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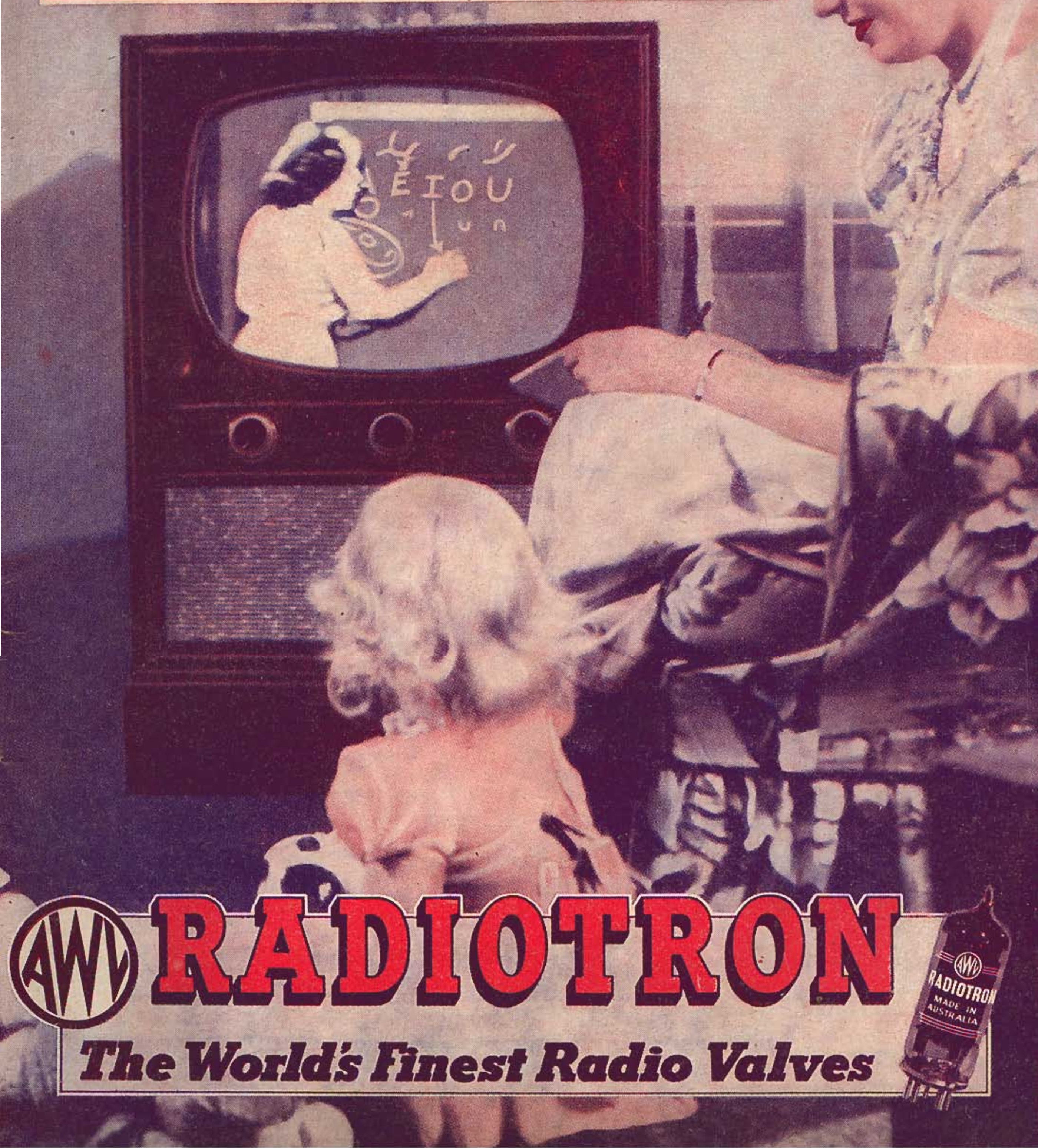

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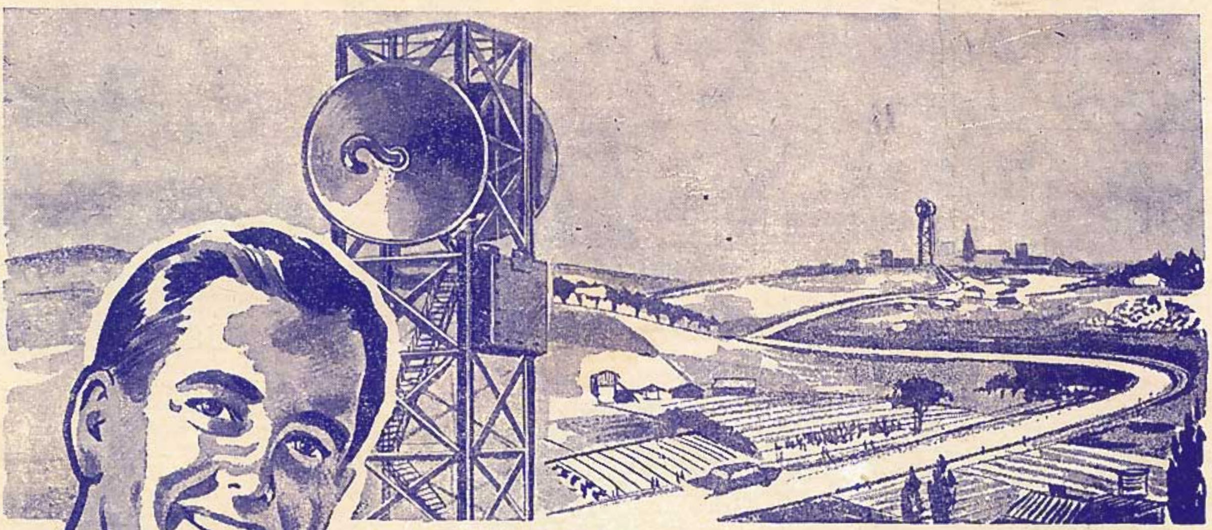


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EDITORIAL

HOW long will it be before we see more active interest in the FM broadcasting band?

It is now about ten years since FM for Australia was first mooted. It is often forgotten that quite a controversy raged about the question at that time but, despite the efforts of a few people, nothing was done. Perhaps it was too early in the piece for Australia to take such a step and in fact, it is only in recent years that FM has made any great impression overseas.

Germany, denied wide use of broadcast band frequencies after the last war, now has hundreds of stations. Other European countries are going ahead with comprehensive plans, and England has already established the first of its FM transmitters which, it is expected, will soon cover the country.

It is inevitable that, for a time, Australian radio interests will be pre-occupied with TV and its problems. But it is also true that the closer acquaintance with FM by TV interests, and by the general public, may focus attention on the FM broadcast bands sooner than we were led to think possible.

There is little doubt that the difficulties of FM technique can be much more easily faced now than in the past. The undoubtedly fine results possible with FM sound through a good TV set will soon intrigue the public, as it has done elsewhere in the world, not merely because of its musical potentialities, but mainly because it is so quiet and interference-free.

All praise to the PMG experimental FM stations in Sydney, Melbourne and Adelaide, which have doggedly kept on the air, year after year, so that invaluable engineering data could be obtained and experimental activity could continue.

Today these stations have enough listeners to make us all hope they are now permanent features.

Who will be the next to join them? Some enterprising broadcast station, determined to meet TV competition with a second programme channel? Or an entirely new company, ready to take a risk on the future?

It would only require one or perhaps two such transmitters to appear on the air to work a major change in the outlook for FM.

Personally, I hope it will happen soon. There are no new fields to conquer on the broadcast band. The future of radio now lies elsewhere.

John Moyle

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RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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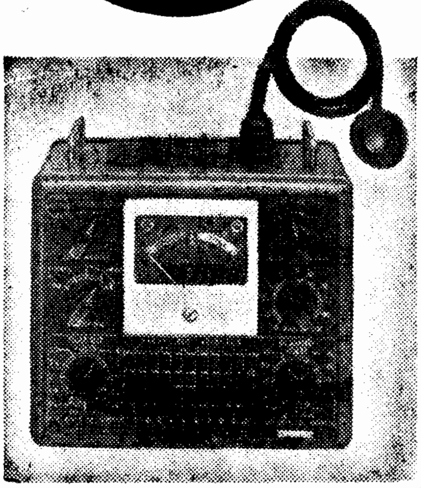
OUR COVER PICTURE

Television can be much more than a prolific source of entertainment. Here for a half-hour, household duties are put aside while Mrs. Julie McNair takes a short-hand lesson from the General Electric TV station WRGB. Fortunately, the programme seems also to have its attractions for her eighteen-months-old daughter.

Palec

Range of TV and RADIO INSTRUMENTS



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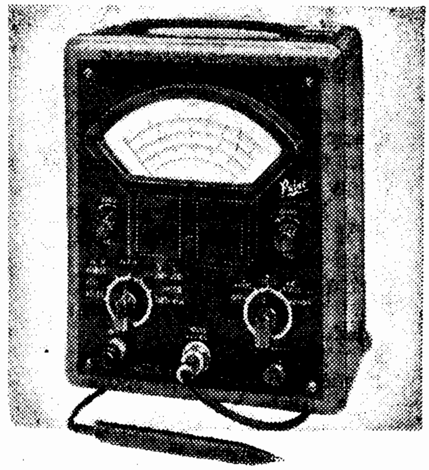

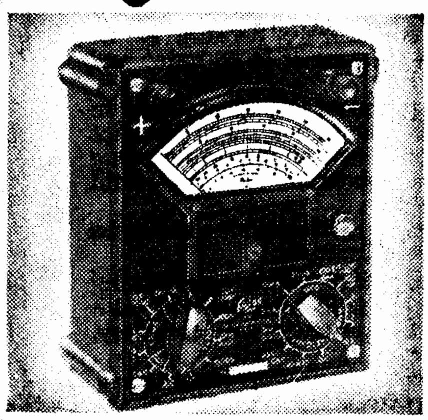

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Television Multimeter:—20,000 O.P.V.
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Current: AC 0-1 mA (for use with ext. C.T.).
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MODEL M32. Thirty-two range.
Radio and Electrical Multimeter:—1000 O P V Ranges as MX32.

MODEL M52. Fifty-two range Laboratory Multimeter:—1,000 O.P.V
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This instrument is a basic necessity for Television Service.
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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 extend range of TVM to 30,000 Volts	£9	10	0
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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
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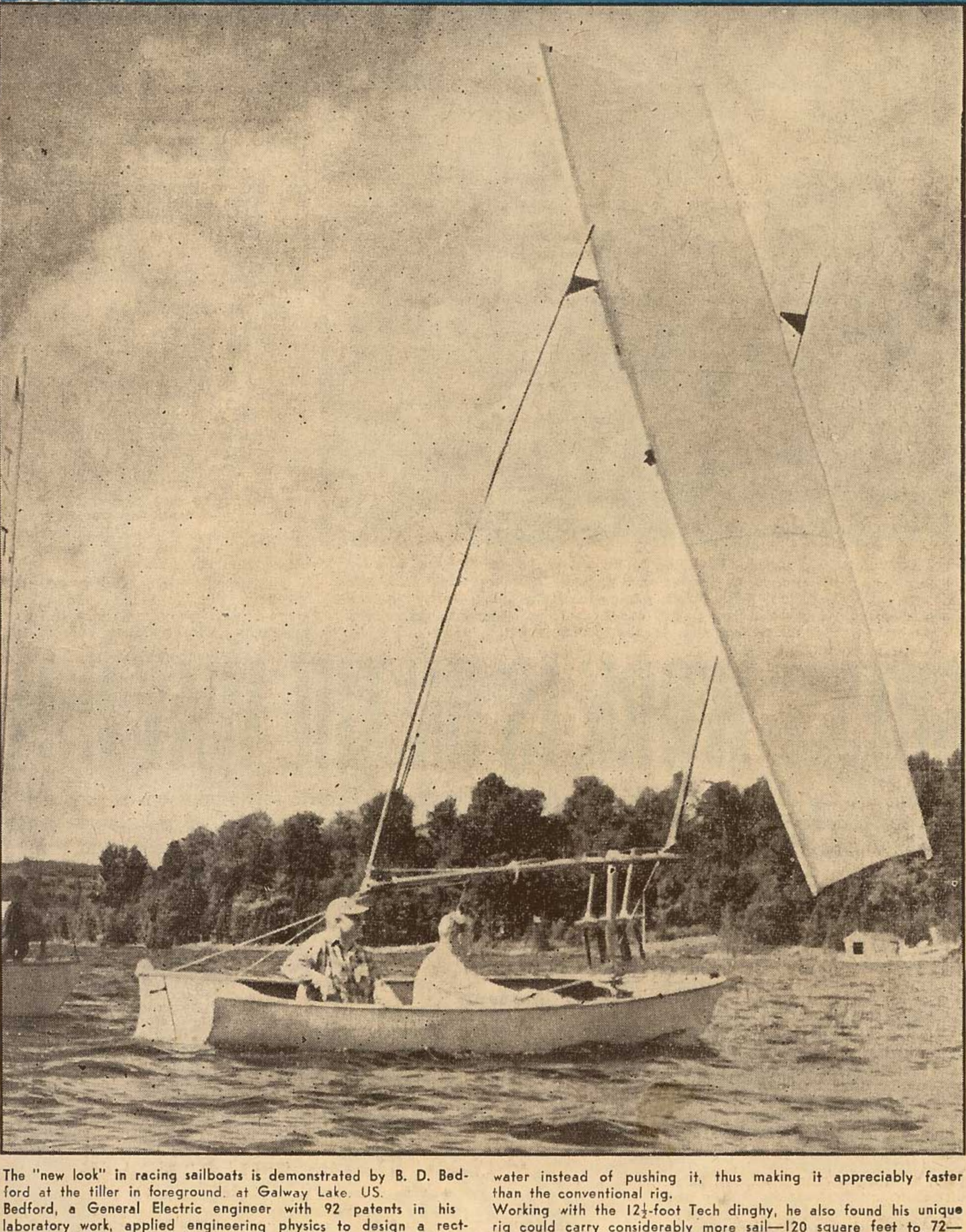
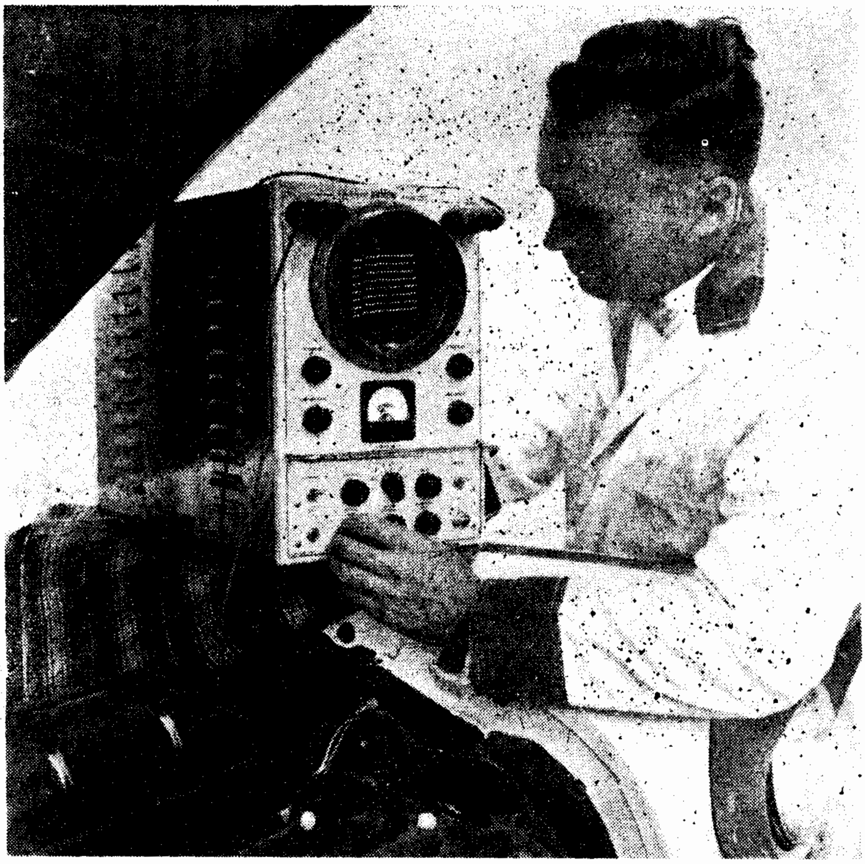
SAILING YACHT OF THE FUTURE?



The "new look" in racing sailboats is demonstrated by B. D. Bedford at the tiller in foreground. at Galway Lake. US.

Bedford, a General Electric engineer with 92 patents in his laboratory work, applied engineering physics to design a rectangular sail on a U-shaped rig. He theorized that a sail swinging outward from the bottom reduces the torque exerted on the sail, which tends to overturn the boat and "pulls" the boat along the water instead of pushing it, thus making it appreciably faster than the conventional rig.

Working with the 12½-foot Tech dinghy, he also found his unique rig could carry considerably more sail—120 square feet to 72—than the standard rig, another factor in speeding up the craft. Bedford, a Texan, uses a series of 12 coil springs on the stubby mast to keep the bottom of the frame upright. See page 24.



The Enginescope, now marketed in the US by the firm of Dumont. By means of a CR tube display, the instrument is credited with revealing defective plugs, coils, condensers, worn distributors, faulty points, pre-ignition faults and a variety of other allied troubles. It operates from an AC outlet or the car's electrical system and, for testing, clips to the ignition wiring.

GUESS-WORK IS ON THE WAY OUT

Gone are the days of hit-and-miss car tuning and repairs. Electric test equipment has moved in to Australia's garages, taking the guesswork out of car maintenance. A new generation of mechanics is arising, which relies just as much on meter readings as their counterparts in the radio industry.

By Pedr Davis

EARLIER this year an article in R, T & H told about some of the electronic problems of automotive ignition, and made the point that, while other electrical fields in industry had been founded on research, the wide sphere of auto electrics—and ignition in particular—had, like Topsy, just grown.

Today, research is beginning to catch up on the lag, and much car equipment bears the stamp of research into why and how matters, instead of just being made to conform with long-established designs first established by hit-and-miss methods.

But if in this specialised field there has been a lag in research, in other automobile territory there has not. And, again, as in many other electronic fields, Australian engineers can hold their own with any in the world.

One feature of car service today is the growing use of electronic service aids; gadgets which take the hit-and-miss out of car tuning and maintenance, replacing trial-and-error fix-it methods with instrument readings which eliminate doubt and pinpoint troubles in seconds instead of expensive hours.

There are machines today which, electronically, can pick faults in a worn distributor; detect wrong jets in a carburettor; wrong timing; faulty batteries, and a string of other trouble-makers as long as one's arm. And, having pinpointed troubles in the fuel and ignition departments, there isn't much left for a mechanic to diagnose.

Such developments, as motorists can testify, haven't come too soon. Modern car engines, with their high compressions, many cylinders, high revolutions per minute and complex construction, need more expert and accurate diagnosis than the four-lunger tourers of the twenties. So an ever-growing flow of mechanical and electronic equipment is stacking up in garages which a few years ago boasted nothing more in the way of gadgets than, perhaps, a battery tester.

Perhaps the most spectacular device from the layman's point of view, and the most interesting from that of an electronics enthusiast, is the exhaust gas analyser.

With this box of gear, which is simply connected to the exhaust pipe, a mechanic can tell whether the car is getting a mixture of petrol and air that is too rich, too lean, or just right. Such a diagnosis has always been important. If a car is running too lean, the engine starves for fuel at speed, can miss, burn out exhaust valves, and lay down all sorts of obscure troubles of which lack of power is only the first.

MIXTURE TOO RICH

If the mixture is too rich, exhaust valves can suffer again. Petrol consumption will rise, performance will suffer, and carbon deposits, leading to an expensive decarbonisation and valve-grind, will grow quickly.

Before the advent of the analyser, a mechanic had only simple aids. If the exhaust gave off black smoke, the mixture was too rich. If it missed, it was too lean. For fine adjustments, laborious trial and error was the only solution. Now, with analysers, fuel and air mixtures in the carburettor can be set exactly right.

The device which makes electrical diagnosis possible is the old Wheatstone bridge in a new form. The four resistances, with a common input and output and a meter strung across the middle, are made of platinum wire 0.0001in thick. Opposite resistances (see diagram) are paired and erected on a baseboard so that each pair rises vertically from its base a few inches apart.

These resistances fit into a pair of hollow cells in an alloy casting. One cell is filled with nothing but air and is sealed off, serving as the standard measuring stick.

The other cell is connected by a flexible pipe to the exhaust of the car under test, so that one pair of resistances is immersed in the burnt exhaust gases.

From here on the device relies on the fact that the resistance of the platinum wire increases as its temperature rises. A current in the order of 130 mA at 3 volts is passed across the Wheatstone bridge and through the pairs of resistances. The current causes the temperature of the wires to rise. This heat is dissipated into the gases surrounding the wires, thence into the walls of the castings and to the open atmosphere.

However, in one cell, the wires are surrounded by plain air. In the other they are surrounded by burnt gases containing carbon monoxide, carbon dioxide, hydrogen and other products of combustion. The speed with which the amount of heat generated by the resistances (small, though it is) is dissipated, depends on the ability of the two different gases, air and exhaust mixture, to conduct it. This relative thermal conductivity is the factor on which the analyser relies.

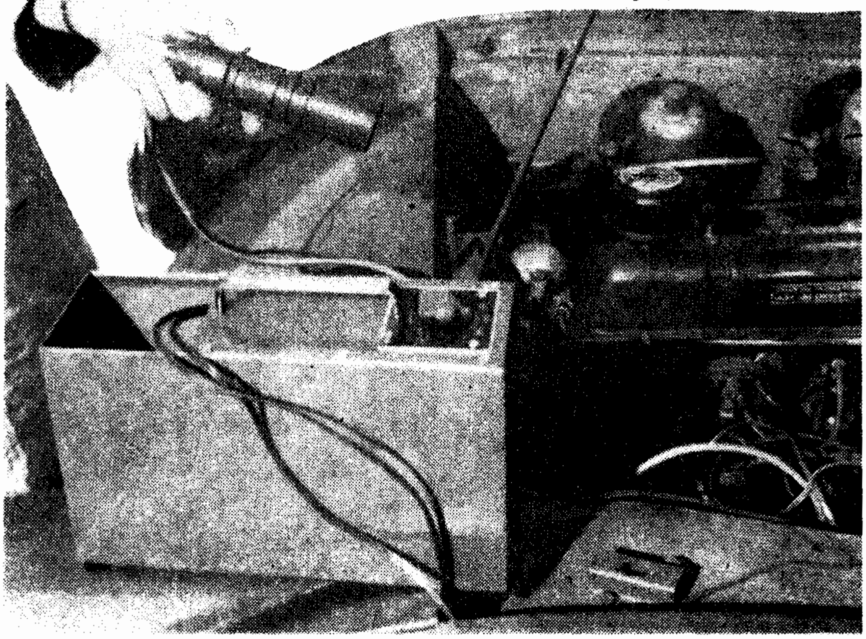
NORMAL MIXTURE

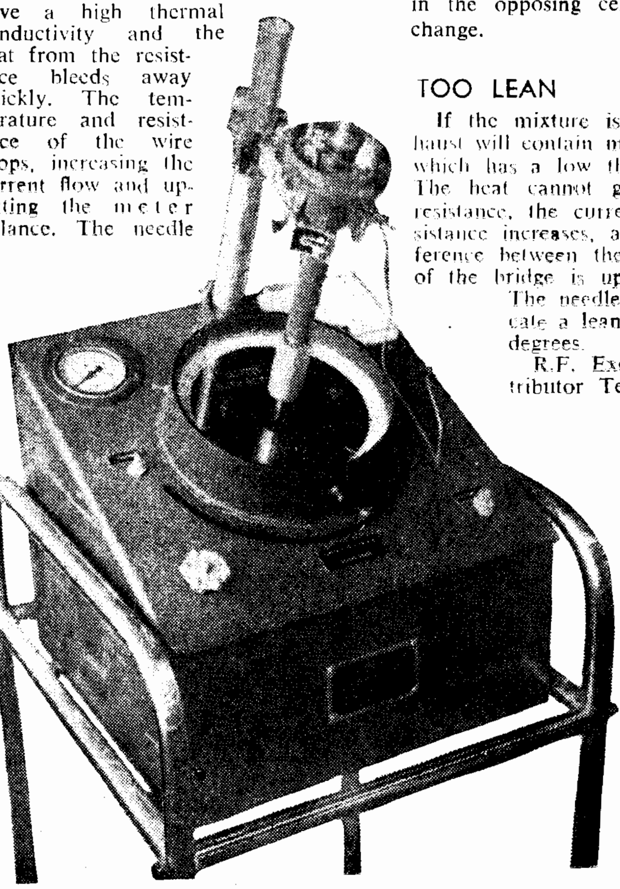
A normal mixture consists of one part by weight of petrol to 13 parts of air. It is rich in carbon dioxide when burnt. Its thermal conductivity is different to plain air — poorer, in fact — and this in turn affects the temperatures of the platinum resistance wires. In the cell containing air the heat gets away fast through the air, and the temperature of the wire stays down — and with it its resistance. In the other cell the heat can't get away as fast and the temperature of the wire rises, increasing its resistance. This difference in voltage of one part of the bridge with respect to the other is read off on a meter. Since this difference represents a correct mixture, the difference is fed into the meter and calibrated to give a centre, or "normal" reading.

If the analyser is then put on a car which has too rich a mixture, the exhaust gas sample in the cell will contain more carbon monoxide and hydrogen than it should. Both have a high thermal conductivity and the heat from the resistance bleeds away quickly. The temperature and resistance of the wire drops, increasing the current flow and upsetting the meter balance. The needle swings toward the low side of the scale, reading directly in percentages of over-rich mixture. It can be seen now that all gas samples are compared in heat conductivity with the straight air in the opposing cell, which does not change.

A high intensity strobe light, which is used to "stop" moving parts of an engine, in the optical sense of the term. The high intensity light allows it to be used in or out of doors and is a big improvement on previous neon lamp systems.

N. F. Black





This machine, called an electro-synchrograph, portrays in visual form, on a central circular scale, the behavior of a distributor mounted on the head above it. The instrument is made by Auto-Lab.

TOO LEAN

If the mixture is too lean, the exhaust will contain more carbon dioxide, which has a low thermal conductivity. The heat cannot get away from the resistance, the current falls as the resistance increases, and the voltage difference between the gas and air sides of the bridge is upset the other way. The needle will swing to indicate a lean mixture in varying degrees.

R.F. Excited Neon as Distributor Test:

Another machine coming into wide use is the Distributor Synchrograph, which diagnoses faults in the advance and retard mechanism, wear in the moving parts, points bouncing open intermittently when they should be closed, and checks on the amount of advance and the time the points remain closed for each cylinder spark plug.

The distributor is removed from the car and mounted on a central shaft above a circular scale calibrated in degrees. Under the transparent scale, revolving in time with the distributor shaft, is a pencil-thin neon light arranged crossways to its circuit of travel, so that when it revolves at speeds up to 3000 r.p.m.—representing 6000 r.p.m. engine speed—it traces a broad band of light around the scale. As the points open and close, the neon tracer goes on and off; and all the irregularities of the distributor action are revealed visibly.

The current to excite the neon, however, cannot be straight DC, because persistance of illumination in the neon would give false readings. Nor can it be straight 50-cycle mains current, because that will also give a visible trace of the wave form. The solution is to feed the neon from an RF signal generator built into the base of the machine. There is then no visible wave pattern or persistance of illumination, and all variations in the light are direct representations of the distributor behavior.

TIMING BY FLASH

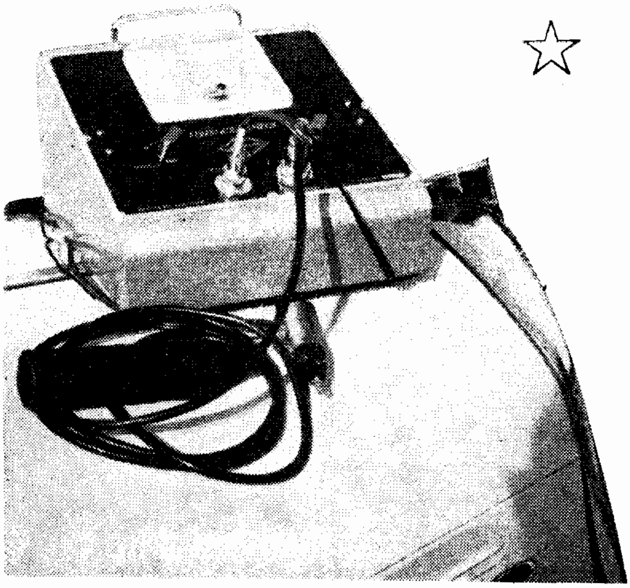
Setting ignition timing—the point at which the spark fires the mixture in each cylinder—is done by adjusting the distributor so that the plug in No. 1 cylinder fires when a timing reference mark appears in a specific position on the flywheel or on the pulley on the front of the crankshaft which drives the fan and generator. Manually, it's a matter of fiddling to get it right.

