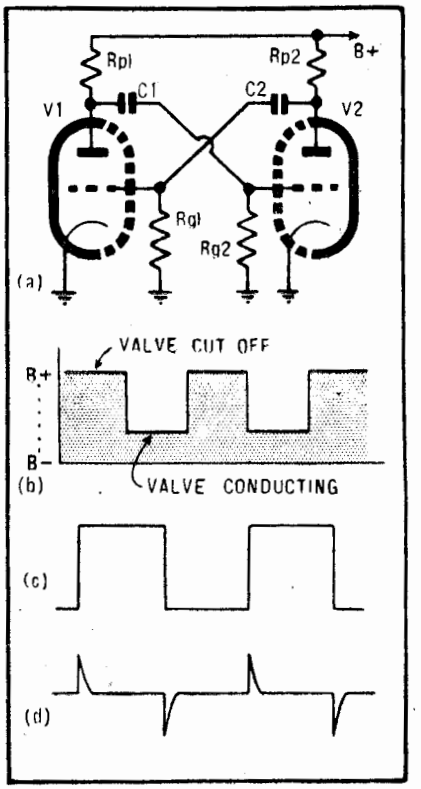


Figure 166: Illustrating the basic principles of the multivibrator. The circuit is shown at (a) and plate voltage changes in (b) and (c).

or line frequencies in a television receiver, or it can be used as a variable frequency sweep for oscilloscope work, provided provision is made to vary the suppressor/screen time constant as well as the basic C/R components in the plate/grid circuit.

It locks best with negative-going synch. pulses, but these need to be of much higher amplitude for reliable locking than for most other types of sawtooth generator. This is something of a disadvantage.

Another type of oscillator, which is very frequently used in television receivers for saw-tooth waveform generation is the so-called "multivibrator."

WELL-KNOWN CIRCUIT

The basic current arrangement is very well known in the radio and electronic art.

Multivibrator circuits, or their variants, have been used in AF and RF test equipment for signal generation, in electronic musical instruments, electronic switching circuits, in frequency multiplying and dividing equipment and in electronic computers, to mention just a few of the many and varied applications.

A simple multivibrator circuit takes the form shown in figure 166(a) involving two triodes, commonly the two sections of a twin triode valve. Each has a plate load and a grid return resistor, the plates and grids being cross-coupled by capacitors as shown.

Since each triode section amplifies any signal applied to its grid and inverts the phase through 180 degrees, a signal passing through both tubes is amplified substantially and changed in phase by 360 degrees. This constitutes a high degree of positive feedback, rendering the circuit unstable and therefore capable of self-oscillation.

STARTING CYCLE

Assume, in figure 166, that a positive potential is present on the H.T line when the cathodes begin to emit. Since it is virtually impossible that the two triodes shall be exactly balanced, the rise in current to one triode will inevitably take place sooner or be more rapid than to the other.

Assume that V1 conducts a trifle more

readily than V2. Its plate voltage will fall more rapidly, as the current through the load resistor rises, thereby applying a greater negative-going signal to the grid of V2 via C1, than is applied to its own grid through C2. This puts V2 at a disadvantage, so that its natural rise in plate current is further retarded.

Actually the effect is cumulative and the negative-going signal on the grid of V2 soon reverses the tendency for its plate current to rise. Instead, current falls and the plate voltage rises again to the B-plus potential, feeding a positive-going signal through C2 to the grid of V1.

In the ultimate, V1 with a positive-going signal on its grid, draws the maximum current which the valve and circuit constants will permit. Simultaneously V2, with a large negative-going signal on the grid, is cut off.

UNSTABLE CONDITION

This condition cannot be sustained because, with no further movement in plate voltage there is no "signal" available to the grids. These both move towards earth potential at a rate governed by the capacitance values of C1 and C2 and the resistance of Rg1 and Rg2.

After a period determined largely by the time constant of C1 and Rg2, the grid of V2 reaches a potential which will allow V2 to draw some plate current. Immediately it does, the plate voltage of V2 commences to fall and a negative-going signal is applied to the grid of V1.

This augments the falling tendency in V1 plate current, due to the disappearance of the former positive-going pulse on its grid. Instead the falling plate current allows the plate voltage of V1 to rise, applying a positive-going pulse to the grid of V2.

Since the effect is cumulative, V2 is driven rapidly to plate current saturation, V1 is completely cut off and the plate voltages again become stationary while the grids gradually drift back toward earth potential. So the cycle continues to repeat itself.

Diagram (b) indicates the change in plate voltages for the respective triodes, one conducting while the other is cut off. Diagram (c) represents the squared waveform which is available at either plate while (c) shows the type of waveform which can be produced if the original squared form is passed through a differentiating network.

BALANCE NOT ESSENTIAL

Figure 166 assumes the use of a twin triode and also balanced circuit constants. Neither assumption is fundamental to the operation of the circuit.

In point of fact, the two valves may be dissimilar and contained in entirely separate envelopes. Furthermore, the coupling components may be far from balanced. Just as long as there is sufficient gain within the total feedback path the circuit will oscillate in some fashion.

A lack of symmetry in the coupling components simply produces a lack of symmetry in the output waveform, the conducting and non-conducting periods of the two valve sections being dissimilar.

By the same token, other methods of coupling can be used between the valves as, for example, cathode coupling but more will be said of this in a later article.

(To be Continued)

APPLICATION OF THERMISTORS

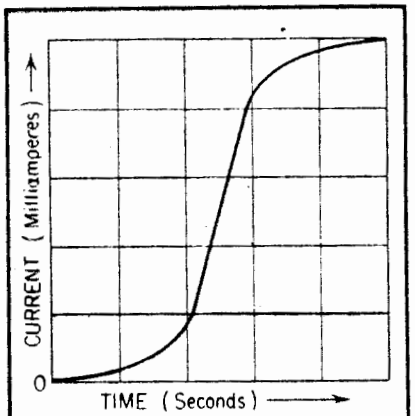
Thermistors are particularly useful devices, and have many valuable applications in electronic equipment. This article, by Aerovox, presents some practical information on their employment in a variety of designs.

AS its name implies, the thermistor is a thermally-sensitive resistor. It is also a non-linear resistor. Although it is a 2-terminal semi-conductor device, the thermistor is not a rectifier. It accordingly may be employed in either AC or DC circuits.

Thermistors are manufactured in a number of shapes, principally beads, discs, and rods, and in variation sizes including subminiature.

The basic property of the thermistor is its change of resistance with temperature. The temperature change affecting it may arise externally or it may result from current flowing through the thermistor. This property gives rise to the nonlinearity of the thermistor resistance characteristic.

Thermistor action may be employed in several ways to modify the behaviour of electrical circuits. Many applications are rendered especially attractive by the



THERMISTOR CURRENT-TIME CHARACTERISTIC

FIG. 3

simplicity of the thermistor and its compactness. A number of typical applications are described in this article.

Figures 1, 2, and 3 illustrate typical thermistor characteristics.

Figure 1 displays a non-ohmic variation of resistance with temperature. From this curve, the resistance of this particular unit is seen to decrease over a range of aproximately 2,000 to 1 for a temperature increase from -60 to -150 degrees C.

Figure 2 shows the static E-I characteristic of the thermistor. This plot reveals that as the current through the thermistor is increased, the voltage drop across this component first increases rapidly from zero to a peak (T2) and then decreases with further increase in current, finally falling to point T7.

Thus, the thermistor shows positive resistance from zero to T, but negative resistance from T, to T7. Points T1 to T7 on the curve represent temperature levels at those points resulting from internal heating in the thermistor due to current flow.

Thermal lag prevents the thermistor temperature from increasing instantaneously with initiation of current. A significant time interval thus elapses after applications of voltage before the current through the thermistor reaches the magnitude expected from an examination of the voltage-vs-resistance characteristic. Figure 3 illustrates this time delay characteristic.

The slopes of the curves shown in figures 1, 2, and 3 and the values of their co-ordinates will vary with thermistors of different types. However, the over-all configurations remain substantially the same.

HEATING METHOD

Each of the wide range of thermistor applications is based upon one of the characteristics illustrated by Figures 1, 2, and 3. These applications may be grouped further according to whether the thermistor is internally or externally heated (that is, whether by current flow or ambient temperature).

The temperature dependence of the thermistor resistance has been utilised for the stabilisation of circuit resistance in an environment of fluctuating temperature. Thus, thermistors have been employed to compensate indicating meters, fixed resistors, and balancing circuits; and, in the DC bias networks of transistor circuits, to stabilise operating points.

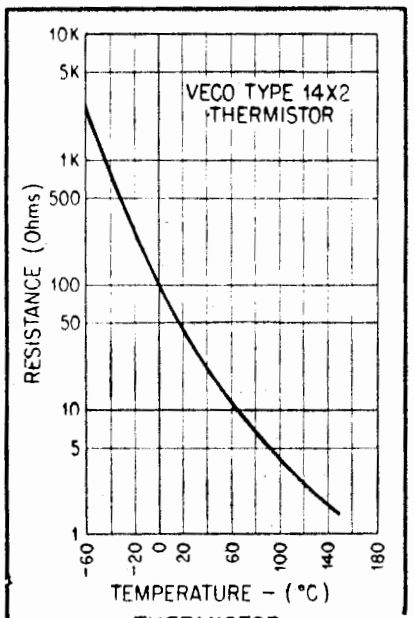
TYPICAL CIRCUITS

Figures 4 to 15 show representative thermistor circuits. These have been selected to illustrate the wide range of applications possible with thermally sensitive resistors of this class.

Temperature Measurement. The thermistor is applicable as a temperature sensing element of good sensitvity. In this connection, a small thermistor may be mounted in the nose of an exploring probe. Figure 4 shows several circuits for temperature measurement.

In Fig. 4(A), the thermistor (T) is connected in series with a DC source, adjustable current-limiting resistor (R), and a direct current meter, (M). Reference to Fig. 1 shows that, since the thermistor undergoes a large resistance change with temperature, meter M probably will be required to indicate amperes as well as milliamperes.

The meter may be set to zero, or to some other desired initial reading, by adjustment of R. As the temperature to



THERMISTOR TEMPERATURE-RESISTANCE CHARACTERISTIC

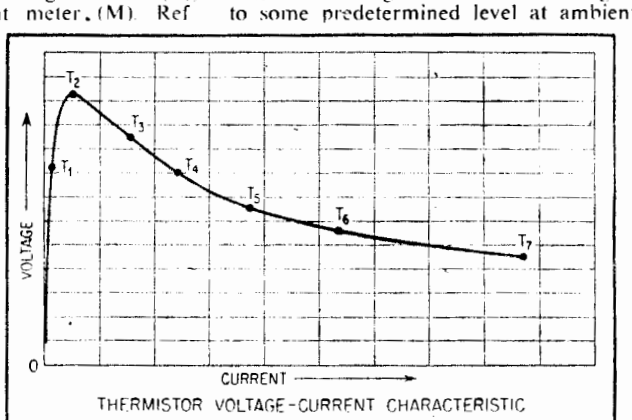
FIG 1

which the thermistor is exposed rises, the meter deflection will increase. The deflection may be referred to a current-vs-temperature chart, or the meter scale may be graduated directly in degrees.

In Fig. 4(B), a conventional DC ohmmeter is employed to indicate the thermistor resistance as it changes with temperature. The meter deflection may be referred to a resistance-vs-temperature calibration or the instrument scale may be graduated directly in degrees on the basis of such a calibration.

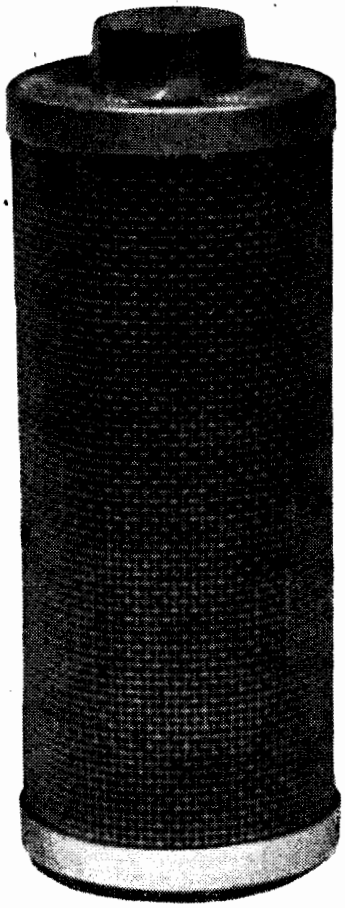
Fig. 4(C) shows one type of bridge circuit for checking temperature by measuring thermistor resistance. In this arrangement, the thermistor (T) forms one arm of the bridge, while the other three arms are conventional resistors.

One resistance arm, R2, is made variable for nulling meter M or setting it to some predetermined level at ambient



THERMISTOR VOLTAGE-CURRENT CHARACTERISTIC

FIG. 2



Ilbott

Complete Audio Equipment
430 Bourke St., Melbourne. MU5032

"360" TWEETER

Absolute Naturalness of Sound

NO PEAK OR BEAM EFFECT

THE ONLY ONE OF ITS KIND IN THE WORLD

Actual Size 5in. x 2in.

Impedance Tappings of 2, 8, and 15 ohms

PRICE £14/14/-

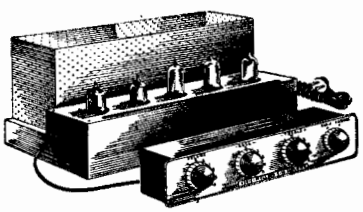
(See "Trade Review," Feb. issue, "R. TV & H.")

QUEENSLAND: C. A. Pearce Pty. Ltd.,
43 Bowen St, Brisbane B5860, B8510

N.S.W.: Audio Engineers Pty. Ltd.,
422-424 Kent St, Sydney BX6731

NEW ZEALAND: Fred Rothschild & Sons,
79-83 Pretoria St., Lower Hutt. 63-581, 61-698

"5-10" Hi-Fidelity AMPLIFIER



FIDELITY TUNER

MADE IN AUSTRALIA FOR AUSTRALIA!

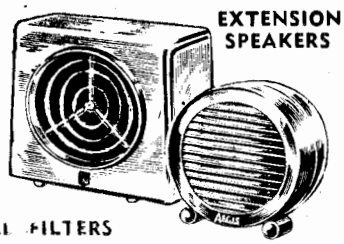
AEGIS

AUSTRALIA'S OWN BRAND!

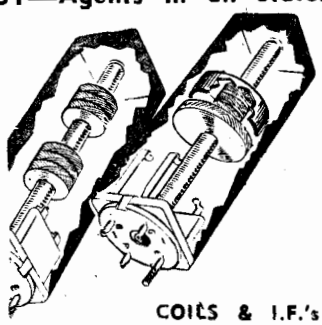
equal to the world's best!

AEGIS MFG. CO. PTY. LTD.
208 LT. LONSDALE ST., MELB., VIC.
Phone FB3731—Agents in all States.

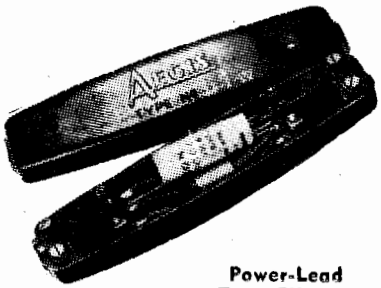
LINE & AERIAL FILTERS



EXTENSION SPEAKERS



COILS & I.F.'s



Power-Lead T.V. FILTER

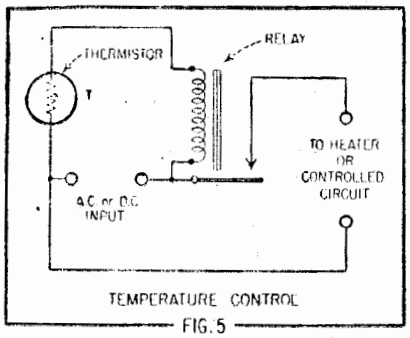
temperature or zero degrees. As the thermistor resistance alters in response to temperature, the bridge unbalances and the meter is deflected.

The bridge may be re-balanced and the thermistor resistance measured in terms of the bridge arms (that is: R=(R1R3)/R2. Or the meter scale may be graduated directly in degrees.

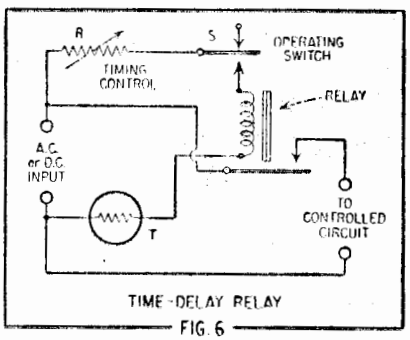
In addition to temperature measurement, a number of thermistor circuits are available for direct temperature control. Fig. 5 shows a simple arrangement utilising the temperature-sensitive resistance of a thermistor in series with the coil of a control relay.

Rising temperature lowers the thermistor resistance, allowing the latter to pass more current to the relay which eventually is actuated. The supply voltage may be either AC or DC, provided the relay is chosen accordingly.

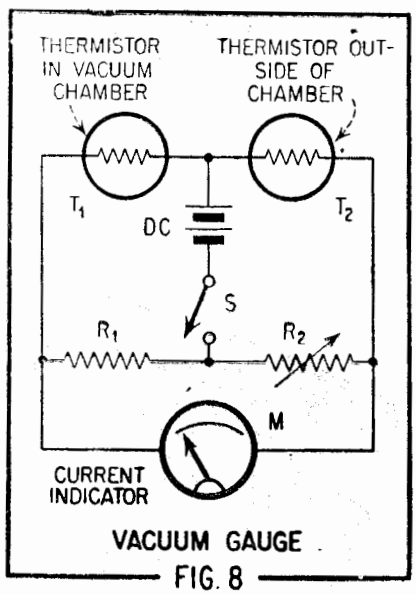
For greater sensitivity to small changes in temperature, a sensitive relay may be substituted for the indicating meter in the bridge circuit in Fig. 4(C).



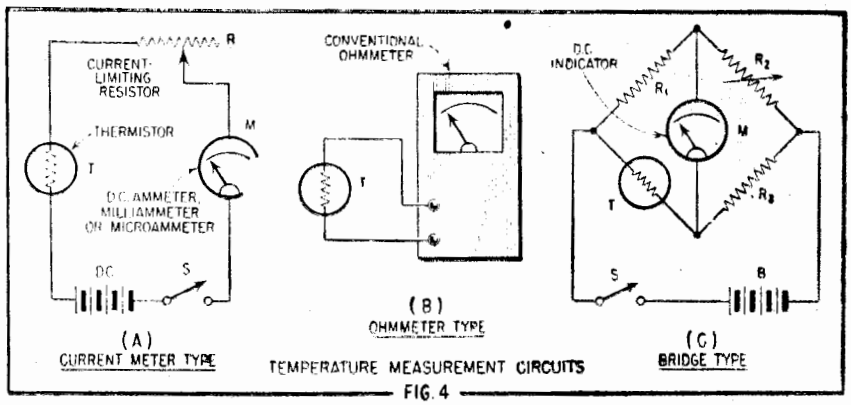
TEMPERATURE CONTROL
FIG. 5



TIME-DELAY RELAY
FIG. 6



VACUUM GAUGE
FIG. 8



TEMPERATURE MEASUREMENT CIRCUITS
FIG. 4

The thermistor delay characteristic illustrated by Fig. 3 may be utilised to obtain time delay effects in a simple manner.

In Fig. 6 for example, a thermistor is connected in series with an AC or DC source and a corresponding relay coil. Resistor R limits current and accordingly modifies the current-time curve of the thermistor.

When switch S is closed, the relay current gradually increases, according to the current-time curve of the thermistor-resistor combination. The current reaches a level sufficient to actuate the relay some time after closure of the switch. The length of the time interval may be selected by adjustment of R.

Within its power handling limitations, the thermistor may be employed as a voltage regulator, especially at low voltages, in the simple circuit of Fig. 7, to stabilise an output voltage against input voltage variations.

R1 is a current-limiting resistor similar to the same resistor in a gaseous-tube regulator circuit. The value of R2 must be chosen, with respect to the E1 characteristic of the type of thermistor in use, for maximum regulating effect.

The voltage regulating action results from the fact that current through a thermistor, and therefore the resultant voltage drop across it, increases at a rate somewhat greater than linearly with applied voltage. A small change in output voltage (voltage drop across the thermistor) thus results from a rather large change in input (applied) voltage.

A particular desirable feature of this circuit is that it may be used to regulate either AC or DC.

For a vacuum gauge as in Fig. 8, thermistors T1 and T2 form two of the arms of a Wheatstone bridge. Thermistor T1 is placed inside the vacuum chamber, while T2 is mounted outside.

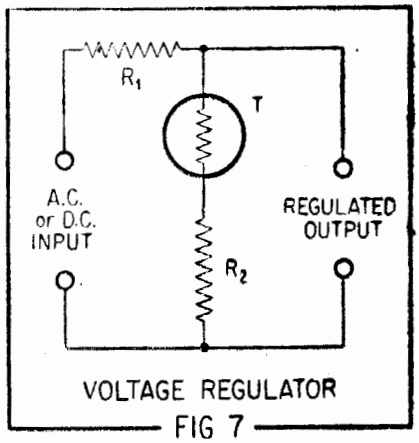
Before evacuating the chamber, the bridge is balanced (meter M nulled) by adjustment of resistor R2.

As the evacuation then progresses, thermistor T2 can dissipate its heat due to current flow faster than can T1 inside the chamber because T1 is surrounded by progressively thinner air. Consequently, the resistance of the hotter T1 differs from that of T2, the bridge unbalances, and the meter deflects.

The meter scale may be calibrated to read chamber pressure.

Fig. 9 shows a flow meter operating on somewhat the same principle as the vacuum gauge just described.

Here again, there is a 4-arm bridge with thermistors in two of its arms. In this instance, one thermistor (T1) is mounted so as to be directly in the



VOLTAGE REGULATOR
FIG 7

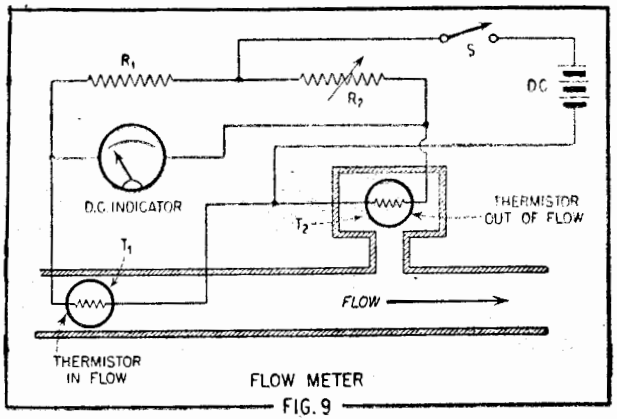
flow of a fluid (liquid or gas), while thermistor T2 is mounted in the fluid but outside of the flow.

The bridge is balanced with the fluid quiet, by adjustment of R2.

As the flow progresses, T1 can dissipate its heat due to current flow rapidly because of the surrounding flow. But T2 becomes hot because of its quieter ambient. Consequently, the bridge unbalances, deflecting the meter which may be calibrated to read flow units.

A similar thermistor circuit has been used as an anemometer.

For a Sequence-Switching circuit as in Fig. 10, several load devices, repre-



FLOW METER
FIG. 9

NOW AVAILABLE . . .

PHILIPS

New Automatic multi-function record changer

PHILIPS

Type NG 1010

PRICE

£25.18.0

240 Volts
50 CYCLES AC

The new NG1010 multi-function record changer combines a simple push button record changer with an automatic record player of completely new design. It incorporates the latest technical refinements for simplicity of operation and trouble-free service. The unit is attractively finished in Gold Hammerloid with burgundy tone arm. The turntable is flock sprayed and effectively cushions the records and so avoids damage. Completely automatic, just load up to 10 records (all sizes or a similar speed intermixed), press the start button and forget. The unit cuts off after the last record and, of course, mutes the pick-up during the change cycle. The loading arm lifts off for automatic single play operation and the record can be placed directly on the turntable. Select the record size, push the start button and the arm is lowered safely and gently on the record with a precision not possible by hand. Push the stop button and the pick-up arm returns to its rest at the finish of the record and switches off.

- Automatic Record Changer, Automatic Player and Manual Player in one unit.
- Push Button operation — Simple and foolproof.
- Plays 7", 10", 12" records of same speed intermixed.
- Featherweight pick-up arm with detachable dual stylus, pick-up head — muting switch.
- All record speeds: 78, 45, 33 1-3, 16 2-3 r.p.m.
- No interfering rumble or wow.
- No record damage.

P6142.57

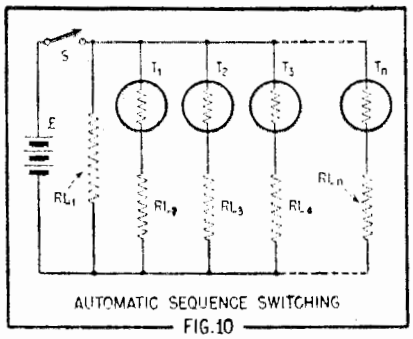
PHILIPS ELECTRICAL INDUSTRIES PTY. LIMITED

Sydney • Melbourne • Brisbane • Adelaide • Perth • Hobart

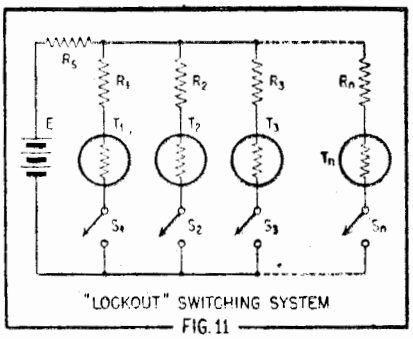
sented by RL1 to RLn are connected across a line supplied by source E and controlled by switch S. All except RL1 are connected in series with thermistors (T1 to Tn).

When switch is closed, load device RL1 can operate almost instantaneously. The other load devices will be operated at later intervals, the time of each depending upon its resistance, since each is in series with a thermistor which introduces a time delay.

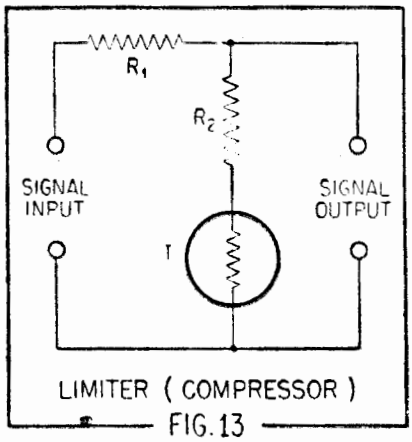
By choice of appropriate values of load resistances (or of individual external series resistances when each load device has the same resistance) the devices may be caused to operate in a desired sequence after the switch has been closed.



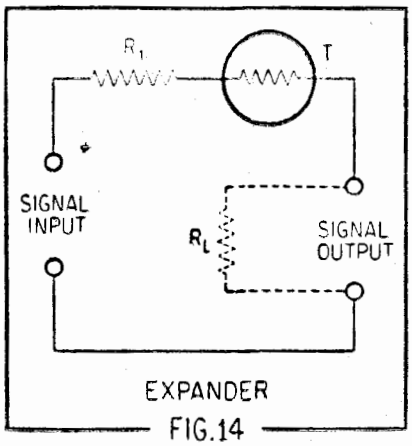
AUTOMATIC SEQUENCE SWITCHING
FIG.10



"LOCKOUT" SWITCHING SYSTEM
FIG.11



LIMITER (COMPRESSOR)
FIG.13



EXPANDER
FIG.14

Fig. 11 shows a Lockout Switching System employing series thermistors.

In this circuit, when any switch is closed, that leg of the circuit draws current through a thermistor. By properly proportioning the series resistor (R1 to Rn), the thermistor can be caused to "fire" analogous to Thyratron action, and to conduct as long as its switch is closed.

When one leg is conducting, the current draw through the common series resistor, Rs, sets up a voltage drop across Rs sufficient to reduce the line voltage too low for any other thermistor to fire.

The result of this action is that when one leg of the circuit is in operation, all other legs are locked out. The latter will not operate when their switches are closed. Only when the switch in the conducting leg is opened will the circuit be restored to the initial condition in which any other leg may conduct.

For amplifier control, the thermistor in Figure 12 is of the heater type. This thermistor has an internal heater element which is connected across the output terminals of the amplifier. The thermally sensitive resistance element of the thermistor is connected across the amplifier input terminals where it forms a potentiometer with resistor Rs.

When the signal output rises, the thermistor is heated by this increased voltage across its heater, and its resistance decreases. By potentiometer action with Rs, the thermistor resistance then lowers the signal output voltage, and in turn the amplifier output.

The amplifier output thus is stabilised at a pre-determined level governed largely by the ratio of Rs to the thermistor resistance and is adjustable by means of Rs.

The simple limiter or compressor circuit in Figure 13 utilises thermistor nonlinearity in very much the same manner as the voltage regulator circuit (Figure 7) to obtain limiting action.

Because current through the thermistor increases rapidly while the applied voltage is increasing slowly, the resulting voltage drop across the thermistor (which constitutes the signal output voltage in this instance) is maintained constant while the amplitude of the signal input voltage fluctuates.

Choice of resistance R1 and R2 for a particular type of thermistor will yield efficient limiting action minus the high distortion encountered with simple limiters of some other types.

The opposite action is obtained with the circuit shown in Figure 14. Here, the output signal is the voltage drop due to the flow of nonlinear thermistor current through a series resistance (RL). A small increase in applied voltage (signal input) causes a large current to flow through RL, producing a large increment in signal output.

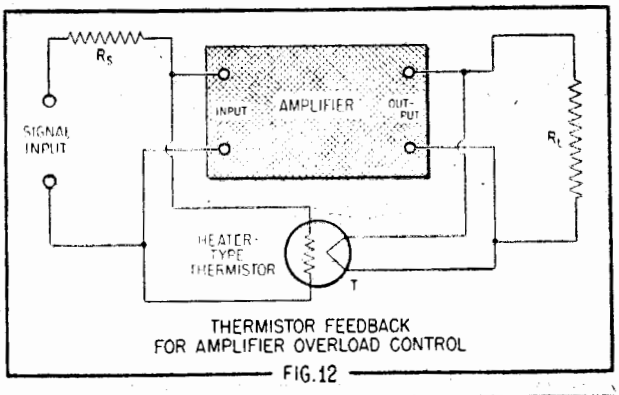
Amplification does not occur because the amplitude of the input signal is not increased by the circuit action, only its rate of change. In fact, the absolute amplitude is decreased by potentiometer action between R-, T, and RL.

The thermistor bridge shown in Figure 15 is invaluable for measuring AC power, since the low internal capacitance of the thermistor enables these measurements to be made anywhere in the frequency spectrum from low, power-line frequencies to microwaves.

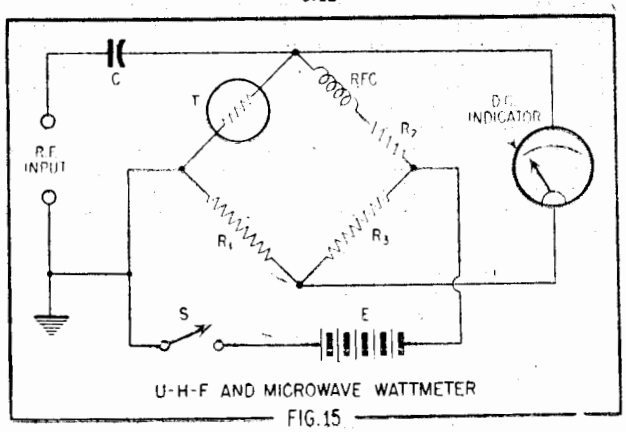
The signal energy is applied to the thermistor only, through the isolating capacitor, C. The radio-frequency choke, RFC, prevents passage of this energy through the other arms of the bridge. The signal current heats the thermistor and thus changes its resistance proportionately.

The thermistor resistance may be checked by adjustment of the bridge to null, whereupon R — (R1R2)/R3, and this resistance value referred to a resistance-vs-power calibration curve to determine the signal watts. Or the scale of the indicating meter may be graduated directly in watts.

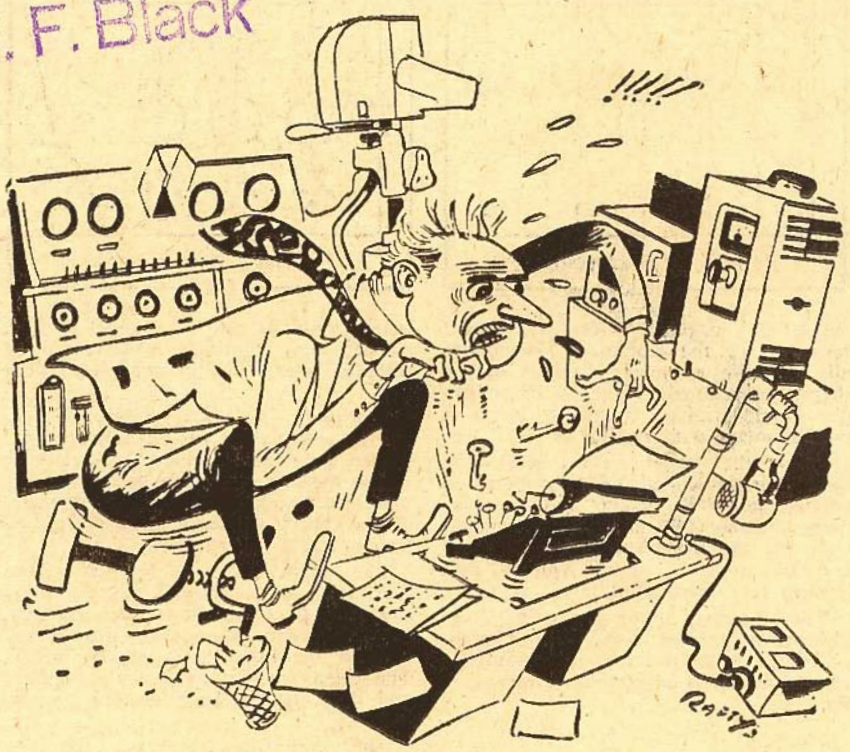
It is customary to employ a DC bridge supply, E, when measuring AC watts. When checking DC watts with a thermistor bridge, capacitor C is omitted from the circuit and an AC bridge supply and AC meter may be employed.



THERMISTOR FEEDBACK
FOR AMPLIFIER OVERLOAD CONTROL
FIG.12



U-H-F AND MICROWAVE WATTMETER
FIG.15



Let's Buy An Argument

As if it isn't enough to keep myself out of trouble, I am confronted this month by a couple of letters objecting to a recent statement in the "Answer Tom" pages, where it was suggested that image interference and double spotting were really one and the same thing.

by Neville Williams

Okay, okay. I'll come quietly. You might have something this time.

Of course I could plead innocence on the grounds that someone else wrote the article in question.

I could even face the editor with a parody of one of the earliest sayings credited to homo sapiens . . . "The man thou gavest me . . . etc."

But all to no avail, I fear. Technical editors are supposed to check articles for their accuracy, and, faced with a possible dereliction in duty, can only stand trembling and abashed in the presence of the editor himself.

It's a fearful experience.

WHAT ABOUT IT?

Well, then what about this matter of image interference and double spotting?

Over and above more or less incidental references to the matter, I have to hand two letters, which I quote. One, from M.P., is short and sweet and is quoted in the panel opposite. I suggest you read it.

The other is sweet enough but not short and carries the signature of one R.F.S.

At first, I was tempted to make a precis of it and group the two together, setting about thereafter to explain the matter in some detail.

Then I had a better idea. Since R.F.S. had made a serious attempt to write an article correcting the original, why not have some diversion and instruction at his expense and examine his contribution also for expression and accuracy?

A kind of quid pro pro or whatever the phrase is!

In so doing, I'm not being in any way discriminating or unfair. Practically every original article that appears in the magazine is written by one member of our staff and vetted by another—at times very critically, to judge by the arguments that follow.

We set a good deal of store by procedure, however.

Coming fresh to a subject, the reader may discover discontinuities and discrepancies in a line of reasoning, which seems perfectly straightforward to the writer, hence the arguments, as aforesaid.

Well then, let's get to it, quoting and commenting as we go—and perhaps leaving ourselves open in turn for further criticism! What's the odds?

THE LETTER BEGINS

Bypassing the niceties at the beginning of the letter, R.F.S. has this to say:

"Dear Sir,

It would be true to say that image interference and double spotting are twin brothers but they are not the same person!

Image interference (also called second channel interference) is caused by having an unselective front-end on a superhet receiver (either no RF stage or an unselective RF stage)."

COMMENT: Hold hard there! The author obviously has the right idea in mind but it is quite incorrect to infer that image interference is determined by the presence or absence or efficiency of an RF stage.

The amount of selectivity required, in terms of bandwidth, is primarily related to the intermediate frequency being used. Whether or not this bandwidth can be achieved in one, two or more input circuits is dependent, in turn, on the frequency range over which these circuits have to tune.

If the intermediate frequency is high enough and the signal frequences low enough, the selectivity available from a single aerial coil may be sufficient to render image interference non-obvious. Conversely a low intermediate frequency and high signal frequency may result in image troubles, notwithstanding one or even two RF stages.

A "WRONG STEER"

All this can't be said in the opening paragraph of the article in question, but the reference to RF stages could best be omitted, to avoid giving the reader a mental "wrong steer" right at the outset.

It would be much better to keep this first statement more general in character and also more accurate, simply making the point that image interference occurs when the front-end circuits of a superhet are not sufficiently selective.

Now to continue:

"In the case of a superheterodyne receiver with 455Kc IF transformers, there are two frequencies which can come in (one wanted and the other unwanted)

one at oscillator frequency plus 455Kc and the other at oscillator frequency minus 455Kc."

COMMENT: Nothing wrong with this statement. R.F.S. includes a small diagram here to illustrate his point further, but it has not been reproduced, for the sake of brevity. Continuing:

"As our front end has to be unselective before image interference can occur, then all stations which are transmitting are finding their way down your aerial lead-in—but you are only going to receive those stations which produce a 455Kc difference with your local oscillator (your IF's being tuned only to pass 455Kc).

"This being so, there are only two incoming frequencies which can satisfy this requirement, one being the desired station and the other the image, which we must eliminate."

EXPLANATION LOOSE

COMMENT: The writer's ideas are still apparently in order, but his explanation is so loose that it is really incorrect and could certainly mislead an uninformed reader.

The selectivity of a receiver has very little bearing on how many signals find their way down the aerial and lead-in. Furthermore, even if R.F.S. didn't quite mean this, it would be wrong to say that poor front-end selectivity allows ALL station signals to penetrate the significant section of the receiver.

R.F.S.'s explanation should suggest, rather, that insufficient front-end selectivity will allow signals from within too wide a band of frequencies to reach the MIXER GRID, thus admitting into the receiver a signal capable of producing an image.

There's one other point, less serious, but which I know is a potential source of confusion for beginners.

An IF channel tuned to 455Kc does not ONLY receive signals at 455Kc. It will normally pass a band of frequencies centred on 455Kc and up to about 20Kc wide. It must do this in order to pass the modulation sidebands belonging to an AM signal.

BAND OF FREQUENCIES

When referring to selectivity, passbands, etc., it is a good idea to forget the word "only" in its very restrictive sense and work in the idea of a band of frequencies or frequencies adjacent to the nominal resonance.

As far as the beginner is concerned, the choice of the right expression, rather than the wrong one, leaves the appropriate inference in his mind, even if it isn't developed. But as surely as you "teach" a beginner that a tuned system will pass only one frequency, there will come a day when he must be "un-teached" and the right idea substituted.

Now on again with the letter:

"One means of helping overcome image interference is to use an IF of higher frequency but, unfortunately, this also decreases the stage gain. Using 1600Kc means that the desired station and the image would be separated by 2 x 1600 equals 3200Kc, which is a much larger separation than when using 455Kc which gives only 2 x 455Kc equals 910Kc.

"It is obvious that if one station is separated from the other by 3200Kc instead of 910Kc, the image ratio is going to be much greater and this will give the RF stage or stages a better chance of discriminating between the two. As a result of this, the 3200Kc image should be almost non-existent.

"We then deduce from the preceding that any superheterodyne receiver with an unselective front end will suffer from image interference. It just can't help it."

COMMENT: The figures are right but the whole force of the argument rests on the comparative selectivity of the signal frequency tuned circuits. It highlights the weakness of earlier references to aerial and lead-in, to "all" stations coming in, etc.

RF STAGES AGAIN!

And, again, we have that unfortunate reference to RF stages, presumably, as an essential feature and a measure of front-end selectivity and image response. The writer completely ignores the fact that an overwhelming proportion of broadcast receivers use a 455Kc IF channel, have no RF stage, rely on a single aerial coil for front-end selectivity—and produce very little embarrassment due to image reception.

So we continue:

"The effect of this image fault is that it produces two stations on the one spot on the dial (when each is as stated 455Kc on either side of the oscillator frequency) and it is difficult, if not impossible, to know whether two stations are transmitting on the same frequency or not, as image interference makes it appear as though they are both on identical frequencies.

"On the short waves (or for the strange modern we now seem to have with us who is not accustomed to thinking ambidextrously but seems to think that wireless only started the day he became interested in it)—high frequencies—image interference shows up at times in a most peculiar manner.

"You may be listening over a period to a desired station and due to changing ionospheric conditions, the frequency corresponding to the image may start coming in (at a later time) causing both confusion and annoyance.

"So much for image interference."

NOT WELL WRITTEN

COMMENT: The first paragraph is okay but the second would suffer drastically from the Editorial blue pencil. Little quips and personal biases may be admissible and even desirable in certain types of article but NOT cut right into the middle of a sentence forming part of a serious technical explanation.

By the time the reader has worked out what all the extra words mean, he may well have lost the original train of thought.

But, in any case, the original train of thought has suffered a sudden and strange malformation.

Surely, the vital point about "short-wave" reception is the relative proximity of the real and image signal in terms of signal frequency and the consequent difficulty of selecting one and rejecting the other. This is where emphasis could have been laid very appropriately on the matter of RF stages.

But the vital points are not made. Instead the reader is introduced to an interesting but much less important occurrence, when signal fading is evident.

Now comes the second part of the letter:

SECOND PORTION

"DOUBLE SPOTTING. As stated, it is related to image interference but is a little different.

"Double spotting is where the same station (transmitting one. only one frequency) can be picked up twice, that is at two different spots on the dial. To receive double spotting you must tune your receiver (oscillator) to the spot twice the intermediate frequency away—that is to a position 455Kc to the other side of the desired station.

COMMENT: Here another drawing follows about which we have some reservation. However, the idea is clear enough in the writer's find. If, for example, the oscillator is normally 455Kc higher than the desired station. then a double spot may be evident if the receiver is tuned to a frequency 455Kc lower than the station's frequency. To continue the quote:

"Double spotting was more prevalent on the broadcast band when 175Kc IF's were common (say about 1928) but today it is not known on the broadcast band with 455Kc IF's (because 2 x 455Kc drops it outside this band)."

COMMENT: This paragraph contains an actual error and also puzzles me somewhat. Why is there no reference to the RF stages that seemed earlier to dominate his thinking? Does he imagine

IMAGE INTERFERENCE OR DOUBLE SPOTS?

Dear Sir,—

I am afraid I don't agree with the statement on page 55 of the January edition, which says that double spotting is just another name for image interference. According to our notes, which are adapted from the Melbourne Technical College notes by the R.A.A.F. they are totally different.

The particular case described in the article is listed in our notes as double spotting and image interference is an effect when two different signals beat with the one oscillator frequency.

For instance, if the oscillator is set to 7,455 Kc/s to beat with a 7,000 Kc/s signal, it will also beat with a signal at 7,910 which will also give a 455 Kc/s beat. The undesired signal is called the image.

In short, double spotting is the effect of one signal beating with two different oscillator frequencies while image interference is an effect between two different signals beating with the one oscillator frequency.

With image interference you have two different stations on the one setting of the dial, while in double spotting you have the same station on two different settings.

Yours Sincerely, M.P.

or only infer by the omission that an RF stage is important in one case and not the other?

Such imaginings or such an inference would be very difficult to justify.

But first the error. A modern broadcast receiver tunes over a range of at least 550 to 1600Kc, so that its oscillator, operating normally on the high side of the signal frequency, tunes simultaneously from 1005 to 2055Kc.

Stations within the range 1460 to 1600Kc have a potential double spot position between 550 and 690Kc. It is largely due to the efficacy of a single aerial coil that the average receiver is not plagued by such trouble.

And still referring to the broadcast band, it is precisely this same aerial coil which prevents stations from the range 1460 to 1600Kc appearing as images on stations 550 to 690Kc. The phenomena are as close as that! Back to R.F.S.

SHORT WAVES

"Double spotting still can occur on the short waves where the front end is unselective (incorrectly tuned or low Q). This is one of the difficulties encountered with home-made receivers where alignment has been slipshod or not at all.

"It is rarely found in good brand communication receivers as the designer has already been through all this with his prototype but unfortunately, with the experimenter, everything he builds is prototype and so he is never completely free from headaches. How little the man who buys a completed set over the counter knows of this—but the experimenter gains knowledge."

COMMENT: Double spotting does occur on the short waves, to be sure but the rest of the paragraph just about qualifies for the W.P.B. (waste paper basket). There is little to choose between comparable home-built and commercial receivers in the matter of double-spotting or image interference. Some sets are aligned better than others and some aerial coils may be better than others but no simple short-wave superhet, to my knowledge is free from the trouble, be it aligned accurately or not.

An RF stage helps, but only to a degree. The image or second spot will be the weaker but still present.

FACTS ARE FACTS

Nor does it help to engineer any number of prototypes. Once the potential of a particular circuit system has been exploited, no amount of fiddling will bring about any drastic improvement.

And "communication" receivers? The definition contains no magic of its own. If a communication receiver only has one RF stage and a 455Kc IF channel, then it will suffer from the effects in question, notwithstanding the fondest hopes of its designer. If it has two RF stages, it will be better, but still far from perfect.

Now we read on:

"The conclusions we thus draw are—a receiver with an unselective front end will automatically suffer from image interference and if it suffers I.I. then the same station can be tuned in at two spots on the dial and this is called double spotting."

COMMENT: Wow! If R.F.S. isn't careful, he'll be agreeing with our "Answer Tom" writer and then he'll start an argument with himself. But why make double-spotting dependent on image interference?

The whole point of the matter is this: The IF resultant in a superhet receiver may be produced whenever the requisite difference frequency occurs between an incoming signal and the local oscillator, irrespective of their relative positions. This is a potential source of confusion and the designer has to rely on one or more circuits tuned to the signal frequency to eliminate (if possible) the unwanted combinations and resultants.

IF INADEQUATE . . .

If the front-end selectivity is not equal to the task, then spurious and confusing signal responses occur, either due to two signals beating simultaneously with the one oscillator frequency or two oscillator frequencies—at different dial settings—beating with the one signal.

The cause is the same and the effects normally occur in association. If desired, the first can be singled out and described as image response, the second as double spotting.

And there, I think, we can leave the matter rest. R.F.S. has made his point successfully and can retire with honour vindicated. But had R.F.S.'s letter been submitted as a technical article, it would have gone back to him duly decorated with blue pencil marks for the reasons listed.

He would have retired with honour vindicated, to be sure, but also with the Editor's words ringing in his ears:

"Better have another go at it, old Bhoy!"

It's happened before you know.

Good heavens. It might happen *again!*

By way of a change, we reproduce in the panel above a couple of letters, or rather extracts from same, which express readers' views, without the need for any lengthy comment from Yours Truly. In fact, I'm not in a very good position to comment.

In an earlier letter, which was reproduced on these pages, D.F. extolled the virtues of the divided load type amplifier. We published it, wondering whether anybody had any strong feelings on the matter—but to no effect. Not a single extra line, to my knowledge was written, either for or against the idea.

In a way this is understandable, because not too many readers would be in a position to say "I have measured and compared results and find that these

(Continued on Page 121)

SYNCHRODYNE, HI-FI AMPLIFIERS

Dear Sir,—

It was with great surprise, and perhaps a little vanity, that I read this month's issue, with my letter so prominently published re Divided Load amplifiers.