Now an improved version of older timing lights is available. It consists of a flash tube (similar to a photo-flash), an 8 mfd paper condensor and a vibrator to give a high voltage supply from the battery in the car. The photo flash is connected across the charged condensor, but will not fire because of the resistance of the gases in the tube which gives the light. To ionise the gases and increase their conductivity so that the condensor charge will fire through them, a coil is thinly strung around the tube and connected through an outside lead to No. 1 spark plug. Whenever the plug

tres, some current will, by induction, onise the gases in the tube and fire it off. The result is a flashing light in time with the engine. If it is directed at any part of the crankshaft pulley, or other rotating part, it will by stroboscopic effect, appear to make it stationary. If focused on the timing mark, and if the spark is firing at the right time, the mark will appear stationary and the operator knows all is well.

However, this is only a simple tester for use at idling speeds, to make sure the initial distributor setting is right. The automatic advance mechanism, in most cars worked by vacuum from the manifold in combination with centrifugal bob weights in the distributor, is intended to advance the spark so that it fires earlier as the engine goes faster, or later when going slowly or when slogging hard under load.

This electronic wheel alignment device interprets the readings of a conventional mechanical machine and, with the aid of galvanometers displays the answer on two calibrated scales. The light spots, as shown, are resting on the centre line markings, with degrees of toe-in or toe-out to either side.



This machine, made in Sydney by Auto-Lab, combines the principle of a conventional timing light with electronic delay circuits so that it can give a visual check of the advance and retard mechanism in auto distributors.

To check on this, a more complicated timing light has been produced, still excited by the spark plug and powered by the car battery, but controlled electronically. Thyratron tubes trigger the flash, and between the two Thyratron stages is a variable delay line, which provides a time delay, measurable on the built-in meter, between the time the spark fires in the cylinder and the moment the timing light flashes.

DELAY CIRCUIT

To use it, the operator sets the engine at idling speed, with the light flashing in time with the spark firing. The timing mark on the pulley or flywheel then appears stationary. When he speeds the engine up, the automatic advance will cut in, altering the timing, and the timing reference mark will disappear. The operator then adjusts the variable delay circuit until the timing mark appears again, which indicates that the spark is occurring a certain interval before the mark reaches its reference point.

This delay could be read off the meter in time, but in automotive practice the lag is expressed in the number of degrees of crankshaft rotation between the static setting and the actual firing position at any engine speed. So the meter is calibrated directly in degrees.

Gearless and clutchless driving is becoming more common every year. The automatic transmission which replaces the gear lever is a complicated mechanism, and many of the controls which take over from the driver are actuated by combinations of engine load and speed. When a mechanic is adjusting these control mechanisms he must know exactly how fast the engine is motoring. Engines generally don't have tachometers or rev. counters built in, so the mechanic uses an electric tach. This counts the electrical impulses coming from the distributor, filters them and passes the current through a meter which is calibrated in engine revs.

However, the instrument, for the sake of accuracy, must feed its own power through the distributor, which leaves the problem of what to do with the current which is already being passed out from the car coil and distributor. This is solved by reversing the polarity of the test current, taking both into the instrument and then chopping off the bottom half of the combination, leaving only the test current in intermittent DC form.

This instrument also reads the degrees of cam angle and the point dwell, and can diagnose point-setting faults or worn distributor parts, without upsetting its function as an accurate electric tach.

An exhaust gas analyser, also Australian-made. By assessing the thermal conductivity of a car's exhaust gas, it gives a direct indication as to whether the mixture is rich or lean.

WHEEL ALIGNMENT

Mechanical wheel alignment has been done for years. Now electronic aids make the job easier for mechanics, more accurate—and let the customer see what's wrong with the front end of his car.

A normal mechanical front-wheel aligner is used as the basis. This consists of two measuring heads which fit on to the front wheels of a car and measure caster, camber, toe-in and toe-out on turns.

A transmitter which has a differential transformer, varying signal strength according to the angular displacement of the measuring heads, is fitted on each unit.

The signal is rectified and applied to two reflecting galvanometers, one for each wheel. The mirror on each reflects a beam of light from a lamp on to a ground glass screen. Variations in wheel alignment alter the signal strength, the galvanometer's response and the position of the light pattern on the degree scale on the ground glass. The mechanic can select which angle he wishes to measure by turning a selector knob with positions for camber, caster, toe-in and toe-out on turns. Reading is accurate and, because of its legibility, error is eliminated. And the customer can see what's going on as well.

Not long ago the only way to test car ignition coils was to run them until

(Continued on Page 109)

TRANSISTORS IN AUDIO AMPLIFIERS

Although in principle a large number of circuits can be obtained by combining grounded emitter, grounded base or grounded collector configurations with transformer or R-C coupling, in practice transistor audio amplifiers tend to follow a simple pattern. A typical circuit can be considered to have grounded emitter stages in cascade, with R-C coupling, and with d.c. stabilisation provided by the potential divider and emitter resistor method.

The maximum power gain available with perfect matching (and transformer coupling) when the effective load resistance in the collector circuit $R_L = \sqrt{r'_{22} \cdot r'_{out}}$ and the effective source resistance $R_s = \sqrt{r'_{11} \cdot r'_{in}}$ is

$$\left(\frac{a'}{\sqrt{r'_{11}} + \sqrt{r'_{in}}}\right)^2 \cdot r'_{22}.$$

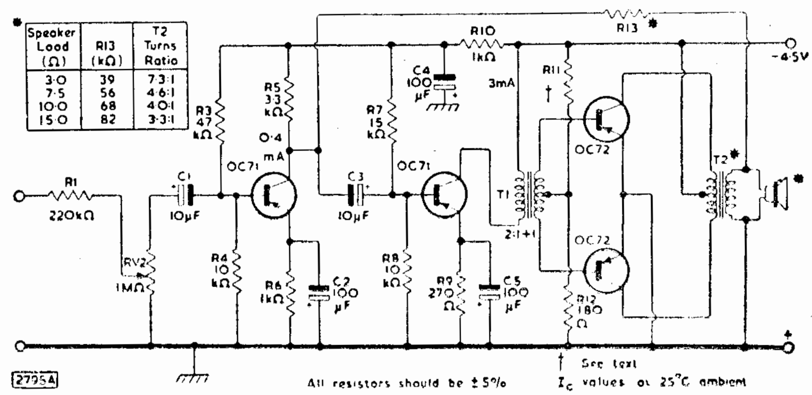
R-C coupling is preferred generally to transformer coupling for low cost and phase shift and good response, but the power gain of each stage then arises solely from the inherently high current gain of the grounded emitter stage, and the higher gain which would be available by impedance matching with the transformer is not achieved.

The factors entering into the design of an R-C coupled transistor cascade are not difficult to appreciate; many of them are similar to those encountered when working with valves. The collector voltage and current are limited by d.c. ratings $V_c$max and $I_c$max, and by a.c. ratings $v_{c(pk)}$max and $i_{c(pk)}$max. For high gain and output power the battery voltage should be high, but a lower voltage and hence smaller current drain is more economical. The high value of collector load resistance required for maximum gain cannot be obtained with R-C coupling, as there is no advantage in making the collector load very much greater than the effective parallel input impedance of the next stage. In addition, the load resistance and collector current determine the voltage available across the transistor, which is also reduced by the emitter resistance included for stabilising. The collector current should therefore be small so that a large collector load resistance can be used; on the other hand a large collector current swamps the variation in collector leakage current $I'_{c(o)}$ with temperature.

After allowing for these various conflicting claims, the number of stages is chosen to give the required overall gain when feedback is applied. Since the signal swing in the early stages is small, the d.c. working point can be chosen for low current drain (and noise), provided they have potential divider and emitter resistor d.c. stabilisation. The power gain in the grounded emitter R-C coupled stage can be calculated from $(a')^2 R_L/r'_{in}$, the a.c. current gain being a' and the voltage gain $a' R_L/r'_{in}$. This expression assumes that R_L is very much smaller than r'_{22} and r'_{out}.

Here, a', r'_{in}, etc. are Small-Signal parameters given in published data and computed for the working point employed. As the load on an R-C coupled stage is formed by its collector resistance in parallel with the input resistance of the following stage, the power and voltage gain for each stage can be calculated by working backwards through the cascade.

Class AB push-pull operation in which the bias corresponds very nearly to that for true Class B operation is a natural choice for the output stage when a transistor amplifier is to be designed as a power amplifier, that is, to give the highest output power permitted by the collector dissipation p_{cmax}, without objectionable distortion. The quiescent power consumption is very small and the efficiency is high. The Mullard OC72 is intended for this mode of operation. An actual circuit is shown in the diagram, the output power being 200mW for 10% total harmonic distortion for an input of about 6mV at C1 or 500mV at R1. Negative feedback is applied over the driver and output stages by R13, which is matched to the loudspeaker. A small amount of bias is provided to the OC72's by the potential divider R11-R12, which is effective in reducing the high crossover distortion inherent in a true Class B transistor output stage.



Speaker Load (Ω)	R13 (kΩ)	T2 Turns Ratio
3·0	39	7·3:1
7·5	56	4·6:1
10·0	68	4·0:1
15·0	82	3·3:1

The value of R11 must be chosen from the range 6.8, 6.2, 5.6, 5.1, 4.7, and 4.3kΩ so as to adjust the total quiescent current in the output stage to 1.3mA ± 10% at 20°C or 1.6mA ± 10% at 25°C. The operating ranges with speech and music are 15°C to 45°C ambient temperature and 4.5V to 2.7V (or even 2.0V, depending on the distortion tolerated by the listener).

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Interstage Transformer
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Window length and breadth = 11/16 in. x 5/16 in.
Strip width = 5/16 in.; Build-up = 5/16 in.
Length of flux path = 2.93 in.; Net area = 0.09 in.^{2}
Primary: 2000 turns of 38 s.w.g. enamelled copper wire. D.C. resistance = 144 ohms.
Secondary: 2 x 1000 turns of 38 s.w.g. enamelled copper wire.
D.C. resistance = 60 ohms + 75 ohms.
Shunt inductance = 10H with primary current of 3mA d.c.

Output Transformer
"C" core, 0.004 in. strip, English Electric HWR/30/8/5.
Window length & breadth = 2 in. x ⅝ in.
Strip width = ½ in.; Build-up = ¾ in.
Length of flux path = 6.34 in.; Net Area = 0.178 in.^{2}
Primary: 2 x 360 turns of 23 s.w.g. enamelled copper wire.
D.C. resistance = 1.45 ohms + 2.45 ohms.
Secondary (for 10 ohms load): 180 turns of 20 s.w.g. enamelled copper wire.
D.C. resistance = 0.57 ohms. Shunt inductance > 0.5H.

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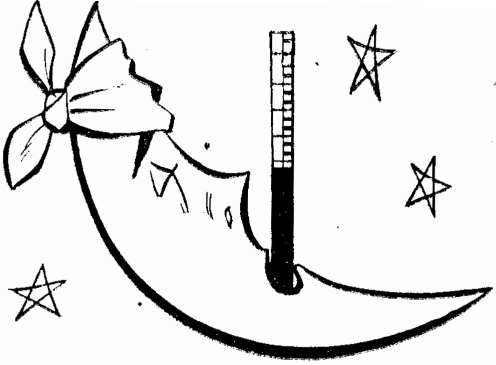

How hot is the Moon?

It seems incredible that a scientist in Sydney — or any other part of the globe — can measure the temperature of bodies far out in space. Yet it is done regularly, by one or other of the methods explained in this article.

THE temperature of accessible objects can be taken, broadly speaking, in much the same way as that of a patient —by popping the thermometer into the mouth.

Here heat from the tested body is allowed to flow by conduction into the mercury or alcohol column sealed in an evacuated glass tube (this is what an ordinary thermometer in fact is) until it reaches the same level in both.

When, however, the temperature is too high or the object itself cannot be reached, this method of direct contact becomes impracticable.

Apart from conducted heat, any user of an electric fire, or for that matter any fire, to say nothing of sunshine, will be familiar with radiated heat.

This is carried by electro-magnetic vibrations of the same kind as light is, but the frequency of these vibrations is lower, or their wavelengths are longer, than in those responsible for optical sensations.

They are not directly visible and are referred to as infra-red radiations, that is to say, the radiations found beyond the red end of the visual spectrum.

WATER CELL FILTER

The distinction between the "obscure" infra-red heat and ordinary light can be demonstrated by screening the fire with a glass container filled with water, known to astronomers as a water cell.

We shall still see the fire, but this will be a cold glow, for a water cell stops the infra-red more or less completely, while allowing the light to pass through.

If we heat, say, a poker with a blowlamp, at first we shall be able to feel its heat at a distance, but there will be no glow. The poker radiates in the infra-red only. Then, as its temperature rises it will turn a dull red, which will gradually brighten up to cherry red and eventually to white.

This means that with increasing temperature the poker emits more and more radiations of shorter and still shorter wavelengths.

If we measure the amount of radiation emitted by a glowing body wavelength by wavelength, which can be done photoelectrically, we shall find that the point of most intense emission of energy will fall within the progressively shorter wavelengths as the temperature of emission rises.

There exists a law relating the latter to the wavelength of maximum energy, and this is how the temperatures of remote stars can be gauged, though some practical difficulties arise from the transparent nature of the star surface.

The stars, however, are immensely hot; their temperatures run into thousands of degrees and their peak emission falls conveniently within the so-called "optical window" where our air is transparent to radiation.

The planets and the moon, on the other hand, are merely warm or cold. Yet, however cold a body may be, it will still be sending forth radiations, only less and less, and their maximum energy will shift farther and farther into the region of longer wavelengths, beyond the red and the infra-red into the range of the shortwave radio, as the temperature falls.

CERTAIN WAVELENGTHS

To most of these longer wavelengths our atmosphere is opaque, so that such radiations can be studied only within certain gaps where the air becomes sufficiently transparent to let them through.

We must, therefore, proceed differently from the case with the stars. Instead of looking for the peak of energy emission, we simply try to find how much heat the body radiates in the accessible wavelengths, either infra-red or radio, and make good the deficiencies from theory.

Here the shorter distance is helpful, for these electro-magnetic waves spread uniformly through space, that is to say, they obey the "inverse square law", if the distance increases twice, the amount of heat received by the same area exposed at right angles to the radiation will drop to one-fourth, if three times, to one-ninth, and so on.

By

V. A. FIRSOFF

M.A., F.R.A.S.

Due to this, the amount of heat coming from a body as cold as Jupiter (about minus 225 degrees F.) can still be measured, while that from hot stars tens of thousands of times as far away cannot.

And, of course, if we know the distance of the body and the amount of heat received from it, say, per minute, we can easily get its temperature. Usually, however, we can obtain only part of this heat.

Part of the heat coming from the Moon, or planet, is merely reflected sunshine, and if we measured this we might learn something about the temperature of the sun but not of the moon.

The lunar heat radiations must be isolated. The way to do this is the same as in screening out fire. The moon radiates only in the longer wavelengths where the radiation from the sun is practically nil. If, therefore, we interpose a water cell the heat of the moon is cut off and only the solar heat comes through.

The difference of the measurements with and without the cell will give us the lunar (or planetary) heat.

THERMOCOUPLE

The amount of this heat is minute but it can be determined by means of a thermo-couple, which is essentially a blackened wire made in three parts of two different metals welded together and sealed in a vacuum bubble, like an electric bulb.

If the two welding points are at different temperatures, a current will flow through the wire. This current can be amplified and read off an ammeter.

It is broadly proportional to the rise (or fall) in the temperature and depends also on the metals used.

Ideally, in the absence of air, a zinc-and-bismuth thermocouple will register the heat of a candle at a distance of three miles; whilst a Cashman cell, which is not strictly thermocouple, is 100 to 1000 times as sensitive to certain parts of the infra-red.

The American investigators Nicholson and Pettit placed a zinc-and-bismuth thermo-couple at the focus of the great 100in Hooker telescope at Mount Wilson and were able in this way to make accurate measurements of the temperatures of the moon and planets.

The temperature of the lunar ground where the sun is directly overhead came out at plus 248 deg F, considerably above the boiling point of water on the earth (on the moon, water is expected to sublime, or boil before melting, at about minus 60 deg, F owing to the almost total absence of an atmosphere).

When the sun is not shining vertically down the temperature of the ground drops fairly rapidly and around about the lunar poles it will never rise above freezing point, whilst in the depth of the fortnight-long lunar night the thermometer will drop as low as minus 239 deg. F.

Here, though, the Mount Wilson figures become unreliable, as at such low temperatures infra-red emission is very weak.

Pettit found that during a lunar eclipse the temperature of the surface of the Moon within one hour of entering the earth's full shadow fell from 160 deg,


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F to minus 110 deg. F and rose as rapidly again with the returning sunshine.

This is possible only if the lunar ground consists of far better heat-insulating materials than anything normally available on the earth.

COMPARISON

In fact, the Dutch astronomer Wesselink tried to match the effect with various substances and obtained the best approximation with fine dust in vacuo—under terrestrial gravity..

This was a point which he overlooked, for on the moon every dust particle would have only a sixth of its terrestrial weight, so that the whole would be lying much more loosely and be an even worse conductor of heat.

However, these results have since been supplemented by the investigations made in 1948 by Piddington and Minnett in Australia, who used a radio telescope and studied, instead of the infra-red, the short-wave radio emission from the moon at 24,000 M/cs per sec. or 1.25 cm wavelength.

For the reasons stated above, this method is especially suitable for low temperatures and will, no doubt, in due course be extended to planets.

Whereas the surface of the moon is opaque to infra-red radiations and the temperatures obtained by Nicholson and Pettit are those of the moon's "skin", the short radio waves penetrate some way underground and the temperatures obtained by the Australian scientists refer to a layer about 3ft deep.

As can be expected, it is much colder there, and indeed the lunar "subsoil" remains in a condition of permafrost, like the subsoil of Alaska or Siberia.

Also, while it takes only a couple of hours of sunshine to bring the "skin" of the moon from the frost of midnight to the scorching heat of the lunar moon, the layer examined with the radio telescope heats up but slowly, reaching its highest temperature 3½ days after the lunar noon and its lowest the same time after midnight.

TEMPERATURE RANGE

The range of variation is also less—about 145 deg. F for the whole moon and 190 deg. F for the narrow equatorial belt. In the latter the maximum temperature attained 3ft underground is only 85 deg. F and the minimum — 105 deg. F. Still deeper the temperature does not vary and stays permanently at about 40 deg. F of frost.

This is cold enough, yet the lunar rocks are such good heat insulators that if the future explorers build their shelters underground there should be no difficulty about keeping these at a genial temperature day and night.

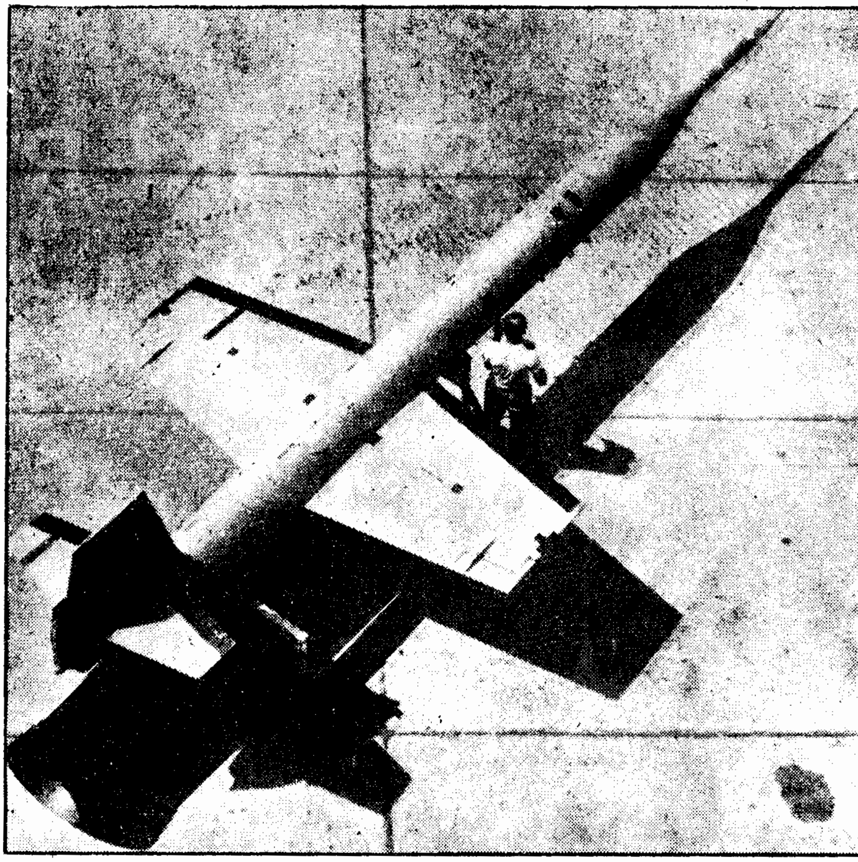
From Piddington and Minnett's data the night temperature of the lunar surface comes out some 40 deg. F higher than as measured with a thermocouple.

These results are interesting also in another way. They permit us to estimate more correctly the rate at which heat flows in the lunar rocks.

In fact, Wesselink's calculations require some revision and it now appears that the case is best met by an extremely bubbly type of rock, resembling pumice, overlaid by a thin skin of dusty material, probably of meteoric or volcanic origin, in the presence of gas. The skin may on the average be only a millimetre thick and it is this dust that gets so very hot in the day and so cold at night.

Such structure of the lunar surface is of considerable importance to the possible existence of some hardy type of vegetation, which might resemble our lichens.

LOCKEED X7 RAMJET MISSILE



Pictured above is a needle-nosed supersonic device called the X7, which is playing a "major part" in the United States Air Force's ramjet development program. Development of the Ramjet will permit the construction of simpler, more powerful guided missiles for both attack and defence.

DESIGNED and built by the Missile Systems Division of Lockheed Aircraft Corporation, the X7 was described recently by Brigadier-General Marvin Demler, deputy commander for research and development of the USAF Research and Development Command.

In an address to the Air Force Association Convention in New Orleans, USA, General Demler said, "Through this program we are developing successful ramjets for operational use as well as other important missile components."

Ramjets, considered the ultimate in jet engines for guided missiles, are comparatively simple devices that give tremendous power at high speeds.

Unlike conventional jet engines, the "flying stovepipes"—as they are called—have no compressors or other moving parts and depend upon their high speed to compress their air intake.

Generally speaking, the faster they go, the better they function, since they are free of limiting factors such as heat and compressor speeds that restrict conventional jets.

The X7 is launched from a B-29 bomber. A rocket booster powers it to the speed at which the ramjet operates efficiently. The missile eventually parachutes to earth and is recovered for use again. Electronic equipment, much of it developed by Lockheed scientists, decodes the flight data obtained.

The ramjet engine of the X7 was developed by Marquardt Aircraft Company.

INDIAN VHF LINK

AN order for a multi-channel VHF radio telephone system has been placed with the Marconi Co., by the Government of India on behalf of Western Railways, Bombay. It will be the first radio-telephone installation in the Republic of India, and is indicative of the present progressive attitude of this ancient land.

The system, which has a potential capacity of 48 two-way telephone circuits between Jamnagar and Rajkot, and 24 between Bhavnagar and Surat, will be equipped initially to provide four circuits. The Bhavnagar to Surat link is approximately 58 miles without any intermediate station.

X-RAYS SHOW MOTOR IN ACTION

A General Electric-Detroit Arsenal engineering team has achieved the near-incredible feat of making motion pictures of the innards of an engine while it is running.

THE job involves taking X-ray pictures of the spinning, throbbing internal movements of the engine through its steel housing, and visually "stopping" with a camera their high-speed motion.

The new technique, called stroboradiography, could have a significant effect on engineering design. Slow-motion X-ray movies and still pictures of pistons, cams and other moving parts have enabled engineers to scrutinise, for the first time, complete cycles of engine operation for faulty performance or wear.

The revolutionary process gives designers their first glimpse inside a completed machine operating at normal speed under load conditions. Improved, lightweight designs, and perhaps important basic design changes could result from the X-ray motion studies.

SPECIAL EQUIPMENT

The special stroboradiographic equipment was developed by the General Electric Company for use with its high-energy industrial X-ray betatron, operating at 5-million to 15-million volts. The company's General Engineering Laboratory in Schenectady, NY, developed the equipment in co-operation with Detroit Arsenal and the General Electric X-Ray Department in Milwaukee.

Engineers in the Materials Laboratory of the Detroit Arsenal, Centre Line, Mich., have been continuing the studies and this month came up with some of the most advanced stroboradiographs yet taken.

Unlike conventional X-ray equipment, the betatron furnishes the surging radiation pulses—416 per second—that have given engineers this unprecedented "inside" view of any deflections, vibrations or bouncings inside a running machine.

Previously, single-shot exposures of moving objects had been made with low-energy eqnipment, but the quality of the radiographs snffered when the object was composed of heavy parts of varying thickness.

SYNCHRONISED EXPOSURES

The new process involves taking thousands of short exposures accurately synchronised with the moving part. With an exposure time of 10 to 15 millionths of a second, it is possible to radiograph an engine turning at several thousand revolutions a minute.

A synchronising disc attached to the specimen engine signals the betatron and releases the surge of electrons that make the split-second X-ray exposure. Several thousand repetitions result in a strong image clear enongh to be analysed for operational data.

The superimpositions form the picture on special film that receives the filtered X-rays after they have passed through the specimen.

To obtain slow-motion movies, X-ray "stills" are taken, for example, of various points in the travel of a piston, and the films spliced in sequence to show the complete cycle of the piston.

The walls of the test specimen, opaque to light, are partially transparent to the high-energy X-radiation, thus enabling the betatron to "see" the internal workings parts in their relationship to each other. The difference in the shape and density of the various parts enables the images to assume their proper perspectives in the stroboradiograph.

Raymond A. Pulk, chief of the Detroit Arsenal's Materials Laboratory who conceived the idea of adapting the betatron to this concept, explained the stroboradiographic process this way:

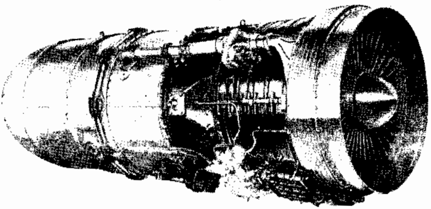
"Flashing a short X-ray pulse in the same predetermined phase of the engine cycle gives an infinitesimally small action per cycle on the X-ray film, but the superimposition of several thonsands of these pulses makes the engine appear to be standing perfectly still when actually it is operating at several thousand revolutions a minute."

Pulk said the technique "will furnish the engineer with a valuable tool to be employed in design and efficiency studies based upon output performance and will definitely contribute to improvement of engine designs."

It is hoped, he added, that any individual shortcomings of a newly-designed engine can be corrected by stroboradiographically examining the engine while it is running under load, thus showing up any components that might not be fnnctioning correctly or efficiently.

NEW R-R JET CONSERVES FUEL

The Rolls-Royce Conway bypass jet has recently completed tests which show it to have a 13,000lb thrust, with the lowest specific fuel consumption of any type-tested jet. Four Conways will power the Vickers V100 military transport.

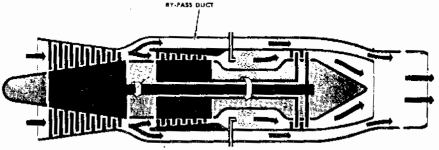


THE by-pass engine resembles the normal jet but has an additional duct through which some of the air from the compressor by-passes the combustion chambers and re-enters the jet stream aft of the turbine.

The advantage over straight jet propulsion is that, although the by-pass engine works at a high pressure ratio giving high internal efficiency, it also produces by means of the by-pass, a final jet containing a greater mass of air moving at a lower speed. This gives a higher propulsive efficiency.

The result is to improve the specific fuel consumption, making it particularly suitable for large long-range civil airliners.

The lower jet velocity in conjunction with the latest form of Rolls Royce jet nozzle will help to reduce jet noise. Installation and fire protection ere also assisted by the duct of cool air which surrounds the hot parts of the engine.



We'll let you into a secret: This attractive lass isn't the least bit interested in the gas content of the lamp. What intrigues her is the fact that this lamp was the one which shone upon the head of the Queen at the instant when the Archbishop of Canterbury placed the crown upon her head.

WHY THE GAS IN LIGHT BULBS?

Perhaps you've wondered, at one time or another, why modern electric light bulbs are advertised as "gas-filled". This article supplies the answer and tells of an amazing chain of discoveries which stemmed from research into this now commonplace item.

Who would think that, from experiments about the workings of an incandescent lamp, would come such things as absorbent gasmasks, high grade lubricating oil, artificial fertilisers, improved flotation methods of extracting ores, safer methods of making vaccines—all, in addition to better lamps, improved vacuum pumps and the atomic hydrogen torch?

Such indeed was the case for all these things derived from a professor's experiments with incandescent lamps, while he was "on holidays".

The Professor was Irving Langmuir of America and his discoveries have given us, what is now, the basic science of chemicophysics and surface chemistry.

It is notable that some people cannot take a real holiday. Wherever you go someone will find you out in whatever occupation you follow and you find yourself mending the radio in the guest house, entertaining the guests by playing the piano, fixing electric light switches, prescribing medicine to someone who was game enough to tackle too much of the guesthouse food, doing a bit of plumbing or carpentering, and so on.

It is also noteworthy that none of these jobs seem to entitle one to a reduction in the tariff and you are lucky to be paid even out-of-pocket expenses

So it was that Professor Langmuir took an opportunity in 1909 to conduct some research, while on "holidays" in the research laboratories of the General Electric Company in Schenectady.

One angle of research going on there at the time was devoted to improving the electric lamp. The metal tungsten was beginning to be used for lamps, instead of the old carbon and tantalum filaments.

Tungsten had the property of withstanding a much greater heat than any other practical solid at that time and so filaments were made from it, inserted into the lamp and the bulb exhausted of air to the greatest possible extent for that period of time.

However, after a couple of hundred hours use the filament became brittle crumbled and the lamp rendered useless.

Several better filaments of tungsten were made accidentally. These gave a better performance but nobody knew why and, unless they found out, the results could never be guaranteed.

GAS ABSORPTION?

This was where Dr. Langmuir came on the scene. He thought that perhaps the tungsten contained some impurities or that it had absorbed some gas.

He, therefore, decided that this latter possibility would be his first line of attack and he set up apparatus with which to collect and measure any gases which may come off the heated wire.

He got gas all right, "and how!" as the saying goes. To be precise, it proved to be an amount equal to seven thousand times the volume of the filament.

It was beyond conception that this enormous amount of gas was hidden in the wire.

This sent Langmuir on to a new track. He wanted to find out where the gases came from. He forgot all about his original idea of just experimenting with different samples of tungsten wire to find out which was the best.

To carry out his experiments he was given a few assistants and thousands of dollars to spend. The "holiday" had now run into three years but, during that time, he became acquainted with the behavior of colliding molecules and highly individualistic atoms.

He found that the gases came mostly from the glass bulb of the lamp. He inserted other gases into the bulb to see what would happen. A small quantity of nitrogen introduced into the bulb behaved in quite a different manner from its usual self. Oxygen gave a different effect and hydrogen was the most fascinating of all.

By introducing a gas into the bulb the loss of heat from the hot filament is accelerated, because the gas molecules coming into contact with the hot filament absorb some of the heat energy from it. Their movements are accelerated and they fly off at great speeds to collide with other molecules or against the inside of the glass bulb.

With hydrogen, the effects of heat absorption were greater than expected. Up to a temperature of 3000 degrees Fah. the heat loss occurred steadily, but beyond this something occurred which made the gas greedy for heat, because the heat loss increased to five times that which was expected. Most surprising thing of all, the hydrogen disappeared entirely!

GAS DISAPPEARS

If a measured quantity of hydrogen was introduced into the bulb, there was, of course, an increase of pressure. But when the lamp was lighted the pressure dropped to zero. More gas was introduced and it, too, disappeared. This continued until, after a time, the pressure remained constant.

Where had all this hydrogen gone? There seemed to be only one place, the inside surface of the bulb.

Accordingly Langmuir heated the bulb in a furnace to almost melting point and lo! the hydrogen began to reappear. It had obviously attached itself to the inner surface of the glass.

The next experiment was the one which cleared up the mystery.

Langmuir had his bulb, into which he had introduced the hydrogen. He had lit the filament and the gas had disappeared. He now allowed the bulb to cool and then introduced a known quantity of oxygen. This also disappeared. He continued to introduce more oxygen until it ceased to vanish and a point of saturation was reached.

On summing up it was found that the amount of oxygen absorbed was exactly that required by the hydrogen to combine into the well-known formula for water, H2O.

Now you just can't take two parts of hydrogen and one part of oxygen, mix them together and get them to unite into water. It requires something like an electric spark or other shocking energy to do that, but Langmuir did it in the cold lamp bulb.

How did this happen? Firstly the hydrogen had an enormous appetite for heat, as described above. Then it had, after being treated with the hot filament and allowed to cool, an enormous affinity for oxygen. It was, therefore, a different kind of hydrogen.

THE EXPLANATION

The experienced Langmuir did not take long to recognise the hydrogen as atomic hydrogen.

What had happened was this. The original hydrogen molecule was split in two by the great heat of the filament. The two halves had a natural affinity for anything. If oxygen was about, so much the better, they would unite with that gas. If there were nothing else, they united with the glass bulb.

This behavior was in keeping with the theory that if atomic hydrogen existed free it would have these characteristics. Well, here they were. Atomic hydrogen was in the lamp bulb.

These studies of Langmuir had far-reaching results.

Whilst the efforts of electric lamp makers were concerned with attaining a high vacuum, Langmuir showed that the presence of the right kind of gas was an advantage.

By coiling the filament in a special manner and filling the bulb with the inert gas Argon, the resulting gaseous pressure prevented the tungsten filament from evaporating. The lamp then consumed about half the power previously required for the same light output.

by Calvin Walters

This alone, according to statistics, saves the American public over 1-million dollars a night on electricity.

Another outcome of Langmuir's experiments was the introduction of the mercury condensation pump. This makes use of a blast of hot mercury vapor and will exhaust a quart container so rapidly and efficiently that in five seconds only one hundredth millionth part of an atmosphere remains. To make the figure more spectacular it means that, in five seconds, the pump will exhaust 24,999-999 million million air molecules from the container.

This pump enabled Langmuir to dig deeper into the vacuum. This is of great importance to the science of electronics and radio communication. The "space charge", an important principle of electronics, was discovered by Langmuir with his pump. He also discovered that a minute trace of thorium introduced into the tungsten filament increased its electrical conductivity over a hundred thousand times.

One fine bit of reasoning by Professor Langmuir led to the discovery of the atomic hydrogen torch.

HYDROGEN TORCH

He reasoned that if the great temperature of incandescent tungsten was required to tear the hydrogen molecules apart, would not the separated atoms—if allowed to reunite—give out great heat in doing so? The idea was tried out with such success that temperatures of over 6800 degrees Fah. are attainable and the torch is today used to weld metal constructions more efficiently than before.

During the experiments, Dr. Langmuir discovered that the hydrogen atoms attached themselves to the inner surface of the glass bulb in a single layer of atoms.

Against a background of equipment characteristic of the year Dr. Irving Langmuir is photographed here, in 1932, in the laboratory of the General Electric Company. From a "holiday" at the laboratory, begun in 1909, stemmed a vast amount of original research.

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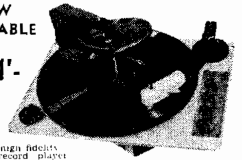

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This was a finding of great significance, as we shall see later.

Other films were experimented with and, in every case, it was found that the film was one layer deep.

Carbon monoxide opened up a new avenue of thought. Here it was found that the molecules attached themselves to the glass surface with the carbon atoms down. The carbon atom seemed to be the one which had the ability to hold on to the surface.

Oil films on water were the same one molecule thick. Oil molecules are groups of hydrogen and carbon atoms arranged in chains linked together. All the molecules have a common characteristic, namely, at the end of the chain, there is an atom of oxygen coupled with an atom of hydrogen. It is this OH end which attaches the molecule to the water.

MOLECULAR CHAINS

Some of the chains mentioned are short and some are long. Oil chains are usually long, so that while the OH end will satisfy its own affinity for water it is not strong enough to drag the whole chain down into the water. Oil is therefore insoluble in water.

Alcohol has only a short chain and the OH end will readily drag the whole chain into the water. It is thus soluble in water.

Sugar is an example of a soluble carbohydrate which is strong in the OH group. In fact, there are several OH groups in each molecule and it is thus very soluble in water.

Pure mineral oil has no OH group in its make up. Therefore it has no affinity for water whatsoever and will form into small globules rather than into a film.

Dr. Langmuir began to measure the thickness of oil films. He found that the length of a molecule of Stearic acid is about one ten millionth of an inch. A film of castor oil is only one hundredth millionth of an inch thick.

The affinity of the OH group for water is responsible for some of the characteristics of water itself.

Water is made up of two parts of Hydrogen and one of Oxygen — H2O. The three atoms are arranged as H—O—H. Thus each end of the molecule presents an H to its fellow. The attraction of these H heads makes water molecules attract one another very strongly. This gives to the water a strong skin which enables insects to walk on the water, causes numbers of molecules to form into large drops and gives the liquid a high boiling point.

ADDING OXYGEN

Langmuir found that by adding an atom of oxygen to molecules which contained hydrogen but no oxygen he endowed the molecule with the important OH group. This in turn not only enabled him to make new chemicals but changed their characteristics. By adding or taking away the OH group, the boiling points could be lowered or raised, the freezing points altered and so on.

The gas Ethane is an example. Its chemical formula is C2 H6. It contains no oxygen. Only 2 parts Carbon and 6 parts hydrogen. It is a tenacious gas, boiling at 120 degrees BELOW zero. Add one atom of oxygen so that the formula is C2 H6 0 and it immediately becomes alcohol boiling at 173 degrees ABOVE zero and is soluble in water because it has been given the OH group.

Dr. Langmuir found that by the study of such behavior he could predict molecular behavior and, from a study of this behavior, he could forecast the structure resulting from the addition of extra atoms into a given molecule.

Langmuir formulated his Principle of Independent Surface Action which is now recognised as a fundamental law of Surface Chemistry.

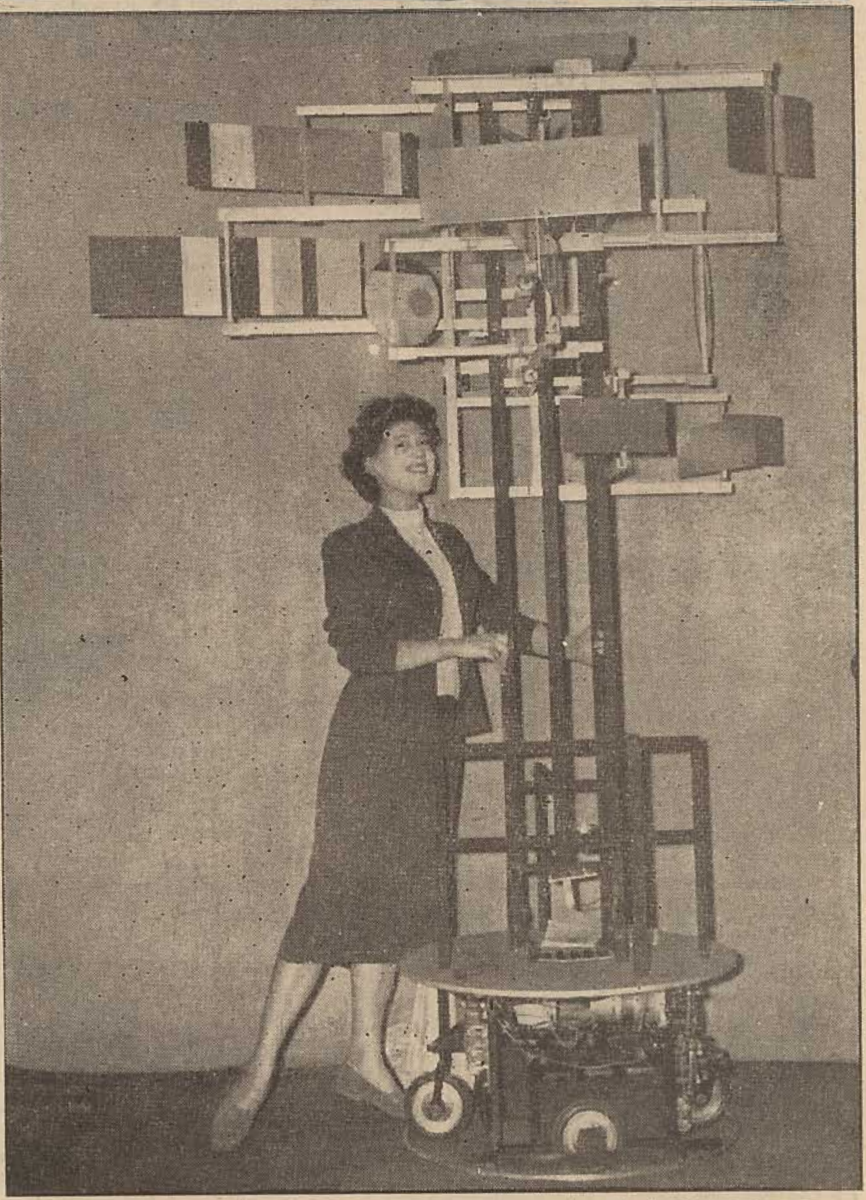
By means of surface chemistry we can now explain the affinities or lack of them which hold the infinitesimal together or allows them to fall apart. With this new knowledge of the differences in molecular surfaces, we are able much better to control many of nature's phenomena to our advantage.

In the field of biology and medicine this new knowledge given to us out of the findings of Professor Langmuir is opening up new fields of experiment which may help in the curing or elimination of disease.

It is increasingly clear that the mechanism of the living cell is one of surface behavior. The mechanism which enables food to enter the thin membrane of the cells and which enables the cell to select the food and chemicals which it requires seems to be bound up with surface behavior.

Perhaps the peculiar characteristics of oil films on water and the odd behavior of Langmuir's one layer gases will also provide man with the knowledge with which to control disease and prolong life. And it all came from trying to find what went on in an electric light bulb!

YOUR PARTNER FOR THE DANCE!



This is what happens when a French abstract sculptor and an electronics engineer join forces. Prompted by signals from its in-built microphones and PE cells, the robot responds to lights, scenery and music. It runs, wheels around and varies its speed in keeping with its title of "Robot danseur electronique."

Technical Review

SIMPLE WOBBULATOR FOR FM AND TV ALIGNMENT

The mounting interest in TV and FM has created the need for a simple sweep generator, suitable for home construction. The following description, taken from a recent issue of Wireless World, should appeal to many readers, if only by reason of its extreme simplicity. At the same time it appears to give very satisfactory results.

(In the American radio altimeters now available on the surplus market there is a component which makes the above possible. The altimeters have the type numbers RT-40/APN, AN/APN-1, AN/ARN-1, AYB-1, AYD and there may be others. The component is often described in advertisements as a "magnetic sounder" but it would be more appropriately called an electro-magnetic frequency modulator.

(These devices appear to be available in small quantities from Australian disposals sources, while the altimeters from which they are taken have been sold in large quantities. Many such modulator units are probably lying in junk boxes waiting to be put to good use. Ed. R. T. & H.)

AN EXAMPLE

It consists of a magnet and coil, similar to that of a moving-coil loudspeaker, to which is attached a slightly domed aluminium diaphragm of about 2in diameter, freely suspended and perforated all over to prevent air loading. Mounted in front of the diaphragm on a ceramic cover are two metal plates and these with the diaphragm form a two-gang capacitor.

The capacity swing of each section is from 10 to 50 pF. It will be obvious that if this capacitor is connected across the coil of an oscillator and the moving coil energised by an alternating current, the oscillator will be frequency modulated.

The circuit of the complete wobbulator is given in Fig. 1. Ample frequency deviation on band I could be obtained by using only one section of the f.m. capacitor, but since it was also desired to sweep the i.f. band around 10 Mc/s the two sections were connected in parallel to give a maximum swing to 20-100 pF. This means that one side of the capacitor is earthed, making it necessary to use a cathode coupled type of oscillator. The 10 pF variable capacitor in parallel with the coil is brought out to a control on the panel to enable the middle frequency to be set.

Any miniature medium-mu triode is suitable for the valve, in fact one of the acorn triodes in the altimeter is an admirable choice. The frequency modulated output is taken from the anode of this valve and its amplitude is controlled by a simple attenuator.

Alternating current for driving the moving coil is obtained from the heater supply. A series variable resistor controls its amplitude, hence the frequency deviation, and a fixed resistor prevents over-drive. The sweep voltage for the X plates of the oscilloscope is also taken from the heater supply.

BLANKING RETURN TRACE

In an ideal case the forward and return traces would coincide exactly, but owing to phase shifts in the amplifiers this does not happen, and a trace as in Fig. 2 (a) is always obtained. There are several ways of removing the second trace and the method adopted in the present case is to take a blanking voltage from a phase shift network across the heated supply and apply it to the grid of the tube.

This not only blacks out the unwanted half of the trace, but brightens the centre portion of the wanted half where its brilliance decreases owing to the increased speed of the spot. A single trace of even brightness throughout its length is obtained, as in Fig. 2 (b).

At full amplitude of the moving coil a sweep of 10 Mc/s in Band I is easily obtained. This is illustrated in Fig. 2 (c). With this amplitude, however, frequency linearity suffers, bnt for a sweep of 6 Mc/s it is very good.

MARKER BLIP

The trace obtained is of little use unless some means are provided of ascertaining the frequency of all points along it, so a marker "blip" is applied by adding the output from a signal generator to the output of the wobbulator through a small capacitor. With a normal wide-range Y amplifier this will appear as a thickening of the trace on each side of the marked frequency.

To get a sharp blip the frequency range of the Y-amplifier must be severely limited, and the simplest way of doing this is to connect a 0.001-uF capacitor across its input. The resultant blip is seen in the three oscillograms in Fig. 2. As the frequency of the signal generator is varied, the blip will travel along the trace marking the spot frequency at any given point.

This particular wobbulator was designed for Channel 3, Band I, and the i.f. band from 9 to 14 Mc/s with switched coils. Both coils are wound on half inch formers and are as follows: Channel 3: 9 turns, tapped at 3 turns, spaced to occupy 3-8 inch. I.F.: 18 turns, tapped at 6 turns, 34 s.w.g. close wound. Adjustments to make the coils resonate at about the middle frequency can be made with either iron dust or brass cores.

The heart of this wobbulator is the unit from the altimeter, but if this component is not obtainable it is possible

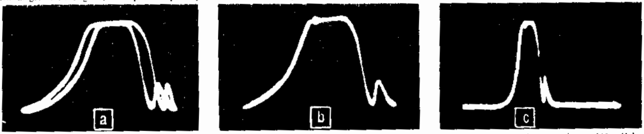


Figure 2. Three forms of the same response from a partly aligned TV receiver. (a) Displaced return half, due to phase shift. (b) Return half suppressed. 6 Mc sweep. (c) Same response with a 10 Mcs sweep. Note the marker pip on the left of the 'flat top' in each case.

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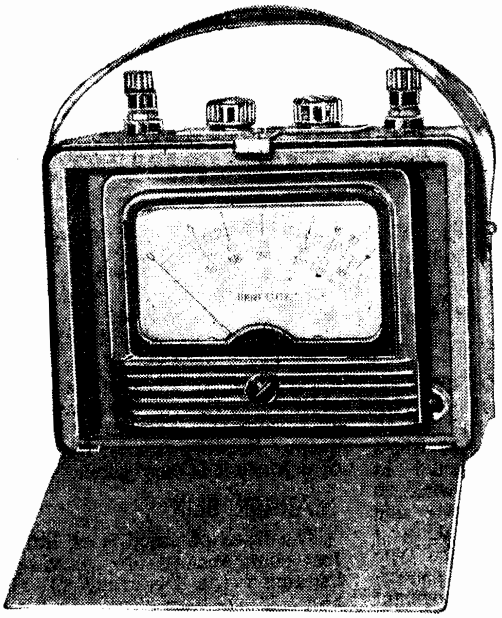

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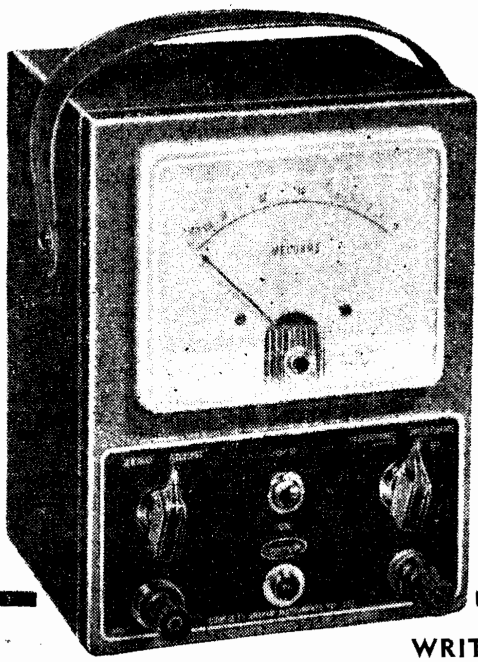
This portable and self contained instrument which covers resistance readings in several ranges has many applications in the Electrical, Radio and Industrial fields. Small in size this instrument uses a 4 inch square meter and is housed in a hard moulded rubber case which enables it to take heavy shocks and be unbreakable. The meter is protected by a metal flap which closes when the instrument is not in use. Ranges are:—

0-20 ohms (2 omhs centre)
0-500 ohms (20 ohms centre)
0-5000 ohms (200 ohms centre)
Size $6\frac{1}{2}$ x $4\frac{3}{4}$" x 3".

MODEL D10D



MEGOHM METER

This instrument is ideal for television purposes and other applications where high resistance values need to be checked. Its major uses are for checking resistance values, leakage parts and capacitor testing. In many cases it will take the place of a Megger and as it operates from power mains it leaves both hands free for other work. It is designed to operate from 240 volts AC and it is small and compact. Two ranges are provided of 0-100 megohms and 0-1,000 megohms. Both of these ranges are at a test potential of 1,000 volts. The available energy is extremely small and therefore the instrument is not dangerous or lethal.

Special terminals are provided which enable standard test leads to be plugged in or wires or components to be connected directly to the instrument.

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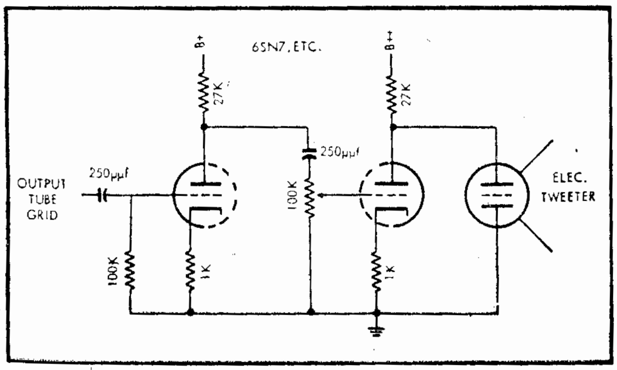
IMPROVED CIRCUIT FOR ELECTROSTATIC SPEAKERS

The author of this article suggests that the conventional arrangement of coupling an electrostatic speaker directly into plate circuit of an output valve is not the best arrangement and describes a simple alternative arrangement with several advantages.

THE conventional arrangement is certainly simple, but it has certain disadvantages which might limit the effective use of the tweeter. First, it depends on the high frequency response of the output transformer, which might fall in cheaper units, keeping the highs away from the tweeter.

Second, in this connection the tweeter is exposed to all the high frequency distortion products developed in the power output stage. If the original speaker did not reproduce these sounds, and they are then brought out in a tweeter, the net result might be just the opposite of the expected improvement.

For the cost of a valve and a few extra components, the above deficiencies can be remedied by the use of the circuit shown. This is essentially a separate output channel for the tweeter, an idea similar to the multi-channel amplifiers which often appear in literature. However, the circuit can be considerably simpler than the usual multi-channel design.



★

The suggested amplifier discussed in the text. Its use avoids losses in the output transformer and distortion in the output stage. Most medium mu twin triodes would be suitable.

SMALL HF AMPLIFIERS

For example, because of the relatively small proportion of signal power in the higher frequencies and the consequent small amount of power that must be fed to the tweeter, voltage amplifiers are quite adequate. The circuit uses a 6SN7 or similar dual medium mu triode as a two-stage voltage amplifier, taking a signal from the power output valve grid and feeding it to the tweeter.

Looking at the circuit in detail, the 250 pf capacitor and the .01 meg. resistor form a high pass filter which transmits to the first section of the 6SN7 the signal at the grid of the power output valve, cutting off frequencies below about 5000 cps. If the main amplifier has a push-pull output stage, a similar dummy RC circuit should be connected to the grid of the other output valve to keep the two sides in balance.

It might be thought that less effect on the main amplifier would be had by using a small capacitor and a larger resistor, keeping the RC product constant; but if this is carried too far the Miller effect input capacitance of the valve, about 50 pf or so, would begin to have a marked effect on the performance of the circuit. Actually the values used would not have much effect at the lower frequencies where the main amplifier does its work.

Between the two RF stages is placed a similar RC circuit, with a pot. instead of a fixed resistor. This serves as a treble control to adjust the amount of signal going to the tweeter. This is another advantage over the simple circuit.

The electrostatic tweeter is connected to the plate of the second valve, drawing both signal and polarising voltage from this connection. The B plus return of this valve (shown as B plus plus) should be connected to the highest voltage, well filtered B plus point available in the set. However, the tweeter manufacturers' voltage rating should not be exceeded.

The B plus return of the first valve can go to any convenient source. Decoupling networks may be necessary in some cases to prevent interaction with other circuits in the set.

(Audio, October, 1956.)

SIMPLE WOBBULATOR (cont.)

to make a very satisfactory one from a three-inch moving coil loud-speaker. There are two ways of doing this, both of which entail the cementing of a thin aluminium disc to the diaphragm. In the first case a metal plate is fixed immediately in front of the disc as closely spaced as practicable to form the variable capacitor.

In the other, the actual oscillator coil is wound in pancake form and mounted closely to the disc. As the disc moves the changing eddy-currents alter the inductance of the coil. This latter method is not as satisfactory, as it prevents other coils being switched in to provide alternative ranges.

The only disadvantage of the generator in the form shown is that it requires a coil for each channel swept. At present, when there are only two, or at most three, channels operating in any area, this is of no real significance.

To cover future development and the possibility of the introduction of color television, which will call for the examination of a band almost in the audio region, this unit can be looked on as the basis of a more elaborate wobbulator of the beat frequency pattern. In this it would form the frequency modulated oscillator which beats with a tunable oscillator to give a resultant swept output over a very wide range of middle frequencies.

This electro-mechanical method of obtaining frequency modulation is far simpler and more reliable than the reactor valve and has proved so satisfactory that it is used extensively, especially in America, for commercial wide-range beat frequency wobbulators.

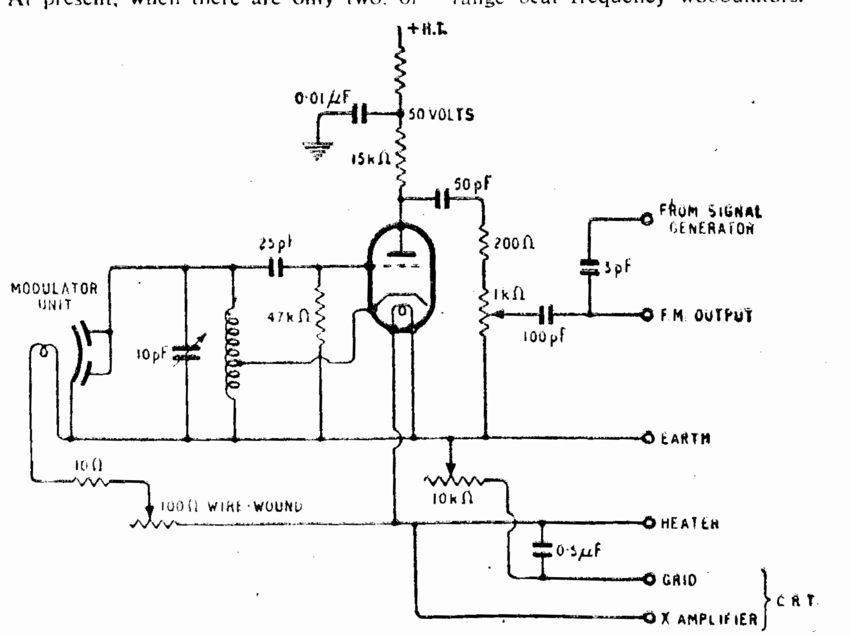


Figure. 1. The circuit diagram of the simple wobbulator. Note the provision for the injection of a marker signal from a conventional signal generator. Coil data is given in the text.

NEW TANTALUM CAPACITORS USE SOLID ELECTROLYTE

The latest addition to the ever expanding range of electrolytic capacitors is the tantalum electrolytic. Developed mainly for use in transistor circuits, current types feature large capacitance values, low voltage ratings and very small size. Sizes are comparable with fractional wattage resistors.

CONVENTIONAL electrolytic capacitors have many limitations imposed by the aqueous electrolytes which they contain. At elevated temperatures electrolytes dry out unless the capacitors are effectively sealed. At low temperatures electrolytes congeal or actually freeze introducing series capacitance and series resistance. Limitations at high frequency also result from the electrolytes.

In the new tantalum solid-electrolyte capacitor the aqueous electrolyte is replaced by a solid semi-conductor. Thus this capacitor consists entirely of stable, non-volatile inorganic materials.

TANTALUM

The anode is tantalum metal which may be had in a variety of forms such as sintered porous bodies, wire or foil. Most of the development to date has been directed at capacitors with porous tantalum anodes, because they give the highest capacitance-to-volume ratio.