Your non-comment on the subject makes me a little apprehensive of your opinion, but I still think it is more Ultra than ever Ultra was.

My present suggestion is a version of the Synchrodyne receiver. To my knowledge such a set has never been exploited in your magazine. This type of set has disadvantages like any other set, but I think its advantages far outweigh these, certainly much more so than the TRF, which is in December issue.

Push button tuning is the suggested remedy for the heterodyning which occurs with the conventional tuning, but I am inclined towards a system of counter A.G.C., which, until the carrier is brought to a pre-set level, the signal and heterodyne are blocked or diverted.

I know what you're thinking (easily said), but I think it can be done. Either way it's a set which is new and interesting, along with being a really top grade performer.

Sincerely, D.F.

Dear Sir,—

Having visited various trade houses in N.S.W., S.A., and Victoria, I am of the opinion that many (in fact, most) of these are creating false ideas about, and doing harm to, Hi-Fi popularity.

In demonstrating such equipment they make such serious technical errors that they render it almost impossible for a customer to form an opinion of the relative merits of gear available. A bit of publicity by R.T. and H. could help correct this.

Here are some examples:—

1. Using the same load resistance on each of several pickups when demonstrating each successively, instead of using the recommended load.

2. Having gone to a lot of expense in setting up gear, demonstrating it in rooms quite unsuited to the purpose.

3. Demonstrating speakers in enclosures, etc., quite unsuited to such speakers. A glaring case is one I saw recently.

These people had set up a Goodman's 3-way speaker setup, but had used about 3/8in plywood for the front panel of the bass enclosure, which had the Acoustical Resistance unit mounted in it.

The demonstrator said, "This beats the Wharfedale 15in — see where we've plugged up the hole where it was!!!" Not that I am plugging for Goodman's or Wharfedale, but how can they compare the two speakers when the cone resonance is so different and the Wharfedale is not intended to work into the Goodman's enclosure—(of 3/8in plywood!!).

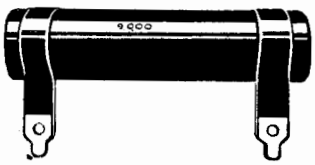
Incidentally, this demonstrator turned the treble down 3 or 4 notches and bumped up the bass. This really did things to the enclosure. "Sounds good, doesn't it?" he said.

I hope you will assist in the campaign for true values in the Hi-Fi game.

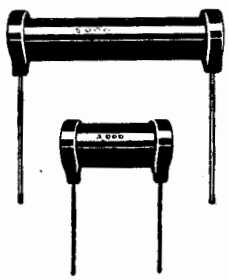
Yours faithfully, H.A.P.

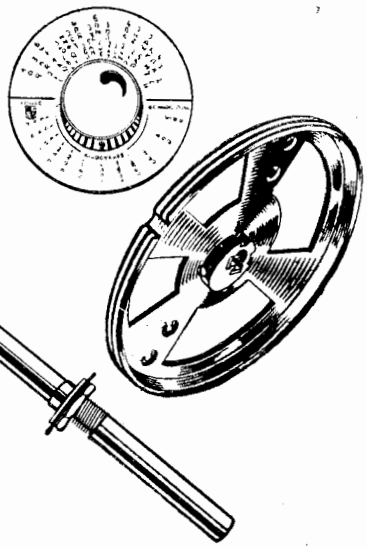
Fine RADIO COMPONENTS

JABEL



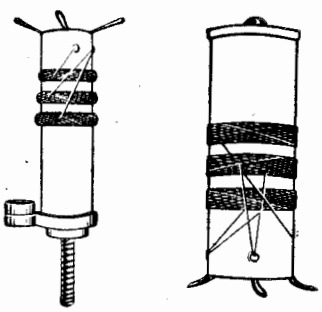
Wire Wound Resistors. 3, 5, 8 and 10 watt, preferred values 5% tolerance, A coat Coat B and C to order.



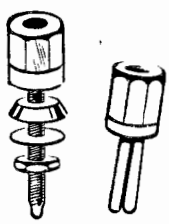


Knob-Dial. Calibrated perspex 180 deg. with stations and Kilocycles. $\frac{1}{4}$" bore, suits direct drive Roblan gangs. DIAL DRUM 5" double track, moulded high impact polystyrene, $\frac{3}{8}$" bore, 2 grub screws.

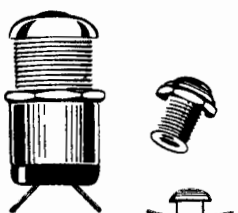
Extension Shafts. 1/4" to 1/4", 1/4" to 3/8", 3/8" to 3/8". Nickel plated with steel grub screws. COUPLINGS 1/4" to 1/4", 1/4" to 3/8" in plated metal; 1/4" to 1/4" insulated. **Expanding Bushes.** 1/4" to 3/8", also 3/16" to 1/4" split brass.



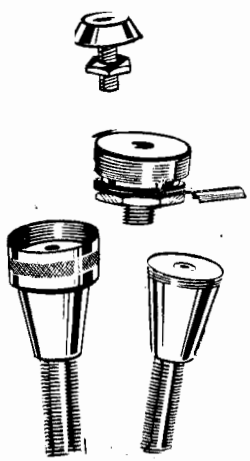
Crystal Set Coil. Three pye, litz wound coil with tappings, mounting base and screw, circuit. REINARTZ type tuning coil, litz wound, iron core and mounting base, circuit.



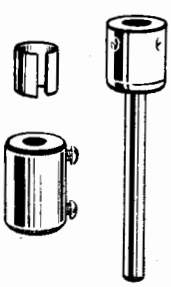
Instrument Terminal With Banana Socket. Red or Black moulded bakelite—takes standard banana plug within captive head. BANANA PLUGS to suit above, also insulated panel BANANA SOCKETS.



Bezels. Chrome plated panel mounting, $\frac{5}{8}$" diameter complete with lampholder, in Red, Green, Amber. Also available in $\frac{3}{4}$" diameter, and bezels only without lampholders, in both sizes. PANEL BEZELS $\frac{3}{8}$" diameter in Red and Green PANEL LENS $\frac{3}{8}$" face, $\frac{1}{4}$" shank translucent plastic with fixing washer, Red, Green, Blue, Amber, Clear.



Dial Spindle Assembly. 1/4" shaft on 3/8" bush, complete with nut and lockwasher. DIAL SPINDLE PANEL BUSH available separately.



Coaxial Connectors. Single contact pressure type, plated finish. Female cable, male cable and male panel fittings.

Discriminating radio engineers, manufacturers and custom-design specialists choose JABEL Fine Radio Components because of their reputation for consistent high quality and reliability which results from many years of accumulated technical experience.

OFF THE RECORD — NEWS & REVIEWS

Articles and comments recently published in our magazine about stereo records have certainly stirred up keen interest. They have also confused many people who are making plans for record-playing equipment. Naturally they do not want to spend good money for items which later they must discard.

IN general, I do not think stereo records will mean casting aside any good equipment you now use, or are thinking about. Naturally, a new pickup head will be needed also a second amplifier and loudspeaker, both of which will supplement the one you have. As long as your turntable is a good one and free from rumble, there seems no reason why you need buy another.

But if you are in the market for a motor, get the best you can afford.

What will be needed—not always forthcoming in an ideal form in the average home—is a good arrangement for the loudspeakers.

It will be necessary to space these several feet apart and to have available a listening position about the same distance from each.

In practice, this may mean placing the speakers against a wall furthest from your normal chair position which is probably near the fireplace if any.

ROOM CHARACTERISTICS

Oddly shaped and highly reverberant rooms are not likely to allow the stereo effect to show up as it should.

Some people appear to have the idea that stereo is by nature part and parcel of hi-fi, by which they imply the highest quality—and cost—equipment.

I don't agree with this at all.

What stereo will give is an extra dimension to sound which so far has been missing, and it will do this whether the original sound is hi-fi or not.

It's understandable. I suppose that anyone used to handling very good equipment can't imagine listening with profit to anything else.

Whereas you and I know that we can enjoy quite modest gear if it is free from obvious and gross sonic malformation which can always be avoided if the owner doesn't try to achieve the impossible.

With stereo, the extra dimension will undoubtedly divert our ears from limited frequency range, and lower output, for, as I have already pointed out, these things will be entirely reassessed with the new records.

VALUABLE ADDITION

In other words, stereo will be a valuable addition to all our present standards, hi-fi or low-fi, both of which terms may suffer considerable modification in the process.

I can foresee that the most popular stereo set-up will be far from elaborate.

It could well consist of a better-than-present-average motor fitted with a crystal pickup from which two outputs are led away. These will feed a twin amplifier with built-in compensation and a minimum of tone controls, if any. Single-ended outputs could be used with no more than about 4 watts apiece, and a common power supply to feed the lot. Two good commercial-quality speakers, possibly 10-inch types, housed in small cabinets of the RJ or back-loaded type would make up the system.

It should not be long before reliable information is available from manufacturers, setting out the standards for the records themselves, and from pickup designers outlining their plans. Even before these details are to hand, we should be able to build up some preliminary amplifiers on these lines, and even use them for a while on a frequency selective basis similar to my old stereoscopic system of about 20 years ago, which I note has been revived somewhat overseas.

Just play the bottom end through one channel and the middle and top end through the other.

Not stereo, but it sounds very good.

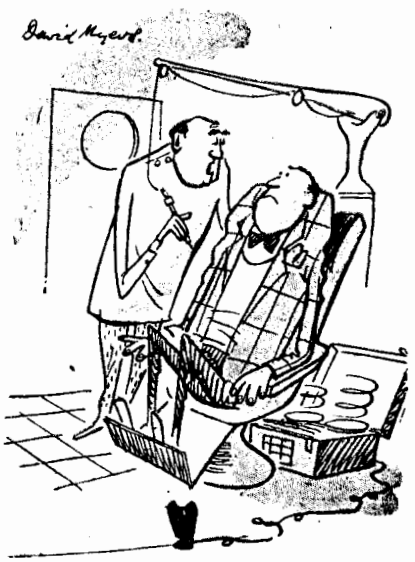
By using it on your single-track records, you could get somewhere near the real thing at all times. Sounds attractive? I think it does.

Strangely enough, I think the major problems might be in handling a really hi-fi stereo system.

Unless the room is quite large, and carefully controlled, multiple speaker set-ups, for instance, could cause some curious effects.

But if you are able to command really good conditions, some fascinating times are ahead.

Like taking a split from each channel and feeding the resultant into a third speaker system spaced midway between the two.



"If this hurts, it's because I need some blood-curdling screams for our Amateur Dramatic Society."
—Record Review

It's going to be interesting to note how successfully we can deal with that "hole in the middle."

Before long I think we are likely to be reading some very learned articles on room acoustics.

They will without doubt be a vital factor in helping us to get the best there is.

RECORD REVIEWS

BRAHMS - Hungarian Dances No 1 in G minor, No 5 in G minor, No 6 in D major and No 10 in F major. Played by the Sinfonia of London conducted by Richard Austin. World Record Club TT1.

DUKAS - Sorcerer's Apprentice. DEBUSSY - Afternoon of a Faun. MOUSSORGSKY - Night on a Bald Mountain. BORODIN - Polovtsian Dances. Played by the Florence May-Festival Orchestra conducted by Vittorio Gui. World Record Club T7.

The World Record Club, now operating in Australia, is joined by paying a 5/ registration fee, upon which a list of records to be issued for the next 12 months is sent out. The member nominates which of these he is prepared to buy, and when ready these are sent to him on a money-back-if-not-satisfied basis. If he doesn't like any of the proposed records, he needn't buy them.

But if he does, they cost only 35/ plus postage for 12in LP's, 27/6 for 10in, and 9/6 for 7in EP's.

Which is a very attractive figure.

The sceptic will ask—at that price are they any good?

Well the names of orchestras and performers are mostly unfamiliar which isn't to say that they are not of good quality.

Some of the orchestras are made up of players from world-famous combinations, and some are probably these orchestras themselves under different names.

GOOD STANDARD

The EP of Hungarian Dances, which is sent free to each registering member, is a good sample of the standard I have so far observed, and there is nothing second rate about it.

Technically it doesn't enter the very top flight, but then very few records do. Definition suffers a little through exuberance, and there is a difference in quality between No 1—which is particularly good—and the remaining three.

Otherwise it is bright and attractive, clean and well defined in the top register, and with low surface noise.

The 12in LP seems a very good buy. Best of the items I thought was the Debussy, which can stand comparison with just about any other version. The

Sorcerer's Apprentice isn't as analytical as the score suggests it might be, but it has the essential excitement and its drama is well shaped. The Polovtsian Dances could have been a little brighter, but many people play them this way.

The sound is again bright and clear, and the surface good.

★ ★ ★

MOZART PIANO WORKS VOL. 10—Sonata in C major K330; Sonata in C major K309; Rondo in D major K485; Eight Variations in F major K352; Capriccio in C major K395. Played by Walter Gieseking. Columbia 330CX 1428.

There isn't a great deal to be said about this record which has not already been said about the earlier volumes.

Gieseking plays with a small, light fingered tone, crystal clear in its enunciation, and beautifully controlled throughout.

He gives the sonatas a limpid quality which is always delightful and always charming, and in most of the material here recorded it comes off very well.

Mostly his tempo is brisk, and he shows little tendency to linger when the temptation offers.

And frankly this is a good thing, nowhere more successful than in the Andante of the K309.

And yet equally welcome would have been a little more brightness, for instance, in the Rondo of the same sonata.

But there is far too much music here to go through it in detail, nor would there really be much profit in doing so.

It is all so consistent and balanced in performance as to resist such treatment.

I liked it as well as any of the nine discs which have gone before, and despite a few reservations most people seem to have about Gieseking's Mozart, that is high praise.

The piano recording is good, and the surface noiseless.

★ ★ ★

MOZART—Bassoon Concerto in B flat major K191; Six Prague German Dances K509; Two Marches K335. Played by Rudolf Klepac (bassoon) and the Salzburg Mozarteum Orchestra conducted by Ernst Marzendorfer. DGG LPM 18297.

It was a feature of Mozart's versatility that he could write fluently and successfully in almost any musical form, so that even the prospect of a bassoon concerto did not cause him any embarrassment.

Not only that, but despite the difficulty of his task, he produced a most tuneful piece of work.

The contribution to orchestral colour made by the bassoon is valuable and unique, but it is a tribute to all concerned that at no time does it sound ridiculous in this concerto.

Once or twice it gives out with some very sad tones, and an odd excursion into the lower registers could be likened by the unreligious as a distant relation to a raspberry.

But when you get through your fashionable and almost inevitable smile, you will realise that the bassoon isn't necessarily an odd or awkward instrument, despite the fairly close miking it was almost impossible to avoid.

Klepac plays with a full and rather luscious tone, making the most of his melodious part and handling technicalities with ease.

The German Dances and Marches on the other side are extremely well played—obviously the orchestra doesn't carry the name of Mozart for nothing.

To a completely satisfying musical standard you can add an equally satisfying recording, smooth and easy to play relaxed and sure in its approach.

Good value for its content and its execution.

★ ★ ★

THE INK SPOTS—Twelve Popular Numbers sung by themselves. Tops L1561

There have been changes in the Ink Spots combination since their palmy days about some 15 years ago, and to be quite honest none of the changes has improved upon or equalled the original team.

Particularly the bass, whose inimitable monologues in those early records were classics.

However, to some extent the better recording of the present company makes up for the difference, although the leader has a huskiness to him which wasn't there when we were all younger.

You will meet again many favourites such as "Into Each Life," "Whispering Grass," and "Making Believe." But what happened to "Address Unknown" and "It's Funny to Everyone But Me?"

The Ink Spots still command a big following, and if you are part of it, this is for you.

The recording is very good.

Incidentally this is a new label of popular music, distributed in Australia by Philips.

★ ★ ★

ADVENTURES IN SOUND—Preludes to Acts 1 and 3 (Traviata); Intermezzo (Cavalleria Rusticana); Overture (Cleopatra); Sicilian Vespers Overture; Notturno in G flat (Martucci); Dance of the Hours (Ponchielli) Played by the London Symphony Orchestra conducted by Pierino Gamba. Decca LX1 5325

Decca's latest sound technique is very different from that of the early days, when pre-occupation with the higher register produced some awkward moments particularly on hi-fi gear.

Today the accent is on balance.

This balance combines every feature in modern recording, frequency response, volume contrasts, the instruments themselves, all combined with a sense of immediacy which is unmistakable.

You'd need to be tone deaf to miss it.

It is very difficult to criticise sound of this order. But I would emphasise that there is nothing exhibitionist about it. This isn't a disc to stun your visitors in showers of brilliant percussion or deafen them with decibels.

Every item is an example of music, superlatively played and superlatively recorded.

It's true that by the time you have played it out, Decca will have demonstrated pretty well the whole range of orchestral resource.

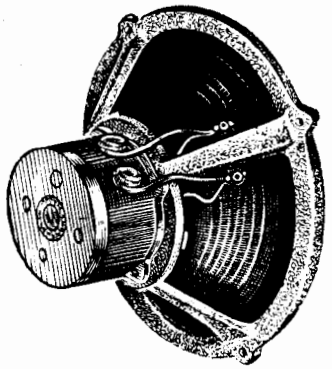
And although you will hear amazingly fine massed strings, subtle metallic noises, strongly bowed basses, and deep strings which for all their quiet accompaniment somehow vibrate your floor-boards, and so on and so on, the true accomplishment is in the cohesion and realism with which they have been blended.

If you listen into the music of Traviata, for instance, or the Dance of the Hours, you will literally discover things you haven't heard before.

This clarity can only be obtained by

Wharfedale

for LOUDSPEAKER SUPREMACY



"The First Wide Range Speaker to sound like True Music . . . ."

(Statement made by leading professional musicians.)

Comparative Listening Tests have proved the Supremacy of Wharfedale Speakers for Absolutely Natural Reproduction. That is why the world's leading manufacturers of high quality amplifiers and pickups (incl. American) recommend Wharfedale Speakers: they do fullest justice to their product.

The Super 12"/FS/AL Speaker

Illustrated above, is fitted with aluminium voice coil, special cone with bakelised apex, and radial corrugations, plus the undoubted advantage of foam suspension. This assembly, with the extremely high flux density, results in excellent transient response and sensitivity with a very wide frequency range. Since the introduction of this model some years ago, the world-wide demand has always exceeded the supply.

Stock position is now improving.

Specifications: Alcomax III Magnet: Flux density 17,000 lines on 1¾in centre pole. Total Flux 190,0000 lines.

We also recommend the following models:

NEW SUPER 3"

A new and highly efficient treble unit for use at frequencies above 3,000 c/s on FM transmissions and wide range record reproduction. Frequency response 3,000c/s—20,000c/s.

SUPER 8" FS

For refined quality up to 6 watts, or for use as Middle or Treble Speaker with cross-over network.

SUPER 8" FS/AL

An outstanding Treble Unit with aluminium speech coil and response maintained up to 20,000 c/s. This model is recommended for use in twin-speaker systems

WHARFEDALE 10" FSB

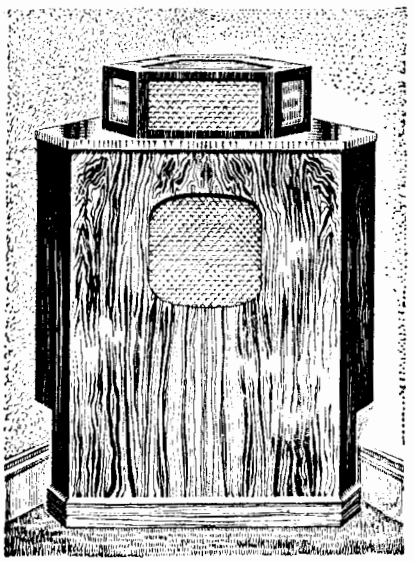
After the Super 12"/FS/AL the 10"/FSB, fitted with wide-response cone and aluminium dome, is the best single speaker in the Wharfedale range

WHARFEDALE 12"/FS

The 12"/FS makes a very good bass unit with suitable reflex loading and a cross-over between 400 and 3,000 c/s, and is the "next best" to the Wharfedale 15"/FS.

WHARFEDALE 15"/FS

Now generally recognised as the best low frequency unit so far produced in England or any other country! This speaker is designed for smooth response between 25 and 2,000 c/s with heavy cone and long speech coil. It is the ideal speaker for cross-over networks. When provided with 8 or 9 cubic feet of air loading the cone resonance is below 25 c/s.



Sand-filled Corner Enclosure as recommended by Messrs. Wharfedale.

Illustration shows unit in use with middle and high frequency speakers facing upwards.

(N.B. This unit also recommended as the ultimate for the Super 12" FS/AL speaker and twin speaker systems.)

The foam suspension, employed in all Wharfedale Speakers, lowers the bass resonance and gives a very smooth "top."

Also now available: The new Wharfedale Bronze 10" FSB

For all further information we suggest you contact your Radio Retailer.

Australian National Distributors:

Simon Gray Pty. Ltd.

28 ELIZABETH STREET, MELBOURNE C.1. Telephones MF 8211, MF 8166

the very greatest care in mike placement, reverberation control, the fixing of presence, the control of distortion, particularly intermodulation, right through to the finished cut, and the reduction of background noises to zero.

There's some mighty fine engineering going on with discs at the moment. This is Decca's way of showing you what it can do, and it will take some beating.

★ ★ ★

HANDEL - The Messiah. Adele Addison, David Lloyd, Russell Oberlin and William Warfield with the New York Philharmonic Orchestra and Westminster Choir conducted by Leonard Bernstein. Coronet KLC 626/7.

Bernstein has already achieved notable success in his explanations of jazz and Beethoven to the unconverted. He performed both tasks with imagination and with an admirable knowledge of his subject matter.

Obviously he has viewed the Messiah as great music in which tradition is in danger of obscuring the greatness.

In this version he has done two things. Firsty he has rearranged the 41 sections into two halves—a Christmas half and an Easter half. Frankly I don't think this is very important, as few listeners hear the work in a continuous manner.

Secondly he has insisted that all concerned sing it with vigour and awareness—he has tried to bring it down to earth from a somewhat distant pedestal.

He has succeeded in this, but in doing so he has lost an air of grandeur which I think is important to hold it together. His close proximity has thrown great emphasis on individual performances.

Of the soloists, Warfield is easily the best. He has warmth and dignity and understanding which if not remarkable are most commendable. Lloyd, the tenor, is quite well cast, but with a vibrato which sometimes interferes with pitch registration.

The others support well, and each has high spots.

The orchestra is extremely good, but the choir has varied success. Technically all four sides are high class.

As compared with previous versions, this one classes itself. It is good to hear the vigour in choruses such as Unto Us a Child is Born, and it compensates for the other passages not so successful.

I must stress that this is an important and a sincere recording, not to be suspected merely because it is different. In the final account of profit and loss it needs no apologies. In the illuminating jacket notes, Bernstein himself makes his case, and in the recording itself he has amply justified it.

It's a stimulating and often inspiring piece of work.

★ ★ ★

BEETHOVEN — Concerto for Piano and Orchestra No. 1 in C Major, Opus 15. Played by Wilhelm Kempff and the Berlin Philharmonic Orchestra, conducted by Paul van Kempen. DGG 18129 LPM.

Kempff is a man whose contribution to recording is best considered as a whole. He has now produced so many fine discs, particularly of Beethoven, which, like those of Backhaus or of Gieseking, can be collected for thier own sake, as well as for their own worth.

This version of the Beethoven No. 1 Concerto is a case in point.

You cannot hear it without being aware of the man's own brand of musicianship, personality, and his long devotion to his craft.

Whether you always agree with what is being done isn't particularly significant. With a musician of his experience and maturity, everything is of importance and worth respect.

I have heard this work played dozens of times, and most of them have impressed me as being little more than playthroughs.

It is an early work, and has enough in it of Beethoven's predecessors to sound very like them in parts, if played that way.

With Kempff, only Beethoven could have written it.

He brings the first movement to life in a dozen different ways of illuminating a phrase, or turning a corner.

He plays the second movement quite slowly, much more so than is normal, and as I am fond of pointing out, that is very, very difficult with Beethoven.

But once again, he is not to be caught out; his phrasing, sense of musical shape, and his trick of making one anticipate every note to come sustain the music and justify his view of it.

The sound is satisfying, although it has a characteristic often heard with DGG which endows a slightly tubby effect to the bass.

It is the best version of the concerto I have heard to date.

★ ★ ★

BEETHOVEN—Violin Concerto in D major Opus 61. Romance No. 1 in G Opus 40; Romance No. 2 in F Opus 50. Played by Bronislaw Gimpel and the Bamberg Symphony Orchestra conducted by Heinrich Hollreiser Vox APL 9340.

This isn't a "big" version of the Beethoven, but it is a very beautiful one.

Gimpel has emphasised its lyrical qualities, and rarely strives to find anything heroic in the music.

We are given a hint of this in the jacket notes, which labels the concerto as "sweet."

Not only will most people find this an inadequate and misplaced epithet, but Gimpel himself obviously has rather more extensive ideas about it.

So please don't be put off by such an assessment, for if you do you will be the poorer by an extremely good version.

If Gimpel is new to you, as in effect he is to me, let me say that he is a most musicianly player. His tone is on the fine side, but sensitive; his intonation is rock steady and his lyricism has sincerity which never degenerates.

He is a fine technician, too, despite a tendency to rush odd phrases which, particularly in this concerto, would have been more effective with greater steadiness.

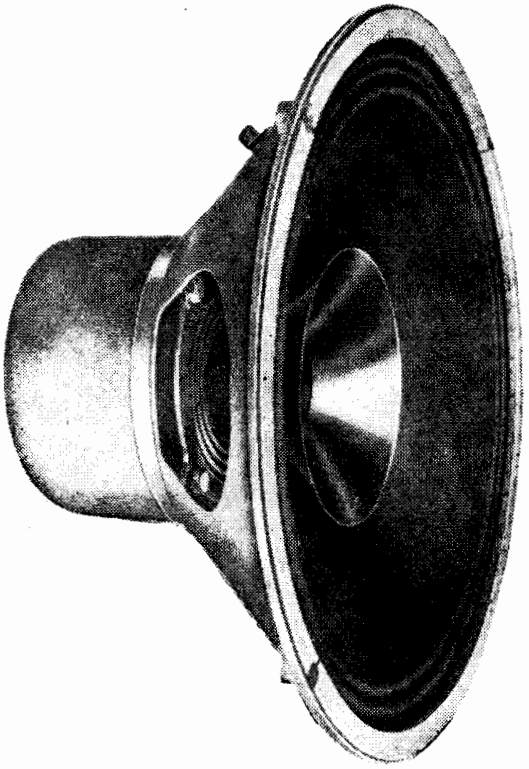
But this is splitting straws—if we leave out the one or two heavyweights in the field, no one has surpassed his work.

The orchestra, in its performance and its recording, is of the same general character.

It doesn't compare in size with some others, nor does it sound as forward, but is very clean and has a nice frequency balance.

It is axiomatic...

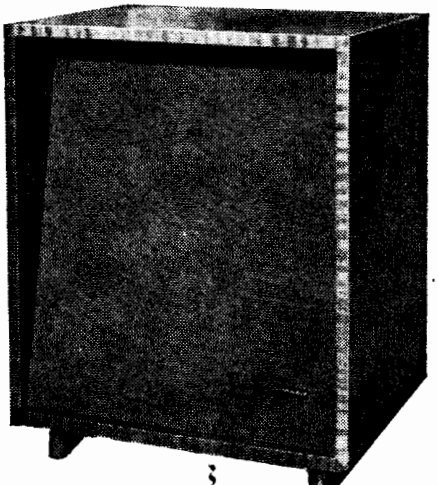
that with most manufactured articles, including Loudspeakers, a relatively small improvement in performance will raise the cost by a disproportionate figure. Therefore at some point in the price range a product will emerge which represents the best value for money. Amongst GOODMANS wide range of High Fidelity Loudspeakers this product is the AXIOM 150 Mk. II, which is outstanding for value and probably the most popular High Fidelity Loudspeaker in the world.



The full versatility of the AXIOM 150 Mk. II is described in GOODMANS new "High Fidelity Loudspeaker Manual." This publication contains details of all GOODMANS High Fidelity products. Available free on request.

AXIOM 150 Mk. II SPECIFICATION

Type:	Twin diaphragm 12" direct radiator on cast chassis.
Frequency Range:	30 c/s to 15,000 c/s
Fundamental Resonance:	35 c/s
Maximum Power Handling Capacity:	15 Watts.
Flux Density:	14,000 gauss on 1½" dia. pole.
Total Flux:	158,000 maxwells.
Impedance:	15 ohms at 400 c/s.



A really good Loudspeaker Unit relies on and repays careful attention to its acoustic loading. In the case of the AXIOM 150 Mk. II, this consideration is fully catered for in the "SHERWOOD" Enclosure. The "SHERWOOD," which has been scientifically designed to load ALL GOODMANS 12in low resonance Loudspeakers, incorporates the Acoustical Resistance Unit (ARU. 172). Provision is made for the addition of a TREBAX High Frequency Pressure-Driven Unit.

GOODMANS

GOODMANS INDUSTRIES, LIMITED,
WEMBLEY ENGLAND

SOLE AUSTRALIAN AGENTS:
BRITISH MERCHANDISING PTY. LTD.,
Box 3456 G.P.O., SYDNEY

BRITISH MERCHANDISING PTY LTD
BOX 3456 G.P.O SYDNEY

Please send a copy of GOODMANS "High Fidelity Loudspeaker Manual" to:

Name .....

Address .....

..... RH/4/58

The violin stands out well from its background without being unduly prominent, and despite a reverberation a little higher than normal, everything is clean and sharp.

The Romances follow the pattern of the concerto, and on the whole there is a great deal of fine music on this disc.

It would be difficult to fit it all in without some sacrifice of dynamic range, but the nature of the recording doesn't demand it.

To make the most of the available space, the first side opens with Romance No 1 and the second ends with No 2.

This is a very good, smooth production, and I'm sure it will win many friends.

★ ★ ★

LALO—Symphonie Espagnole in D Minor Opus 21. Played by Bronislaw Gimpel and the Munich Philharmonic Orchestra, conducted by Fritz Reiner. DGG LPEM 19071.

The most impressive recording of this work is that of Stern for Coronet. It has a tremendous amplitude, and Stern produces a powerful performance.

But if you are looking for one which represents more completely the sensitivity and lyricism of the music, you will look to this new disc, whose only rival is an older Decca with Campoli.

In many ways these two have much in common, but I would choose Gimpel, who, while technically the equal or superior to Campoli, plays with greater vitality and even greater deftness.

The recording itself is rather remote —don't expect to find one of those overpoweringly vivid violin recordings in which the bow brushes the end of your nose.

It has been engineered in concert-hall style, with no obvious attempt to vary the balance in the softer passages.

If Gimpel has a powerful arm it doesn't register very strongly here, and there are times when closer miking it would have helped.

Otherwise I thought this a lovely record. The music is a favourite with me, and for that matter its charm and tunefulness are immediate to everybody.

I like it best to date.

★ ★ ★

STRAVINSKY — Petrouchka. Played by the Philharmonia Orchestra conducted by Efrem Kurtz. HMV OALP 1503

Petrouchka was already famous in the world of ballet when recording came into its own, and it was a perfect medium for Decca's LP of about nine years ago which created a sensation in the industry.

That disc, by Ansermet and the Suisse Romande orchestra, made many reputations, and has now become part of gramophone history.

Since then, a number of versions have been released, and in each case the recording engineers have undoubtedly set out to surpass it.

It has become, with Pictures at an Exhibition by Mercury, an unofficial test piece for all.

So far, only Dorati for Mercury, with the same orchestra which made history with the Pictures, has clearly exceeded Decca's milestone. This latest member of the family would also be granted that honour, but not so clearly.

I say this because Dorati's disc is outstandingly good for its immense frequency and dynamic range, and for the excellence of its theatre.

After all, this is ballet music, and no matter how we rationalise a concert version, must retain the essential drama and point of the score.

I don't think Kurtz has realised this nearly as well.

The most obvious example is in the closing passages in which Petrouchka is slain by the Moor, to lie a pathetic and twitching heap on the stage until the Magician, dragging the mess of rag and sawdust into the wings, is horrified to see the spirit of his puppet mocking him from the roof of the stall.

The music is alive with every moment of this, and Dorati does it so well as almost to make up for the absence of the scene.

But Kurtz's drama is rather dim.

In the main, it is the story of a good version being overshadowed by an exceptional one, for there is no doubt that the Philharmonia plays well.

★ ★ ★

BRAHMS—Double Concerto in A minor Opus 102. Played by David Oistrakh (violin), Pierre Fournier (Cello) and the Philharmonia Orchestra conducted by Alceo Galliera. Columbia 33OCX 1487

This was the last orchestral work of Brahms, and in some ways it is a curious combination. Quite a few major composers have written concertos for more than one instrument.

The single instrument concerto is a comparatively recent development if we consider the history of music as a whole.

In the main it has a greater impact than one in which more than one soloist is used, for it has a unity of thought and of purpose almost impossible to obtain where the interest is divided between multiple players and types of instruments.

The over-all effect of this concerto is unique. In selecting instruments at opposite ends of the string family Brahms has used them to enlarge the orchestral texture rather than to give them the full lead.

Their contribution, of course, is a most important one, and we hear them individually almost from the start, but their work is complementary in sustaining movement and force of ideas.

For this reason, it is difficult to avoid a sense of dispersal and lack of cohesion, nowhere more apparent than in the first movement, which is the heart of the work.

It is almost inevitable, too, that one or other of the soloists will assume a lead which, by implication, was not intended, otherwise there would be no point in specifying two instruments in the first place.

In this instance it is the cellist, who announces his presence in the first few bars, and who overshadows his colleague whenever opportunity allows.

Some of this is due to the caprice of recording, which, in demanding that particular attention be paid to the instrument with the least naturally prominent voice, cannot avoid highlighting its strength which emerges under close miking.

Very few cellos sound as powerful on the concert platform.

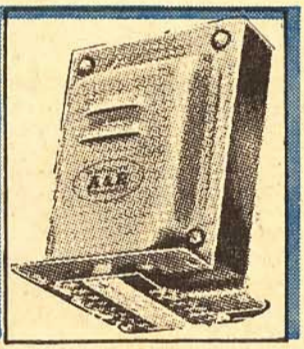
Oistrakh, in addition, is unusually re

ELECTRONIC **A&R** EQUIPMENT

Transformers

FOR THE ULTIMATE IN ...

...performance...reliability...appearance!



POWER TRANSFORMERS

Type	D.C. mA	Prim. Volts.	Sec. Volts.	Filaments
1763	100	200 — 230 — 240	300-CT-300	5V-2A; 2 x 6.3V — 2A
1764	"	" " "	325-CT-325	" "
1765	"	" " "	385-CT-385	" "
1766	125	" " "	285-CT-285	" "
1767	"	" " "	300-CT-300	" "
1768	"	" " "	325-CT-325	" "
1769	"	" " "	350-CT-350	" "
1770	"	" " "	385-CT-385	" "
1771	150	" " "	285-CT-285	5V-3A; 6.3-2A; 6.3-CT-2A
1772	"	" " "	325-CT-325	" " "
1773	"	" " "	350-CT-350	5V-3A; 6.3-3A; 6.3-CT-3A
1774	"	" " "	385-CT-385	5V-3A; 6.3-CT-3A; 2.5-5A

Type	D.C. mA	Prim. Volts.	Sec. Volts	Filaments
1775	150	200 — 230 — 240	385-CT-385	5V-3A; 6.3-3A; 6.3-CT-3A
1776	175	" " "	285-CT-285	" " "
1777	"	" " "	325-CT-325	" " "
1778	"	" " "	350-CT-350	" " "
1779	"	" " "	385-CT-385	" " "
1780	200	" " "	350-CT-350	" " "
1781	"	" " "	400-CT-400	" " "
1782	"	" " "	450-CT-450	" " "
1400	250	200 — 220 — 230 —240 v	565-500-425 a side	2 x 6.3V-3A; 5V-3A 2 x 2.5V-3A
1371	300	" " "	1000, 850, 750, 600, 500 a side	

ULTRA-LINEAR

TYPE 931-15: 20 watts
Prim.: 4500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60,000 cps
Valves: EL37 KT66 6L6 etc.
19% Screen Taps

TYPE 931-8: 20 watts
Prim.: as 931-15.
Sec.: 2 or 8 ohms
Resp.: As 931-15
Valves: As 931-15.
19% Screen Taps

TYPE 921-15: 20 watts
Prim.: 6600 ohms P.P
Sec.: 3.7 or 15 ohms.
Resp.: 10-60,000 cps.
Valves: 807, KT66, etc.
19% Screen Taps.

TYPE 921-8: 20 watts.
Prim.: As for 921-15.
Sec.: 2 or 8 ohms.
Resp.: As 921-15.
Valves: As for 921-15.
19% Screen Taps

TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6BW6, 6V6, KT61, etc.
19% Screen Taps.

TYPE 916-8: 12 watts.
Prim.: As 916-15.
Sec.: 2 or 8 ohms.
Resp.: As for 916-15.
Valves: As for 916-15.
19% Screen Taps.

TYPE 949: 12 watts.
Prim.: 8000 ohms P.P.
Sec.: 2, 8, 12.5 and 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6V6, 6BW6, KT61, EL84, etc.
19% Screen Taps.

HIGH FIDELITY

FOR MULLARD "5-10" AMPLIFIER

TYPE 2525 — 12 watts.
Prim.: 8000 or 6000 ohms CT.
Sec.: 8: 2 or 8 ohms
15: 3.7 or 15 ohms
Response: + — 1 db 10-100,000 cps.

SPECIAL HI-FIDELITY +—, 1db 20-40,000 cps
OUTPUT TYPE

TYPE 870 — 6 watts.
Prim.: 10,000 ohms P.P.
Sec.: 2 or 8 ohms.
(for "Rola" 120X)

TYPE 871 — 12 watts.
Prime.: 10,000 ohms P.P.
Sec.: 2 or 8 ohms.

TYPE 872 — 12 watts.
Prim.: 10,000 ohms P.P
Sec.: 3.7 or 15 ohms.

HIGH FIDELITY +—1db 30-15,000 cps
OUTPUT TYPE

TYPE 763 — 15 watts.
Prim.: 5000, 3000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms

TYPE 920 — 15 watts
Prim.: 5000, 4000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms

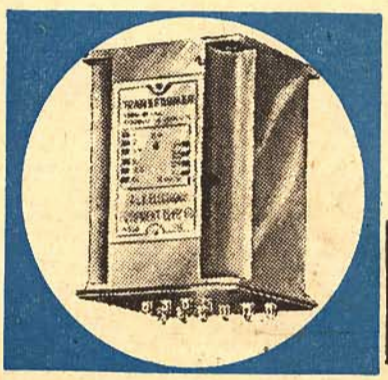
TYPE 897 — 15 watts
Prim.: 10,000, 8000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 896 — 15 watts.
Prim.: 10,000, 8000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

MEDIUM FIDELITY +—2db 50-12,000 cps

Type	Watts	Primary	Secondary
809	15	500 ohms	15, 12, 8, 3.7, 2 ohms
914	15	5000, 3000 P.P.	500, 250, 166, 125 and 106
915	15	5000, 3000 P.P.	15, 12.5, 8, 3.7 and 2
917	15	10,000, 8000 P.P.	500, 250, 166, 125 and 100
918	15	10,000, 8000 P.P.	15, 12.5, 8, 3.7 and 2
922	25	8000 P.P.	500, 250, 166, 125 and 100

Type	Watts	Primary	Secondary
891	35	6600 P.P.	500, 250, 166, 125 100, 83 ohms
892	55	3200 P.P.	500, 250, 166, 125, 83, 62 and 50
928	5	7000, 5000 S.E.	12.5, 8, 3.7 and 2
929	10	4000, 2500 S.E.	15, 12.5, 8, 3.7 and 2
930	10	4000, 2500 S.E.	500, 250, 125
932	7	10,000 P.P.	15, 12.5, 8, 3.7 and 2



WRITE, CALL OR 'PHONE OUR DISTRIBUTORS FOR FREE ILLUSTRATED SPECIFICATION SHEETS

Victoria: Homecrafts P/L., J. H. Magrath and Co. P/L., Radio Parts P/L., Warburton Franki Motor Spares Ltd. **Sth. Aust.:** Gerard and Goodman Ltd., 196 Rundle St., Adelaide. **Qld.:** A. E. Harrold, 123 Charlotte St., Brisbane; Messrs. Chandlers P/L., Cnr. Albert and Charlotte Sts., Brisbane; Trackson Bros., 157 Elizabeth St., Brisbane. **W. Aust.:** A. J. Wyle P/L., 1064 Hay St., Perth. **Tas.:** Homecrafts P/L., 220 Elizabeth St., Hobart. **N.S.W.:** Factory Reps.: R. H. Cunningham P/L., Meadowbank; United Radio Distributors P/L., 175 Phillip St., Sydney; Homecrafts P/L., 100 Clarence St., Sydney.

A & R ELECTRONIC EQUIPMENT CO. PTY. LTD.

378 ST. KILDA ROAD, MELBOURNE, S.C.1

Telegrams: "ARLEC," Melbourne. MX 1150, MX 1159

strained, and perhaps less happy in the mood of the music, but his mastery is always there, and it would be hard to argue on any standard of balance where such complex values are to be accomodated.

Having made these remarks, there is little more to say except that the overall result isn't just good as we would expect—it is mostly superlative.

It is important and beautiful music, and I strongly commend it to every music lover as a disc not likely to be excelled for many a day.

The Overture has received more urgent and vigorous treatment, but its quality is sufficient to make it a valuable asset in support.

Musically and technically, this is very nearly five star standard.

★ ★ ★

BEETHOVEN—Symphony No 9 in D minor Opus 125 (Choral). Played by the Hague Philharmonic orchestra and the Amsterdam Toonkunst Choir conducted by Willem van Otterloo. Philips S 04040 L.

Two single-disc versions of the Ninth in one month is a bit hard on reviewers, for whichever way you look at it, someone must steal someone else's thunder.

The Philips version was made originally some years ago, and it was a very good one, not bristling with high spots but with very few of the obvious flaws of more spectacular issues.

For instance its choral section was always among the best in that the voices were cleaner and less liable to distortion than on some others.

Some time later it was issued a second time, but from newly made masters.

It was obvious that someone had been to work to highlight its sound, for it displayed a much re-inforced bass end which I thought improved it, plus other commendable features.

The only difficulty was that, in bringing up the bass, a hum had made its appearance, clearly heard on high quality equipment.

This, then, is the third version of Philips Ninth, and it bears more relationship to the first issue than to the second.

As with the Vox, compressions have been made, but they are judicious

For general consumption, in which ordinary commercial radiograms will be used, I don't suppose many will notice much difference, but for the sake of the many who have something better, I hope the fashion of fore-shortening big works won't get out of hand.

Despite the optimistic reports of some reviewers, there is a difference, and plenty of listeners want to avoid the compromise and will pay the extra money to do so.

With the Philips version you are lucky. You can take your pick, and either buy is a good one.

★ ★ ★

BACH — Toccata and Fugue in D minor, Preludes and Fugues in E minor, A minor, C major and C minor. Played by Albert Schweitzer (Bach Organ Music Volume 1). Coronet KLC592.

Bach and Schweitzer are almost synonymous today, for the latter's reputation as a player of the great organ works is world wide.

It is for this reason I think his records will be valued most, and, to tell the truth, there are not many other versions to be had.

The recordings are satisfactory without being brilliant, the only flaw being a change of pitch when the A minor fugue comes in, probably due to the tape machines. A pity this couldn't have been adjusted, for it's just enough to be a worry.

The better one knows Bach, according to Schweitzer, the more one learns to play him slowly. This principle is carried out on this record, for the tempos are extremely steady.

Some of it I feel may be due to tired fingers, for the organist is an old man, and, although this record was probably made a few years ago, not as deft as he used to be.

But, despite any such criticisms, the day will come when people no longer able to hear him in the flesh will turn to his recordings to find out how Schweitzer did it.

And this alone gives them a particular value.

★ ★ ★

DINNER MUSIC FOR PEOPLE WHO AREN'T VERY HUNGRY. Spike Jones demonstrates your Hi-Fi. Twelve numbers on two sides. Verve MG V-4005.

Hilarious high-fidelity with a great deal of typical Spike Jones foolery throughout.

Many of them are deadly plagiarisms of popular artists well known on records.

George Rock's "Little Child" in imitation of Frankie Lane and Jimmy Boyd is a natural. The Sow Song and the barking dogs who break into the number popularised by Dean Martin are only two highlights.

A couple of old favourites brought to life are the Blue Danube and Chloe.

Altogether there are 45 special noises, not forgetting the 1911 Black Hawk Stutz which somehow get in.

The recording is very definitely hi-fi, with tons of range and a nice, quiet surface.

Maybe the sibilants are overcut a trifle, and an isolated, difficult note below perfection, but only the meticulous will bother about that.

If you are a Spike fan you will know what to expect.

★ ★ ★

SYMPHONIC DANCES — by Tchaikowsky, Kabalevsky, Grieg, Weinberger, Ravel, Gleire, Bizet, Massenet, Delibes, Khachaturian, and Saint-Saens. Played by the Hollywood Bowl Symphony Orchestra conducted by Felix Slatkin. Capitol P-8369.

No one can complain of short measure—here are eleven of the most popular from the light classical field, and all types of music are represented

None of them places much strain on the orchestra, but it plays them all easily and competently.

The sound is typically clean Capitol, situated in the mid-distance and with no favourite frequencies.

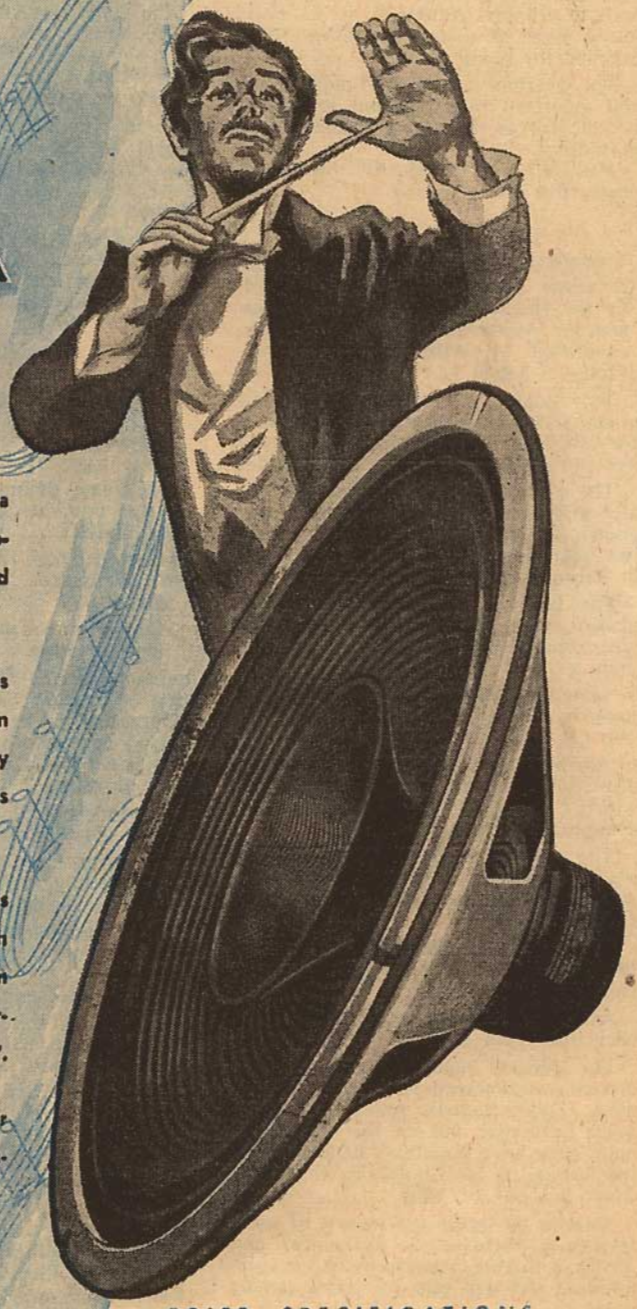
It sounds well on any kind of gear, and very good indeed on a good outfit with a goodly level.