A thin layer of tantalum oxide, Ta_2O_5, is formed on the tantalum surface by making the tantalum piece positive with respect to a cathodic member in a suitable electrolytic bath. The thickness of oxide film is proportional to the formation voltage.

Capacitance is proportional to the tantalum surface area, and inversely proportional to the oxide thickness. The working voltage is approximately proportional to the oxide thickness.

An intimate layer of the semi-conductor MnO_2, is deposited over the surface of the Ta_2O_5. This MnO layer is formed by decomposing manganous nitrate introduced in aqueous solution. A carbon layer is added by applying an aqueous dispersion and allowing the water to evaporate.

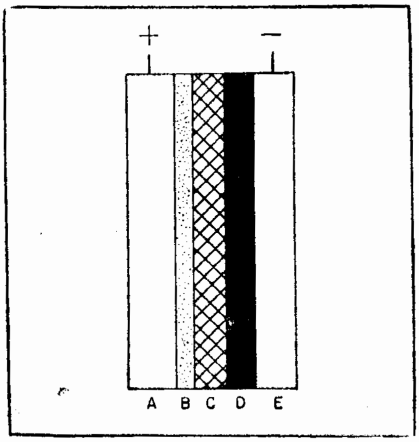
STRUCTURE

The carbon produces intimate electrical contact with the MnO_2, and constitutes a mechanical buffer between the inner structure and the cathode which relieves strains and allows for differential thermal expansion.

The structure of the tantalum solid-electrolyte capacitor is represented schematically in Fig. 1. The capacitance values for a working potential of 8 volts are 5, 25, and 100 microfarads. For a working voltage of 35 volts, these values are divided by five.

Like other electrolytics, these capacitors are polar. At present, the porous type is being restricted to an upper operating potential of about 35 volts.

Voltage rating practice has been to establish ratings for the temperature range up to 65 C, with voltage derating for higher temperatures.



The structure of the new tantalum electrolytic. Performance is more stable over a wide variety of working conditions and long periods of time than with the convential electrolytic.

CHARACTERISTICS

Capacitance-temperature characteristics of various solid-electrolyte capacitors are shown in Fig. 2A for a frequency of 1 kc. It is believed that the capacitance change with temperature represents the temperature dependence of the dielectric constant of Ta_2O_5. Only at the higher temperatures is this true for the wet types. Low temperature behavior is controlled by the electrolytes which interpose series capacitance as their resistivity increases.

Power factor values against temperature are shown in Fig. 2B.

From Fig. 2B and other measurements it appears that the losses in solid electrolytics consist primarily of dielectric loss in the tantalum oxide.

Power factors in the range of 2 pc have been obtained up to 200 kc.

In frequency characteristics, the solid type appears to be limited by the MnO_2, and carbon layers. However, at equal capacitance and voltage ratings, the solid type characteristics hold to about a decade higher frequency when compared with wet types at equivalent capacitance and voltage ratings. This is illustrated in Fig. 2C.

The leakage current values observed for the solid type are much more dependable and stable than those for the wet types. In particular, the values do not deteriorate with shelf ageing even at elevated temperatures and no forming period is required after disuse.

Leakage currents are stable on long continued application of voltage if the voltage and temperature are moderate. Leakage currents do increase progressively if voltage and temperatures are too high —(Electronics, October, 1956.)

Mid-air collision warning device

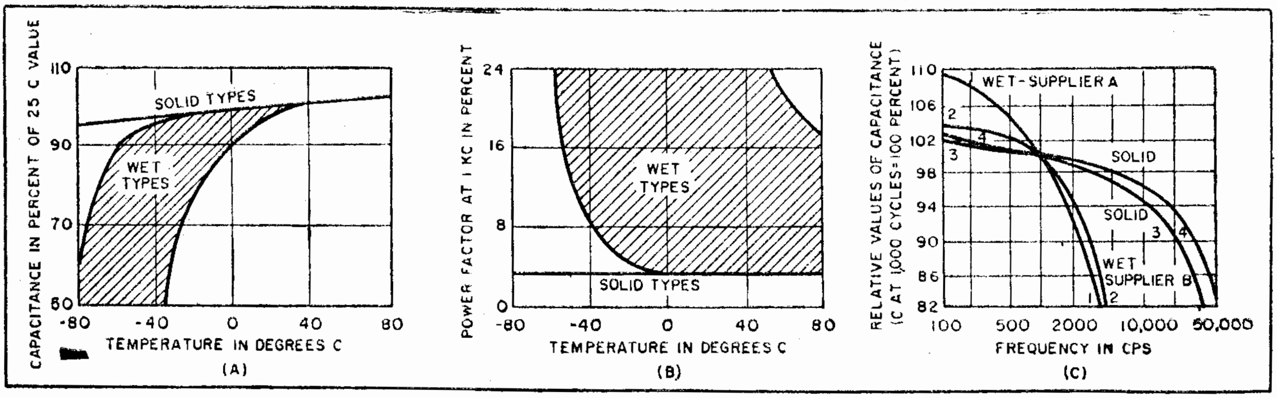
ANTICIPATING the dangers of ever-increasing air traffic density in the US, the Collins Radio Co., have developed a special mid-air collision warning device.

It has been approved by a special commitee of the nation's airlines and two companies, American and United, are already negotiating to purchase and instal the device in their planes.

The installation is to be in two steps. The initial set-up will consist of a horn and six warning lights, which will warn the pilot of the approaching plane and tell him its general direction and distance.

The second step will give instructions which way to turn to avoid collision, as indicated by "abrupt turn" instruction lights in the cockpit.

The lights will be actuated by electronic computers which will consider the position of the merging planes, their relative speeds and their direction of flight.



Typical characteristic curves for the solid electrolytics. (A) Capacitance-temperature, (B) power factor-temperature, and (C) Capacitance-frequency. Note the comparison to the wet types which behave poorly at extreme temperatures.

NEWS AND VIEWS OF THE MONTH

Novel sail boat

PICTURED on page 3 is a novel sail boat, the brainchild of G.E. Engineer B. D. Bedford. Despite its unromantic appearance, it apparently performs well.

In trial runs it not only pulled easily away from other standard 12½ft dinghies, but kept pace with larger boats.

Bedford explains the greater speed by the larger sail area—120 feet compared to 72—and the sail angle that causes the wind to "pull" his boat through the water instead of "pushing" it.

Bedford applied the engineering principle of force vectors to sail design. He reasoned that by positioning the sail to receive the force vectors, or wind, at a specified direction, he could reduce the torque, or "overturning moment" exerted on the boat.

He theorised that a design that would swing the sail upward from the bottom would not only reduce the traditional lean of the boat, but convert the downward pushing force of the conventional sail to a forward pulling force.

Bedford's sail tends to lift the boat. It enables the skipper to "spill" a heavy wind to any desired degree.

Bedford's U-shaped rig pivots off-centre from a stubby four-foot mast. The twin uprights, flexible enough to bow slightly when the sail is under pressure, are 12 feet high. The bottom of the U-frame, which acts much like the boom on conventional rigs, is nine feet long.

The sail is roughly rectangular-shaped, stretched on a slightly "bow-legged" H-shaped frame. A wooden crossbar eight feet in length links two aluminium side frames 16 feet long, between which the sail is stretched. The top and bottom of the sail's rectangle are taut between the stretchers.

A series of 12 coil springs, keeps tension on short levers below the "boom" to hold the U-structure in an upright position.

Bedford estimates that his rig "probably weighs twice as much as the ordinary Tech dinghy rig", and is about the maximum the craft can safely carry.

Faster French train

SPEED ceiling of French trains, now fixed at 140 kilometres (86.8 miles) an hour is to be raised to 150 kilometres (93 miles) an hour. This ceiling will come into force in 1957, provided the approval of the Secretary of State for Public Works is given, as undoubtedly it will be. Eventually the ceiling for maximum speed may be raised to 160 kilometres (99.2 miles) an hour.

The new speeds will be applied first to the famous Mistral express (Paris-Nice), already the fastest train in the world, for a distance of 500 kilometres (315 miles), between Paris and Lyons. When the speed ceiling is eventually raised, as expected, to 160 kilometres an hour the journey between Paris and Lyons will be possible in three hours 42 minutes.

Largest P.A. ?

AT the final gathering of the German Evangelic Church Congress held late last year in Frankfurt, a Phillips high power loudspeaker system was used to cover a congregation of 300,000.

For this purpose, at the Rebstock Airport a huge 100ft cross was erected in which the vertical pole served as an enormous Sound Column. Two hundred and fifty speakers were beamed over an area of 32,000 square metres with a power of 2000 watts. The vertical pole was a triple speaker column radiating the sound in three directions and distributing speech and music to people listening up to half a mile away.

When the congregation was dispersing full power was used for police instructions and paging purposes and every word spoken could be clearly understood in the streets of the city several miles away.

For the facilities required 14 microphones were used. In addition to the various speakers, it was necessary to reinforce the voices of 5000 singers and 2000 trumpeters. Six 750 watt amplifiers were used to feed the sound columns.

The equipment was also used in Cologne for the final gathering of the Roman Catholic Congress, 1956.

POPULAR SCIENCE QUIZ

Q: What is meant by "cathodic protection" of ships and is it worthwhile?

A: Cathodic protection is an electrical method of inhibiting corrosion and fungus growth from the hulls of ships, which are idle for one reason or another.

The hulls are connected to the negative side of a low voltage DC supply, usually about 24 volts. The positive side of the supply goes to a series of carbon anodes lying on the harbor bed beneath the hulls.

Due to electrolytic action, current passes through the intervening water and a layer of tiny hydrogen bubbles develops over the submerged surface of the hull. This greatly reduces the tendency to corrosion and retards sea growth.

As far as cost is concerned, quite substantial savings are possible. It has been estimated that the cost of current consumed by the electrical circuit would only be about one quarter the cost of having the ship or ships docked, cleaned and painted at regular intervals.

Q: Speaking of ships, do ship-owners and captains have any special feelings about trading in and out of freshwater ports?

A: Depending on the parts concerned, they may have lots of feelings of a personal nature. On the business side, stay in a freshwater port (if you can call an up-river berth by that name) may pay off handsomely.

Much sea growth, which develops in salt water, dies and falls off in fresh water. This means fewer visits to the dock for cleaning and painting.

Q: Does radiation have any hereditary effect?

A: Answers to this question have ranged from highly colored "alarmist" theories to an almost complete dismissal of possible effects. Actually the question is the subject of much concentrated study and has not been resolved one way or the other.

It seems likely, however, that genes are affected to some extent by all forms of radiation and that the resulting mutations are cumulative from one generation to the next.

This being so, the possible influence of cosmic rays and other natural radiations over the centuries may be quite significant to our present stage of development.

What scientists are trying to discover is whether the increase in artificial radiations during the past few years, ranging from X-rays to hydrogen bombs, will make any significant difference to the total radiation absorbed during an average person's lifetime. If such is the case, what is possible effect of this on future generations?

In the meantime, many scientists are calling for caution in the development of nuclear devices and even the use of medical X-rays, particularly for age-groups still likely to produce children.

Q: What is a neutrino?

A: A neutrino is an atomic particle, predicted about 20 years ago. Reports indicated that neutrinos have now been identified at the Los Alamos scientific laboratory. They are said to have such penetrative powers that they can pass through billions of miles of solid matter.

Olympic record

THE 1956 Olympic Games, held for the first time in the Southern Hemisphere, opened with unforgettable ceremony—the majestic fanfare of trumpets, the march-past of the world's greatest athletes and the entry into the Games Stadium of the Symbolic Olympic Torch.

Amalgamated Wireless (Australasia) Limited in conjunction with the Australian Broadcasting Commission, has prepared a record of the opening of the 1956 Olympic Games. This record portrays in sound the excitement and pageantry of the opening ceremony.

All manufacturer's profits derived from the sale of this special souvenir recording will be donated to the Organising Committee for the XVIth Olympiad by Amalgamated Wireless (Australasia) Limited.

New lamp

DEVELOPED by General Electric's Large Lamp Department, a new fluorescent lamp doubles the light output of present tubes of equal length.

The increased light is made possible by a revolutionary change in tube design. It features a series of lengthwise dents or grooves along one side of the eight-foot-long fluorescent tube. Because of its high light output and unique appearance, the new lamp has been named "Power Groove".

At the grooves, the new tube is nearly U-shaped in cross-section. This design permits a maximum circumference of the tube while constricting its inside area.

The greater light output results from an increase in area of the lighted tube surface, the higher wattage at which the new tube can be operated, and the more effective use of energy within the tube.

Eiffel Tower wobbles

THE Eiffel Tower wobbles, not violently, but it does wobble. In a very high wind the displacement at the top of the famous 1000ft tower may be as much as 18 centimetres (7in).

It took only two years to build the Eiffel Tower, opened for the Paris Exhibition of 1889, whereas the installation of a third lift will require as long today.

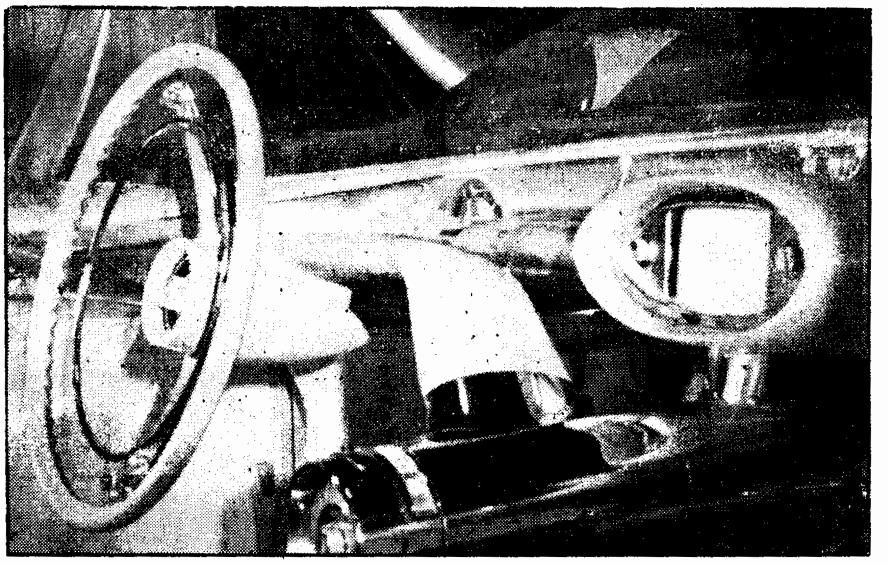
Its builder, Eiffel, said his tower could stand a wind-force six times greater than any tornado recorded up to his time.

Cloth saver

A NEW type of electronic metal detector, sensitive enough to react to a metallic speck smaller than the period on a typewriter, has been developed by RCA for the continuous inspection of textile fabrics in production. The new machine can keep a careful watch on materials moving along as rapidly as 1000 feet a minute and is expected to relieve a "tramp" metal problem that costs the textile industry hundreds of thousands of yards of fabrics and damage to machines each year.

A product of RCA's Theatre and Industrial Equipment Department, the machine is expected to have important applications also in the plastics field, where materials are processed in sheet form.

TELEVISION RIDES THE HIGHWAY



If you ever own a Buick "Centurion" it might have this built-in television receiver. But it doesn't carry a TV program—merely an unobstructed view of following traffic. For night driving it eliminates the glare of following headlights, as in a conventional rear-view mirror.

Improved Stroboscope

AN improved stroboscope put out by Precision Scientifique et Industrielle of Paris allows inspection of almost anything in motion.

It permits precise observation, photographing and controlling of defects and changes of adjustments regardless of the speed of the alternating or rotary motion of any object or one of its parts.

The apparatus has a powerful light which flashes at 1/100,000th of a second, at a rate that can be synchronised with the object or phenomenon to be observed.

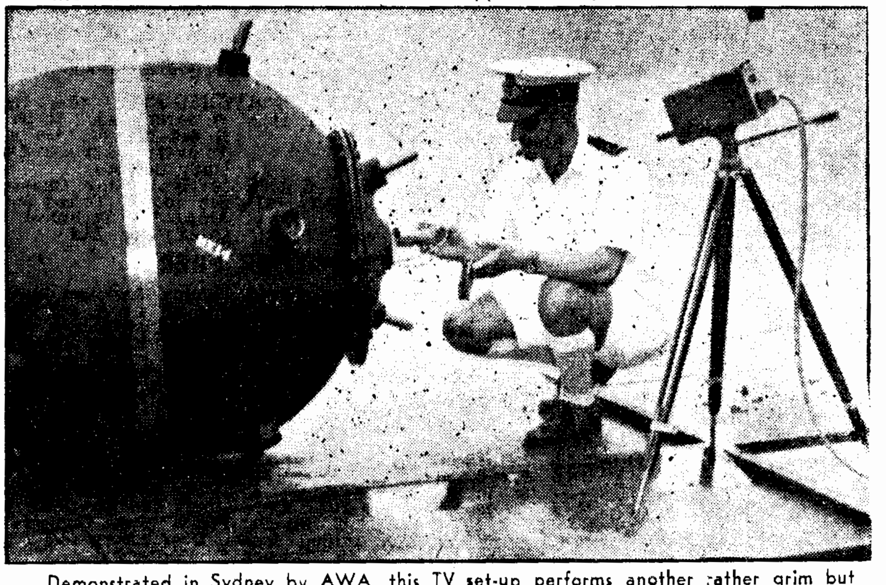
The stroboscope is ideal for measurement of the speed or oscillation of inaccessible objects and of those where no contact is possible when they are in motion.

BBC VHF service

THE BBC's Very High Frequency (VAF) sound broadcasting station at Holme Moss, near Huddersfield, was brought into service on December 10. This new station, which is on the same site as the BBC's Holme Moss Television Station, will transmit the North of England Home Service on 93.3 Mc/s, the Light Programme on 89.3 Mc/s, and the Third Programme on 91.5 Mc/s, each with an effective radiated power of 120 kW.

As at other BBC VHF sound broadcasting stations, the transmissions will be horizontally polarised.

The area in which satisfactory reception is expected has a population of approximately fourteen-million people.



Demonstrated in Sydney by AWA, this TV set-up performs another rather grim but practical task. If an expert makes a fatal mistake when "de-lousing" a mine, observers know exactly what the mistake was. They don't repeat it!

ELECTRONIC

A&R Transformers

EQUIPMENT

FEATURING:— POWER! . HI-FI OUTPUT! . . ULTRA-LINEAR! . . MATCHED KITS!

TYPE NO.	D.C. MA	PRIMARY VOLTS	SEC'N'D'RY VOLTS	FILAMENTS
1763	100	200 — 230 — 240	300 — CT — 300	All in this Section 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	200 — 230 — 240	285 — CT — 285	5v—3A; 6.3v—2A; 6.3v—CT—2A.
1772	„	„ „ „	325 — CT — 325	ditto
1773	„	„ „ „	350 — CT — 350	5v—3A; 6.3v—3A; 6.3v—CT—3A.
1774	„	„ „ „	350 — CT — 350	5v—3A; 6.3v—CT—3A; 2.5v—5A.
1775	„	„ „ „	385 — CT — 385	5v—3A; 6.3v—3A; 6.3v—CT—3A.
1776	175	200 — 230 — 240	285 — CT — 285	All in this Section 5v—3A; 6.3v—3A; 6.3v—CT—3A
1777	„	„ „ „	325 — CT — 325	
1778	„	„ „ „	350 — CT — 350	
1779	„	„ „ „	385 — CT — 385	
1780	200	„ „ „	350 — CT — 350	
1781	200	„ „ „	400 — CT — 400	
1782	200	„ „ „	450 — CT — 450	
1400	250	200—220—230—240	565, 500, 425 A side	2 x 6.3v—3A; 2 x 2.5v—3A; 5v—3A.
1371	300	„ „ „ „	1000, 850, 750, 600 500 A side	— — —

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.

FOR MULLARD "5-10" AMPLIFIER

TYPE 2505 — 12 watts
Prim.: 6000 ohms C.T
Sec.: 3.7 or 15 ohms
Resp.: 10-50,000 cps.
Type 2505-8 for 2 or 8 ohms Sec.
Type 2505-15 for 3.7 or 15 ohms Sec.

SPECIAL HI-FIDELITY + — ½ db 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
Prim.: 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 + — 1 db 30-15,000 cps

OUTPUT TYPE

TYPE 763 — 15 watts.
Prim.: 5000, 300 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

TYPE 920 — 15 watts.
Prim : 5000, 3000 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.

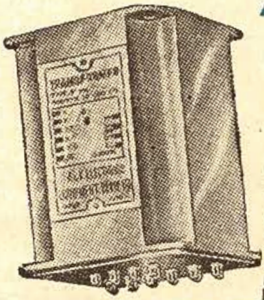
TV KIT

(Designed for use in T.V Circuit. Published by Philips Elect. Ind. P/L.)
P.T. 1790: P: 200, 230, 240V; S: 230-CT-230, 350 mA; F: 2 x 6.3V at 6A.
O.T. 2507: To Philips Specification
Z 1090: 3 Hys-300 mA Choke. D.C Res. 50 ohms.

MATCHED KIT (For Mullard 20W EL34 Amp.)

P.T 1783: P: 200-230-240v., 50cps
S: 410-CT-410v., 180 mA.
F: 5v-3a; 6.3v -CT-4A; 6.3v -CT-2.5A (Electro-static Screen)
Z. 1092: 10 Hys-180 mA Choke; D.C. Res., 200 ohms.
O.T. 921: See above. Tested and approved for use in this Amp., by Technical Service Dept of Mullard (Aust.) Pty Ltd

A REFERENCE FOLDER FREE!



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US TV sales

SALES of US television receivers in overseas markets are soaring.

Both Census and Foreign Commerce spokesmen agree that the Americas south of the US border comprise today's booming market for US television receivers. They point to new stations in the Central American Republics, such as Panama, Guatemala, Nicaragua and Salvador and to the expansion in TV set ownership in cities with long-established stations.

But overseas markets for TV sets are by no means limited to the Americas. An interesting disclosure in the just-released US Government statistics is the fact that US manufacturers are making some sales in Europe. Sales in Italy, Portugal and Switzerland, for example, are increasing substantially, and a market is slowly being built in Sweden. According to the Bureau of Foreign Commerce, US makers attribute their success in Europe, where locally made models are available at lower prices, to the improved performances of US models.

"Quiet room"

J. B. WASSALL, director of engineering for Lockheed Aircraft Corporation's California Division, said recently that his company was building a new "quiet room" so soundproof, "that you can hear your own heart beat as you walk through it".

"The quietest place in town", it is designed to bring forth new ideas to capitalise on the basic quietness of turboprop power in the new Electra.

It will be used to isolate sound produced by mechanical devices, in order to learn how to muffle them without interference from other noises. The room is designed on "anechoic" principles — that is, it will not reflect sound. Inside, it is 7ft high, 9ft wide, and 13ft long. Walls are 4½ to 5ft thick.

Record air drop

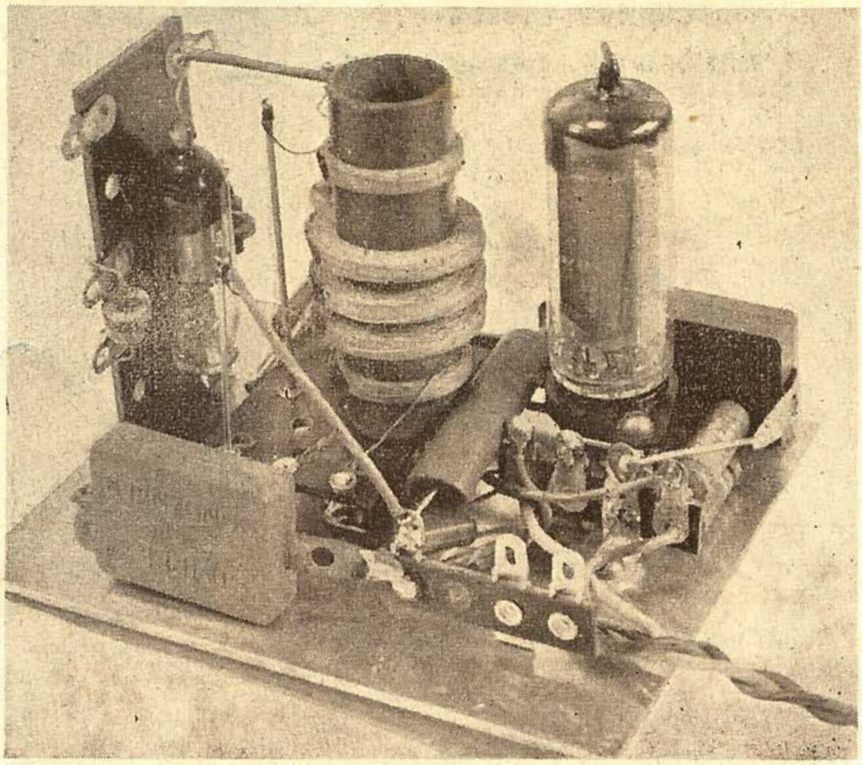
THE United States Air Force's new medium troop and cargo carrier, the prop-jet C-130A Hercules, has successfully dropped the heaviest single load ever extracted by parachute from an aeroplane.

A 27,000-pound (12,227 kg.) load was extracted from the turbo-prop Hercules during aerial delivery tests at El Centro, California, Naval Auxiliary Air Base.

At least two new world's records were established during the tests — for heaviest single load, and for biggest multiple drop ever accomplished from an aeroplane.

The air freighter, soon to enter active service with the Air Force's Tactical Air Command, made aviation history in a series of 37 parachute drops, including aerial delivery of a huge road-grading machine—such as moves earth in construction of superhighways — and a 400mm. gun mount.

Heaviest single item to be yanked by parachute from the cavernous C-130, was a 27,000-pound dummy load of iron, its load-carrying platform and six 100ft cargo parachutes, which were necessary to float it easily to the ground.



One view of the completed power supply. The RF transformer is in the centre, the 6BW6 on the right, and the 6X2 on the left. The 1st filter capacitor is at left front and the filter resistor encased in the tubing between the RF transformer and the 6BW6.

A 2000-VOLT RF POWER SUPPLY

As promised in the December issue, we describe here an RF power supply capable of delivering between 2000 and 2500 volts under typical conditions, and suitable for use in most 5-inch CRO units or for the experimental 5-inch TV receiver described last month. Its construction is well within the capacity of any reasonably experienced enthusiast.

THE use of high frequencies for the generation of high voltages has a number of advantages, and is used quite extensively. In commercial TV receivers the EHT voltage is generated by this method, the line time base circuit (approximately 15 Kc) being used for this purpose as well as its main function of deflecting the electron beam in the picture tube.

OVER 2000 VOLTS

Many oscilloscopes also use an HF system and, in general, it is considered that EHT requirements in excess of, say, 1500 volts, may well justify the use of this type of supply. In fact, above about 2000 volts the scales swing rapidly in favor of the HF supply, both as regards economy and safety.

A characteristic of all TV and CRO EHT systems is that they are not called upon to deliver any great amount of power. At most, the current drain will be only a couple of milliamps and, even allowing for the high voltage, the total power is quite small.

This is one reason why the conventional 50 cps power supply becomes clumsy and uneconomical for this class of work. In spite of the limited power, we must still provide a large, iron core and wind a secondary with wire which, for mechanical reasons, is likely to be of heavier gauge than is strictly necessary.

The result is a transformer capable of supplying much more power than necessary — and likewise, more costly and bulky.

By increasing the AC input frequency, we can reduce the size of the iron core, or even eliminate it altogether. In the case of a TV set the frequency is set by the line oscillator and is of such an order as to require some kind of ferrous core. A small iron-dust core is usually employed, and the resulting transformer is relatively compact.

For oscilloscopes and similar applications, higher frequencies may be employed (of the order of 1 Mc), making it possible to dispense with the iron core completely. The result is a simple air-cored transformer only a little larger than a conventional aerial coil, weighing a few ounces, and costing much less than the conventional 50 cps variety.

by Philip Watson

LESS CAPACITANCE

We also score in the filter network. At 50 cps the amount of capacitance required to provide adequate filtering can be relatively high, even for the few milliamps of current drain. Typical values would range from .5 mfd upwards and, with suitable high voltage ratings, these become both bulky and expensive.

In addition, they store a considerable amount of energy—certainly enough to give one a nasty "bite" and with the possibility of more serious consequences at the higher voltages.

At higher frequencies, however, very much less capacitance is needed for equivalent filtering, values between .001 and .01 being typical. The amount of energy stored in these is so low that it can hardly be regarded as a serious hazard, even at very high voltages. Such capacitors also are much smaller and cheaper.

Finally, the magnetic field from such a transformer is much more easily controlled than that from a 50 cps type, a conventional metal box or shield normally being sufficient to prevent interference with the trace on the CRO screen. Even when RF circuits are present a similar order of shielding, plus some elementary filtering, is normally all that is required to prevent interference.

Considering all these advantages, it is easy to see why this type of power supply is often preferred for oscilloscope and TV EHT supplies.

So much then for the general background. Now let us consider a practical unit along these lines.