Of its type it can be recommended.

Another new

ROLA

LOUDSPEAKER



Model 12MX, the latest addition to the Rola range, has been designed to give improved reproduction from better class amplifiers, radiograms and TV receivers.

This new, low-cost, triple-cone loudspeaker does not need special baffles—it works excellently in conventional open back cabinets and has a frequency response and power handling capacity which is outstanding in its price class.

The frequency response of Model 12MX extends from 60 to 11,000 c.p.s. and is extremely smooth throughout. The large area of its 12" diaphragm provides excellent bass, and the low frequency performance of Model 12MX is notably free from 'boom'.

All in all, this is an outstanding loudspeaker for the radio, radiogram or TV user who seeks high-grade sound at moderate cost.

BRIEF SPECIFICATIONS

Fundamental Resonance	65 c.p.s. ± 5 c.p.s.
Frequency Response	60 c.p.s. — 10 k.c.
Power Handling Capacity	7 watts

ROLA COMPANY (AUST.) PTY. LTD.

RICHARD STRAUSS—Sinfonia Domestica, Opus 53. Played by the Saxon State Orchestra, Dresden, conducted by Franz Konwitchny. DGG LPM 18331.

This symphony, or tone poem if you like, is a musical portrait of married life in the Strauss family, and as such it probably meant a good deal to the composer.

And, by following the score or the programme, and being suitably impressed at the right moments, no doubt the listener can be at one with him should he so desire.

But as so often happens when a composer consciously bends his talents to a special occasion, there is much difference of opinion as to the successful outcome.

I join with those who agree with conventional criticism which says this is a very long and involved way to portray one's domestic relations in detail, no matter how happy these may be.

I find it more rewarding to forget the programme and listen to the music as I find it.

After all, the jacket notes remind us that Strauss declared he saw no difference between absolute and programme music as it concerns this work. I cannot follow him in this.

But it is big enough and well enough written to be taken seriously.

Acoustically it is most reverberant, almost dangerously so. Otherwise the recording is good, and the concert hall atmosphere at which it aims is convincing.

It adds trailing ends to the sounds, so that many passages blend into a not unpleasant overhang, and this robs many moments of the impact they should have.

The orchestra has plenty of size. Frequency and dynamic range are good, but not as wide as they would have been with a closer recording technique.

★ ★ ★

JOHANN STRAUSS — Fledermaus, with new lyrics and libretto in English featuring Lily Pons, Ljuba Welitch, Richard Tucker, Charles Kulman, Martha Lipton, John Brownlee, and the Chorus and Orchestra of the Metropolitan Opera Association conducted by Eugene Ormandy. Coronet KLC 612-613.

Coronet have turned out a tasteful and informative production, with a full and new English text as used by the Metropolitan Opera of New York.

Although the records themselves contain only the musical numbers, together with a few examples of the spoken lines to help tie it all together, this text is of the greatest value to the listener.

Perhaps it is as well that we don't hear it all, for those members of the cast who do speak are not particularly convincing.

This is perhaps the fate of most performances in which English words are used. Few operas are blessed with good libretti, and generally sound best when another language is used, provided we know what is going on.

It seems much harder to do it well in our mother tongue.

Recently Columbia issued a version of Fledermaus with a European cast and the Philharmonic Orchestra. It was a superb issue, and makes comparisons extremely difficult.

The recording of the Coronet set is more forward and in many places better than Columbia's, but the latter had a bloom to it which the Metropolitan cast don't match.

It also had the superb presence of Schwartbkopf, who is particularly good in such things.

Lily Pons is the darling of the American opera world, but she hasn't the same charm, and it must be confessed, doesn't always sing precisely in tune.

It would be rather tedious to present a detailed comparison of all the characters. It is simpler and just as effective to say that I thought the Coronet version a lively and gusty performance, and well recorded at that. But it is not as smooth nor as subtle as Columbia's in which, by the way, John Brownlee is heard as Dr Falke.

It is presented by the best team America is likely to gather together, and that isn't to be taken lightly.

Technically it is extremely good, with clean sound and quiet surfaces. And if you like to hear and understand the words, you will find the new text an advantage.

★ ★ ★

CHABRIER — Espana Rapsodie; RAVEL—Rapsodie Espagnol; IBERT—Escales. Played by the Detroit Symphony Orchestra, conducted by Paul Paray. Mercury MG 50056.

The quality of the recording hit me first and hardest. It is one of those brilliant, single-mike Mercurys in which every tiny touch of a triangle and brush of a bow comes out with a realism that seems to hang in the air.

It is interesting to play Ravel's Rapsodie by Karajan for comparison. Believe me, there is plenty of it.

Paray is one of the pacy, precise school for whom all music is a challenge to efficiency.

Because of his faster tempo, the whole atmosphere of those opening bars take on a different light from that of Karajan.

I have rarely heard such a contrast between conductors. You might say that Paray matches Karajan's understatement with his own overstatement.

An example is found in the last few bars of the first section. There is a flourish of a flute which Karajan handles in a shapely sweep, and which Paray produces with a penetrating flourish.

I don't mean by all this to talk down the Paray record. It is far too brilliant musically and technically for that.

Its high tempo does, I think, take warmth from many of the colours, and some passages in Escales, for instance, are attacked with what I can only describe as ferocity.

Ibert's own recording for Capitol does not hit nearly such a high temperature.

The Detroit Orchestra is at its best. I can only admire the technical accomplishment of such fine playing.

Chabrier's exciting and memorable contribution is cast in the same mould.

When played at high volume, as such a disc demands, there is some tape background, and rumble too, I fear.

Nevertheless, it is a notable issue, so brilliant that one just can't overlook it.

Cutting amplitude is very high—it makes a big noise.

Dynamic range, too, is extremely good.

SHORT-WAVE NOTES BY ART CUSHEN

NEW CALLSIGNS FOR TAIWAN

Some new callsigns and frequencies have been assigned to the Broadcasting Corporation of China at Taipeh.

THE B.C.C. advised our reader Arthur Harris, of Benalla, Vic., that if sufficient letters are received from Australia and New Zealand, it is possible that a service to this area may be commenced by the station. At present it carries transmissions to most other areas of the world, and as the listening to the station is carried out here by many radio enthusiasts it would be expected that such a service would be commenced shortly.

The broadcasts from Taiwan are carried on the following schedule.

North America and Hawaii, 1130 a.m. to noon, on BED66 9575 Kc, BED6 11815, BED57 15345, BED63 on 17810 Kc.

English is broadcast from 11.30 to 11.45 a.m.

Transmission to JAPAN and KOREA, 8.05 to 9.20 p.m. on BED7 7130, BED66 9575, BED6 11815, BED57 on 15345 Kc. English is for the first 25 minutes, 30 minutes in Japanese and the last 20 minutes in Korean.

Transmissions to SOUTH EAST ASIA, 9.30-10.35 p.m. on BED7 7130, BED66 9575, BED6 11815, BED57 15345 Kc. English from 10 p.m. to 10.35 p.m. Second transmission from 11.0 p.m. to 2.0 a.m. on BED66 9575, BED64 on 11840 Kc.

Transmission to the Middle East, 5.20-5.40 a.m. on BED7 7130, BED6 11815 Kc.

Test from Tangier

TEST broadcasts from the Voice of Tangier have been logged by Ronald Pearson, of Parramatta, N.S.W., who has been hearing the station at 6.30 a.m.

The station was testing a new antenna system for reception in Europe and was very strongly received. The program was released on 9490 Kc and included choir items, in various languages. Reports were requested to Voice of Tangier, Post Box 2219, Tangier, North Africa.

NOTES from listeners should be sent to Arthur Cushen, 212 Earn Street, Invercargill N.Z. All Times are Australian Eastern Time.

Radio Sweden Schedule

THE present schedule as broadcast from the Stockholm station includes some changes in program times, and the complete transmission lineup is now as follows.

North America, 11.0 a.m.-12.15 p.m. on 11810 Kc, midnight-12.30 a.m. on 17840 Kc.

U.S.A. East Coast, 12.30-1.45 p.m. on 11810 Kc.

Mexico 2.0-2.45 p.m. on 11810 Kc.

South America 9.0-10.30 p.m. on 9660 and 11705 Kc; 11.0 a.m.-3.15 p.m. on 11705 Kc.

Africa from 3.45-5.0 a.m. on 17840 Kc; 5.15-6.15 a.m. on 11705 Kc.

South Asia, 12.45-2.0 a.m. on 15240 17840 Kc.

Far East 10.30 to 11.45 p.m. on 15240, 17840 Kc.

Europe, 6.30 to 8.0 a.m. on 7210 Kc.

Middle East, 2.15-3.30 a.m. on 11705 and 17840 Kc.

New Tokyo Call

THE Home Service of the Japanese Broadcasting Corporation operates several 5 Kw and 10 Kw transmitters to relay the local programs to listeners in outlying islands. Recently the service has been noted on 11800 Kc, with a new callsign in use.

The station is best heard after 8 p.m. when Cologne on 11795 Kc leaves the air to give the Tokyo signal a better channel. The station is usually carrying Japanese local programs and announces with the NHK break at 8.30 p.m. but no key station has been included with these announcements, is presumed that the program is from JOAB in Tokyo and carries the first network programs. Other stations are also known to have changed callsign, the former call on 11800 Kc was JK14 and it is now JKH3.

NEWS FLASHES FROM EVERYWHERE

FRENCH SUDAN which has been mentioned on this page before, has now been verified by a Cyprus listener, who sends information on Radio Sudan at Bamako. The station operates daily from 4.30 to 5.15 and 10.15 to 11.10 p.m. on a frequency of 9745 Kc, and also from 5.0 a.m. to 7.0 a.m. and at times to 8.0 a.m. on 4835 Kc. The station uses a 4,000 watt transmitter and a temporary aerial which is soon to be replaced by a permanent system. The station verifies reports; address to P.O. Box 171 Bamako, and the Station Director confirms the reception reports.

SALISBURY using 3396 Kc from Southern Rhodesia, is reported to be relaying the B.B.C. Radio newsreel program at 3.0 a.m. daily.

NORWAY is reported with its popular program in English on Monday at 3.0 a.m. It is called "Norway this weekend." It has been heard as late as 3.35 a.m. and uses the frequencies of 11735, 15175, 17825, and 21670 Kc.

DAMASCUS in the new United Arab Republic, and formerly Syria has been heard over the past few weeks with the usual English news broadcast at 6 a.m. and using the frequency of 15165 Kc. The programs from Damascus are normally verified with a large folding card, which is usually sent by registered mail.

ILOILO CITY station of the National Civil Defence in the Philippines has been heard by William Hawthorne of Warrnambool Vic., opening transmission at 8.30 p.m. in the normal broadcasts of NDCA. The station appeared to close at 9.30 p.m. after a musical program.

FREEDOM station using the slogan Radio Free Russia on the frequency of 11600 Kc, broadcasts from 2.0 to 6.20 a.m. on 6400 and 6800 Kc also. Transmissions are in German every Saturday and Hungarian on the first and fifteenth of each month, while Bulgarian is released on the tenth and twenty-fifth of the month. Reports can be sent to Berlin address, or Box 346, Luxembourg.

TASHKENT which was reported recently in this page, has now settled on 11690 and has news in English at 10.30 to 11.0 p.m. and repeated at 2.30 to 3.0 a.m., the transmission is beamed to India and Pakistan.

HAITIAN station 4VW1 has been heard in New Zealand on 11800 Kc which has replaced the 19 metre band channel at 7.30 p.m. The station has a fair signal but at 8 p.m. suffers interference from the Tokyo station JKH3 on the same wavelength. 4VW1 is in parallel with 4VE using 6100 Kc but the latter is only weak in strength.

CUBAN station COBL broadcasting from Havana seems to be on a 24 hour a day schedule and has been heard in New Zealand on the normal frequency of 9833 Kcs from 5 p.m. to after 6.30 p.m.

BUDAPEST in the new transmission to South East Asia, advises that this is carried from 10.30 p.m. to 11.0 p.m. and repeated at 11.30 p.m. to midnight using the frequencies of 9833, 7220 and 6195 Kc.

TANGIER station 18RA which has frequently been heard in this area on the usual off-band channels has moved from 11342 to 11458 Kc. The other frequencies are 9275 and 14858. Signals are heard best at 7.15 a.m. in English.

RADIO DAKAR in French West Africa has added the additional frequency of 5980 Kc, reports the Swedish DX Session, and with the 11895 Kc outlet, is on the following schedule, 4.30-6.0 p.m., 11.0 p.m.-12.45 a.m., 6.0 a.m.-10.30 a.m. On Sundays from 6 p.m. to 9.30 a.m. on Monday, also on 4950 Kc.

LISBON in the relay of the Home Service has changed the frequency to 6373 Kc, with the programs of Emisora Nacional, which were formerly on 11996 Kc. The station is on the air from 4 a.m. to 10 a.m.

SEOUL has been reported by Dick Pollard of Golden Downs, N.Z., as operating on the new frequency of 7010, with native programs from 6.30 p.m. The station uses the usual KBS-HLKA break but does not appear to be in chain with the station on 7180 Kc.

NIGER is the latest country to plan operating on shortwave and Radio Niamey, Niger, has been assigned the following frequencies, 3260, 5020, 7105, 9610, 9710 and 11775. The station will possibly use the two lowest frequencies when operations commence.

BELGIAN CONGO station OQ2AD, Radiodiffusion UFAC, Section del 1 Union des Anciens, Combattants du Katanga, Elizabethville, uses 3000 watts and operating on 4980 closes transmission daily at 6 a.m.

ECUADORIAN station HC1GP has changed callsign to HCRCX, and operates from 10 a.m. to 2.30 p.m. on 5010 using the slogan Radio Catalica, Quito. HC2G1 Radio El Telegrafo Guayaquil, operates from 10 a.m. to 2.30 p.m. on 4710 Kc, while HC4MX Radio Cenit, Portoviejo, on 4700 Kc, operates from 10 a.m. to 2.15 p.m.

PRAGUE in the transmission to Australia and New Zealand recently made some frequency changes. The session from 6.30 to 7.30 p.m. is now carried on 17815 and 11835. The transmission for Europe from 8.00 p.m. to 9.45 p.m., 10.15-10.45 p.m. is carried on 15145 and 15285 Kc. The transmission 9.00 a.m. to 3.30 p.m. for South America is now on 11935 11900 Kc.

BAGDAD broadcasts with a new 100 Kw transmitter to 7180 Kc, 2.30-4.30 p.m., 6.00 p.m.-7.00 a.m. in Arabic only.

ANGOLIAN station CE6RE, Radio Clue de Malange, on 7245 Kc with 250 watts, is operating 5.00-6.00 p.m., 10.00-midnight, 4.00 a.m. to 7.00 a.m. on Sundays the transmission is 6.00-9.00 p.m., and 11.30-7.00 a.m.

ANGOLA transmitter CR6RC broadcasting from Luanda, on 11862 Kc, has been heard in the USA from 7.20 to 8 a.m. with Latin American music, and identification was heard at 8.28 a.m. with the station leaving the air at 8.30 a.m.

BRAZIL with its wealth of stations is generally in the news each month. The details, learned from the World Radio Handbook, is that ZYS33 6045 Kc, and ZYN29 959 Kc are now in operation. ZYN32 is on 11875 while the callsign on 11815 Kc is ZYW24. Radio Record is again operating PRB24 on 11965 Kc, with 7500 watts.

RADIO CANADA STATIONS

The broadasts from Montreal by the Canadian Broadcasting Corporation are well received by readers, and this list contains all the callsigns and frequencies.

KCS	CALLSIGN	11760	CKRA
5970	CKNA	11900	CKEX
5990	CKAY	11945	CKNK
6060	CKRZ	15105	CKUS
6090	CKOB	15190	CKCX
6160	CHAC	15255	CKSB
9585	CKLP	15275	CKBR
9610	CHLS	15320	CKCS
9630	CKLO	17710	CHSB
9710	CHLR	17735	CHRX
9740	CHFO	17820	CKNC
11705	CKXA	17865	CHYS
11720	CHOL	21600	CKRP
		21710	CHLA

A NEW TRANSMITTER HEARD FROM BRAZIL

The many Brazilian signals we are hearing at 7 p.m. and onwards has been added to this month by the reception of further stations from this country. The best signal is that of the Manaus transmitter on 9695 Kc broadcasting from the heart of Brazil on the Amazon headwaters and heard daily opening transmission at 8.05 p.m. The station at times is a few moments late in opening, and the march "El Capitan" opens the programme for the day. The station identifies as "Radio Riomar, Manaus Brazil," stations ZYL22 on 9695 Kc and ZYB20 on 1480 kilocycles. The station after a short news summary at 8.15 p.m. has been heard with light music, generally of United States origin. There is some interference from the Los Angeles transmitter on 9700 Kc but this is not very severe.

THE HAM BANDS WITH BILL MOORE

Of all periods in amateur history, this is the one during which we should tell the world of our history and our achievements in order that we may help preserve our future. Every amateur today should consider himself called to justify his existence.

ONE of the most impressive statements yet published covering the work of radio amateurs and their contributions to radio techniques is the presentation by the ARRL to the FCC in support of the present amateur occupancy of the 25 to 890 Mc/s portion of the spectrum.

The FCC is conducting a study of frequency usage in that range and the ARRL's response is published in the January issue of QST.

The statement is well worth reading. Outstanding contributions especially on propagation phenomena observations are listed hereunder.

The discovery of the practical employment of short waves and their subsequent use by other services was essentially an amateur accomplishment. The first published explanation of the ionospheric transmission of high frequencies was made by a radio amateur. Amateurs were first to observe and demonstrate extended ground wave working on the VHF bands by means of bending by the lower atmosphere

AIR MASS BENDING

The original investigations on "Air Mass Bending" were begun in 1934 under the control of an Australian, the late Ross A. Hull then Technical Editor of QST. Extensive experimental work was carried out on the 56 Mc band.

Sporadic E propagation was first observed in 1935 when radio amateurs were amazed to hear signals on the 56 Mc/s band from distances ranging from 500 to 1,200 miles. This was the first indication that signals above 30 Mc/s would be useful for long distance communication.

In Australia signal reports of stations were received above 300 miles.

In 1937 amateurs discovered that during periods of marked magnetic disturbances, signals could be heard over much greater than normal distances if the directional antenna arrays were pointed toward north rather than toward one another.

In those days very little was known of Aurora effects and these amateur observations were used by a number of American universities in studying the Aurora.

After the war with improved VHF equipment available it was possible to observe similar effects on 144 Mc/s transmissions. In 1948 and in 1951 auroral communication was established on the 220 Mc/s amateur band.

With the change postwar from the 56 to 60 Mc/s band to 50 to 54 Mc/s amateurs had improved opportunity for DX working. In 1946 they established communication between Great Britain and U.S.A., the highest frequency ever used for radio communication across the Atlantic.

Since then F2 layer reflections have been responsible for amateur communication being extended on this band to a distance of 12,000 miles.

In 1947 a new propagation medium was observed on 50 Mc/s called "Equatorial Scatter." Often when the predicted maximum usable frequency was as low as 25 Mc/s 50 Mc/s communication was established between the U.S.A. and stations south across the equator. Experiments are still being conducted on this form of propagation.

METEOR TRAILS

In 1953 amateurs using the 144 Mc/s band heard snatches of signals from distances many times the normal range at that frequency. It was suspected that the signals were reflected from meteor trails as they were more often heard during meteor showers.

A day-by-day check over two years made by a number of amateurs, showed that signals could be returned to earth from meteor trails in the ionosphere.

This knowledge is now being put to work and promises to be a means of consistent long distance working with a high degree of secrecy—an important military objective.

Currently an important project is IGY propagation study and some 1,200 amateurs throughout the world under the U.S. National Academy of Science are co-operating. These amateurs are giving freely of their time to collect information on VHF band operation. It is anticipated that this information will shed new light on the previously mentioned modes of propagation.

Another useful work performed recently by amateurs was the reporting on the 20 and 40 Mc/s signals from the Russian satellites. These frequencies were too far removed from the 108 Mc/s Minitrack installation to allow them to be used and amateurs throughout the world were requested to supply information on the signals.

AMATEUR REPORTS

During the first days of the satellites, eye reports received by official organisations were practically exclusively from amateurs.

The number of reports available would have been greatly reduced only for the co-operation of this group of skilled volunteers.

The article continues to explain the uses to which each of the VHF and UHF amateur bands are being put and the outstanding features of each allocation.

In conclusion the League states that the current U.S. amateur population is 160,000, increasing at the rate of 12,000 each year. At a most conservative estimate the 200,000 mark will be reached at the end of 1960.

The 300,000 mark should be achieved in 1967, only 10 years away.

The document is an illuminating study of the work of a group of scientifically inclined private citizens and a clear account of the contributions of radio amateurs toward a further understanding of the workings of the ionosphere.

AMATEURS CO-OPERATE IN THE IGY

ONE outstanding contribution by amateurs in this country toward the IGY program has been the operation of members of the N.S.W. VHF and TV group in their recording of the progress of satellite Alpha 1958 in its orbits passing across Eastern Australia.

Expressions of thanks have already been received from IGY headquarters in Adelaide for their co-operation.

It has been a task that has taken many hours of spare (?) time and meant operation in the small hours on many occasions.

Information on the satellite's progress has been relayed to two sources—firstly to the Amateur Astronomers' Moon Watching Station at Belfields, Sydney, and to Gordon Bowen, VK5XU, at VK5WI.

From the latter it is then passed to IGY HQ, Adelaide, and finally to Woomera. The VK5WI link also provides information for the Belfields station from Woomera. Amateur radio has also supplied another relay link from Woomera to U.S.A.

SSB on 14 Mc/s has been used by VK5WC, station of the Woomera Radio Club, for the transmission of information on IGY projects to America.

The main contribution to the study has been made by Hugh Stitt, VK2WH, of Forbes, Neville Wilde, VK2DR, of Blayney, and John Miller, VK2ANF, of Sydney. During orbits of Alpha likely to be passing within a reasonable distance of Sydney, the transmissions on 108.0 and 108.03 Mc/s have been monitored.

The three stations have been linked on either the 3.5 or 7 Mc/s bands depending on propagation conditions and have supplied warnings on the first appearance of the satellite's signals.

Further warnings are supplied until the signals reach their peak strength. The time elapsing between the first recording of signals and their maximum depends on both the height of the moon and its path on that particular orbit.

Since the batteries failed on the higher power (60 milliwatts) transmitter on 108.03 Mc/s, monitoring has continued on 108.00 Mc/s.

The 108.00 mc/s transmitter runs 10 milliwatts and is anticipated that it will stop on the air for two to three months. The transmitters each weighed 2lb. complete with batteries.

Four special "Microlock" detecting stations are plotting orbits. The receivers freeze to the signal, measuring the shift of frequency and use it to estimate the satellite's speed. Directional antennas pinpoint its position.

The lower power 108.00 Mc/s transmission has been difficult to copy in noisy locations.

Information from VK5WI has been passed to the Moon Watchers in Sydney by telephone. If there is any possibility of a visual sighting, the Moon Watchers are alerted and Bob Winch, VK2OA dashes to Belfields, sometimes in the middle of the night.

His 144 Mc/s mobile transmitter provides the final link from VK2ANF so that the early warnings from VK2WH and VK2DR can be utilised.

It is likely that these observations will continue for some time and it is usual to check three orbits per day.

It would appear that this work has provided invaluable information on the plotting of the orbits of Alpha and amateurs who have participated are to be congratulated on a useful contribution to the IGY.

NOVICE LICENCES

THE introduction of limited class AOCP licences in this country has made an impact on amateur population and the last 12 months has seen a healthy increase in the number of licensees.

They, too, have made a valuable contribution to experimenting on the VHF bands. Allan Hennesey, VK2ZAL, for instance, has been working JA stations on 50 Mc/s as well as establishing a VK2 to VK5 144 Mc band record.