SMALL TV SET OR CRO

The one we have produced is suitable for either an oscilloscope or experimental TV set. Later in the article we will discuss the modifications necessary to adapt it to circuits having different polarity requirements.

At least two coil manufacturers, one in Melbourne and one in Sydney, are able to supply suitable RF transformers, both apparently designed around data originally published in Radiotronics No. 117. Any reader who is interested in the more mathematical approach to this component is referred to this article.

The RF transformer consists of three windings—a grid coil, a plate coil and the EHT winding. The latter is wound in between the other two.

As can be seen from the circuit, the grid and plate windings are connected in a conventional oscillatory arrangement, the plate circuit being tuned.

The frequency of oscillation is determined mainly by the natural resonance of the EHT winding, maximum activity being evident when the plate coil is tuned close to this frequency.

The valve may be a 6V6 or a 6BW6 and requires a HT voltage of between 250 and 300. The total HT current will be around 40 to 45 mA, the latter figure, at 300 volts, approaching the safe maximum as determined by the plate dissipation ratings of the valve.

FILTER COMPONENTS

The filter system is quite simple, consisting of two only .001 mfd capacitors and a .1 meg 1 watt resistor.

The two capacitors are large mica types (such as the type "M") and appear to be quite capable of operating at this voltage. Admittedly it is higher than the official rating but at least one manufacturer has given the arrangement his blessing, on an experimental basis. We have had voltages approaching 5000 across them for brief periods without sign of distress.

We built the entire unit on a small rectangular plate measuring 4½in x 3¾in. This is intended to be mounted on the main chassis and covered with a suitable shield box to prevent radiation affecting either the CRT or any RF circuits which may be present. This applies particularly where the unit is used for a TV set.

All components are above the plate, the 6BW6 socket being supported on a couple of 1in long bolts with additional nuts. This arrangement simplifies the mounting of the sub-assembly on the main chassis and the few components are easily accommodated in the available space.

To facilitate the wiring of the valve socket we punched a standard ¾in socket hole immediately beneath it and through which a small iron tip may be passed to reach the socket terminals.

LAYOUT

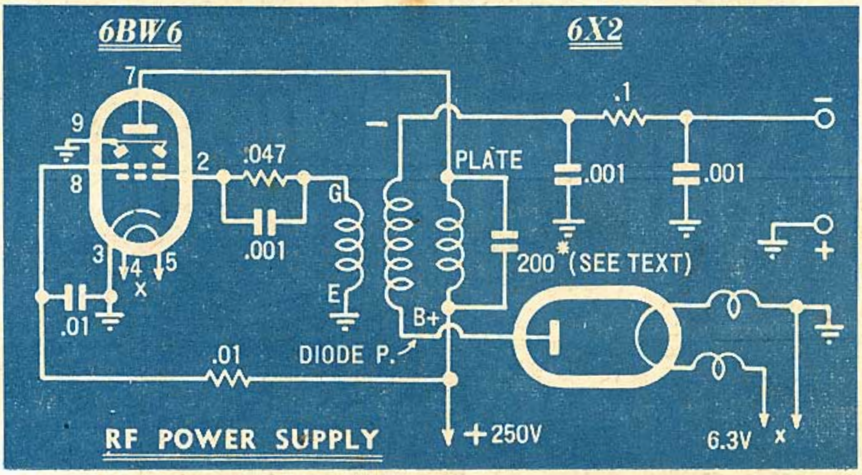
The RF transformer is located in the centre of the plate, the offset terminal board being toward the rectifier assembly. The 6BW6 is on the opposite side and, although shown slightly to one side in our case, could probably be on the centre line without complicating the layout.

The rectifier is the 6X2 or the European equivalent, type EY51.

These have been specially designed for the high frequency power supplies used in TV receivers, one of their main features being a very low heater wattage (6.3V, 90mA). This enables them to be operated from a filament winding on the HF transformer, thus simplifying the provision of a filament supply at a high potential from the chassis.

Physically they are slightly smaller than the conventional miniature valve and have no base. Three "flying leads" are provided and which are intended to be wired directly into the circuit.

CIRCUIT DETAILS OF RF SUPPLY



The circuit is basically that of a simple oscillator, to which has been added a high voltage winding, rectifier, and filter system. As shown it provides a negative output and the rectifier can be operated from the main filament supply.

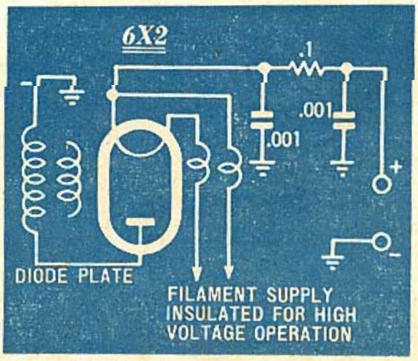
In the prototype supply, we provided a length of narrow terminal strip, about 3in long, and supported it in an upright position by means of a simple aluminium bracket at the end of the plate. We drilled out all unnecessary terminals to provide better spacing between high voltage points and fixed the rectifier to it by simply soldering the three leads to the appropriate lugs.

When bending the plate lead, grip it near the glass seal with a pair of pliers to avoid any strain on the glass.

RECTIFIER INSULATION

Since it is possible that the unit may be called upon to deliver a positive output with the filament above chassis by the output voltage, we treated both filament and plate terminals as possible high-voltage points.

In addition, we had to provide a filament choke in each filament lead as a precaution against RF finding its way back into the front end of the receiver via the filament line. The two chokes we used are tiny honeycomb windings on iron dust cores and which have recently been made available by a local coil manufacturer for use in TV receivers. The choke is designated as type VPC2. It has a current rating of 100 mA and should not be used in heavier filament circuits.



How the circuit is modified to provide a positive output. The rectifier filament must withstand the full HT voltage. See text for details of how this is arranged.

These are mounted between the filament terminals and an extra pair of terminals left on the strip for the purpose. The filament line is terminated on these latter two terminals.

The components in the HT line, the filament chokes and the provision for shielding represent routine RF filtering measures in such a supply. They may need to be augmented in applications where RF interference is a special problem.

Throughout the construction, considerable care was exercised to provide adequate protection against breakdown at the high voltages involved and we cannot emphasise too strongly the need for the builder to exercise similar care. This will be better appreciated when it is realised that, under no-load conditions, the output voltage can rise to 5000 volts, and that at least twice this voltage can appear between some points in the circuit and chassis.

PRECAUTIONS

While these voltages cannot be regarded as a serious hazard to the operator, due to the small amount of power involved, any suggestion of leakage or the possibility of breakdown at a later date, due to humid atmosphere, &c., must be avoided, if the unit is to give reliable performance. For this reason, we suggest that the following precautions be observed:

- All high voltage points which are terminated on terminal strip lugs should have at least one blank lug between this point and others of lower potential. Better still, the blank lug should be removed by drilling out the rivet.
- Particular attention should be paid to the lead and terminal associated with the rectifier plate. The voltage at this point (to chassis) can be more than double the DC output of the unit when the rectifier is not conducting. During this half of the cycle, the voltage across the transformer winding is effectively in series with the voltage stored in the first filter capacitor from the previous half-cycle.

● Where the transformer is provided with a baseboard, the manufacturer's terminal specifications should be followed exactly, since these have been allocated on the basis of the voltages likely to be present on each. The unit may work with other connections, but performance is likely to be erratic.

● If there is any possibility that the insulation resistance of the terminal board may not be adequate, due, say, to prolonged humid conditions, it would be better to fit some other form of terminal. This could be a small trolitual stand-off insulator or a short length of polystyrene rod, drilled and tapped at both ends, and fastened to the baseboard.

● Encase the .1 meg. filter resistor in a length of plastic tubing to provide additional protection.

The remainder of the construction is fairly straightforward, and should not cause the average home constructor any bother.

ADJUSTMENT

Having completed the construction, the next step is to get it working and correctly adjusted. Connect it temporarily to a suitable source of filament and HT supply and connect a meter to the output, remembering that the chassis is positive.

The meter should have a range of about 5000 volts and, ideally, be of the 10,000 or 20,000 ohms per volt variety. However, a conventional multimeter may be pressed into service, and we will discuss this in a moment.

To avoid generating unnecessarily high peak voltages, there should be a load across the output of not more than 5 meg. If the voltage-divider into which the unit is intended to work is available, it would be most logical to use it, otherwise something of approximately the same value can be mocked up. If a standard multimeter is used it will provide sufficient load in itself to control the output voltage.

Depending on the load in use and the adjustment of the tuned plate circuit, the voltage when first switched on may be either too high or too low and will call for some adjustment. This is normally achieved by varying the capacitance in the tuned plate circuit. If only a rough adjustment is required, this may be provided by adding small values of capacitance in parallel with the 200 pf shown, or by substituting slightly smaller values.

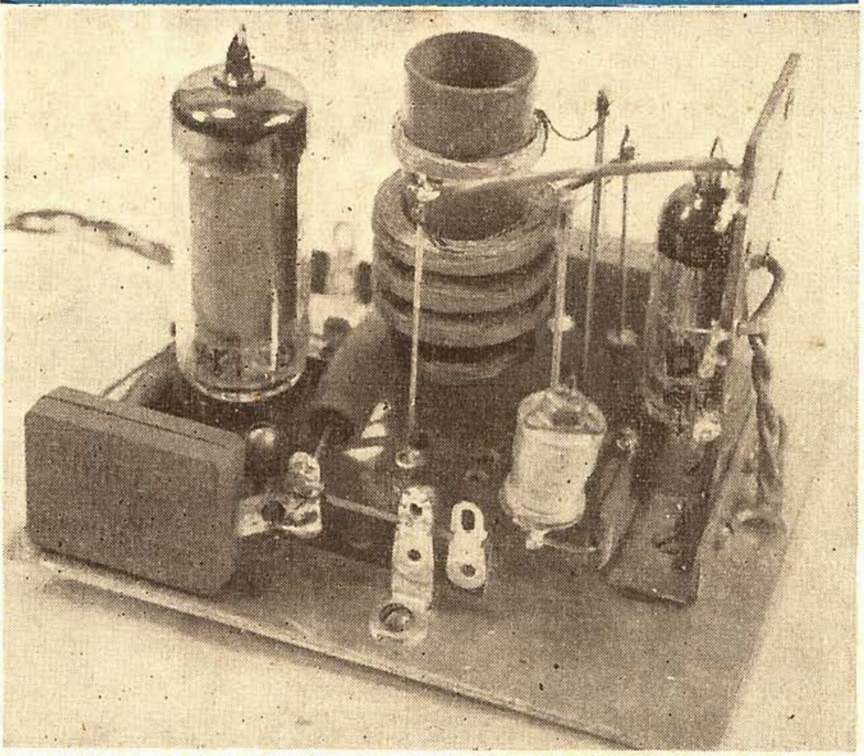
TUNING CAPACITOR

Once it is determined whether an increase or a decrease is required it should not be difficult to provide the correct value to give the voltage required. If the load is light, more exact tuning may only result in voltage in excess of requirements, and is quite unnecessary.

On the other hand, a heavier load may call for fairly exact tuning in order to provide the required voltage. If this appears to be the case, we suggest that the best results should first be obtained by judicious selection of fixed capacitors, making the total capacitance slightly lower than appears to be necessary. Then fit a simple air trimmer to provide the final adjustment. In our case, a 150 pf mica capacitor, plus a trimmer set near its maximum capacitance gave the maximum output.

Note particularly that the very small

SUPPLY BUILT ON FLAT PLATE

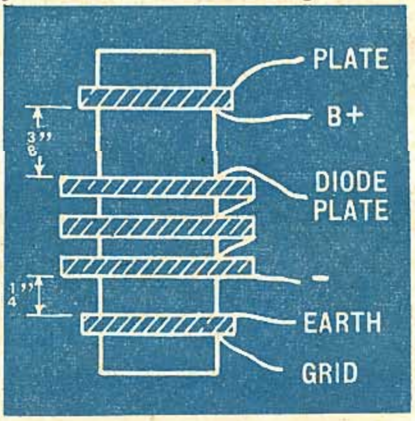


A view from the opposite side. The second filter capacitor is on the left in front of the 6BW6. The trimmer on the right is part of the plate tuning circuit, the remainder being formed by the mica capacitor behind and to the right of it.

ceramic capacitors are unsuitable in this part of the circuit. Due to the high circulating current they will overheat and perform erratically, usually resulting in eventual complete oscillator failure. All the standard mica types appear to be quite satisfactory.

If, as is likely, the only meter available is a standard 1000 ohms per volt type with a top range of 1000 volts, it can be easily adapted to read 5000 volts. It is merely necessary to provide an external multiplier of 4 megohms in series with one lead and to set the instrument to the 1000-volt range.

Strictly speaking, this extra multiplier should be made up from resistors no greater in value than .25 meg. but this



Connection details of the HF transformer. These should be adhered to exactly for reasons discussed in the text. Other arrangements will work, but with reduced efficiency and reliability.

is hardly justified for a simple job like this. On the other hand, lumping all the resistance into one unit is not desirable and we suggest using four only 1 meg. resistors.

Since, under typical output voltage conditions (2000 to 2500 volts), the meter will be drawing around .5 mA, its effect on the output voltage cannot be completely ignored. However, it is not serious and it should generally be sufficient to add about 10 pc to the value indicated in order to determine the correct value.

Of course, if the load of the meter can be used in place of, rather than in addition to, the normal load, its effect can be disregarded and the accuracy will be determined by the accuracy of the multipliers. In any case, the exact voltage is not particularly critical and we are mainly interested in knowing whether it is nearer 2000 volts than, say, 1500.

POLARITY

The unit, as shown in the circuit, has a negative output with respect to chassis, making it suitable for use with most conventional CRO circuits where the CRT anode is close to chassis potential and the cathode is negative by approximately the EHT voltage. Among other things, this arrangement has the advantage that the rectifier filament may be at chassis potential.

However, the TV set described in last month's issue required the opposite arrangement; a positive output with respect to chassis and the rectifier filament, as a consequence, operating above the chassis by the EHT voltage.

This means that the entire rectifier filament supply must be insulated from the chassis sufficiently well to withstand

the EHT voltage, plus a reasonable safety margin.

In considering these two arrangements it must be realised that, whichever one is used, one of the heater systems—either the rectifier or the CRT—will have to be at a high potential relative to the chassis and that a suitably insulated heater supply must be provided.

This can be done in several ways. It may be in the form of a special winding on the main transformer, it may be an additional winding on the HF transformer (generally only suitable for the rectifier filament), or it may be an additional 50 cps filament transformer with suitable insulation.

PARTS LIST

- 1 Base plate $4\frac{1}{2}$in. X $3\frac{3}{4}$in.
- 1 RF transformer (Type HF3K, M23, or similar)
- 1 6BW6 valve
- 1 6X2 valve
- 1 9 pin miniature socket
- 2 miniature filament chokes (VCP2 or similar)
- 1 .1meg. 1W resistor
- 1 .047 meg. $\frac{1}{2}$W resistor
- 1 .01 meg. 1W resitor
- 1 .01 mfd 400V paper capacitor
- 1 .001 mfd mica (miniature type) capacitor
- 2 .001 mfd mica (large, type "M" or similar) capacitor
- 1 200 pf mica capacitor (See text)
- 1 air trimmer (Optional, see text)
- 3 4 tag terminal strips (SM24)
- 3 in. resistor strip $1\frac{1}{4}$in. wide

One manufacturer has recently made available three such transformers, all having insulation rated at 5000 volts. One delivers 2.5 volts and is intended for use with the AV11 and 2X2 rectifiers; another delivers four volts and is intended for use with the VCR97 and 511B CRTs; the third is a 6.3 volt version for use with the 5BP1 and 5CP1 CRTs, or the 6X2 rectifier.

CIRCUIT MODIFICATIONS

If the unit has to be converted to a positive output the 6X2 filament leads should be disconnected from the normal 6.3 volt supply and run as a separate line to one of the alternative supplies discussed above. The remainder of the circuit is modified to take the EHT from the rectifier filament instead of the transformer winding. (See amended circuit on page 29.)

An interesting possibility regarding the filament supply is the fitting of a filament winding to the HF transformer. We tried this, and results were sufficiently promising to justify some further investigation, particularly as such an arrangement would offer some advantages.

Among these are the ease with which a filament supply with high-voltage insulation can be provided, and the fact that the filament supply, being self-contained, is less likely to radiate RF into the rest of the system. No RF chokes would therefore be necessary.

One problem, as far as the home-builder is concerned, is the difficulty of measuring the filament voltage accurately. This is particularly important, since the relatively fragile 6X2 filament needs to be operated within fairly close tolerances.

If you wish to try this idea, wind four turns of plastic hook-up wire (5/.0076) between the grid winding and the bottom of the HT winding. Naturally, the energy taken for this purpose will reduce the available HT voltage somewhat, but it should be possible to develop close to 2000 volts and still energise the filament correctly. It may be necessary to vary the filament winding by half a turn either way to suit a particular combination of components.

VTVM ESSENTIAL

At the frequency involved (about 1 Mc) the ordinary multimeter is useless and a VTVM with an external probe would appear to be essential. Even here one is likely to encounter misleading results, due to the presence of so much high voltage RF energy so closely associated with the filament circuit.

The best method appears to be to measure the voltage and make all adjustments with the aid of a dummy filament. We used a couple of 6.3 volt, 50 mA dial lamps in parallel, but a resistor of 70 ohms could also be used. When the correct voltage is read across this the connections may be transferred to the 6X2.

Since any factors which affect the activity of the oscillator will upset the filament voltage, it would be unwise to make any adjustments after the correct filament voltage has been determined. The normal tolerance on the 6X2 and EY51 filaments is 7 pc.

In place of the 6X2 it would be perfectly satisfactory to substitute the older types 2X2, AV11, VU134, &c. Note, however, that these are larger physically, require heavier filament supplies, — a 2.5 volt supply for the first two and a four-volt supply for the VU134.

Likewise, the 6BW6 can be replaced by the 6V6 or the 6AQ5. In most cases there alterations will necessitate a larger base plate and, possibly, some alteration to the layout. The extra height of some of these valves may also need to be taken into account.

As mentioned earlier, provision should be made to shield either the entire unit or, in the case of a CRO, at least the HF transformer. In practice it would appear simpler to shield the entire unit in all cases, particularly as the presence of a shield around the transformer only may affect its performance sufficiently to require re-adjustment of the circuit.

METAL BOX

The simplest approach appears to be a metal box which will completely enclose the unit and bolt to the main chassis. One suggestion is to fold up a "U"-shaped portion which will form the top and two sides, plus mounting flanges. The other two sides may take the form of a rectangular plate with a mounting flange, plus a flange at the opposite end which may be fastened to the top.

A fair amount of heat will be generated by the unit and reasonable ventilation should be provided. If the box is made from aluminium a series of holes in the sides and top should be provided. Alternatively, the "U" section could be made from perforated metal or stout mesh. In any case, both sides and top should be open to allow a circulation of air.

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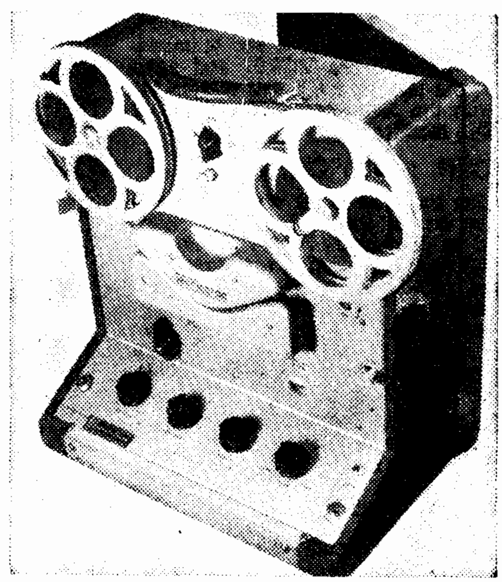

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FROM THE SERVICEMAN WHO TELLS

There appear to be so many weird and wonderful stories going about concerning TV picture tubes, their expected life, the makers' guarantees &c., that I have devoted a fair amount of space this month to a discussion which I hope will clarify the position somewhat.

THERE is undoubtedly considerable misconception by the general public on this subject; generally to the effect that the price is high and the life unduly short, thus making TV an expensive pastime — even after a set has been purchased.

Believing that such an attitude is, to say the least, unduly pessimistic, I have been waging my own personal war on such rumors at every opportunity. I had even convinced myself that I was achieving a small measure of success, since these stories did seem to be croppnig up less frequently in my own group of acquaintances and customers.

It came as something of a shock, therefore, when a customer I had not seen for some time raised the question once again.

"Is it true," he asked, "that these picture tubes only last a few months?"

Although framed as a question, it was in reality a statement; I had no doubt that, as far as my questioner was concerned, it was virtually a fact.

"Now, where on earth did you hear that story?" I inquired, feeling my blood pressure rise a point or two. His reply sent it up several more points.

"Oh, it was in the paper," he countered, with an air of finality which implied that I couldn't possibly contradict such an authority.

"When and where?" I asked. (It was a challenge I could not ignore, plus the fact that, for once, I looked like getting on the track of one of the most elusive things in the world — the origin of a groundless rumor.)

"Oh I dunno. About a week ago, in one of the morning papers. Some bloke in Parliament raised the question."

Then I remembered. Yes, there had been a report of a query raised in Parliament regarding picture tubes. As far as I could remember, the point at issue was the price and the imposition of an excise tax on these devices. In making his point, one honorable member had made some capital of the fact that the tube was only guaranteed for six months and that after this period the user would have to stand the full cost of replacement.

A RUMOR IS BORN

So there it is. A member of parliament happens to mention a six months' guarantee period — purely incidentally to his main theme — the newspapers report it — accurately and in context — and a section of the public immediately jumps to the conclusion that this is the expected life of the device. At least I now know how such rumors start!

Such reasoning is about as logical as assuming that a modern motor car, refrigerator, washing machine, or any other appliance will only last as long as its guarantee. If such were the case there would be few, if any, that would last more than six months.

In fact, the life expectancy of modern picture tubes is quite high. Local manufacturers to whom I have spoken confidently anticipate that their picture tubes will perform every bit as well as those already produced overseas — and the record overseas is quite impressive.

American users normally get from three to four years life from a tube and, naturally, American sets run brighter, and for longer periods per day, than any other sets in the world! (This statement is not quite as sarcastic as it may seem; the higher frame frequency—60 cps—allows these sets to be run at a higher brilliance without objectionable flicker, while the longer periods of transmission encourage longer use.)

English conditions are more like our own, with a 50 cps frame rate and moderate periods of transmission. Under these conditions a life of from four to five years is normally expected, while isolated cases of up to seven years have been reported.

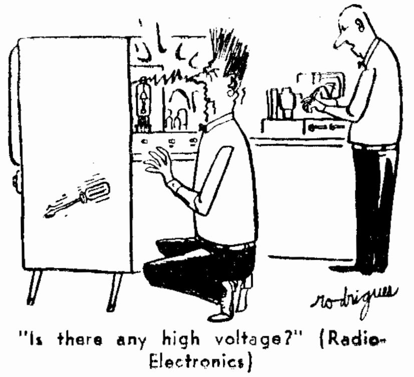
And just how do these figures tie in with the six months' guarantee already quoted. The guarantee period for picture tubes is based on the same principle as that used for conventional valves, except that the period has been increased from three months to six months.

"SHAKE DOWN" PERIOD

This principle assumes that any manufacturing defects will show up well within this "shake down" period and that any device which survives the trial period should then be good for its normal life span.

This appears to be borne out in practice, at least as far as valves are concerned. Apart from loss of emission and a few other defects due to old age, the great majority of valve faults do show up quite early in their life. And in this respect I must say that all valve manufacturers appear to be quite sincere in the guarantees which they offer.

I mention this last point because there are still members of the public who believe that a valve guarantee means nothing in practice: that the manufacturer will automatically dismiss all claims as due to overload or abuse by the user and that there is no means of proving it otherwise.



"Is there any high voltage?" (Radio-Electronics)

This may appear so in theory, but in practice I can only say that I have never known a valve manufacturer to reject any reasonable claim. In fact, it seems more likely a proportion of the claims which are honored by them are, strictly speaking, not their responsibility and that the customer is often given the benefit of the doubt.

A "FAIR GO"

While I do not anticipate that picture tubes will be treated as leniently as valves (after all, they do represent a lot more money) I do feel that users will be treated fairly. After all, if a tube does fail, the engineers concerned are just as anxious as anyone else to determine the real cause of failure. Only in this way can the high standards achieved overseas be maintained and, eventually, improved.

All the local valve manufacurers have reached an agreement on the general conditions of such guarantees though, naturally, it is left to the individual manufacturer to work out the mechanics of administration.

In brief, the following are the guarantee conditions: Each picture tube is guaranteed for six months from the date of being put into service. If it fails during that period and the makers are convinced that the failure is due to a defect in the tube and not to physical or electrical abuse, then the tube will be replaced.

The replacement tube will be a new tube and will carry the same six months' guarantee. In this respect the situation favors the owner since, whatever life he has obtained from the faulty tube has been at little cost and no loss of guarantee privileges.

On the other hand, the makers require that the allegedly faulty tube be forwarded to them for inspection, correctly packed, and at the owner's expense. This may sound like something of a hardship for the owner, but, in reality, it should not be.

DEALER'S JOB

The tube manufacturers hope — in fact expect—that the dealer who sold the set will undertake this job as part of his normal service to his customer. This is a perfectly logical arrangement because, after all, he will probably be the person who breaks the sad news that the tube is faulty. In addition, he is better equipped than anyone, apart from the manufacturer, to advise the customer whether the fault is likely to be covered by guarantee.

He is also the logical person to organise transport back to the makers, since he should have an adequate supply of cartons and packing materials salvaged from previous deliveries.

Finally, the makers will almost certainly require a written explanation of the circumstances in which the tube failed. It will fall to the dealer to provide

the necessary technical data to back up the claim.

In practice, this will generally mean that the dealer will handle the whole of the claim application; packing and shipping the tube, filling in the claim form, and even "chasing" the makers if a decision is not forthcoming in a reasonable time. Meantime, the customer will probably want a new tube fitted anyway, reasoning that he will have to have it, whether the makers replace the faulty one or not.

DEALER'S CHARGE

What the dealer charges his customer for this service is a decision best left to the individual. He will, of course, be entitled to his normal service fee (unless the entire set is still under guarantee), and it would seem reasonable to pass any freight charges on to the customer. Otherwise it would seem good policy in most cases not to add any further costs.

All of which adds up, as far as the customer is concerned, to a pretty well equipped organisation to ensure that he gets the life from his picture tube which he has a right to expect. Similar schemes have been in operation overseas for many years, and have been very successful. Let us hope they work as well here.

On the purely technical side, there are also some bright spots for the customer. Even when a tube has given several years of useful life and appears to be on the way out, there are a number of very useful tricks which the serviceman can use to prolong their life.

(An interesting sidelight here is that most of these tricks can be, and have been, used on conventional valves in days gone by. The reason they are no longer employed is that they are no longer economical, a new valve being cheaper than a repair. If ever picture tubes drop to fifty bob a time (!) the same will apply to them.)

EMISSION LOSS

It is almost inevitable that the most frequent cause of failure is simple loss of emission, as in a conventional valve. Strangely enough, the "cure" is also relatively simple, and, apparently, almost 100 pc successful. Overseas practice is to raise the filament voltage by anything from 25 to 50 pc until normal emission is restored. It is claimed that this procedure will prolong the life by two years or more.

There are at least two ways in which this increase can be brought about. One (the most usual) is to provide a simple step-up transformer which is inserted between the normal filament line and the picture tube filaments. Ideally it should have two tappings, one at 25 pc and one at 50 pc, so that, after the 25 pc increase is no longer effective, the 50 pc increase may be employed.

The other method is to take advantage of the filament circuitry employed in certain receivers. These supply the filament of the picture tube from a higher than necessary voltage, using a dropping resistor to reduce the voltage to its correct value at the filament pins.

The main purpose of this idea appears to be to protect the filament at the moment of switching on. This is when most filament failures occur, due to the heavy surge of current through the cold filament. (A cold filament may have from one-fifth to one-seventh the value of its normal running, or hot, resistance.)

By supplying the filament from a supply having poor regulation (as brought about by the resistor) the current cannot rise to excessive values, even under short-circuit conditions. Thus the filament is protected. However, there is also the secondary advantage that a weak tube can probably be given a new lease of life by simply reducing the dropping resistor to bring about the required percentage of filament voltage increase.

And, if you are wondering just what the filament has to say about all this deliberate overloading, it would appear that it is quite capable of withstanding it. Admittedly, such a procedure would be highly undesirable in a new tube, but the main effect would be on the cathode.

LITTLE TO LOSE

However, when the cathode is otherwise worn out, there appears to be everything to be gained, and little to lose, by running it at the higher temperature. Even if the tube failed after another six months, the cost of the transformer would probably be justified. In most cases considerably more life than this should be obtained.

A slightly different version of the above stunt appears to be advocated by some overseas writers. This is to run the filament at a fairly solid overload, up to 100 pc, for a period ranging from half an hour to two hours, without any HT voltages being applied. Then it is restored to normal operation within the set, the cathode having been, supposedly, reactivated by this procedure.