Currently in the U.K. discussions and exchanges have been taking place on the virtues of "novice" licencees.

Opinion is very varied but following the success of novice and technical class licences in the U.S. and Limited AOCP operators in Australia there is no doubt that they can make valuable contributions to amateur radio especially on the VHF bands.

The main points of debate centre on the value of Morse and the possibility of the lowering of standards.

Those supporting the introduction of "Novice" class licences point out that many amateurs can no longer copy Morse Code at approximately the Novice speed of five words per minute.

One very good point in favour of Limited licences is that in the future more and more young people are being trained as tchnicians and scientists in the electronics field. Most of these youngsters would be able to take the technical examination in their stride but jib at the thought of spending much time learning Morse.

The introduction of these persons to amateur radio would populate the VHF bands, strengthen the movement, and the National Amateur Society

URUNGA CONVENTION

PROGRAM for the North Coast WIA's Urunga Convention includes many interesting events. It is the ninth annual event of the North Coast and Tablelands Zone and attracts members from all over the State and VK4.

Easter weekend, April 4, 5, and 6 is the period and Friday evening has been set aside for a discussion on WIA affairs and similar subjects.

Registration will take place on the Saturday morning and from 3 to 5 p.m. heats of the 144 Mc/s Blind and Hidden Transmitter search will be conducted.

Concurrently the Gerry Challender Remembrance contest on 7 Mc will be run.

A nocturnal 144 Mc Fox Hunt will be a feature of Saturday evening followed by a social. Sunday will be a full day with further 144 Mc Fox Hunts and an all band scramble, the night session includes a film show, concert and disposals auction.

Amateurs attending are assured of a pleasant weekend held in traditional amateur style—even if you make the convention at the last moment you will be very welcome.

Lectures to amateur bodies in N.S.W. presented in February were by Stuart Fairburn, VK2ZBF, on VHF equipment at the Hunter branch and Joe Reed, VK2JR, to the Central Coast Radio Club on Sputnik and allied subjects.

DELEGATE TO ITU

Although the fund for the financing of an Australian amateur delegate to attend the 1959 Berne ITU conference had not been officially opened over £100 has been subscribed in N.S.W. Amateur support for the whole scheme is gaining momentum and response is excellent.

Plans are still being prepared by Federal executive on the expected coverage of such a delegate and it will be necessary to select an able spokesman with wide experience in negotiation and organisation at conference levels.

The delegate will have much detail work to do before he leaves and the preparation of a report on his return will be a prolonged job.

It has been stated that such a delegate representing the amateurs of Australia would become an accredited member of the official Australian delegation to the ITU conference.

MINITRACK TESTS

As a test for "Minitrack" stations mentioned previously, a special 108 Mc/s signal was bounced back from the moon last December. The signals were heard by a number of radio amateurs. The transmitter used 50 Kw and a 60ft dish antenna. The experiment will be repeated on a number of occasions and amateurs reporting on the reflections will receive a special "Moon QSL."

Conditions during the first weekend of the W/VE DX contest were excellent on all bands 28 through 7 Mc/s.

Despite the sun spot maxima the 3.5 Mc/s band provided good W DX, Frank Hine, VK2QL, working W2, 3, 6, 7 and 8 on that band.

WIDE OPEN ON 50Mc

JANUARY and February provided radio amateurs throughout the world with some extraordinary propagation on the 50 Mc/s band.

Many distant contacts were made over paths never previously covered. In February, according to Morrie Meyers, VK2VN, recently returned from the U.S.A., it was common talk of WAC's made on 50 Mc/s in a few days. Exact details are not available.

Quite a number of WAC's have been accomplished by W stations. The first has been credited to W6NLZ.

He made the final contact when he worked with VQ2PL. W9DSP is another station who has worked the five other continents.

A large number of American stations have one outstanding continent and when the full story is told of the 50 Mc/s contacts during the last few months, quite a number of WAC's will undoubtedly be listed.

In this part of the globe the two outstanding contacts to date were made between K6RNQ and ZL stations. The first was established with ZL4GY on February 1st.

A day later he contacted ZL2ABX. Both QSO's were made around 1,000 hrs. E.A.S.T.

LOOK FOR U.S.A.

A number of North American stations are anxious to contact VK's. XE1GE will be listening out and operates just a few Kc/s inside the band. He expects that the best conditions will be experienced during February- March and September-November. KH6 and W6 stations are beaming signals to Australia each Sunday morning, calling at 15 and 45 minutes past the hour.

A station from Macquarie Island (call unknown) will provide automatic morse on 50.195 Mc/s each evening between 2,000 and 2,100 hrs. E.A.S.T.

Openings between Japan and Australian stations occurred on many occasions in February, some VK's working dozens of JA's. VK2WH, of Forbes, recorded 14 contacts in one session. A number of Z calls also established communication with Japanese stations. Two other stations in the country, VK2ADT and VK2ATS, of Inverell, worked many JA's.

Amateurs in Queensland enjoyed even better conditions. George Heilbronn, VK4GG, has now worked 55 different JA stations in all districts from JA0 through to JA8. VK4ZAG, VK4KK and a number of other stations have worked many Japanese stations.

The JA's have also been heard calling ZL stations, but it is not known whether contacts have been established.

Approximately 15 openings occurred in February at varying times from 1,000 hrs. until 2,100 hrs E.A.S.T. About half extended to N.S.W.

According to Norm Burton, of Revesby, who is well briefed on 50 Mc/s activity in the U.S., the first contact between W1 and KH6 was made on that band—W1CLS and KH6UK were the stations concerned. TV reception across the American continent was commonplace during these months. The channel concerned was approximately on channel 2's frequency.

FROM EUROPE

From Europe a number of stations have heard [illegible] and W7's one G amateur having worked the whole lot.

Some of the leading DX stations have now contacted over 25 different countries on 50 Mc/s and lists are steadily growing.

Prediction experts consider March, and even April, will provide the best opportunities for Australian amateurs, especially those situated in the north-east of the continent.

One problem that these conditions have produced in U.S. is the low end crowding of the [illegible]

Many amateurs, although running up to 1KW input, make use of cheap disposals crystals on spot frequencies, with the result that when the band opens dozens of stations appear on the one frequency.

Another point that has caused trouble is that of splatter. Normally amateurs were not greatly concerned with some over-modulation. So few stations heard it, anyway, and it did assist in a distant ground wave contact. The appearance of S9 plus signals from many areas has highlighted the damaging effects of splatter.

Many a distant contact has been spoiled by another station's overmodulation.

Information on distant contacts on 50 Mc/s is being recorded in each Australian State for relay via VK3WIA, official Federal station, to IGY headquarters. Similar action is being taken by national amateur radio societies throughout the world and it is anticipated the collating of reports will supply useful propagation data.

the...MORE we produce

the...LESS you pay!

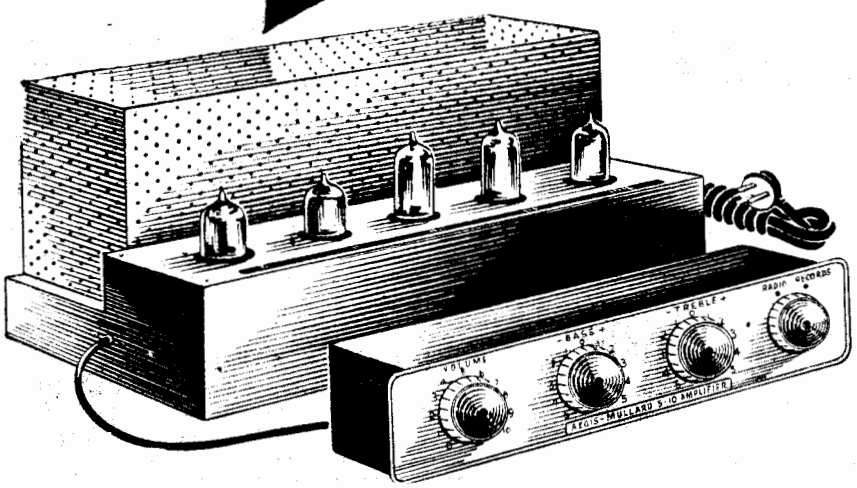
AEGIS

AUSTRALIA'S OWN BRAND!

IN KEEPING WITH SUCH
A FAIR-MINDED POLICY

WE'RE REDUCING OUR PRICE! NOW...

£49/10/- (Retail)



AEGIS Mullard "5-10" HI-FIDELITY AMPLIFIER (illus.) Rated power output 10w. Max. 12-13w. Frequency response plus or minus 0.5 db. 10 c/s to 20,000 c/s. Alternative impedances available. Amplifier: 11¼in. by 6½in. Control Panel: 12in. by 3in. by 1¾in. Carefully finished in quality metal and plastic.

Also **AEGIS** "Five-Ten PLUS" Hi-Fidelity Amplifier £74/ 5/-
AEGIS Mark 1 TUNER with own power supply ..... £35/ - /-
AEGIS FIDELITY TUNER Mark 2, less own power supply £32/17/6

● *EQUAL TO THE WORLD'S BEST!*

SO KEEP ON SUPPORTING AEGIS
MADE IN AUSTRALIA FOR AUSTRALIA!

AGENTS IN ALL AUST. STATES

AEGIS MANUFACTURING CO. PTY. LTD.
208 LITTLE LONSDALE ST, MELB. VIC. FB3731

A CONSOLE CABINET FOR YOUR TV SET

(Continued from page 51)

time improving its appearance, lengths of ½-inch quad dressed moulding were selected to match the ply and these were cut to the correct size and glued and pinned to the back of the cabinet, the whole length of the sides and the top and bottom.

In this way, the cover plate, in position, is completely concealed from the view of even the most inquisitive onlooker.

As we stated at the beginning of our article, this cabinet was designed so that the complete novice could duplicate it with the least trouble.

This applies particularly to the edges of the ply. To dress these edges in a professional manner requires some skill and we avoided this by selecting ½-inch wide flat, fancy moulding, about ½-inch thick.

WATCH THE GLUE

This is cut to size, the surfaces lightly glued, and then attached to the cabinet with small panel pins, the heads being punched slightly below the surface for subsequent filling

If the glue used seeps out on to the surface of the ply, a wet rag will usually remove it, but it is a good idea to continue rubbing the rag over the whole surface so that the surface of the ply will not be stained in patches.

Turn the cabinet over carefully on to its side and attach, with glue and screws, the four pre-shaped legs.

The pores of the ply may now be filled, using a commercial filler and rubbing with a pad the whole surface across the grain, then rubbing off with a dry rag.

We selected a maple filler which coloured the surface a little to the desired shade.

After rubbing slightly with a very fine grade of sandpaper, French polish or go over the cabinet with clear lacquer and allow to dry.

In our case the cabinet proper was French polished, while the frame supporting the safety glass was clear lacquered. This gave a very pleasing contrast.

Before attaching the back cover plate, which, by the way, is made from Masonite or some similar material, allow plenty of holes for ventilation, as the interior of the cabinet becomes fairly warm during operation. As you can see from the photograph, holes are also cut to allow access to the various controls at the rear of the set, without having to remove the cover.

The small box fitted to the centre of the coverplate allows for the end of the picture tube and should clear the tube by an inch or two all round. The end of the box has been covered by a scrap of expanded aluminium left over from the speaker grill.

In the finished article a piece of gold coloured expanded aluminium cut to fit into the recess in the frame is held in position by the speaker baffle board, which, in turn, is held by cleats on either side, screwed into both the baffle board and the sides of the cabinet.

In concluding the article, we might add that a small, flat carrying handle attached to each end of the chassis will greatly assist in removing the set from the cabinet and in carrying it from place to place. These can be seen in the photographs and no difficulty is experienced in doing any under-chassis repair work or adjustments, as the chassis rests on the edge of the EHT box and the handle.

So much, then, for our easily constructed console TV cabinet.

FOR THE CONVENIENCE OF COUNTRY VISITORS OVER EASTER WE ARE EXTENDING OPENING SALE DURING APRIL.

TRANSCEIVER SPECIALS

No. 22 TRANSCEIVERS

The 22 transceiver covers a frequency of 2 to 8 Mcs. and has been approved by the P.M.G. for use on fishing boats, small craft, bush fire brigades, etc., if converted to crystal control, for which it is easily adapted. These sets are supplied complete with valves, 12v. vibrator power supply, dynamic headphones and microphone leads.

£12/17/ F.O.R.

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 Mcs. and contain 15 6.3 volt valves including 1-807, 2-6V6, 6-6K7, 2-6K8, 6B8, etc., also 500 micro-ammeter.
Units supplied complete with valves, leads, junction box, genemotor power supply and dynamic headphones and microphone (operate from 12v. supply).

£7/15/- F.O.R.

PACKAGE 15/- EXTRA.

No. 11 TRANSCEIVERS

Supplied complete with valves, high and low power genemotors, leads, headphones and microphone.

£6/15/- F.O.R.

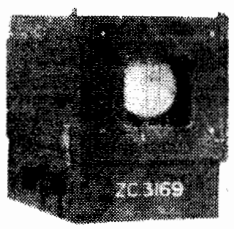
No. 108 TRANSCEIVERS

These 6-valve Walkie-Talkies are supplied complete with valves, headphones and microphone.

£7/15/- F.O.R.

PACKAGE 15/- EXTRA.

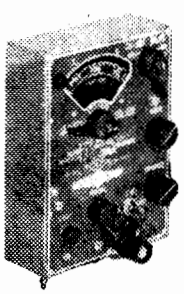
AMERICAN HANDY TALKIE. SUPPLIED WITH VALVES BUT LESS COILS AND CRYSTALS. TYPE BC/611, £8/15/-, POST AND PACKING 15/- EXTRA



NEW INDICATOR UNITS

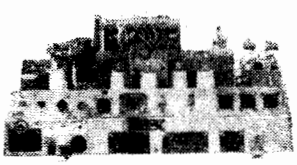
These new indicator units contain 3 valves, controls etc., and V.C.R. ACR/10 C.R.O. tube and socket. Ideal for that small scope

£3/10/- F.O.R.



NEW MN26 COMPASS Control Box 25/-

Drivers For Above 10/- Plus Postage



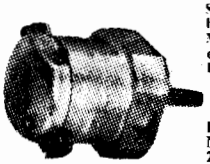
RADAR RECEIVERS

These radar receivers type ZC955 contain 16 valves and a 30Mcs. I.F. strip suitable for your TV experiment. Units are in new condition.

£2/17/6

Packing 15/ extra.

24 Volt Midget Motors Shunt Wound



Fully Laminated Fields Wound Armature Sixteen Segment Commutator, ball-bearing. Ideal for Model Trains, Hobbyists etc. Condition new. Price, each

25/-

Packing and postage, N.S.W., 1/6, Interstate, 2/6.

NEW SCR 522 GENEMOTORS

28 volt input D.C. regulated and filtered output filtered D.C. 300 volts at .26 amps: 150 volts at 0.1 amps: 14.5 volts at 5.0. Completely shielded in metal case, 12 x 8 x 5 inches. Each . . . **27/6** Price F.O.R.

SPECIAL—FREE VALVE OFFER

WITH ALL ORDERS OF £6 OR OVER SIX NEW VALVES SELECTED FROM THE FOLLOWING LIST WILL BE SUPPLIED FREE (COUNTRY ORDERS PLEASE ADD 2/6 EXTRA POSTAGE)

1Q5GT — 1C7G — 6H6GT — 6K7G — VR65A — EF50 — 954 — 6C8G — 1P5GT — 1K5G — 7193 — CV6 — 6J7G — 12SK7

NEW 3in. R.F. METERS

Supplied with New Scale to Convert to 0-10 or 0-100 MA. METER. 7/- PLUS 2/6 Postage.

LIFEBOAT TRANSMITTERS

These units use single 14.v Valve and have Telescopic Aluminium Aerial. **17/6** Postage 4/- extra.

CO-AX CABLE

Light 90 Ohm Twin Co-ax

1/3 YARD, plus postage.

CO-AX. CONNECTORS

PYE TYPE . . . . . **4/- Pr.**

AMERICAN . . . . . **6/- Pr.**

New Throat Microphone

3/6 plus postage

NEW MICRO SWITCHES

5/6 plus postage

METROPOLITAN RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7398

640 KING STREET, ST. PETERS, N.S.W. PHONE LA6087

NEW VALVES AT BARGAIN PRICES

1T4	10/	6SH7	3/6	6U7G	6/6	CV6	3/6
1S5	10/	1Q5G	5/	6Y6GT	12/6	42	12/6
3S4	10/	1P5G	5/	6X5GT	10/	7193	3/6
3V4	12/6	1C7G	5/	6J7G	5/	954	4/6
1R5	12/6	1K5G	2/6	6U7G	5/	955	10/
1A7GT	9/6	6AC7	2/6	6J6	15/	12A6	10/
1D8GT	9/6	6C8G	7/6	6F8G	10/6	EF50	2/6
6A8G	10/6	6S57	8/6	6A3	15/	110TH	£2/9/
6K8G	9/6	6F6G	9/6	7C7	3/6	811	£1
6SJ7GT	9/6	6E5	8/6	7A6	3/6	866/866A	15/
6X5GT	10/	6H6	2/6	78	7/6	828	£1/9/
12K8	10/	6H6GT	1/6	71A	7/6	12SH7	5/
12SK7	7/6	6J7G	7/6	EL32	10/6	12SL7	10/
EK32	10/6	6K7G	3/6	KTW62/6U7	6/6	6K7G	4/6
6SA7GT	9/6	6K7GT	7/9	VR65A	2/6	100TH	20/
830B	12/6					866	12/

Please add Postage on All Valves.
SPECIAL PRICES FOR QUANTITIES.

New Power Transformers

60mA prim.: 204v with 230v tapping, Sec. 285 x 285 with 6.3v filament winding.

22/6

Plus Postage: N.S.W. 3/6; INT. 5/3.

NEW 4in Per-Mag. Speakers

5T. or 7T. Trans., 30/.

30/-

Post. and Packing, 3/6.

New Midget Power Trans.

40mA Prim. 250v. Sec. 225 x 225 with 6.3v. Fil. Winding. Upright or Flat Mounting. Size 2in v 2½in.

22/6

2/6 Postage, N.S.W.; Interstate, 4/6

30mA, 240v. Prim. 150 x 150v. Sec. with 6.3v. Fil. Winding.

20/- **Postage, N.S.W. 2/6; Interstate 3/6.**

BUILDING R. TV & H. TV SET

All Major Parts in stock, including R.C.S. IF Strips and Tuners. Valves, Power Transformers, Chassis, etc.

NEW DYNAMIC HEADPHONES

These headphones made by Rola are a high quality unit giving excellent tone. Fitted with comfortable ear pads.

22/6 **Post 4/6.**

NEW No. 7 HAND MICROPHONE

with Switch Dynamic Unit.

20/- Plus Post.

VALVE SPECIALS

20/- will purchase any one of the following Valve Specials.

5	1P5	3	6K8G
6	1C7	6	6SH7
5	1Q5	8	6AC7
12	1KS	5	6J7G
6	954	4	6U7G
6	6C8G	4	12A6
10	EF50	2	6X5GT
12	VR65A	7	6K7G

Post and Packing, 4/6 extra.
ALL VALVES ARE NEW.

NEW 6H6 OR 6H6GT VALVES

Individually Cartoned.

14 for 20/-

Post 2/6.

New Transmitting Valves

803	30/-
100TH	£1
866	12/-
811	15/-
830B	12/6

New Micro-Ammeters

New Paton Micro-Ammeters.

0-500, M.A. 1¾in diameter. Flush mounting. **25/-**

Post and Packing, 2/6.

CONDENSER SPECIAL

Boxes of 100 new mica paper and electrolytic condensers in values ranging from 50pf mica to 5 400v. paper. Values include .0001, .00025, .00075, .01, .02, .05, .1. Also 500 mfd/12v., 10 mfd/40v., 8 mfd/525v., 16 mfd/350v., electrolytics.

25/- per 100.

Post Extra: N.S.W. 2/6; Int. 3/6.

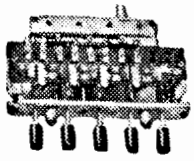
NEW VIBRATORS

A.W.A. Oak 6 volt Synchronous 7-pin base. 6/6

A.W.A. 12 V Synchronous octal base.

7/6. Post 1/6.

NEW PUSH BUTTON SWITCHES 20/-



Five pole push-button switches. New control box fitted with above switch, also 5 bezels with globes and multi-contact by key switch. Post: N.S.W. 2/- Int. 3/-

NEW I.R.C. RESISTORS

I.R.C. carbon resistors, ½, 1 and 2 watt, in values 50 ohm. to 5 meg., including many popular sizes, 3T, 15T, 20T, 25T, 50T, 100T, 250T, 500T, etc.

(Standard resistor colour code supplied)

100 for 25/-

(Plus 1/6 postage.)

New High Impedance Headphones

27/6 Post 1/6.

Telephone Generators

New small telephone generators, ideal for bell ringing, etc.

10/6 **Postage 3/- extra.**

GERMANIUM DIODES

for that Crystal Set.

5/6. Post Free.

511A C.R. TUBES

These 12in tubes have been recommended for TV use in "Radio World." Uses same sockets as VCR97.

£4/17/6 **F.O.R.**

Please address all correspondence to 332 Parramatta Road, Stanmore, N.S.W.

METROPOLITAN RADIO SUPPLIES

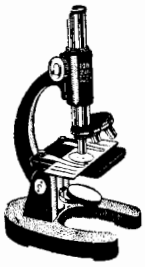
332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7392
640 KING STREET, ST. PETERS, N.S.W. PHONE LA6087

FOR TECHNICAL EQUIPMENT AND USEFUL GADGETS. MAIL ORDERS TO BOX 5234, ELIZABETH ST. POST OFFICE.

WALTHAM
TRADING CO.
229 Elizabeth St., Melbourne

SYDNEY: 96 Oxford St. Mail Orders to Box 22, Oxford St. Post Office.
ADELAIDE: 243 Rundle St. Mail Orders to that Address.

IDEAL MICROSCOPES



The Student's Friend

Single Eye Turret Model. 300 Magnification. Provides not only many hours of pleasure, but fascinating discoveries for the whole family.

PRICE: 79/6.

Packing and postage, 3/6; interstate, 4/6.

MAGNIFYING GLASSES

3in lens, 3 7/8in handle. **PRICE: 25/**
2½in. lens, 3½in. handle. **PRICE: 17/6**
Packing and postage, 2/6.

VALUE IN VALVES

Special Prices for Quantities

1D8	8/11	7C7	1/11
1Q5	8/11	7W7	2/6
1J6	7/6	807	19/6
1P5	8/11	811A	19/6
2V3	15/-	829B	£5
2X2	12/6	954	3/11
6A6	10/6	955	3/11
6A8	12/6	705A	15/-
6AC7	2/9	12SR7	7/11
6AJ5	9/6	1626	5/-
6C8	7/6	1629	7/6
6F8	12/6	AV11	5/-
6H6G	1/6	CV.66	4/6
6J5	2/11	DQ2	17/6
6J7	7/11	EL3N	11/6
6K7	3/11	EF.50	2/9
6K8	9/6	VR53/EF39	3/6
6L7	12/6	VR.65A	2/6
6N7	9/6	VR.78	7/6
6SH7	2/11	VR.100	4/6
6SJ7	12/6	VR 150	15/-
6SL7	12/6	**Cathode Ray Tubes:**	
6U7	6/9		
6X5	9/6	VCR112	50/-
6Y6	12/6	3API	60/-
7A6	5/-	EF50 Sockets	3/6
7A8	5/-	**Please add Cartage.**	
7C5	5/-		

DURAL TUBING

VERY USEFUL

For TV aerials, tent poles, etc. Strong metal tubing in these sizes:

Diameter	Gauge	Price per foot
¼in	20	1/
7/8in.	20	1/6
9/16in.	22	1/3
1in.	16	9d
5/16in.	16	1/
7/16in.	16	1/
¾in.	16	1/9
⅛in.	17	1/
9/16in.	17	1/6
7/16in.	18	1/
¾in.	18	1/3
5/8in.	16	1/3
1in.	20	1/9
15/16in.	20	1/6

(No Mail Order for Dural Tubing.)

Battery Chargers, dual voltage, 6 and 12 v. Charges at rate of 6 amps. **PRICE: £9/15/.**
Packing and delivery to railhead, 5/.
Headphones, Low Impedance, **17/6.**
Packing and postage, 3/6.

• RANGE RECEIVER •

A Receiver with two inputs—one a straight receiver, 38 megacycles, containing 954.6G8, and 6J7 valves. The other input is a standard super heterodyne, IF.1600 Kcs. supplied with 33.3 and 33.8 megacycles crystals. It contains the following valves: 6U7 (3), 6A8 (1), 6G8 (2). High Tension Input. 250 v. DC. 60 MA. Model wired for 12-v. DC has switching motor for 6 crystal positions.
Model wired for 24 v. DC has relay switch with 2 crystal positions.
IN WORKING ORDER. PRICE: £10
(Available at Melbourne Branch only)

FINE TELESCOPES

DRAW TELESCOPES: 50 x 50. Has adjustable prismatic eyepiece, blued lens. Complete with 8in. Tripod.

PRICE: £19/19/

50 x 40 (same features as above)
PRICE: £17/17/. EIKOW x 20, **£5/5/.**

BRASS DRAW TELESCOPES. Ex-Army. Two lenses, 1-10x 1-15x **£15**

HEAVY MOUNTING TELESCOPES, ex-Army. 2 lenses, 10 and 15x, **£17/10/.** EIKOW' 'SCOPE, 30 x 40, with tripod, **£10/19/6.**
Packing and postage, 5/-; interstate, 6/6

THE FAMOUS SANWA MULTIMETERS

Model 305G, 20,0000 ohms per volt. AC and DC . . . . . **PRICE: £15/15/**
Model SP5. 2,000 ohms per volt. AC and DC . . . . . **PRICE: £7/10/**
Packing and registered postage 6/.

Sanwa Micro Amp. Meters
0-100, **50/;** 0-50, **70/ and 75/.**
0-1, Ma., 1in. square, **37/6.**
Packing and postage, 3/6.

Air Force Eight-Day Dashboard Clocks

Precision instrument. Ideal for cars. Dial, 2 inches by 2 inches.
PRICE: £7/10/
Packing and postage, 3/6; interstate, 5/

No. 3 Carbon Hand Microphones, **12/6**
Packing and postage (all States), 3/6.

MORSE BUZZER SETS

Complete with headphones, and a **BARGAIN FOR 32/6.**
Packing and postage, 11/6.
BATTERIES, 1.5 volt, suitable for Morse Buzzer Sets. **Price 7/ per pair.**

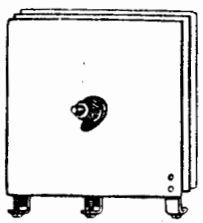
Slide Rules—Four Types

Precision-built, Scientific Instrument
No. 605: 7½in. long, 1½in. wide, cardboard case . . . . . **55/- each**
No. 450: 6in x 1in, fitted with magnifying cursor. In leather pocket case. **PRICE . . . . . 50/- each.**
No. 403: 4½in x 1in, fitted with magnifying cursor. In leather pocket case. **PRICE . . . . . 39/6 each**
No. 28 (Circular type): Diameter, 3in. In plastic cover. **PRICE: 25/ each**
Packing and postage, 2/.
These Slide Rules are complete with Instruction Manual.

VERNIER DIALS FOR NO. 11 TRANSCEIVERS.

Price: **17/6.** Packing and postage (all States), 5/.

HERE FOR RECTIFIERS



6 v. 2 amp., **24/6**
6 v .4 amj. **45/**
6 y. 5 amp., **50/**
6 v. 10 amp., **79/6**
12 v. 2 amp., **32/6**
12 v. 3 amp., **45/**
12-15 v. 6 amp., **79/6**
12 v. 3 amp., or 6 v. 4.5 amp., **45/**

Packing and postage, 5/

STUDENTS' DRAWING SETS

By Becon; 10 pieces, including spring and firm-joint compasses and dividers, etc. **PRICE 33/9**
Another BECON Set, super quality with 12 pieces. **PRICE: 79/6**
Packing and postage, 3/6

THE ASTRO COMPASS

With slight modification can be made into an accurate DUMPY LEVEL. Additional requirements are a light tripod and telescopic sight. Astro, a precision instrument, has declination scale with micrometer adjustments, azimuth circle, cross levels, and adjustable turntable. Fully calibrated. **PRICE: 59/6**
Packing and postage, 11/.

We have **PRISMATIC TELESCOPIC SIGHTS** which can be adapted for use as a sighting tube with the Astro Compass. **PRICE: 50/ each.**

Crystal Set Cases; Bakelite, in attractive colours, **7/6.** Call and choose. **Germanium Diodes,** for Crystal Sets. **Only 3/6** (and post free).

LET'S BUY AN ARGUMENT

(Continued from Page 99)

amplifiers are better than or worse than others . . . ."

We've had one or two examples of the divided-load technique in our laboratory and have checked them in a routine kind of way without, however, getting down to the exhaustive detail which would be necessary to define completely their performance.

And even then, only half an answer would be available.

Excellent results can be obtained by any of several circuit techniques but the ultimate result depends as much as anything on the output transformer. Is it the best example of the maker's art for this class of amplifier? Could equivalent results be obtained from a simpler transformer using another technique? Are the present results superb, only because an uneconomic transformer has been used?

More important for the present, I think, is the question "does it really matter?"

Using various circuit techniques, amplifiers can be made so good these days that they are not limiting factors to the end result. Records, pickups, speakers and baffles are all likely to be more significant in their contribution to total distortion.

It is little wonder then, that hi-fi enthusiasts aren't too easily "het up" by talk of a particular circuit arrangement. But mention another type of pickup or speaker and watch their interest quicken.

And what of the synchrodyne receiver? We don't have any strong feelings ourselves, never having tried the circuit in practice. It gets back to what we said last month about time to do all these things and the tendency to skip them unless there is an apparent urgency.

Unfortunately, it's a bit hard to get a sense of urgency about the synchrodyne. The circuit idea is as old as the proverbial hills but it's never been exploited to my knowledge. I've seen one or two "how to make" articles in overseas mags, but I can't recall ever having seen or heard the finished product. In fact, I can't recall having met anyone who has.

It's a kind of technical will 'o' the wisp.

Well then, let's toss the question into the arena. Who amongst our readers has actually built or operated or even seen a synchrodyne receiver in years sufficiently recent for the memory not to have been garnished by its remoteness? Was it shatteringly good, or fairly good or just ordinary or disappointing? Was it simple to get going or a real headache?

We'd like to know.

Meanwhile, another correspondent, H.A.P. isn't happy about the conditions under which hi-fi equipment is being demonstrated.

I wonder how many other readers have similar complaints?

SOME IMPROVEMENTS TO SYNCH. SEPARATORS

(Continued from Page 83)

In wiring the stage, it is important that the 22K resistor, be mounted close to the video amplifier valve, both to obviate capacitive loading of the video plate and to avoid carrying high intensity video signals throughout the chassis. This was provided for in the original layouts.

The lead feeding the input grid should run direct to the socket pin and not too close to the plate or other components. Purpose of this is to reduce capacitive feed-through of video information to the plate and second grid and thence to the synch. output circuit and the line oscillator.

Some slight feed-through is inevitable by reason of wiring capacitance, socket capacitance (it should ideally be a wafer type) and also the direct grid-plate capacitance within the valve itself.

The video content can be seen on an oscilloscope but tests have shown that, with ordinary wiring care, its level is so far below the pulse information that it has no measurable effect on either oscillator. On a comparative basis, the pulse/video ratio is better than many commercial receivers.

Pursuing the matter of video content, by way of general interest, we rewired the socket to use a 6U8 triode pentode. All constants were as for the 12AU7, with the addition of a 1-meg. resistor from B-plus to feed the screen, a 0.1 meg. bleed to earth and a 0.1mfd. bypass.

Using the pentode section in this way for video input and clipping and the triode as an amplifier, the video content appeared to be somewhat less and the pulse amplitude somewhat greater than for the 12AU7.

Neither factor appeared to be important to the end result, however, the suggestion, on the contrary, being that the pulse input to the line circuit at least could be above optimum, if increased beyond that available from the twin triode.

The adaptability of the circuit to a triode-pentode is interesting, nevertheless, and may warrent closer examination should the occasion arise.

SUPERCONDUCTIVITY

(Continued from Page 9)

Cooling apparatus for maintaining materials at these temperatures by the use of cold helium gas or liquid hydrogen is commercially available. We can now consider employing superconductors for sensitive electrical measuring instruments, switches, computer memory devices, resonating chambers in radio equipment and perhaps even transmission lines, say from the antenna to the amplifier of a radio telescope. In all these devices a superconductor would make it possible to handle extremely tiny currents or signals without any loss of their energy.

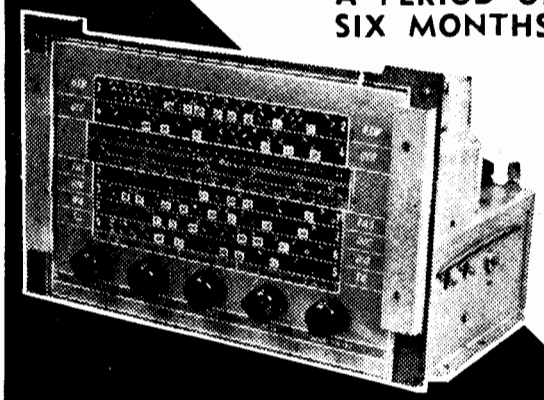
before purchasing your radio see our—

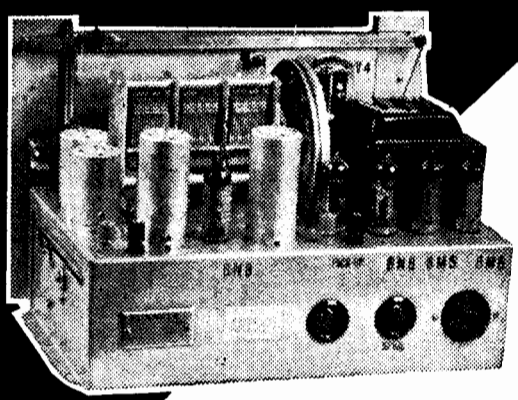
Hi-Fidelity

RANGE

and compare these NEW features..

ALL CHASSIS GUARANTEED FOR A PERIOD OF SIX MONTHS





NEW:

Ultramodern circuit using nine high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short wave range of 12,000 miles. All valves used are the new Mullard nine pin Innoval series.

NEW:

Tone control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving plus or — 15 db. boost or cut at 50 cycles L.F. and 10,000 H.F., combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favourite recordings.

NEW:

Dual Speaker combination, using a heavy duty wooter (12in M.S.P. Jensen AU54 special) with matching 6in tweeter and cross-over network giving a frequency response of 46 to 13,000 cycles. Speakers are mounted coaxially making only one 11in mounting hole necessary.
If required the new Magnavox high-fidelity twin coned speaker can be supplied.

NEW:

Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Indicator lights are fitted showing which band is in operation. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of an F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo motor.
Power switch is fitted to volume control, radiogram switch, combined with wave change switch. Audio end of set can be used with TV receiver if required.

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard 5-10 AMPLIFIER CIRCUIT Frequency response 40-13,000 cycles. Max. output 10 watts.

£41/15/0 F.O.R.

A NEW 10 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST

The ideal chassis for those difficult locations where reception is doubtful. Specifications are nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

£44/15/0 F.O.R

NEW SEVEN-VALVE HI-FI CHASSIS

This new compact dual wave seven-valve chassis uses the same tuner circuit as our 9-valve unit with the Mullard tone-control circuit giving separate bass and treble controls. Push-pull output using two of the new 6BM8 dual purpose output valves and heavy duty M.S.P. speaker **£31/15/-** F.O.R. PACKING 10/ EXTRA.

Also available with Magnavox 12W.R. Hi-Fi speaker and Ferguson output transformer at £4/15/- extra.

Write for full specifications

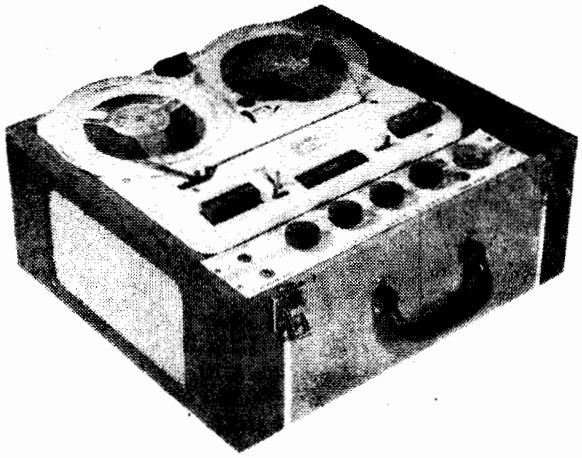
ALL 4 SPEED RECORD CHANGERS AND PLAYERS STOCKED

Classic Radio

245 PARRAMATTA ROAD HABERFIELD N.S.W PHONE UA2145

Buying a Tape Recorder?

First see and hear the new Hi-Fi Recorder by Classic incorporating the new Collaro Mark III Transcription deck. The only deck with ALL these features.



THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE PLASTIC COVERED CASE COMPLETE WITH ACOS MICROPHONE

The six-valve amplifier incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Record monitoring and outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck.

- **HIGH FIDELITY**
  Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second Azimuth adjustments on both impedance "record" and "play-back" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second
- **INSTANTLY REVERSIBLE**
  Instantaneous changes can be made from one track to the other. Fast re-wind in either direction
- **CONSTANT TAPE TENSION**
  A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan
- **FULLY MECHANICAL**
  No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical
- **FINISH**
  Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
  3¾, 7½, and 15 inches per second.
- **FOUR HEADS**
  Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
  One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape
- **PAUSE CONTROL**
  This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected position. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURING & CALIBRATING DEVICE**
  The three digit counter makes the location of any recorded passage the simplest of operations.
- **TRANSCRIPTION TECHNIQUE**
  A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter to less than 0.15 of 1.0 per cent.
- **TWO MOTORS**
  Each dynamically balanced motor does only one job at a time. Motors never act against each other and are of low wattage input with consequent reduction in heat and wear

COMPLETE RECORDER WITH MIKE—80 GNS. f.o.r.

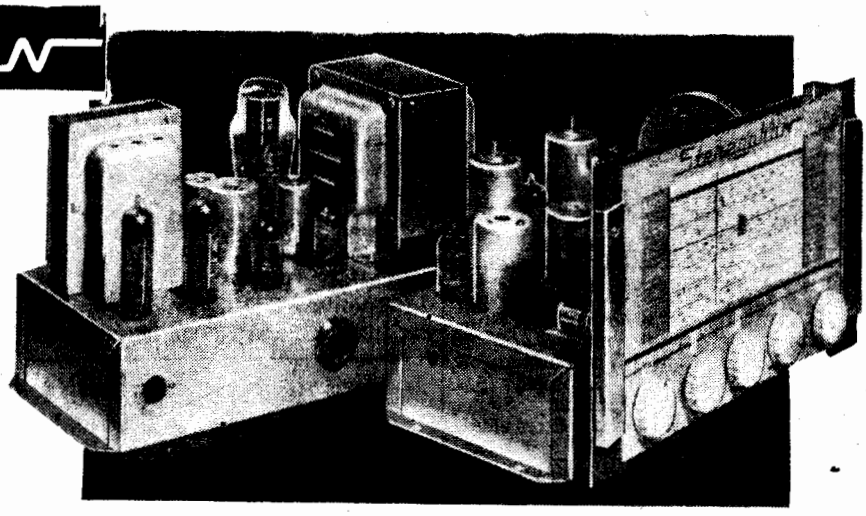
DECK WITH AMPLIFIER, POWER SUPPLY & 6in x 9in SPEAKER 70 GNS.

Stereophon

—LIVING SOUND—

A compact 11-Valve High-grade Radiogram in two chassis featuring a variable band with Tuner multi-input preamplifier and Tone Control in one unit and a 10-Watt Ultra-linear Amplifier. Ideally suited for use with High-grade pick-ups and Speakers.

65 GNS. F.O.R.



Classic Radio

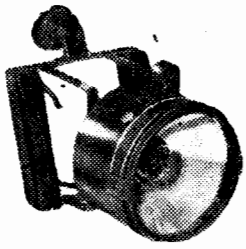
245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145

SURPLUS STORES, 512 ELIZABETH ST., MELBOURNE

Bargains in Ex-Army and Ex-Air Force Articles.

Please Mention Your State in Your Mail Order.

Ideal for shooting SIGNALLING LAMPS



12-VOLT Long Beam Army Spotlights. Can be adapted for fitting to cars, trucks, boats, etc. Twin handles; trigger switch. With spare globe.

PRICE 39/6

Packing and postage, 6/; interstate, 8/6

Leather Flying Helmets

ex-R.A.A.F. Takes Standard Gosport Tube.

PRICE: 50/. GOSPORT TUBES, **50/.**

Packing and postage, 3/6.

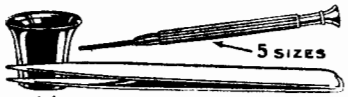
SAFETY BELTS

As used in Aircraft

Highly recommended for car trials. Quick-release catch. Complete with body harness. **PRICE 19/6 EACH.**

Packing and postage (all States) 3/6.

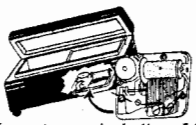
Watchmakers' Tweezers, **5/6 and 6/6.**
Watchmakers' Eyeglasses, **6/6.**
Extra Strong Double Lens Eyeglasses, **15/.**



Screwdrivers, set of five **13/9**

Packing and postage (all States) 3/.

Make your own Music Boxes with these Swiss Music Units.



30/-
EACH

Many tunes, including Lili Marlene Harry Lime Theme, Wedding March, Merry Widow, Happy Birthday, Parade of the Wooden Soldiers, Silent Night, Swedish Rhapsody, Annie Laurie, How Dry We Are, Roll Out The Barrel, Who's Afraid Of The Big Bad Wolf.

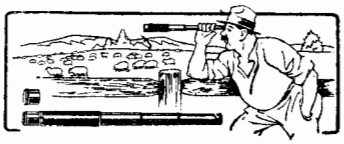
Packing and postage, 3/; interstate, 4/6

LOOK! VERY SPECIAL

Magnifying glasses, 8 mags., **8/6;** 10 mags., **12/6.** Tapped Transformers, 6, 12, 18, and 24 volts, 3 amps, **45/-.** Genuine Army Telescopic Sights, **£9/19/6.** American Oxywelding Torches, **£5/10/-.** 24 volt, 1,500 watt Generators, **£12/10/-.** Ball-bearing Step-down Gear Box, 50/1 reduction, **39/6. Steel Masons' Squares,** 24 x 12, **14/6.** 14mm Spark Plugs, **4/** each. Long-nose Pliers (English), **9/6.** Spark Plugs (7-8in), suit most old cars and tractors, **2/6.** Flying Goggles, complete with spare lenses, **17/6.** German Jack Planes, **25/-.**

(Please add Postage.)

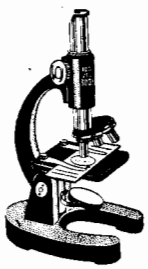
Look Ahead! Telescopes!



50 x 50 magnification .. .. **£19/19/.**
40 x 50 magnification .. .. **£17/17/.**
20 magnification, in pigskin carrying case; pocket size, very handy **£5/5/.**
30 magnification, with tripod **£10/19/6**
Packing and postage, 7/6; interstate 10/.

MICROSCOPES

Wonderful Value



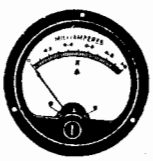
A splendid gift for any person — either young or grown up. This instrument is much more than a toy; it can provide many hours of study. 300 magnification.

PRICE: 79/6 EACH.
Packing and postage, 3/6; interstate, 4/6.

Never before at such low prices!

METERS

British-Made



0-1 Milliamp Meters, 2½in **50/**
0-5amp Meters, AC-DC, 2½in dial .. **45/**
50-0-50 amps .. **50/**
0-1 Miniature Milliamp Meter, 1 1/8in. **37/6**
0-14 amps, AC, DC, 4½in dial. **65/**
0-25 amps, DC, 3in **29/6**
0-200 amps, DC **£4/10/**
20-0-20 amps, DC.. .. .. **37/6**
0-200 amps, AC-DC, 3½in. .. **£4/19/6**
0-150 milliamps, DC, 2½in **27/6**
0-20 volts, DC, 2½in. **22/6**
0-30 volts **30/**
0-50 micro amps, 1 7/8in. **70/**
0-100 micro amp meters, 1½in .. **50/**
0-30 V, AC, DC, 2½in **45/**
0-300 Volts; AC-DC, 4½in dial, **£6/10/**

Packing and Postage, 3/6; interstate, 5/.

Brand New English Micrometers

0 to 1, **18/6;** 1 to 2, **22/6.**
Packing and postage, 3/6.

STUDENT'S DRAWING SETS

Splendid quality, 9 pieces **33/9**
Others: 6 pieces, **40/6;** 5 pieces, **16/11.**
In velvet-lined cases.
Packing and Postage, 3/6.

WHIP AERIALS

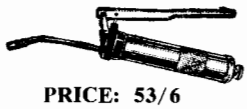
AMERICAN SCREW TYPE—
3-PIECE, SEAMLESS
PRICE: 39/6 PER SET
ALSO, TANK, WHIP AERIALS

In flexible steel. Three Sections (12ft), **22/6**
2 sections (8ft), **15/ per set**
Packing and freight, 5/

THESE ARE JUST THE THING FOR FISHING RODS AND CAR AERIALS.

Grease Guns, Lever Type

BRAND NEW



PRICE: 53/6

Ideal for all types of TRUCKS,, TRACTORS or CARS. Pressure, 7,500lb
Packing and postage, 5/; interstate, 8/6

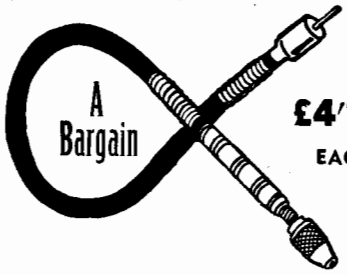
PROTECTION AGAINST GLARE

SUN GLASSES

R.A.A.F. Type .. .. **Price: 16/6**
De-Luxe Type **22/6**
Packing and postage, 2/6

UNIVERSAL FLEXIBLE SHAFT

44in. **log; ¼in.** chuck.



£4/15/-
EACH

Packing and postage, 5/; interstate, 7/6.
Grinding and Engraving Burrs.
Packet of six, **2/**
Polishing Brushes, **6d each**
For hobbyists, die-makers, home handymen, garagemen, engineers, plastic workers.

VERNIER CALIPERS

MEASURED IN INCHES AND M/M.
Complete with Depth Gauge.
PRICE: 12/6
Packing and postage, 2/

ANSWERS TO CORRESPONDENTS

M.C.G., (Coburg, Vic.) sends in some ideas for the "Reader Built It" page.

A. Many thanks for your contribution. We are always on the lookout for interesting items for this page.

N.R.D. (Charters Towers) comments on our recent article and the heading "Death Rides The Hot Chassis."

A. There has been a lot of comment about this article, nearly all of it favourable. Your comments have also been noted. We cannot imagine a more fiendish device than a transformerless mantel receiver fitted with earphones and we suggest you have nothing to do with the idea. Either half-wave or bridge rectification is possible, the former being simpler in many cases. Heaters are usually connected in series and operated through a dropping resistor.

W.O. (Nowra) sends in the circuit of a 3-transistor receiver which he has built.

A. Many thanks for the circuit, which has been passed on to our staff member handling the "Reader Built It" page. Until he has examined it in detail, it would not be possible to comment further.

G.A.E. (Abbotsford, Vic.) was interested in our recent explanation as to why some people hear the whistle from a line output transformer and others don't. He says that his own son can always tell when the family TV set is switched on, even from a remote part of the house. It is impossible to trick him by keeping the volume low because he hears the 15,625cps line frequency.