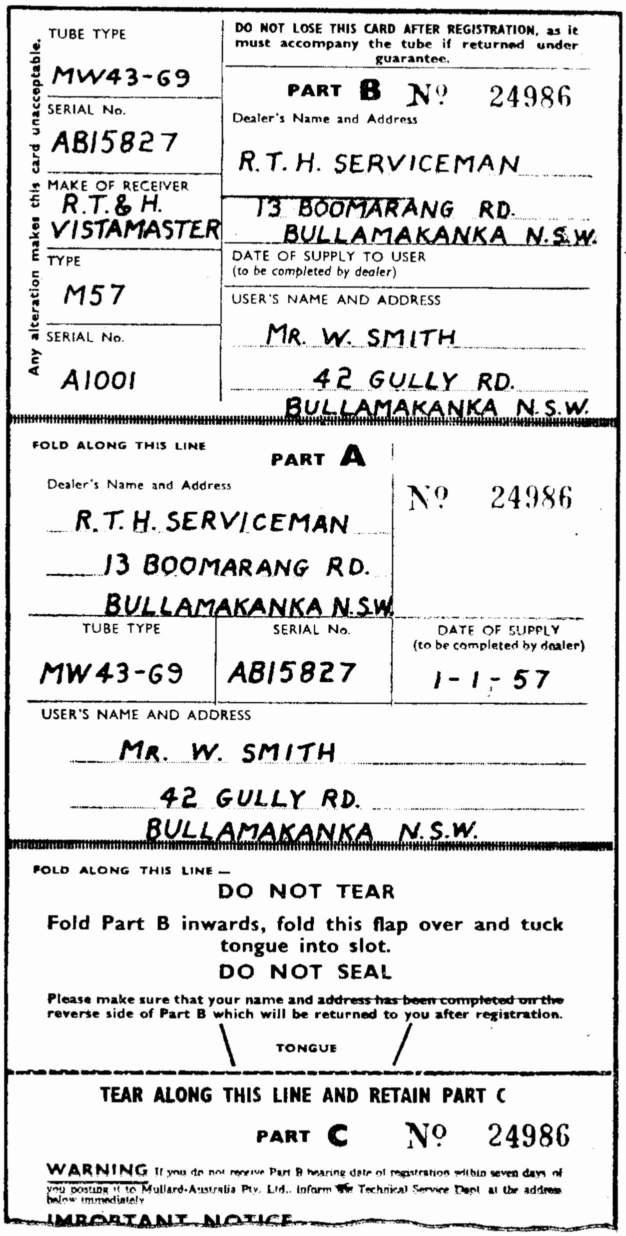
I cannot speak from experience on the effectiveness of this scheme, but it is significant that it does not appear to be as popular overseas as the previous arrangement. It is an idea originally recommended for thoriated-tungsten filaments, whereas picture tube cathodes are the more popular oxide-coated type. Re-activation of these is likely to be less successful.

HEATER-CATHODE SHORT

Another fault which is easily cured is a heater-cathode breakdown. As far as I can make out, these do not occur any more frequently in picture tubes than in conventional valves—they are just more serious when they do occur. In fact, there appear to be several reasons why this insulation should be better in picture tubes than in valves.

Nevertheless, such shorts do occur, and when they do they completely wreck the performance. In most cases the input signal would be short circuited and probably replaced by a 50 cps signal from the filament, while the normal grid bias would be reduced or removed, resulting in excessive screen brightness.

Again the approach is to use a special transformer, this time to isolate the tube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Dealer's Name and Address
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DATE OF SUPPLY TO USER
(to be completed by dealer)
USER'S NAME AND ADDRESS
MR. W. SMITH
42 GULLY RD.
BULLAMAKANKA N.S.W.

FOLD ALONG THIS LINE
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No 24986
Dealer's Name and Address
R.T.H. SERVICEMAN
13 BOOMARANG RD.
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TUBE TYPE MW43-69
SERIAL No. AB15827
DATE OF SUPPLY (to be completed by dealer) 1-1-57
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FOLD ALONG THIS LINE —
DO NOT TEAR
Fold Part B inwards, fold this flap over and tuck tongue into slot.
DO NOT SEAL
Please make sure that your name and address has been completed on the reverse side of Part B which will be returned to you after registration.
TONGUE

TEAR ALONG THIS LINE AND RETAIN PART C
PART C No 24986
WARNING If you do not receive Part B bearing date of registration within seven days of you posting it to Mullard-Australia Pty. Ltd., inform the Technical Service Dept. at the address below immediately
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filament from the filament line and allow it to "go along" with the cathode. Such transformers are simply one-to-one types which will probably become available when the demand is sufficient. In the meantime it would not be hard to wind one on an old core, should an emergency arise.

Other troubles are internal shorts — other than cathode filament shorts — internal open element leads, and external open element leads.

MORE SHORTS

Internal shorts are usually caused by particles of cathode material or flakes of metal between support rods. The technique appears to be to burn these out by applying a high voltage between the affected elements, often making use of the voltage at the plate of the line output valve. This can have a peak value of several thousand and should shift all but the most stubborn shorts.

External open circuits are nothing new. Most of us have encountered dry joints in valve base pins and apparently picture tubes are no exception. The treatment is also the same; a hot iron, plus plenty of flux and solder. It is usual to turn the tube on its face to encourage the flux and solder to run well into the pin.

Internal open circuits are not so easy. In fact, I was rather surprised to learn that one could even consider repairing them. However, it seems that where an expensive picture tube is concerned, anything is worth trying—even in the US. where tubes are more plentiful.

Unfortunately, I have only the barest details at the moment as to how this is done. The data I have secured came from one of those "popular" accounts in an overseas magazine and which are noted for their delightful vagueness.

However, it appears that the device is in the form of an RF induction heater which is used to heat the metal structure within the valve, presumably up to red heat. There also seems to be a high voltage RF generator which, in a manner not fully explained, applies this voltage between the two broken ends of the lead.

"BASH" TECHNIQUE

At the same time the operator is supposed to tap the neck of the tube as vigorously as possible, in the hope that the two ends will be brought together momentarily and be welded permanently.

In some respects it reminds me of the old trick of repairing a light globe by gently tapping the two broken ends together while the voltage was applied. Once they did touch they usually welded themselves together. As often as not, of course, the tapping simply snaps off the loose ends!

Summarising, it would appear that the owner should get more than an even break when it comes to getting value from his picture tube. The position also looks bright for the serviceman, since nothing is likely to please a customer more than having a supposedly defunct picture tube salvaged by a bright serviceman. Be ready to pull one of these tricks out of your bag when the time comes, and your reputation will spread like wildfire.

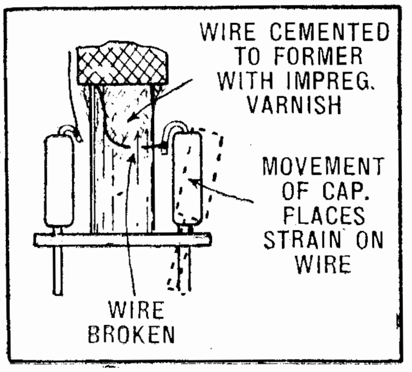
Reverting to more mundane matters, I dropped in on a colleague a few days ago, purely in the way of being sociable, and came away with a little story which I think bears repeating.

After we had exchanged the usual pleasantries, my friend suggested we retire to his workshop. "You're just in time to see me locate a fault," he remarked, adding—"I hope", in a manner which suggested that he may have had some doubts.

He indicated a chassis on the bench. "Set I'm building for a friend up the country," he explained. "He wanted something a bit better than average, so I offered to knock one together. I'm hoping it will be a good job when I clear this bug out of it."

"And what is the 'bug'?" I enquired.

"Something has gone noisy and intermittent," he replied. "I've only had it going about half an hour and I was just about to line it up when it started to play up. I think I've tracked it down, but I'd like you to see what you think. Here"—he handed me a screwdriver—"—give it a bash and see what you find."



Why the IF failed. Insufficient lead to allow for play in the base pin caused the lead to break when pressure was applied. Easily fixed but hard to find.

I took the screwdriver and, using the "blunt" end tapped the chassis moderately hard. The speaker emitted a jangling kind of raspberry and the general noise level rose. I bashed it again—with much the same result, except that the sensitivity seemed to drop again.

Adopting a gentler touch I commenced tapping again. Nothing happened until I approached the general area of the IF channel where things appeared to be particularly touchy, I tapped the IF amplifier, the first IF transformer, and the second IF transformer. There wasn't much to choose between them and I went over them again. This time I felt reasonably sure that the second IF was the most sensitive.

After one more try I offered my opinion: "I'd say the second IF has 'had it'."

AGREEMENT

"That's what I reckoned," said my friend. "Since we both agree, what about pulling it out and finding out why?"

He picked up the iron as he spoke and attacked the chassis. A few minutes later we lifted the can off the transformer and commenced our search.

It didn't take us long. My friend happened to apply pressure to one of the base pins. As he did so we both noticed the same thing; a tiny break in the winding wire a fraction of an inch from where it joined the pin.

But, more interesting, was the reason why it had broken. You have probably seen the type of base pin I am about to describe. It is actually a part of the resonating capacitor, the latter having two lugs for each connection, one protruding from each side.

One lug passes through the coil base, is given a half twist, and becomes the base pin. The opposite lug, being the same connection, serves to terminate the winding wire. Due to the method of securing the assembly, ie, the half twist of the lug, it is inevitable that there will be some play in the base pins.

PRECAUTIONS

This, in itself, is not necessarily bad and is probably justified on the score of simplicity and economy. But if such movement is to be regarded as permissible, then precautions must certainly be taken to see that there is enough free wire to allow for such movement without imposing a strain on the wire.

In this case there wasn't. Certainly the assembly operator had intended that there should be but had made the mistake of allowing the wire to rest against the coil former, at a point quite close to the pin, while the coil was dipped in the impregnating varnish. As a result the wire was securely cemented to the former with only about half an inch between this point and the pin.

Naturally, in the process of soldering external leads to the pin, it had been moved about quite freely, eventually exerting enough strain on the wire to break it However, on returning to a more average position the two ends of the wire made contact again, allowing the winding to function after a fashion but very erratically and very noisily.

Of course, once located, it didn't take us long to fix the trouble, and we were careful to peel the wire free from the former to avoid any chance of a recurrence. But that didn't alter the fact that it had taken valuable time to locate the trouble, dismantle and reassemble the coil, and so on. My friend made some pretty caustic comments about the coil manufacturer and his final inspection system.

I SCORED!

For myself I didn't mind quite so much. I had scored a story out of the incident.

Seriously, though, it is faults of this kind which create a lot of bad will, if only because they should never happen. While most of us will shrug our shoulders philosophically at some fault which was obviously unpredictable, it is quite another thing to be faced with one which is clearly due to someone's carelessness.

When that happens the manufacturer's name is really mud!

UNIQUE POWER PLANT

An emergency power plant which ensures an uninterrupted supply of power has recently been developed in England. Intended for broadcasting stations, hospitals, airports etc. it is intended to eliminate the brief break in supply — about 8-10 seconds — normally required to get the standby diesel up to speed.

Under normal conditions power is supplied through a motor generator set with similar input and output characteristics. On the same shaft is a large flywheel which stores enough kinetic energy, not only to start the standby diesel, but also to carry the load until the latter can take over. A typical system has an output of 55KVA.

Here's your answer, Tom!

In these columns, we often have the opportun ity of answering readers' questions in greater detail than is possible through the query servi ce. If, at times, the questions seem a little naive, it must be remembered that they are posed by readers who are often just breaking into this fascinating but complex hobby.

THE first two questions are from a junior reader who is evidently struggling with the construction of a one-valve regenerative set, and is puzzled as to the meaning of some of the terms used.

* * *

What is a "standard loopstick"?

The term "standard loopstick", Tom, refers to a ferroxcube (or similar) rod aerial. It consists of an iron core about eight inches long and similar in composition to the iron cores used in IF transformers and coils.

Over this core is wound a high "Q" coil, tuned by one section of the gang, which couples the signal collected by the rod, into the first grid circuit. In areas where signals are reasonably strong, it eliminated the need for an aerial coil with separate aerial and earth.

The idea has only become practical in recent years with the development of suitable core materials.

The earliest cores were suitable for use at intermediate frequencies, in IF transformers, but were quite useless at higher frequencies. Nowadays cores have been developed to the point where they may be used effectively at frequencies of 30 to 40 Mc., as in television IF channels.

ESSENTIAL FEATURE

The essential feature of any iron core is its permeability to high frequency magnetic fields. In case this is a new word to you, Tom, permeability may broadly be explained as the magnetic equivalent of conductivity.

The higher permeability of a loopstick distorts the pattern of magnetic lines of force arriving from the transmitting aerial so that many of them pass along the core. In so doing, they pass through the coil wound over it and induce a voltage across the coil which becomes available as a signal to the first grid.

Thus, instead of using a large aerial to intercept lines of force, as in ordinary practice, the lines of force are concentrated toward a small coil.

By reason of this effect the "loopstick", as it is commonly known, is very efficient, more so in fact than all but the largest loop aerials.

* * *

What is a reaction winding?

A reaction winding, Tom, is something one normally encounters in small one or two-valve sets. These sets depend for their gain and selectivity on the use of regeneration or positive feedback, both terms meaning the same thing.

Positive feedback, in this role, involves feeding some of the RF energy from the plate circuit of a detector back into the grid circuit and the feedback winding provides the means by which it is accomplished.

A reaction winding may be part of the grid winding which is tapped at an appropriate point.

In your case, Tom, it is an auxiliary winding located near the grid winding. It is wound on the loopstick around a suitable former, such as a complete turn of paper, so as to enable it to be adjusted along the core in relation to the grid winding.

* * *

What is a cold-cathode valve and how does it function?

A cold-cathode valve, Tom, is one containing a cathode which emits electrons without the initial application of heat, and which consequently does not require a heater supply. A number of rectifiers, voltage regulators and thyratrons use this principle.

The cold-cathode rectifier, for example, contains an inert gas under slight pressure and discharge through the gas from the cathode commences when the anode-cathode potential reaches a certain value. As no primary electrons are available from the cathode, the process of conduction is dependent on the ionisation of the gas.

For special applications, a third electrode may be placed near the cathode and any discharge occurring between these electrodes starts the main discharge between the cathode and anode.

In actual use, the anode-cathode potential is adjusted to a value just below that required for ionisation and a high resistance is connected in series with the grid or starter electrode to keep this electrode current low. The application of a few volts to the starter then triggers the main discharge.

I have frequently seen the terms "conductance", "conduction" and "conductivity" used in radio books. Do they refer to the same thing?

Well, Tom, fundamentally these terms do refer to the same thing, that is, the flow of electric current or electrons. However, there is a distinction in their usage.

Conductance, for example, is the property of any material which allows it to pass an electric current and is the characteristic of materials known as conductors.

Conductivity, on the other hand, is the property of a conductor of being able to conduct an electric current with a particular degree of ease. In other words conductivity is a measure of the conductance of a given metal under given conditions.

Conduction is the term used to describe a process whereby current is led along a definite path other than in a wire circuit, such as in a valve or a liquid.

What do the letter kWh stand for?

The letters kWh, Tom, are an abbreviation for killowatt-hour, which is a unit used to express the rate of power consumption. Both the magnitude of the power-flow and its duration are taken into account. As an example, the use of 5 kW of power (5000 Watts) for five hours would represent a power consumption of 25 kWh.

* * *

Why are pickup arms offset?

When a disc is being cut, Tom, the cutting head travels along a radius, being supported on a lead-screw above the surface of the disc.

An ordinary pickup is merely pivoted

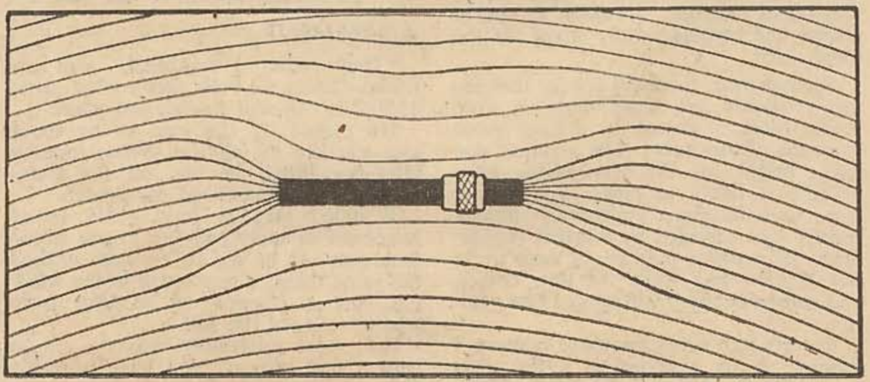


Diagram illustrating the action of a loopstick aerial.

at its base so that the head describes an arc across the record. At all but a couple of points in its travel, the head is not exactly in line with the groove being played. More precisely, the head does not make a tangent with the groove at the point where the stylus rests.

By offsetting the head, or bending the arm to accomplish the same result, the degree of "tracking error" can be reduced substantially.

★ ★ ★

Why does the screen voltage of valves vary when a station is tuned in?

The reason for this variation, Tom, is simply a matter of current drain. The dropping and shunt resistors in the screen circuit are calculated to give the correct screen voltage at minimum bias in the absence of a signal.

When a signal is tuned in an AVC voltage is developed and the plate and screen circuits of the valves under control are reduced. This produces less voltage drop across the dropping resistor and consequently increases the screen voltage.

If the screen supply has a single series-dropping resistor this effect is more marked. However, this variation should not upset the performance nor endanger the valve, if the design is correct.

Decreasing or shorting out the bias would cause the exact opposite to happen. The screen current would increase and the voltage would drop.

★ ★ ★

How does a vibrator work?

Firstly, Tom, we will commence with an explanation of why a vibrator is necessary.

Let us assume that you wish to operate a receiver or amplifier which requires some 200 or 300 volts for the HT supply and the usual six volts for the valve heaters.

The usual method of obtaining these voltages is from a power transformer whose primary is connected to the AC mains and whose secondary supplies the required voltages.

Now suppose that an AC mains supply is either not available or inaccessible and all that you have as a source of voltage is an accumulator.

VARYING FIELD

You may already know that it is not possible to feed DC into a transformer primary and expect anything but a volume of smoke from it. If you do not, Tom, we hasten to assure you that that is exactly what will happen.

When AC is applied to a transformer primary winding the magnetic field around it continually builds up and collapses. Because of the inductance of the winding a counter EMF is generated which opposes the original voltage and ensures that excessive current does not flow in the primary circuit.

At the same time, the varying magnetic field induces voltage and current in the secondary windings, proportional to the number of turns.

But with DC applied the magnetic field would build up and remain stationary. Excessive current would flow through the winding, since there would not be an opposing current, and after a short while the transformer would begin to smoke and ooze impregnating wax.

This state of affairs could be avoided by rapidly reversing the battery leads across the primary. The field would build and collapse in the same manner as with AC applied.

However, you will agree with us that one would get very sick of doing that for any length of time and cast about for some automatic means of overcoming this problem.

This is where the vibrator comes in. Fundamentally it operates in the same manner as an electric bell, in that a metal reed vibrates back and forth, generally at a rate of 100 times a second.

The provision of contacts on either side of the reed and on the reed itself enable the unit to make-and-break the flow of DC to the primary of a transformer.

The primary is usually centre-tapped and the contacts are so arranged that the vibrator sends an impulse first in one direction and then in the other. This results in a behavior identical to that when AC is applied.

HIGH STEP-UP

The transformer is wound with a very high step-up ratio, so that the six volts applied to the primary are converted to the HT voltage required. The voltage available at the secondary is, of course, AC, and in order to allow it to be fed to the HT circuits of a receiver has to be rectified in the usual manner.

To save weight and space in small receiver units, vibrator cartridges that will also rectify are available.

This action of rectification is accomplished in the following manner. Two extra sets of contacts are provided on the vibrating reed and a centre-tapped secondary is used.

By suitably connecting these contacts it is possible to pick off the voltages from the respective halves of the secondary during that part of the cycle when they are positive.

This type of vibrator is called a "synchronous" type, while the former is called a "non-synchronous" type.

★ ★ ★

What is a reflex circuit?

A reflex circuit, Tom, is an arrangement in which one valve performs the function of two, by being an RF and AF amplifier. This is accomplished by reflecting RF signals that have been amplified and rectified, back into the grid circuit of the combined-duty valve for amplification at audio frequencies.

These circuits were very popular once, when valves were expensive and consumed large filament currents, and much ingenuity was devoted to their development.

The overall amount of gain was generally limited by stability problems, but some success was obtained with the simpler circuits.

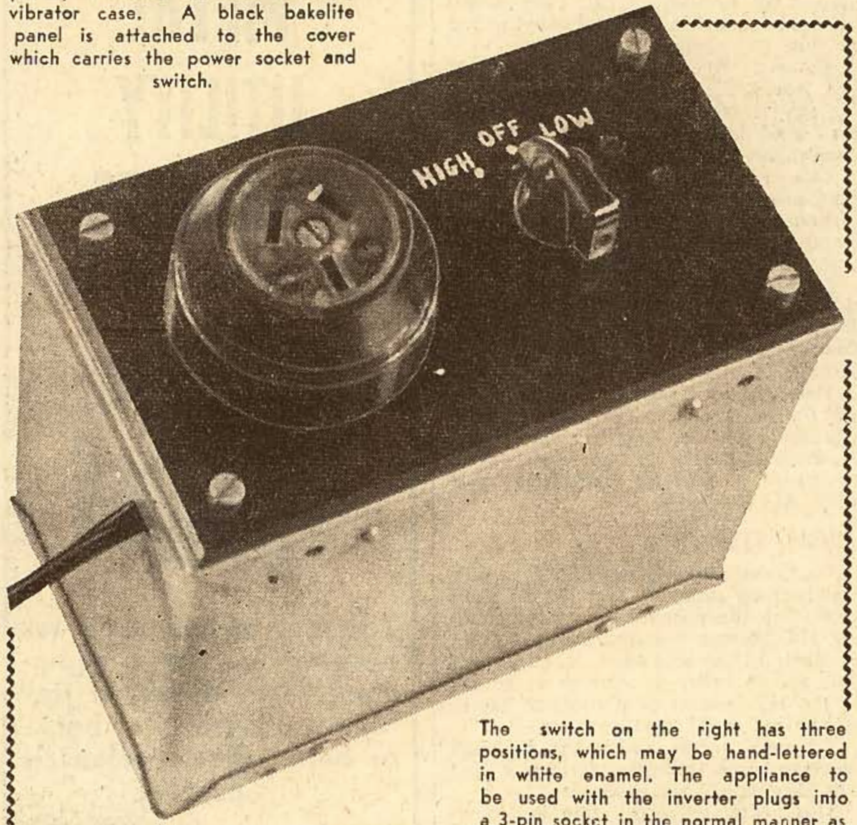
★ ★ ★

What is a stroboscope?

A stroboscope, Tom, is a speed-checking device used on gramophone turntables. It may consist of a series of black and white markings on the periphery of a rotating member, or a small disc having black and white radial divisions, or a series of holes in the periphery of a moving part, and illuminated by an AC source.

In each case, when the black and white markings appear stationary, correct speed setting is indicated.

A view of the inverter unit completely enclosed in our standard vibrator case. A black bakelite panel is attached to the cover which carries the power socket and switch.



The switch on the right has three positions, which may be hand-lettered in white enamel. The appliance to be used with the inverter plugs into a 3-pin socket in the normal manner as with an AC power point.

been exhausted, we decided to feature an up-to-date version of the old inverter unit.

The specifications for the new unit remain essentially the same as the original. It consists of a dual-interrupter vibrator, operating with a vibrator transformer and providing 240 AC at 100 c/s to an outlet point.

The type of vibrator used will depend on the voltage of the accumulator. The transformer is suitable for use with either voltage, the only alteration being to the method of connecting the primary windings.

TOTAL LOADING

In a unit such as this, most o. the design work centres around wattage rating. Since the power transformer has quite a reserve of wattage rating, the vibrator unit is the limiting factor. The main limitation is the current carrying capacity of the interrupter contacts.

A maximum load of about 40 watts for the inverter unit would be in keeping with the capabilities of the 6-volt vibrator. The 12-volt vibrator has greater leeway because of the reduced contact current for the same wattage load, and the total loading may be increased to 60 watts.

The operation of other AC equipment with wattage ratings within the limits stated, will depend on their behavior with a 100-cycle near-square wave excitation.

Shavers and such like appliances will operate from this inverter unit only if they are motor driven. Vibrat-

240 AC SUPPLY FROM A BATTERY

Doubtless, numerous readers have on occasio ns wished to operate a conventional mantel radio, shaver or similar appliance, from the car battery. Well, here is a simple, easy to build unit, which makes this possible. The current drain is fairly heavy—about 7 or 8 amps on full load—but that should not be too hard on the battery if the unit is used discreetly.

THE problem of current drain is applicable to all battery operated equipment whether it is a portable or a car radio, and the heavier the drain, the more restricted must be the periods of operation. Since this unit is intended as a standby in emergencies, or for occasional short periods of use, heavy current drain should not be any bother.

USEFUL APPLICATIONS

The useful applications of this unit are numerous. Hundreds of motorists, who do not possess a portable or a car radio, may have been forced to miss a favorite program or race broadcast, while on the beach or out in the never-never. To make matters worse there was a perfectly good mantel set sitting idly at home.

Then perhaps there are servicemen readers who have been forced to twiddle their thumbs, while their suburb was undergoing a power "blackout".

These and other cases create a demand for a cheap alternative source of power. The inverter unit offers an answer to these problems, for it is a portable AC outlet point, independent of the mains and requiring a 6 or 12 volt accumulator for its operation.

Such a unit was described some years ago, and there has been a steady demand since for circuit reprints. As back copies of this issue have long

by Wes Yashin

ing reed types designed for 50-cycle operation may not work with a 100-cycle source.

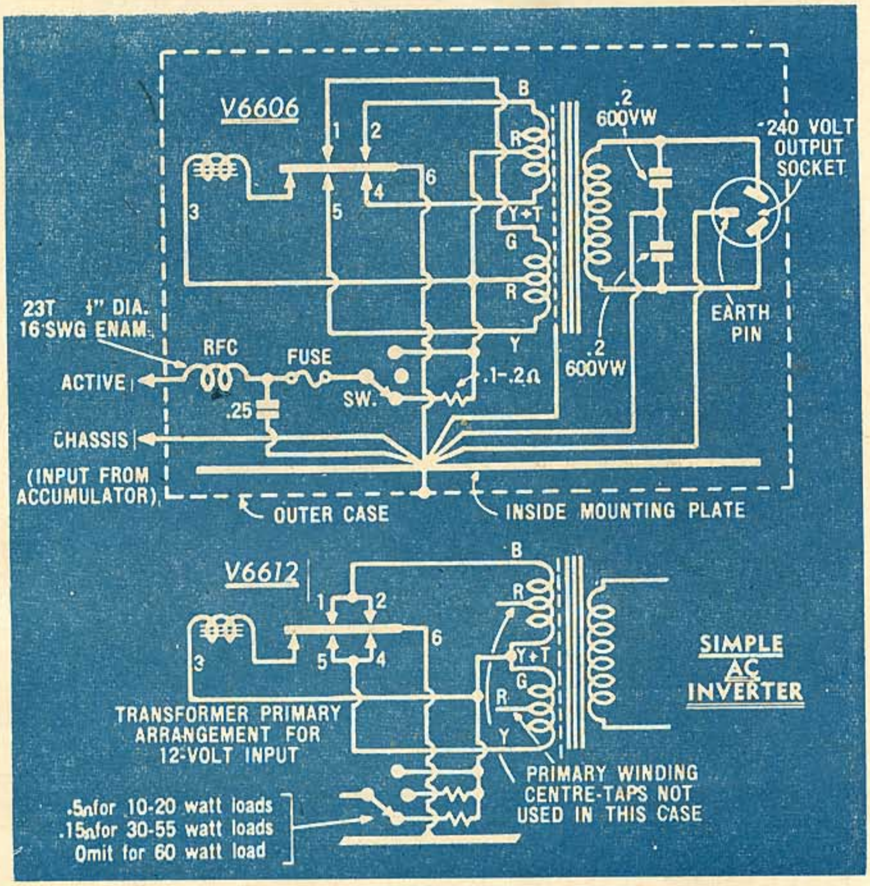
A word of warning at this stage will not be out of place. This unit is not suitable for operating such high consumption devices as toasters, irons or radiators. The 6-volt unit will cope with a standard 40-watt soldering iron, while a 60-watt iron may be used with the 12-volt version.

Glancing at the circuit you will notice that it is the essence of simplicity. The transformer has two primaries which are connected in parallel for 6-volt operation and in series for 12-volt operation.

ADVANTAGE OF SEPARATE WINDINGS

Using two separate primary windings for the 6-volt connection, has the advantage of better load distribution on the interrupter contacts, than if

CIRCUIT OF AC INVERTER UNIT



The circuit is quite simple and very few components are required. The odd values of resistance shown are discussed in the text. Color coding is for a Ferguson transformer, which should be available on order through radio trade houses.

the contacts were paralleled and a single winding used. This is not quite as important for the 12-volt connection, because of the lower current flow for the same wattage.