A. Your problem is being repeated in many homes and for the same reason — young ears can hear high frequency sounds much better than older ones. Receiver manufacturers are well aware of the difficulty but it is not easy to prevent some residual mechanical movement in a device which is handling as much power as the line output transformer.

It is a much more urgent problem in Britain, where the frequency is around 10Kc and therefore within the hearing range of most people. In your case, the trouble may be so bad as possibly to be classed as fault. Your only course would be to approach a reliable service organisation or, better still, the manufacturer's own service department.

E.C.D. (Dalby, Qld.) sends in an idea for the "Reader Built It" page.

A. Thank you for your letter. The hint would appear to be quite a useful one and has been put into the appropriate file for future use.

A.L.I. (No address) encloses a 2/ stamp and asks about a certain back number.

A. We would like to help you but though your letter is signed, there is no address appended.

P. McD. (No address) is another reader who poses a query but does not include his address. The answer, as originally phrased for reply by mail is as follows:

A. Calibration of signal strength meters for amateur communication receivers is usually a somewhat vague business and in practice many amateurs are satisfied to have an arbitrary scale and supplement the scale with an aural judgment. The A.R.R.L. Handbook lists the signal strength scale as follows:

S1—Faint signals, barely perceptible.
S2—Very weak signals.
S3—Weak signals.
S4—Fair signals.
S5—Fairly good signals.
S6—Good signals.
S7—Moderately strong signals.
S8—Strong signals.
S9—Extremely strong signals.

However, if amateur stations, in giving reports to one another were to use this scale literally, there would be many S3, S4 and S5 reports and few S9 reports. In practice reports tend to be up around the 8 and 9 mark.

If we remember correctly, there was an attempt to make a more rigid definition of signals strength measurements by making S1 equal to 1 microvolt and each S point 6db above the other. In order to follow this idea you would need a calibrated signal generator.

About the only way you could obtain a factory prepared scale would be to supply a rough version to the manufacturers after the signal generator calibration. However, the cost would, in most cases be all out of proportion to the worth of the scale and the best plan may be to prepare one by hand with the aid of a lettering guide.

M.R.R. (Sencliff, S.A.) would like to see some work on UHF converters. He also has a question about sidebands.

A. We would like to see one too but have not been able to tackle one recently. To obtain the answer to your sideband question would really need resort to the maths of the matter. Various resultants can come from modulation and demodulation but, if some of them cancel, they disappear as significant quantities. Fortunately for the AM system, the output of an ideal detector contains only the original modulating frequencies, not their harmonics.

J.B. (Wollongong, N.S.W.) encloses the circuit of a small one-valve set from an American magazine.

A. It is a pleasure to see one of these circuits which is conventional, not some super-regenerative or transmitting device calculated to drive neighbours or the authorities to distraction. The circuit is quite straightforward and would work as well here as in the U.S.

G.D.M. (Blackwood, S.A.) says he would like to see a modernised version of the audio generator described in the August, 1945 issue.

A. You must have missed the September, 1955 issue in which a modernised version of the instrument appeared. It is capable of much better results than the original, though it is physically smaller. Many thanks for your contribution to the "Reader Built It" page. The most likely criticism of your mixer would be in regard to possible treble loss due to Miller effect in the mixer triode. Hum might also be evident from the active cathode circuits if the valves are in any way suspect.

B.M. (East Malvern, Vic.) wants to know the advantages of a doublet aerial over the more usual type.

A. Used as a general purpose aerial, a doublet's only advantage is that there is much less signal pickup on the lead-in than on an ordinary single-wire lead-in. This may be helpful if the receiver is suffering from interference coming from the power mains or some device very close to it. By keeping the aerial away from the source of noise and using a twin lead-in wire, the interference effect can be kept to a minimum. To operate properly, a doublet must have a twin balanced lead-in connected to the two ends of the aerial primary winding. If the two lead-in wires are connected together or if one of them is simply connected to the chassis earth terminal, the system loses any advantage it might have. Over and above the problem of purely local noise, the doublet does not necessarily give any better signal pickup than a conventional aerial and lead-in. It certainly does not confer any advantage in relation to distant interference or atmospheric static. Amateur stations use doublet style aerials but under different conditions, where they are proportioned so as to be naturally resonant on the relatively narrow amateur bands. We can supply details of a general purpose all-wave doublet through our 2/ query service.

P.E. (Indooroopilly, Qld.) asks us about some morse buzzer sets advertised recently.

A. We cannot offer you any technical advice about these items or, in fact, many others which are appearing in advertisements. If advice is required, it would have to be sought from the advertiser who may or may not understand the technicalities of the units he is selling. In some cases we have had occasion to use or test advertised products but this would be incidental to our normal technical activities. As far as we know, the buzzers would have to be interconnected by wire circuits. There is no thought of radio transmission involved. In fact, if there were, the items would be classed as transmitters and some kind of licence would be needed to operate them.

P.T.M. (Ryde, N.S.W.) has a lot of questions to ask about technical terms.

A. Your letter involves too much to answer in these columns but it provides excellent material for our "Answer Tom" feature. You can expect to see the queries discussed within the next couple of months.

L.S. (Bentleigh, Vic.) is interested in the galvanomagnetic amplifier mentioned in the article "Survey of Tubeless Amplifiers."

A. This article, as indicated, was reprinted from an overseas source and we have no information on the constructional aspects of any of the equipment. Short of making a special study of the subjects, we could not answer your questions. These "survey" articles are intended to open up lines of thought but we must leave it to individual readers to follow up any aspect which particularly interests them.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

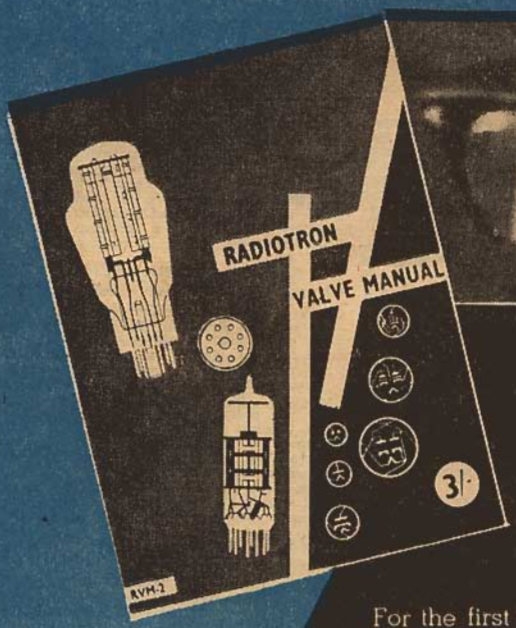
Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

You will See the Difference



Servicemen, technicians and salesmen alike will see the difference the Radiotron Valve Manual makes to their valve characteristic problems.

For the first time under one cover the Amalgamated Wireless Valve Company presents the following complete and comprehensive technical data:—

Receiving Valve Classification Charts • Base Charts • Valve Data • Picture Tube Data Photocell Data • Semi-conductor Diode Data Transistor Data.

This information is tabulated in numerical and alphabetical order, and lists, for each type, principal functions heater voltage, typical operation and base connections.

Covered in heavy art board for durability and priced at 3/- including postage, the Radiotron Valve Manual (RVM-2) is available on request from A.W.V.

AWV

Published by

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

47 YORK STREET, SYDNEY

TRANSISTOR AMPLIFIER

(Continued from page 39)

will be included in the chassis blueprint and should be available ready made along with the chassis.

For the switch hook proper we required an assembly of contacts which could be mounted against the inside front of the case and which could be operated by the vertical movement of the handset.

We soon determined that the requirement could be satisfied by a standard relay movement, and a check with the manufacturer confirmed that he would be willing to supply relays less the coil through the trade.

The relay is a 600 type, and in the case of the transistor telephone amplifier, need only have one set of contacts, which are normally open.

The 600-type relay is rather smaller than the better-known type 3000 and has been available through disposals stocks. It is likely that many readers will have suitable types on hand. To adapt it for this purpose the coil should be removed and the shorter arm of the yoke, which previously held the coil, cut off. This allows the longer arm of the yoke holding the contact assemblies and the armature, to mount flat against the inside front of the case.

A slot must now be cut in the case to allow the armature to protrude through the cutout in the rear of the U-shaped bracket. The position of this cutout should be determined with care. For our unit, the top of the slot was 2¼in from the top of the case (outside). It is ¼in deep and ⅛in wide.

Before cutting the slot, the leatherette covering should be cut with a sharp razor blade on a horizontal line along the centre of the proposed slot. Short vertical cuts at each end should now be made, and this will allow two small pieces of the covering to be peeled back while the slot is made. It is most easily cut out with a coping saw and finished off with a file. The leatherette is then glued back into place and the surplus turned into the slot.

Because of the angle of the case front, the armature does not protrude through the slot at quite the angle required, and we found it necessary to make a further modification. This takes the form of an extension to the armature consisting of a piece of sheetmetal approximately ¼in x ½in which is fastened to the back of the armature.

By punching out the small copper slug in the armature, a hole is provided by which this attachment can be made. A rivet is the best means of fastening, plus some solder for added stability.

The protruding portion of the attachment may now be bent slightly downwards so that it presents the correct angle to the receiver case. In our unit we found it best to space the relay away from the inside front of the case by 3/16in. A strip of 3/16in ply provided the necessary spacing.

The relay was mounted to the case by means of two ¼in machine screws, appropriate holes having been drilled and tapped in the yoke.

With the relay working correctly, the remaining units—speaker, amplifier, batteries, etc.—may be fitted into the case and the device tested. A handset hung in position should produce the normal dial tone in the speaker, and dialling one's own number will produce the engaged signal. This should be quite strong. If feed-back occurs or appears likely, the gain should be reduced until the system is stable.

And that's about all there is to it. In any office, such a device will prove a marvellous work aid. It should pay for itself in a few weeks in the time it saves by releasing personnel who would otherwise be chained to the phone—wastefully—for many hours per week.

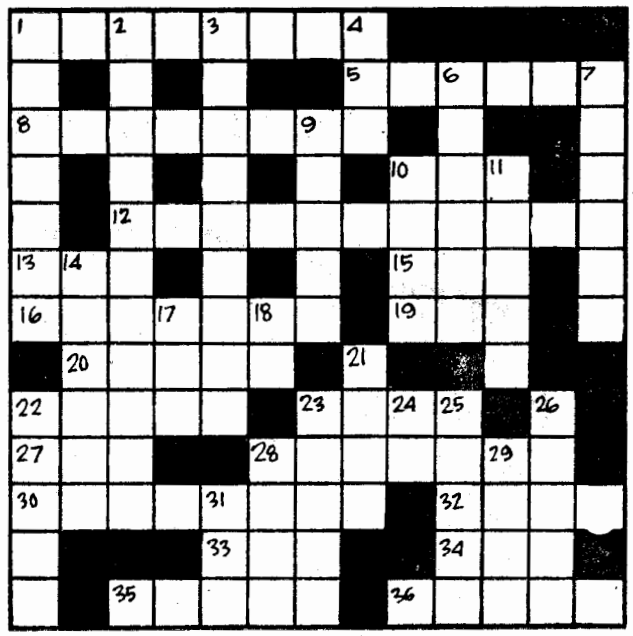
DRIVE-IN THEATRES

(Continued from page 25)

To such comments Vido-Sound people reply that they have not experienced any noise pickup of any kind and expect none. That at Dover the wire loops carrying the signal are fastened to the underside of the concrete upper deck, and that in nontheatrical applications signals have been picked up quite successfully from a submerged submarine.

Vido-Sound not only expects many more drive-ins to adopt its system, but foresees its successful use in many other applications—public-address systems at county fairs, carnivals and travelling shows; for two-way intercoms; possibly even for ground to air communications that will not interfere with any radio communication.

THE R., TV & H. CROSSWORD No. 48



ACROSS

1. Transferring energy from one circuit to another.
5. Obsolete name for triode valve.
8. Continuous oscillations.
10. To sever.
12. A clock worked from AC.
13. Floor protector
15. Tear.
16. Paper for drying ink.
19. Greek letter.
20. To dress with feathers —as a bird.
22. Summoned.
23. Small area of ground.
27. Single.
28. Type of cable.
30. Australian bushranger.
32. A malarial fever.
33. Place protected from the wind.
34. To decay.
35. Blows.
36. Leaves of a book.

DOWN

1. Unit of flow of current.
2. Without distortion.
3. Describes transformer cores.
4. A short-pointed chisel.
6. A piece of equipment for long distance reception (two words).
7. Sounds.
9. An anaesthetic.
10. Part of a transformer.
11. A translucent or transparent gem.
14. Pertaining to Alps.
17. Golf ball support.
18. Half an em.
21. To engage in sport.
22. Fruits of the Pine.
23. Part of a magnet (pl.).
24. Beast of burden.
25. Crown-like head ornament.
26. A musical instrument.
28. A musical character.
29. Highly excited.
31. A mischievous fairy.

Solution and further crossword next month

R	U	T	H	E	R	F	O	R	D		T	
E		A	I	R		O			I	R	O	N
S	U	P	P	R	E	S	S	O	R		R	
I		S	P	A	R	T	A		E	T	C	H
D			O	N	S	E	T		C		H	
U		A	D	D	E	R		S	T	E	E	R
A	V	E	R				G	A	I	N	S	
L		R	O	T	O	R		T	O	T		
		A	M	I			T	U	N	E	R	S
W	A	T	E	R		C	U	R	A	R	E	
A		I		A	E	R	I	A	L		L	
T		O		D		Y		T			A	
T	E	N	D	E	R		H	E	A	V	Y	

Last month's solution

WANTED TO BUY, SELL OR EXCHANGE

SELL: Garrard 3-speed player in cabinet, £8 H.G.P. 40 pickup, £8/10/-. Rola 120 Deluxe, £3. **Brisbane, ring M1314.**

SELL: Real bargain. £100 buys. English M.S.S. Tape Recorder, dual-speed, three motors, fast forward auto-stop complete with microphone, separate loudspeaker, instructions and circuits. **Phone WF3233, Melbourne. LX2875. Sydney.**

SELL: Genemotors 1a V input, 275 V. at 110 ma. and 500 V at ma dual output, several, 37/6 each, add postage if required. Also 50 Microamp meter, 3in Elliott 90/-; and 1 ma meter rectifier. W'house. 10/-. C. Luckman, 2 Milton St., Canterbury. Vic. WF8653.

SELL: Wobbulator for sale. C/- Lot 4 Seaview Ave., Curl Curl, N.S.W. XF3630.

FREE: Large Junk Box to buyer complete 60 watt Ham Rig. 10-tube R.C.A. Recvr. V.F.O Freq. Meter/Monitor. Consider exchange for camera equip. br. £100. VK2PT, Stephenson, 10 Eketchley Pde., New Lambton, 2N. LU3483.

SELL: Hallcrafters SX28 communication receiver 540 kc-43 mcs. Good condition, £90. J. G. MacIver, 21 Hurd Tce., Morningside, E.1., Brisbane.

SELL: A.W.A.—A13 transmitter, 2-20 mcs, 500 watts, as new, £40. U.S. twin modulators type mdl./F.R. output 300 watts each. Good condition, £30. J. G. MacIver, 21 Hurd Tce., Morningside, E.1., Brisbane.

SELL: Portable 18 valve F.M. transceivers, 48-52 mcs, including headset and mic., handset, 3 whip aerials, set of spare valves. Good condition, £15. J. G. MacIver, 21 Hurd Tce., Morningside, E.1., Brisbane.

FOR SALE: Wired 6in TV as per R.T.V. and H. circuit in metal cabinet. All brand new, £50. Now built 17in set. Also I.F. strip, Q.-Plus coils, plus valves, £7/10/-. 5 P.B.I.'s. Wobbulator, unit and parts. 1 Mernda St., Sunshine, Vic. MM2918.

FOR SALE: Castings and designs for Marine, Locomotive and general engineering students. Catalogue 5/6. Bolton, 72 King St., Sydney.

FOR SALE: Communication Receiver type R107, 1.2-17.5 m/cs, ac /dc, perfect condition, Handbook, £70 or near offer. 26 Embankment Grove, Chelsea, Vic.

FOR SALE: Old established Radio business in Lismore. Good Agencies, with large sales potential. Particulars, Box 389, P.O., Lismore, N.S.W.

FOR SALE: B.J. Pick-up arm and shell, with imp. German M.S.T. cartridge. Bargain, £10. JF3562, Sydney.

WANTED: One 144MC Receiver or Converter, will give good price. Mr R. J. Germon, C/- C'wealth Bank of Aust., Kyogle, N.S.W.

WORK AVAILABLE: Stop switches for electronic organs. We refer to our advertisement in the February issue in this column. Nearly 400 replies were received, and we are quite unable to respond individually; we wish to thank those who replied. A tender has been accepted. Electronic Organ Co.

SERVICING: New Books! See our advertisement in this issue regarding two new, low-priced titles on radio and TV servicing. Electronics Publications (Aust.).

WANTED: Assembly work. Contract chassis wiring expertly carried out. Phone XM2880, Sydney.

ANSWERS TO CORRESPONDENTS

A.D.B. (Caulfield, Vic.) says he has a commercial AC/Battery radio which he wants to use in his car. He wants to know whether the AC inverter described some time ago in these columns would make this possible by turning his 12-volt car supply to 240 volts 100cps.

A. We are not to keen to buy into discussions about what can and can't be done with commercial receivers. It would pre-suppose a complete file of commercial circuits and time to peruse them, added to which possible changes made on our advice may invalidate guarantees, etc. It is one thing to experiment with home-made equipment: quite another when the said equipment is of commercial manufacture. As far as we know, the 100-cycle aspect would not cause any complication. The big danger would be in the possibility of over-running the valves in terms of voltage, either by reason of the unit itself or the high voltage which can appear in a car system when the battery is being charged heavily. AC valves will take a certain amount of abuse but not the frail battery types. On this last count alone, we doubt whether the manufacturers would give the idea their blessing. It is one of those schemes which could be arranged and may work well if everything is just right. But it could equally well lead to trouble.

Printed and published by Sungravure Ltd., at the registered office, 21-29 Morley Avenue, Rosebery, N.S.W.

Signal Tracer and V.T.V.M. Model A.S.T.

SERVICE by SIGNAL TRACING

Signal Tracing has long been recognised as the most efficient means for locating faults in radio receivers, audio amplifiers and similar equipment. University Instruments have produced something more than a Signal Tracer. It is a sensitive Signal Tracer combined with a Vacuum Tube Voltmeter which opens up a wide range of possibilities and brings fault finding in service work to a stage where faults can be quickly located and analysed ready for speedy repair.

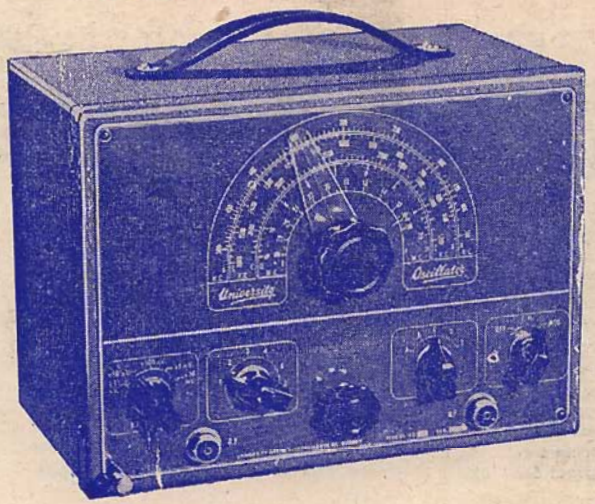
Faults such as lack of sensitivity, radio frequency oscillation, audio oscillation distortion and hum can be quickly pinned down with the new model A.S.T. Brief specifications are: Power: 240 volts, 40 to 60 cycles.

VTVM: 0/5, 0/25, 0/100, 0/500 Volts AC and DC.

The signal tracer covers from 175 kilocycles to 18 megacycles.

A leaflet giving full details is available on request.

DYNAMIC "ON THE BEAM" PERFORMANCE



MODEL YOA OSCILLATOR

Gives dynamic "on the beam" performance and the new Vernier or fast drive dial makes for quicker and easier tuning.

Has an improved attenuation system and the dial is calibrated in spot frequencies for quick tuning over the main alignment points merely by changing the switch. Has continuous coverage from 30 megacycles to 150 KC. in overlapping bands. Write for free literature.

UNIVERSITY GRAHAM INSTRUMENTS PTY. LTD.

***TV servicemen and service organisations**

You are invited to inspect our television and Radio Test Equipment under working conditions in a special demonstration room at our factory.

MAIL THIS COUPON TODAY

TO: University Graham Instruments Pty. Ltd.
5 North York Street, Sydney.

Please place me on your mailing list for TV and radio test equipment.

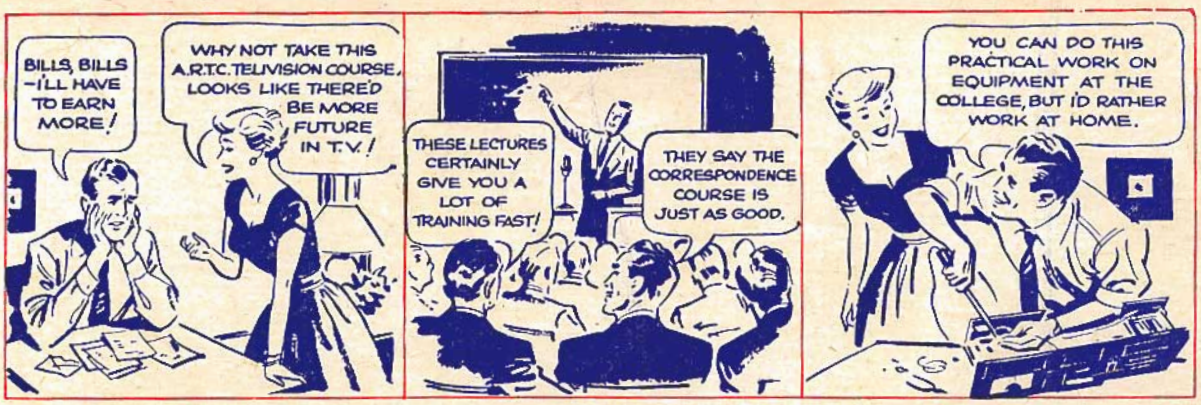
NAME .....

ADDRESS .....

.....

5 NORTH YORK STREET, SYDNEY, N.S.W. BU3169

This A.R.T.C. Success Story Can Be Yours!



GET INTO ONE OF THESE PROFITABLE CAREERS IN RADIO AND TELEVISION

There is a profitable career for you in the many phases of radio television including manufacturing, radio servicing, television servicing, research, sales broadcasting and television executive, armed forces. A.R.T.C. can help you gain one of these much sought-after positions, but remember, it is only the trained man who succeeds and A.R.T.C. can give you the complete training which is necessary.

TRAIN AT HOME OR AT THE COLLEGE

With A.R.T.C. you can obtain the training you need. At the benches and in the lecture halls of Australian Radio and TV College or in your own home, by correspondence . . . you can be taught every important aspect of radio-television, details of every application of the fundamental principles. The course is intensely practical and individual.

Make Spare-Time Money.

If you wish you can make your spare time earn money for you. Many students make extra money at spare time work after only the first few weeks. Think of all those things extra money can bring you . . . home of your own, car, time for relaxation, etc Safe-guard your future . . . *mail the coupon* today!

MAIL COUPON NOW

You are invited to mail the coupon below which can be your first step towards securing a job or business of your own with good prospects, security and big money. A.R.T.C. will mail to you by return, at no obligation to you, the big free booklet "Careers in Radio and Television." This booklet will show you definite steps you can take for a better job . . . how you can succeed *in life*. Post the coupon, 'phone or call NOW.

AUSTRALIAN RADIO AND TELEVISION COLLEGE PTY. LTD.

E. S. & A. BANK BUILDING

Cnr. Broadway and City Road, Sydney
(opp. Grace Bros.) Phone BA4891-2

AUSTRALIAN RADIO & TELEVISION COLLEGE PTY. LTD.

206 Broadway, Sydney, N.S.W.

Dear Sir,
Please send me, without obligation. your free booklet "Careers in Radio and Television."

NAME .....

ADDRESS .....

.....