The secondary winding of the transformer is designed to provide 240 volts under maximum load conditions. The output voltage could rise to about 300 volts under "no load" conditions, but this is provided for in the design.

An important point is the selection of the optimum value of buffer capacitor. A poor selection will upset the regulation and prejudice the life of the vibrator contacts.

For low input voltages and medium power operation it is possible to economise in the size and cost of the capacitor, by placing it across the secondary and relying on the reflected capacitance on the primary winding.

The optimum value of buffer capacitor is selected experimentally by adjustment for minimum no-load primary current. With the particular type of transformer used, the value required was .05 mfd.

WEAR OF CONTACTS

However, this value does not take into consideration the wear and erosion of the contacts during their operating life, the consequent increase in spacing between them, and the resultant increase in the "off" contact time intervals.

To allow for these effects a somewhat larger value of buffer capacitor is required for an old vibrator than for a new one. It is, therefore, wise to select an initial capacity above the optimum value.

The final value selected for the particular combination used was .1 mfd., and consisted of two .2 mfd. 600-volt capacitors connected in series. This series connection gave an effective working voltage of 1200 volts, to remove any possibility of breakdown. Moreover, earthing the junction of the two capacitors provided RF bypassing on the outgoing leads.

The same value of buffer capacitors was retained for the 12-volt version, since it proved equally effective.

The regulation of the unit is fairly good, considering the DC resistance of the primary circuit from the battery leads to the interrupter contacts. Then there is the DC resistance of the transformer windings and the leakage reactance between them.

SERIES RESISTANCE

If the load on the unit is a little on the light side it is necessary to introduce a resistance so that the output voltage will remain at about 240 volts.

In the 6-volt unit, a three-position switch allows a resistance to be introduced in series with the active lead from the battery for "light" load, the remaining two positions being "off" and "heavy" load.

The 12-volt version will require a four-position switch to allow for a wider range of loading. Three positions will be required for light, medium and heavy loads, the remaining one being an off position. Alternatively, the three-position switch may be retained by using the off position as one of the load positions, and relying on the battery clips or terminals to make and break the circuit.

When taking readings of the output voltage it must be remembered that the standard multimeter will give erroneous readings. Meter deflection varies with the waveshape, which in this case is near-square.

Where the input voltage is critical, as in some piece of test equipment, it would be advisable to measure the rectified DC, and adjust the input voltage to the inverter accordingly.

In the case of a mantel radio a good deal of leeway is permissible and the readings taken with a multimeter may be considered near enough.

Glancing at the circuit again, it will be seen that the incoming leads are not marked with respect to polarity. These are identified as active and chassis, to conform with the arrangement of car batteries.

CIRCUIT DETAILS

The chassis lead is connected to the common earth point on the supply subchassis. The active lead is taken through an RF choke with its associate bypass to a fuse which is a piece of 26 swg wire soldered between two lugs on the main mounting strip, and thence to the moving arm of the switch.

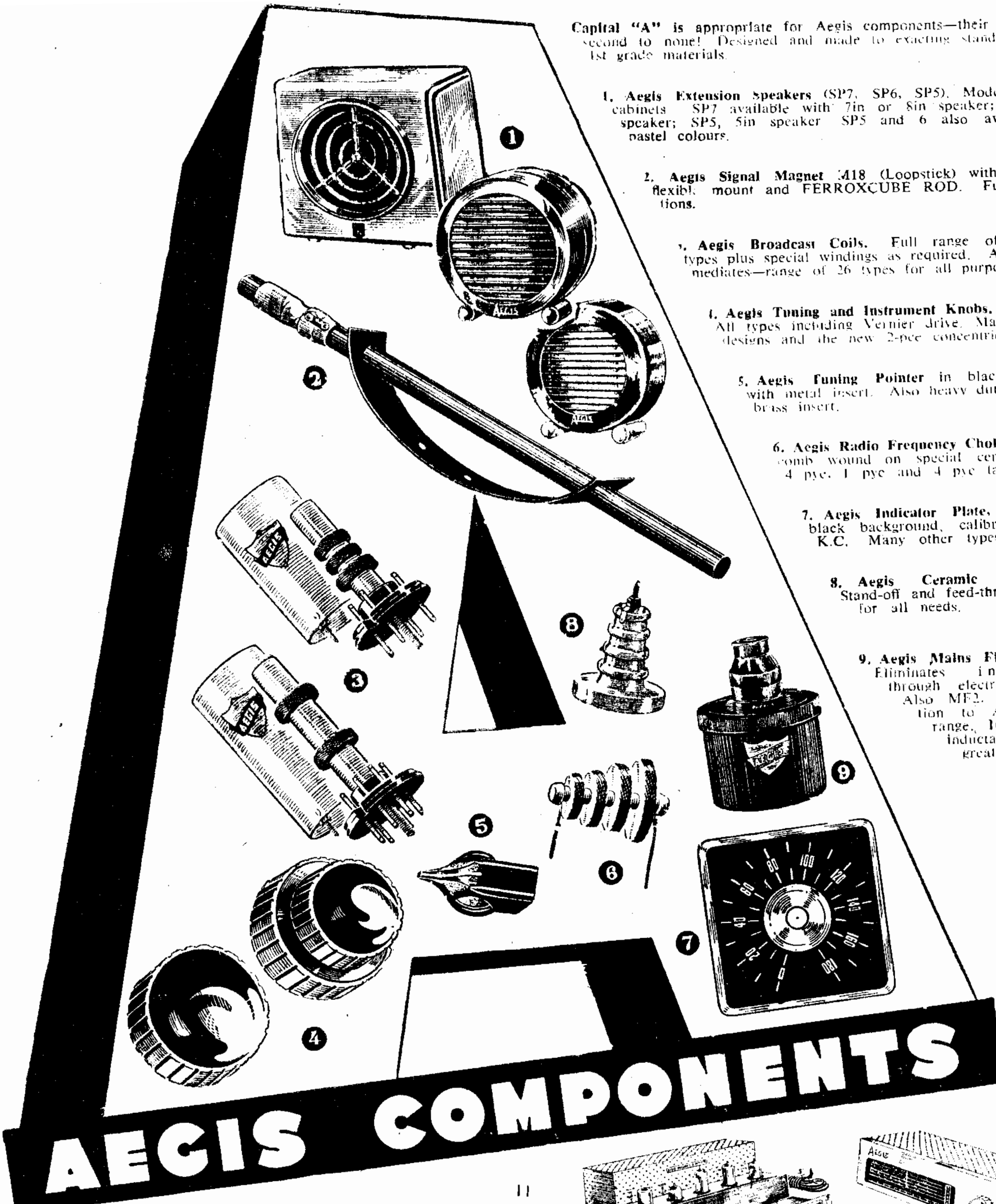
The switch is a 10-amp rotary type, similar to that used in our Battery Charger. The centre position may most

PARTS LIST

1 Standard vibrator case, with top and bottom lids and internal mounting plate.
1 Piece of ⅜in bakelite to fit top cover.
1 Vibrator transformer (VT 146 or similar)
1 Dual-interrupter vibrator unit (V6606 for 6 volts, V6612 for 12 volts).
1 3-pin power socket.
1 1x3 10-amp rotary switch.
1 .25 mfd 200 volt capacitor.
2 .2 mfd 600 volt capacitors.
1 6-pin socket.

SUNDRIES

4 1½x3-16 brass bolts, ⅜x⅜ nuts and bolts, washers, solder lugs, rubber grommets, hookup wire, TC wire, winding wire for resistances (see text), length of 5 mil automotive wiring cable, 1 threaded mounting pillar, 2 25 amp battery clips, 3½ft 16 swg enamelled wire for RF choke, 1 3-lug mounting strip, 1 7-lug mounting strip, 1 pointer knob.



Capital "A" is appropriate for Aegis components—their quality is second to none! Designed and made to exacting standards from 1st grade materials.

1. **Aegis Extension Speakers** (SP7, SP6, SP5). Modern plastic cabinets SP7 available with 7in or 8in speaker; SP6, 6in speaker; SP5, 5in speaker SP5 and 6 also available in pastel colours.

2. **Aegis Signal Magnet** 418 (Loopstick) with insulated flexible mount and FERROXCUBE ROD. Full instructions.

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4. **Aegis Tuning and Instrument Knobs.** All sizes. All types including Vernier drive. Many modern designs and the new 2-pce concentric.

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6. **Aegis Radio Frequency Chokes.** Honeycomb wound on special ceramic rods. 4 pye, 1 pye and 4 pye tapered.

7. **Aegis Indicator Plate,** bright or black background, calibrated 0-180 K.C. Many other types available.

8. **Aegis Ceramic Insulators.** Stand-off and feed-through types for all needs.

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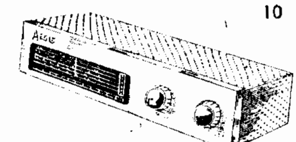

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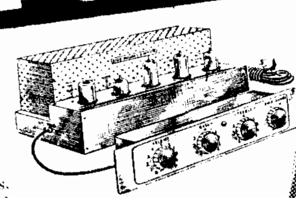

ALSO PACKAGED HARDWARE containing asstd. nuts, bolts, cored solder, etc

10. Aegis Hi-Fi Tuner. Features newest circuit techniques and miniaturisation of components. I.F. Stage has band width nearly double that of ordinary receivers. Combined with any good treble boost circuit of an amplifier (preferably AEGIS Mullard 5-10) will give the desired response from broadcasting stations.

11. AEGIS Mullard 5-10 Hi-Fi Amplifier. Rated power output 10 W. Max. 12-13 W. Frequency response + or − 0.5 db, 10 c/s to 20,000 c/s. Alt. impedances avail. Amp.: 11¾in x 6½in x 6in. Control panel: 12in x 3in x 1¾ in.

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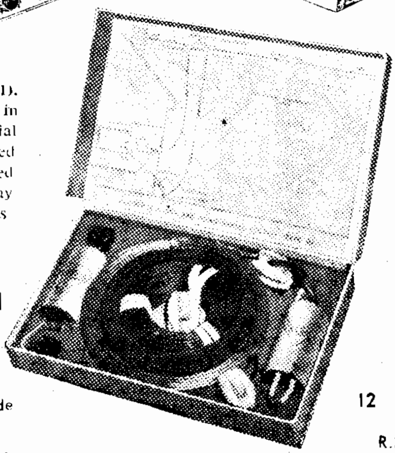

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Manufactured in Australia by:—

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If you experience difficulty in obtaining supplies of these Aegis BRAND LINES, contact us or the principal Aegis Agent in your State.

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R.H.

conveniently be the "off" position. One of the remaining two connects directly to the centre tap of the transformer, and the other through a series dropping resistor.

There should not be any evidence of hash interference, as the RF choke and its bypass capacitor form a RF decoupling network to prevent hash currents developed within the unit from appearing across the battery leads. Further hash filtering is provided by returning the junction of the buffers to earth.

Due to the single point wiring arrangement, and connection of the case to this point, the case is quite cold to RF. When operating a mantel receiver from the inverter unit, it may be desirable, in the interests of hash elimination, to connect the chassis to the common earth point of the inverter. For this reason the earth pin of the output socket must be connected to the common earthing point.

CONSTRUCTIONAL DETAILS

Now for some constructional details. The method of construction adopted is that used for all our vibrator supplies. The major components are mounted on a metal plate, which is insulated from the case and bonded to it by a single connection.

The case and internal plate as specified for the "Kar-set" supply may be used. Some modification to the plate may be necessary to accommodate the various components. Modifications will consist mainly of drilling a new set of mounting holes.

Two holes will also have to be provided on the mounting plate to take the wafer retaining bolts on the switch. The switch is mounted on the top cover of the case alongside a flat 3-pin power socket.

The top cover of the "Kar-set" power supply case has a number of holes which would mar the appearance of the finished unit. To mask these holes we used a piece of three-sixteenth bakelite, cut to fit the top cover and bevelled on the edges.

Drill four holes, one in each corner, to take three-sixteenth by one and a half inch mounting bolts. These will serve to hold the bakelite in place while acting as mounting bolts for the internal chassis. Use lock washers under the nuts that hold the top cover to the bakelite, to obviate any possibility of the assembly becoming loose through vibration.

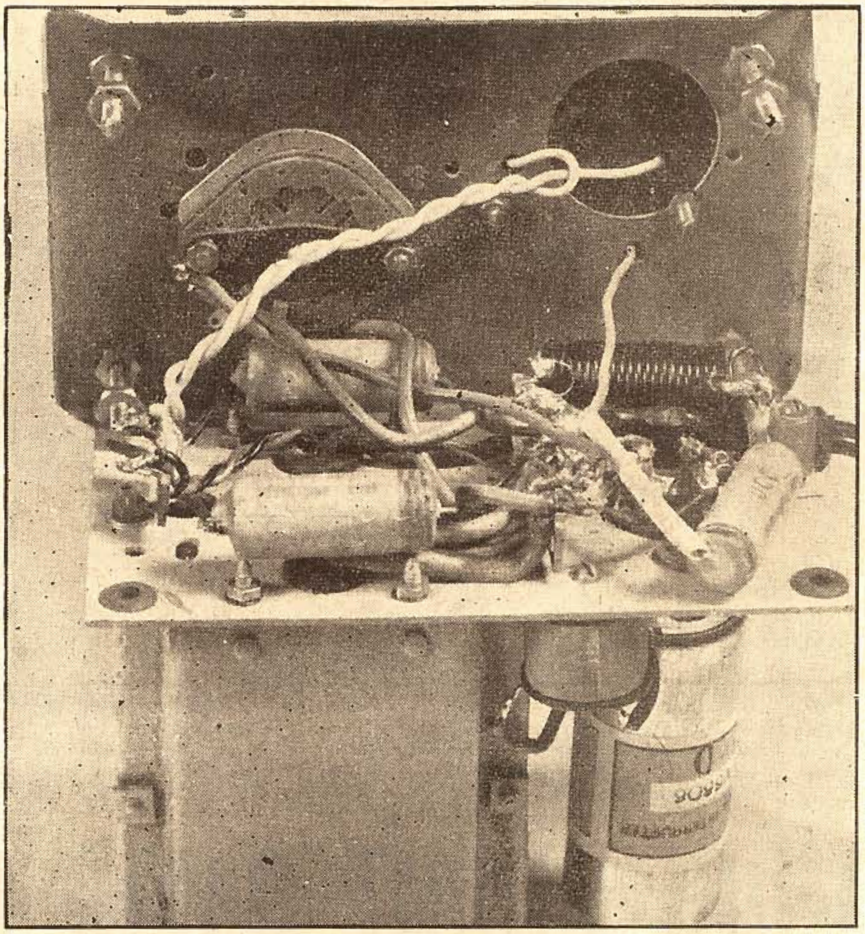
MOUNTING THE SOCKET

The mounting bolts eventually pass through corresponding holes in the internal chassis, and are insulated from it by means of ¼in grommets. A nut on either side of the grommet will give the required height between the chassis and top cover.

The vibrator socket is likewise mounted with the aid of grommets to isolate vibrations generated by the vibrator from being transmitted to the rest of the assembly.

The method of mounting the socket is as follows: Pass 1-8in bolts through the grommets set into the chassis on either side of the socket hole. Use four metal washers with each bolt, one on each side of the grommet and one on each face of the socket plate.

WIRING AND FILTER COMPONENTS



An inside view of the unit showing the placement of components. Adherence to our layout is not essential to the performance of the unit but it is advisable, since the space available for the components is limited.

The socket should be raised some 3-8in so that the socket pins protrude through the socket hole in the chassis.

The power socket is mounted by means of 1-8in bolts. Place a solder lug under one of the bolts and bond the case to the common earth point on the internal chassis. The power lead from the transformer secondary and the earth lead to the socket may be run with ordinary hookup wire.

The switch is mounted approximately 1¼in from the power socket and in direct line with it. Drill a 3-8in hole through the bakelite and top cover, then countersink it from the inside for about one-sixteenth of an inch, to take the wide section of the threaded bush, nearest the clicker plate.

This procedure is necessary to give sufficient clearance between the switch and the internal mounting plate. Wiring runs to the switch should be made with a heavy lead, the cores out of a 40/36 three-core cable being ideal.

The value of dropping resistance for light loads may vary with individual units. In our case, with a resistive load representing 15 watts, a value of .1 ohm proved adequate, the output voltage being a little over 240 volts. In general, values may range from .1 to .2, depending on the total lead resistance and the load.

Those readers who wish to wind their own dropping resistor, should use nothing less than 20 swg wire, 18 swg being the ideal. A value intermediate between .1 and .2 ohm may be obtained by winding 34 feet of 18 swg or 20 feet of 20 swg on a suitable bobbin.

We found that the simplest way was to use an RCS RF filament choke, which has a resistance of .1 ohm, and is capable of handling 3 amps. Whether you use a filament choke or a hand-wound unit, these will have to be mounted above the chassis. Adequate room is available a little forward from the vibrator and next to the transformer.

RESISTANCE DETAILS

For the 12-volt version two resistances will be required, one for 10 to 20 watt loads and the other for 30 to 50 watt loads. The resistor previously described should be suitable for the medium loads, but, for the light loading, a value of .5 ohm is necessary.

A suitable resistor may be made up of 113 feet of 18 swg or 63 feet of 20 swg, wound on a bobbin. Both resistors may be mounted above the chassis, one on top of the other and anchored to the chassis by a common bolt.

The battery leads to the unit should be as heavy as possible, so as not to

(Continued on Page 109)

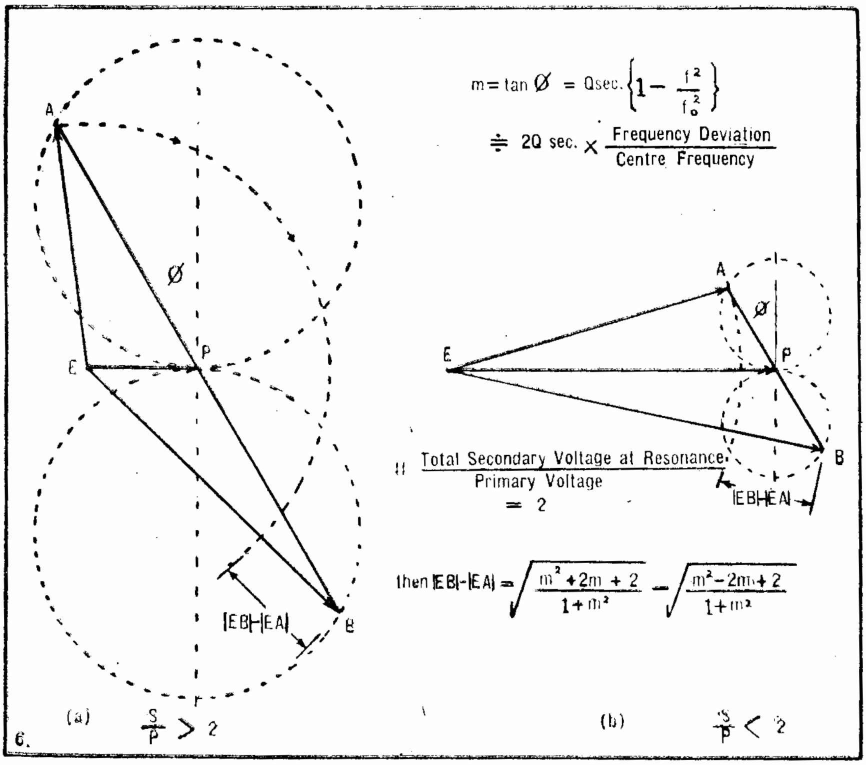


Figure 6. The basic vector diagram which is necessary for an understanding of the ratio detector is shown at (a) where the secondary voltage is high compared with the primary voltage and (b) where the secondary voltage is low compared with the primary voltage. The relation between the magnitude of these two voltages is an important factor in determining the maximum deviation which the detector can handle without distortion.

MORE ABOUT RATIO DETECTORS

An essential part of modern television receivers not generally well understood is the FM detector. This article reviews briefly the methods of FM detection, discusses the phase discriminator, its application in the ratio detector connection and finally deals with the important considerations involved in the practical design of a ratio detector.

by Maurice Findlay

IN the case of a frequency modulated carrier the frequency deviates from the nominal frequency by an amount proportional to the amplitude of the modulating signal, the amplitude remaining constant. This contrasts with the AM signal where the carrier frequency is fixed and the amplitude varied.

The practical advantage of the frequency modulation method is that it allows a detector to be designed which is insensitive to amplitude variations. Since ignition pulses and other interference signals result mainly in amplitude variations FM results in an improvement in signal-to-noise ratio.

FM TO AM CONVERSION

The problem we are to discuss here is the design of a detector which will convert a frequency-modulated carrier into audio amplitude variations but not respond to amplitude variations of the carrier. However, we will consider first the problem of recovering the modulation from an FM carrier, leaving the amplitude rejection until the subject has been further developed.

Consider the curve of Figure 1 which may represent the amplitude/frequency characteristic of an ordinary amplitude modulation receiver. It can be seen that if a carrier is applied at frequency A the amplitude of the output from the detector will be A[1]. An increase in frequency (in this case) will cause the amplitude of the output to decrease while a decrease in frequency will cause the output to increase.

In other words the desired conversion from frequency modulation to amplitude modulation has been achieved and the signal can be applied to a diode detector in the ordinary way.

In fact you can apply an FM signal to an ordinary AM receiver. By slightly detuning the receiver the output will be detected as just described. The practical objection to the slope detector is that it is difficult to design a circuit with linear output over a sufficiently wide range.

This objection can be overcome by employing a double tuned discriminator in which the outputs of two slope detectors, tuned to different frequencies, are combined in opposition to each other. By carefully tuning the two circuits excellent linearity can be obtained.

The objection in practice is that very careful tuning is necessary and it is difficult to design circuits which maintain their tuning over a long period of time. Other designs are able to do as good or a better job without the practical difficulties of the double tuned discriminator and therefore it has little practical application in FM receivers.

GATED BEAM TUBE

Yet another type of FM detector involves the use of a gated beam tube. This method is not widely used at present and since it does not lead naturally toward the discussion of the ratio detector we will not go into further details. The subject was discussed in Part 16 of "A Course in Television" which appeared in the December issue.

The circuit which produces amplitude variations from frequency variations and which is the basis of popular FM detectors is known as the phase discriminator. In order to understand its behavior it is desirable to consider first the properties of a simple radio frequency transformer where the windings are loosely coupled and the secondary tuned to resonance.

The particular factor that most interests us in connection with FM detectors is phase and in fact it is not possible to understand how these detectors work without grasping some of the significance of phase.

Both phase and magnitude can be represented on paper by means of lines, the length of the line representing the magnitude of the AC voltage and the direction of the line its phase. The resulting diagram is imagined to be rotating, each rotation representing the time of one cycle so that the diagram we draw represents the situation at one particular instant.

We can do no more than remind you of the idea of vectors here. If the subject is new to you it would be a good idea to look at the chapters on AC theory which appear in one of the standard electrical textbooks.

The situation, in terms of a vector diagram, when a resonant secondary coil is coupled to a primary winding is shown in Figure 3. Due to the magnetic coupling between the two coils a voltage appears across the secondary which is 90 degrees out of phase with the primary. The situation can also be represented symbolically as shown by the figure where e1 and e2 are the primary and secondary voltages respectively, L1 the inductance of the primary, Q2 the Q of the secondary and M the mutual inductance between the windings. The symbol j is included to represent the 90 degrees phase change between the two voltages.

Figure 3 shows the situation at resonance. However at frequencies higher or lower than resonance both the magnitude and phase of the secondary voltage will change. Two examples of the change in phase and magnitude resulting from detuning are shown by e' and e" and it can be proved that the ends of the vectors resulting from various amounts of detuning in either direction lie on a circle which has the vector for e2 at resonance as its diameter.

In the phase discriminator the secondary winding is mutually coupled with the primary as before, but a centre tap is included. The active side of the primary is connected to the centre tap so that the entire secondary winding has the voltage of the primary superimposed on it. The circuit is shown at Figure 4.

VECTOR RELATIONSHIPS

At resonance the voltage between point A and ground is equal to the primary voltage plus half the secondary voltage while the voltage between point B and ground is equal to the primary voltage minus half the secondary voltage. The situation can be represented vectorially where EP represents the primary voltage, PA the upper half secondary voltage and PB the lower half secondary voltage. If EP and PA are added vectorially the resultant is EA, which has amplitude greater than EP or PA and phase intermediate between the two. The vector EA therefore represents the voltage between point A and ground while EB represents the voltage between point B and ground.

At resonance the vector AB is at right angles to EP and PA is equal to PB so that by simple geometry the lengths of EA and EB are equal.

When the frequency of the equivalent generator is different from the natural resonant frequency of the secondary (as happens during frequency modulation), the vector AB is changed in amplitude and its phase with respect to the primary also changes. The resultant vectors EA' and EB' are now no longer equal in length.

Therefore the arrangement of Figure 4 produces two radio frequency voltages whose amplitudes are dependent on the frequency of the incoming signal. In other words, we have an arrangement which turns a variation in frequency into a variation in amplitude.

Note that with the phase discriminator there need only be one critical tuning adjustment and the problem of maintaining two circuits in relative tuning with high precision does not arise.

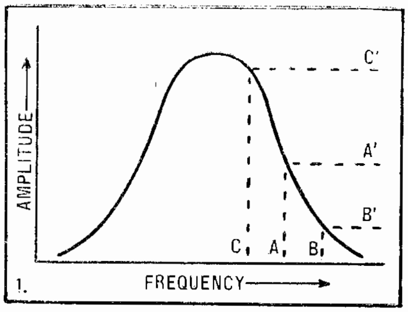


Figure 1. The gain frequency charateristic curve of most receivers intended for amplitude modulation reeption has this general shape. It is often possible to receive FM signals on an AM receiver but the distortion is high if the deviation is appreciable.

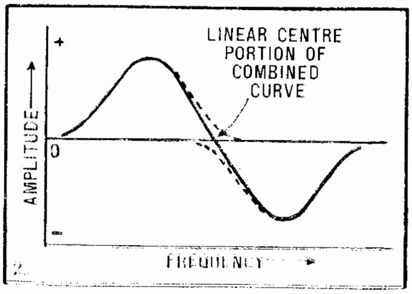


Figure 2. A linear FM detector can be made by combining the outputs of two AM detectors tuned to different frequencies in opposition. The circuit has serious practical disadvantages.

Bear in mind too that the vectors EA and EB are still sensitive to variations in the source voltage. A variation in the generator voltage (EP) will cause the size of the whole diagram to change by the same amount. Therefore if the output of the discriminator is detected, amplitude variations along with frequency variations will appear in the output and the use of this circuit alone does not reduce the noise of the system.

EA and EB are still radio frequency voltages and have to be rectified and filtered in a manner similar to that of an ordinary amplitude modulation detector before the signal can be applied to an audio amplifier.

Both the balanced discriminator and the ratio detector circuits involve two separate diode rectifier valves and filter circuits. After rectification and filtering, the resultant audio signals are combined and it is the method of combining the two signals to produce the audio signal which constitutes the basic difference between the two.

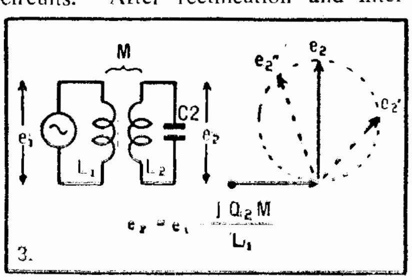


Figure 3. The phase relationship in a loosely coupled transformer with a tuned secondary. When the frequency of the voltage generator varies, the phase angle between the two voltages becomes either greater or less than 90 degrees.

In the ordinary discriminator, outputs of the two detectors are connected in series but with the polarities of the diodes in opposition. Therefore, the audio output from the detector is proportional to the difference between the length of the vectors EA and EB. This is zero at the centre frequency.

Much of the confusion in the understanding of the operation of FM discriminators arises at this point. It is important to realise that the audio ouput is not proportional to the vector difference between EA and EB which has a large value at the centre frequency. The reason for this is that the differences in phase over the RF cycle cease to be significant due to the RF filter which forms part of the detector circuit.

This FM detector circuit is responsive to variations in amplitude as well as frequency and in order to realise the noise reducing properties that a frequency modulation system is capable of providing, some means must be included to make the amplitude of the incoming signal constant.

LIMITER STAGE

A valve operated with a low plate and screen voltage will behave as an amplitude limiter provided it is driven sufficiently hard. One and often two limiter stages plus a high gain amplifier usually precede the discriminator in order to make sure that there is no amplitude modulation present, i.e., that the limiters are saturated when the input signal is weak.

The Foster-Seeley discriminator is of this type and since the circuit and a description have appeared in the recent Television course we will not cover the same ground again here.

The ratio detector uses the same discriminator as the Foster-Seeley but the diode detector, filter and audio circuits are arranged so that the detector is inherently insensitive to amplitude modulation.

In fact, most of the design which goes into a practical ratio detector is directed toward providing optimum AM rejection. Such factors as the coupling between the coils, the Q's of the circuits and the values of the diode load resistors all affect the final result and are interconnected in a complex way.

So complex are the relations between the various factors that it is doubtful if a complete theoretical analysis of the operation of the ratio detector has ever been made. Several lengthy engineering papers have been published which combine the results of theoretical analysis with direct measurement and many significant factors are well known. It is largely from these papers that the information which follows is drawn.

ADVANTAGES

The reason for the interest in the ratio detector is that its properties allow worthwhile economies in FM receiver design without prejudicing the performance.

With a well-designed ratio detector it is often possible to omit the limiter stage or in cases where two limiter

stages would normally be required, use only one limiter. The design can be such that the amplitude modulation rejection properties are maintained down to very low signal levels so that it is not necessary to have enough gain to saturate a limiter stage in all circumstances.

The circuit of Figure 5 shows the basic ratio detector connection. The left-hand side of the circuit is the discriminator transformer we have already described. Two diodes connected so as to conduct in the same direction around the circuit are placed in series with load resistance, the load resistance having a centre tap.

RATIO DETECTOR EXPLAINED

The filter capacitors C1 and C2 are connected from the diodes, in each case, to ground. Therefore the voltage across C1 (A rectified and filtered component which contains little RF) is a function of the length of the vector EA (phase is not significant) and the charge built up across C2 is a function of the vector EB.

The total voltage appearing across the load resistor XY is equal to the sum of these two.

If Z is at the exact centre point of the load resistor XY and the voltages across C1 and C2 are equal then obviously Z will be at earth potential.

When, however, the input signal varies from the centre frequency of the discriminator transformer tuned secondary the lengths of the vectors EA and EB will be different and hence the voltages across C1 and C2 will be different and Z will be no longer at ground potential. It can vary either above or below earth according as the frequency deviation of the generator.

In mathematical terms:

$$\text{OUTPUT VOLTAGE} = \frac{E_1 - E_2}{2}$$

where: E_1 = voltage across C1
E_2 = voltage across C2

This is half the output voltage from the Foster-Seeley arrangement provided all other things are equal.

Nothing has been said so far about the change in output with change in the generator voltage e and in fact the output voltage will vary in direct proportion to e. The circuit is still sensitive to amplitude variations which may be due to ignition interference, etc.

Let us assume now that by some means we now maintain the total voltage across the load resistor XY constant. (A battery with low internal resistance would do this. Alternatively a large value capacitor would keep the constant for short periods of time.)

All that can vary then is the ratio of the voltages across C1 and C2. This is determined by the ratio of the magnitudes of the vectors EA and EB which, in turn, is determined by the amount which the frequency of the generator e varies from its nominal centre frequency.

Looking at the circuit and noting the expression for the output voltage it is obvious that provided the voltage across XY is constant the output is dependent only on the ratio of E1 to E2. In other words the output voltage is independent of the generator voltage.

A battery could be connected across XY to make sure that the voltage is

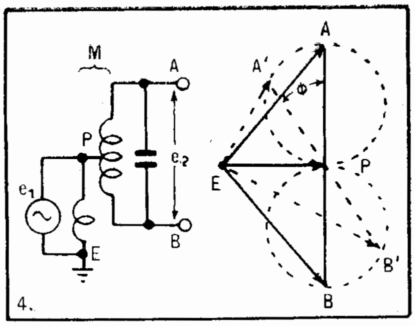


Figure 4. The discriminator transformer and diagram showing the magnitudes and phases of the RF voltages. The diagram is for a typical case where the total secondary voltage at resonance is about twice the primary voltage.

maintained constant. The objection is that the diodes will not start to conduct until the battery voltage is exceeded.

We only require to keep the voltage across XY constant for a time which is long compared with the longest burst of interference which is likely to occur. Therefore, if a large capacitor (C3 of Figure 5) is connected across the load the desired result will be achieved. Long term variations such as fading will cause a change in the average signal strength but short term amplitude changes in the incoming signal will have no effect. Long term signal strength variations can be countered by AVC, the control voltage for which can come from the ratio detector itself.

The effect of the stabilising capacitor can be considered from another point of view.

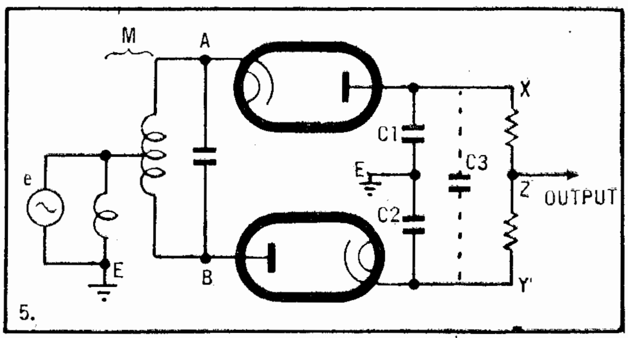


Figure 5. The basic ratio detector circuit. The action of C3 in maintaining the output constant for short term amplitude variations is explained in the article.

When the amplitude of the incoming signal increases momentarily due to a noise pulse a large current flows into the capacitor which tries to keep the total voltage constant. This can be considered as equivalent to decreasing the diode load resistance and thus decreasing the efficiency of the detector.

A reduction in the amplitude of the incoming signal has the effect of increasing the effective diode load resistance, improving the efficiency of the detector circuit and thus tending to keep the detector output constant.

However, if the amplitude of the incoming signal is suddenly reduced, say, due to a noise pulse in antiphase, the stabilised voltage across the load resistor may be momentarily higher than the voltage developed across the tuned circuit. The diodes will then not conduct until the signal rises again with the result that noise is heard in the output.

In general terms, the method of overcoming the problem is to use a high Q coil for the secondary and low value diode load resistances so that the detector heavily damps the circuit giving it an operating Q much lower than the unloaded Q.

This mean that the increase in effective load resistance with reduction in signal amplitude results in an increase in the circuit Q and hence a higher voltage developed across the tuned circuit which tends to prevent the diode being cut off. The trick is to proportion all components for the best results. It appears that the loaded Q should be about one-quarter of the unloaded Q in a practical detector.

The same problem does not apply in the case of noise pulses which cause upward modulation and the ratio detector is well able to deal with this type of interference.

The foregoing explains in general terms the operation of the ratio detector.

However, there are a number of factors so far neglected which affect its operation making it quite a difficult matter to design a ratio detector to give optimum rejection of AM, the desired shape of the discriminator curve and so on.

OVER SIMPLIFIED

Of the information on the subject which has been published some neglect important factors in the quest for simplicity, while the explanations which do attempt to be rigorous, frankly, tend to be difficult to follow.

Some of the factors which make a complete analysis of the ratio detector difficult may be appreciated from the discussion which follows. A logical starting point is the discriminator transformer.

The Q of the secondary tuned circuit is a major factor in determining the output voltage of the detector for a given frequency deviation and the permissable frequency deviation for low distortion.

The working value of the secondary Q depends on the diode load resistance and the efficiency of the diode detectors. Obviously a low load resistance will cause the circuit to be heavily shunted. Also the shunting increases as the detector efficiency increases.

As was explained earlier, the dynamic value of detector load, consisting of the resistor and large capacitor in parallel varies. It is lower than the resistor if the average amplitude of the signal is increasing and higher if the amplitude of the signal is decreasing at the time considered.

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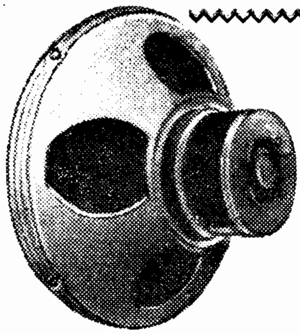

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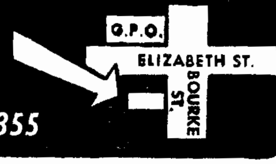

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Therefore if the signal applied to the ratio detector contains amplitude modulation components, the Q of the tuned secondary will vary during the AM cycle. Further, the amplitude of rectified signals varies during the FM cycle since the sum of the magnitudes of the vectors EA and EB varies during the FM cycle. Therefore the Q of the tuned secondary varies during the FM cycle also.

As if this were not sufficient complication detector diodes are invariably somewhat non-linear making the rectification efficiency and hence the equivalent loading depend on the amplitude of the applied signal. Further the detector is usually supplied from a valve having a high source resistance, making the output voltage a function of the load. This impedance is complex and varies throughout the cycle.

DEPENDANCE ON Q

Having established that the Q of the secondary tuned circuit is a complicated function of the operating conditions of the detector, it is worth examining in more detail how a change in Q affects the performance of the detector.

Consider the fundamental discriminator circuit and vector diagram of Figure 4. The angle between the vector AB representing the condition at the centre frequency and the vector A'B' representing the condition with frequency deviation may be designated phi and the tangent of this angle m. Then it can be shown that m is a function of the Q of the secondary, the centre frequency and the frequency deviation

$$\tan\phi = m = Q\sec.\left(1 - \frac{f^2}{f_o^2}\right)$$

which for most of the cases of interest to us in a consideration of the ratio detector can be taken with small error as:

$$\tan\phi = m = 2Q\sec. \times \frac{\text{Frequency Deviation}}{\text{Centre Frequency}}$$

Therefore the sensitivity of the ratio detector in terms of volts/kilocycle deviation/volt input to the discriminator transformer increases as the Q increases.

Looking at the vector diagram of Figure 4 again, the audio output voltage of the ratio detector depends on the amplitude of the generator voltage and the difference between the magnitudes of the vectors EA and EB. The latter depends on the ratio of the second to primary voltage, the Q of the secondary tuned circuit and the frequency deviation.

The following reasonably simple expression for the difference between the length of EA and EB can be derived if the length of the total secondary vector is made double the length of EP— and EP is made equal to unity.

$$EA - EB = \sqrt{\frac{m^2+2m+2}{1+m^2}} - \sqrt{\frac{m^2-2m+2}{1+m^2}}$$

Where m has already been defined. When this expression is plotted in terms of frequency against amplitude, the familiar discriminator "S" curve with a shape similar to the curve of Figure 2 is obtained.

The dependance of the output voltage on the ratio of the secondary to primary voltage can be understood by referring to Figure 6 where (a) shows the shape of the vector diagram when the secondary to primary voltage ratio is high and (b) shows the case where the ratio of secondary to primary voltage is low.

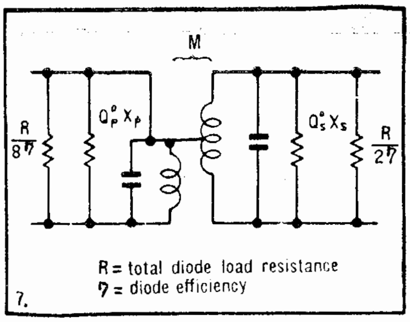

Figure 7. Both the tuned circuit losses and the loading of the diode detector circuit can be represented by resistors in parallel with primary and secondary circuits. Diode efficiency can be obtained from manufacturers' data.

The feature of these diagrams, which is not so obvious, however, is that the frequency deviation between the peaks of the S curve depends on the ratio of the secondary to primary voltage. If, therefore, it is desired to accept a certain frequency deviation without distortion, it is necessary to consider carefully the ratio of these two voltages.

The problem can be analysed mathematically or you can satisfy yourself on the point by drawing diagrams similar to 6a and 6b and noting the angle phi for the maximum difference between the lengths of the lines EA and EB varies with the ratio of secondary to primary voltage. (Remember the definition for m.)

You will find that the greater S/P the greater the separation between peaks. In very general terms with the circuit constants likely to be used in an Australian television receiver intercarrier IF strip at 5.5 Mcs, a ratio of S/P of 4 is likely to result in a peak separation of 250 Kcs, a ratio of 2 a peak separation of 150 Kcs, and a ratio of 1 a peak separation of 100 Kcs.

In the case of the Australian system the maximum deviation is 50 Kcs. For low distortion at full deviation a peak separation of about 150 Kcs would be reasonable, so that a ratio of total secondary to primary voltage of 2 to 1 is about the optimum.

AM REJECTION

The ability of the ratio detector to reject amplitude modulation is closely connected with S/P so that the ratio cannot always be determined on considerations of peak separation. It has been shown experimentally that optimum amplitude modulation rejection cannot be obtained if the ratio of S/P is made greater than about 2. Further, it has been shown that if S/P is less than 2 good AM rejection will be obtained only if the stabilising capacitor is connected across part of the load resistor. For example, if S/P is made equal to 1, best rejection of amplitude modulation components will be obtained if about 75 pc of the diode load is stabilised.

It is fortunate in the case of the Australian system that a ratio of S/P of equals 2, which corresponds to optimum AM rejection with the full load stabilised, gives about the correct peak separation. Had the situation been otherwise, the circuit may have been complicated by two additional resistors to make up the unstabilised portion of the load.

Having read thus far it will not be hard to convince you that an attempt to design a ratio detector on purely theoretical grounds could easily lead to many many notebooks full of figures and little in the way of results. However, ratio detectors have been designed and work extremely well and it is interesting to follow a typical procedure which may be adopted in practice.

A reasonable starting point is the tuned secondary coil of the discriminator. The unloaded Q of this coil is in general made high. Other circuits are then arranged so that the damping under normal operating conditions with a steady signal at the centre frequency is such as to make the working Q about one quarter of the unloaded value.

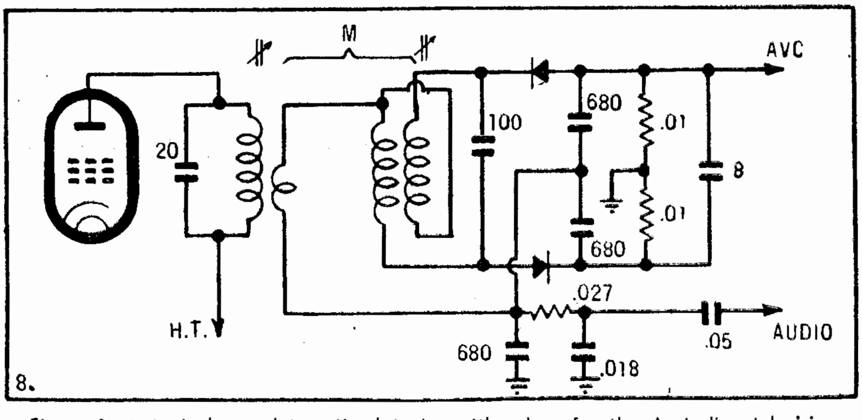

Figure 8: A typical complete ratio detector with values for the Australian television standards. A slight re-arrangement llows the audio signal to appear at the tertiary coil but connectio of Figure 5 is sometimes used. A de-emphasis circuit is included.

This allows the Q to increase when the amplitude of the incoming signal drops and the diode current decreases which tends to prevent the detector circuit cutting off.

Too high a value of unloaded Q will cause the separation between peaks of the discriminator curve to be reduced with downward amplitude modulation and therefore the deviation which can be accommodated with low distortion

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reduced. Too low a Q will prejudice the ability of the detector to reject amplitude modulation.

The inductance/capacitance ratio is also an important factor. A high inductance, low capacitance circuit is desirable since it increases the sensitivity of the detector and at the same time reduces the peak current flowing in the diode circuit.

Conflicting factors are that it is difficult to obtain a high Q with a high L/C ratio and further that the valve and stray capacitances should be low compared with the tuning capacitance so that it will be possible to change a valve without adjusting the circuit. Good stability of the centre frequency is easier to obtain with a low L/C ratio.

TYPICAL VALUES

All factors considered and for operation at the television intercarrier IF of 5.5 Mc it would be reasonable to choose an unloaded secondary Q value between 75 and 100 while the secondary tuning capacitance could reasonably be of the order of 100 pF.

In order that the curve be symmetrical, the discriminator secondary should have both halves equally coupled to the primary winding and closely coupled to each other. The easiest way to satisfy both requirements at the same time is to make the secondary a bifilar winding. Practical details of a typical construction (for 10.7 Mc) are given in the article describing an FM tuner in this issue.

The next thing is to establish the value of the diode load resistors to provide the desired loaded Q and the coupling between the windings to give the desired ratio of secondary to primary voltage. The problem is best examined by means of the equivalent circuit of Figure 7.

It is assumed that the tuned circuit has no losses, the actual losses being accounted for by the shunt resistor. The loading contributed by the diodes is accounted for by R divided by 2 eta, where eta is the efficiency of the diodes.

The total load is that of the two equivalent resistors in parallel. The resulting Q of the circuit can be calculated if it is remembered that Q is equal to the ratio of the equivalent shunt resistance to the reactance of either the coil or capacitor at the frequency in question.

Similarly the loading on the primary winding and its Q is calculated. In this case the equivalent loading due to the diode circuit is D divided by 8 eta because of the arrangement of the coils and diodes.

PRIMARY Q

In other words the primary Q also varies with the detector efficiency and hence the upward or downward modulation as the case may be. This is desirable since it assists in the rejection of amplitude modulation for the same reasons as do variations in the secondary Q.

Actually there are two opposing effects here. The increased impedance coupled into the primary from the secondary when the secondary Q increased tends to decrease the signal fed to the detectors while the increased primary Q tends to increase the gain of the valve feeding the circuit. In a design aimed at optimum AM rejection the latter effect can usually be made the greater.

Usually the equivalent shunt resistance across the discriminator transformer secondary to give the required loaded Q of about 25 will be of the order of 10,000 ohms, making the parallel impedance of the primary of Figure 5 about 2500 ohms.

Obviously, this is too low for good efficiency with a pentode valve and the winding is usually conected to the plate by means of a closely coupled transformer designed to present a high impedance to the valve.

In the usual nomenclature the plate winding is referred to as the primary, the low impedance winding as the tertiary and the remaining winding the secondary.

Both the coupling between the primary and secondary and the primary to tertiary turns ratio affect the ratio of secondary to tertiary voltage at resonance. When a design is aimed at providing optimum AM rejection it is generally found desirable to adjust the coupling to about one half critical.

Not only does this have the advantage of making the tuning adjustments of primary and secondary of the ratio detector transformer relatively independent but when the Q's of the tuned circuits increase during downward modulation, this value of initial coupling causes the greatest percentage increase in gain to make up for the decreased carrier strength.

Again the choice is directed at obtaining best AM rejection.

At this stage it may be worth pointing out that not all practical designs aim at maximum AM rejection. There are cases where some form of limiter is used and a measure of AM rejection is sufficient. For example with one limiter stage ahead of the ratio detector the load resistors may be made higher than mentioned earlier with a resulting improvement in gain.

THE COIL

In arriving at the physical form of the coil you would probably first decide on the former size and then either by calculation or experiment (probably the latter) wind a bifilar coil which, when paralleled with a suitable capacitor, can be tuned either side of the required frequency by means of a slug. For the Australian TV IF channel the capacitance would be 100 pF approx. and the frequency 5.5 Mc/s.

The required number of turns for the primary when resonated with a small value capacitance is then determined. (It may be desirable to have some C in addition to the strays in order to allow valve replacement without retuning.)

An estimate of the unloaded Q's of both coils is helpful at this point. If you haven't a Q meter an estimate can be made using a signal generator loosely coupled to the circuit and a valve voltmeter, provided the loading of the valve voltmeter is known. The unloaded Q of the secondary will probably be about 100 and that of the primary about 80.

Final adjustments will be made later but for a first try you could decide that the loaded Q of the primary will be about half the unloaded Q and the loaded secondary Q about one quarter the unloaded value, i.e., say, 40 and 25 respectively. If it is desired to work on the coil separately, shunt resistors to give these Q's can be connected.

In practice, it is then a matter of juggling the physical spacing of the coils and the number of turns on the tertiary to make the coupling about half critical and the total secondary to tertiary voltage ratio about 2 to 1. The juggling is necessary since the number of turns on the tertiary affects the Q of the primary which affects the coupling factor in turn.

Having chosen the diode rectifier types and knowing the approximate signal level at the detector it will be possible to consult the curves for rectification efficiency and choose the load resistance to give the required equivalent shunt resistance across the secondary.

MEASUREMENTS

In the final setting up of the ratio detector some of the quantities are difficult to measure directly and unfortunately space does not permit a detailed description of suitable methods.

For further detail on this subject we would suggest that you check with the references given below. Most of the measurements can be made with readily available instruments such as signal generators, valve voltmeters and cathode ray oscilloscopes.

For measurement of AM rejection qualities a signal generator capable of simultaneous FM and AM modulation is desirable. Unless accurate quantitive measurements are required, it is usually possible to improvise with relatively simple signal generators.

After all quantities have been determined, the final alignment procedure can be carried out with an ordinary signal generator (unmodulated) and a valve voltmeter. With the valve voltmeter connected to the AVC take off point, the primary tuning is adjusted for maximum output. The voltmeter is then transferred to the audio take off point (tertiary coil side of capacitor) and the secondary tuning adjusted for a null. Since the coupling between the coils will be low, there will be little mutual detuning.

REFERENCES

The following articles contain further information on the design and adjustment of ratio detectors.

Radiotron Designer's Handbook, 4th Ed. Chapter 27 (book).

Loughlin B. D. "The Theory of AM Rejection in the Ratio Detector." Proc. I.R.E. USA, March, 1952.

Seeley S. W. and Avins J. "The Ratio Detector." R.C.A. Review, June, 1947.

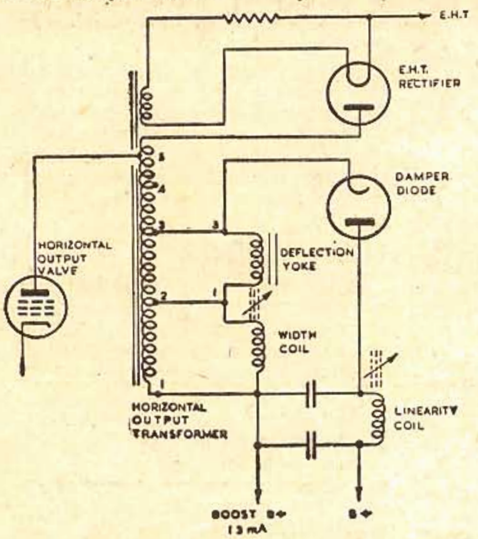
Sturley K. R. "Radio Receiver Design." Part 2, Chapters 13 and 15 (book).

The last gives a relation from which the sensitivity can be calculated in volts/kilocycle deviation/volt input. Note that the relation given should be divided by 2n, where n is the primary to tertiary turns ratio, to account for the tertiary coil and the method of extracting the audio.

RADIOTRON

TELEVISION VALVE SERIES

The damper diode in a TV receiver increases the efficiency of operation of the horizontal deflection circuit by recovering energy from the magnetic field which is set up — in the yoke and output transformer — by current from the output valve. Briefly the operation is:—



SIMPLIFIED DIAGRAM OF HORIZONTAL OUTPUT AND E.H.T. CIRCUITS.

(1) A voltage of approximately saw-tooth wave-form is applied to the grid of the horizontal output valve with the "pulse" of the saw-tooth in a negative direction.

(2) This negative pulse in the grid wave-form cuts off the plate current of the horizontal output valve so that a large positive pulse is developed across the inductance of the horizontal output transformer.

(3) This positive pulse sets up, and becomes the first quarter-cycle of, a damped high-frequency oscillation in the plate circuit.

(4) During the first half-cycle of the damped oscillation the cathode of the damper diode is positive with respect to the plate and the damper diode cannot conduct.

(5) During the second half-cycle the cathode becomes negative with respect to the plate causing the damper diode to conduct.

(6) The diode conduction current flowing in the horizontal output transformer (and thus in the yoke) is in fact the first part of the sweep deflection current in the yoke.

(7) As the damper-diode current decreases towards zero, the saw-tooth voltage on the grid of the horizontal output valve is passing from cut-off to less-negative and then positive grid voltages.

(8) The horizontal output valve consequently starts to conduct and draws a steadily increasing plate current through the output transformer and yoke thereby providing the second half of the sweep current.

(9) During the period of damper-diode conduction the horizontal output valve is cut off and current flows into the capacitor across the linearity coils, charging them to a voltage some hundreds of volts higher than the normal B+ supply voltage.

(10) The plate of the horizontal output valve is supplied from this boost supply, thereby making use of the power recovered by the damper diode from the magnetic field of the deflection yoke and output transformer.

The damper diode thus provides the first half of each cycle of deflection current in the yoke by rectifying the damped oscillation in the output transformer and then allows the power recovered to be used in the plate circuit of the horizontal output valve.

CHARACTERISTICS:

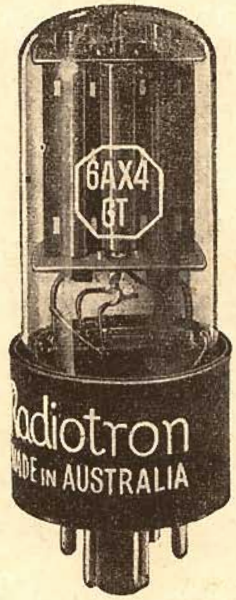
HEATER VOLTAGE	6.3 volts
HEATER CURRENT	1.2 amps.
CAPACITANCE (Heater to cathode)	7.5 μμF

MAXIMUM RATINGS (damper service)

PEAK INVERSE PLATE VOLTAGE* (absolute max.)	4400 volts
PEAK PLATE CURRENT	750 mA
AVERAGE PLATE CURRENT	125 mA
PLATE DISSIPATION	4.8 watts
PEAK HEATER-CATHODE VOLTAGE (absolute max.) (heater negative with respect to cathode).	4400 volts

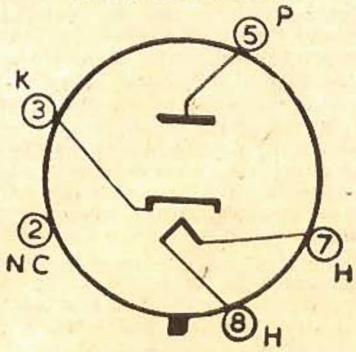
*The duration of the voltage pulse must not exceed 15% of one horizontal scanning cycle.

†For further information on the 6AX4GT and other Radiotron Television Valves, consult the TV1 Booklet. Additional copies of this advertisement are available free and post free on request.



6AX4GT†

SOCKET CONNECTIONS



(bottom view)

Pin 2 — No Connection (Do not use.)
Pin 3 — Cathode
Pin 5 — Plate
Pin 7 — Heater
Pin 8 — Heater

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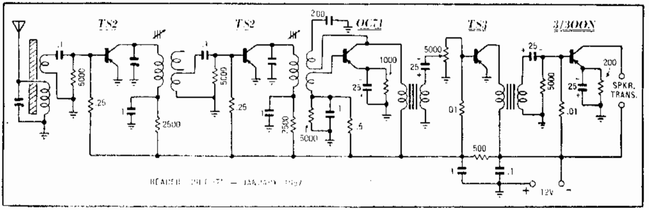
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A SIMPLE FIVE-STAGE T.R.F. TRANSISTOR RECEIVER



A reader from Rockhampton, Queensland, has submitted a circuit which should be of immediate interest to those keen on experimenting with transistors. It is for a 5-transistor TRF receiver, which appears to have excellent performance.

THE reader in question is Mr. O. Andersen, c/o Inspector of Mines Office, Box 257, Rockhampton, Qld.

He points out that his set uses types TS2, TS3, OC71 and 3/300N transistors, all of which have been advertised in Australia.

The OC71 is marketed by Philips and Mullard, the others by STC under the Brimar label.

Discussing the circuit, Mr. Andersen says:

"The TS2 type will give RF amplification over the broadcast band despite their rated cut off frequency of 500 Kcs.

"I am very happy with the performance of the set. With a ferroxcube aerial local stations are received with good volume and good selectivity. With an earth and a few feet of indoor aerial added, interstate stations can be heard well at night. The set performed so well that I have been using it as a car radio.

THE COILS

"The coils used were slug-tuned RF coils with 60 turns wound on between the plate and grid winding; the grid winding was used for the collector circuit and the added winding as the low impedance input to the transistor. About 15 turns were wound over the ferroxcube rod as the low impedance winding.

"Audio coupling is by hearing-aid type transformers. The last stage has a low impedance winding of 200 ohms.

"Paper condensers were used in the RF side, as electrolytic condensers proved less efficient, due, I believe, to some tendency of the electrolytics to predetect the signal. All transistors are wired into the circuit.

"The set is built on a 4in x 7in x 1in chassis and could be much smaller. A 5in permagnetic speaker is used although an 8in speaker would be preferable.

"The set was built in the beginning of June and has been in constant operation ever since; there have been several circuit changes and alterations in bias values before the present good performance was obtained.

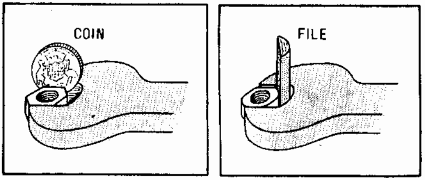
"It was given hard work to try it out thoroughly and was left on all night for all Test matches.

"The original battery consisted of eight torch cells soldered together in series to make a compact battery. After four months' running, at least 800 hours, the battery was run down.

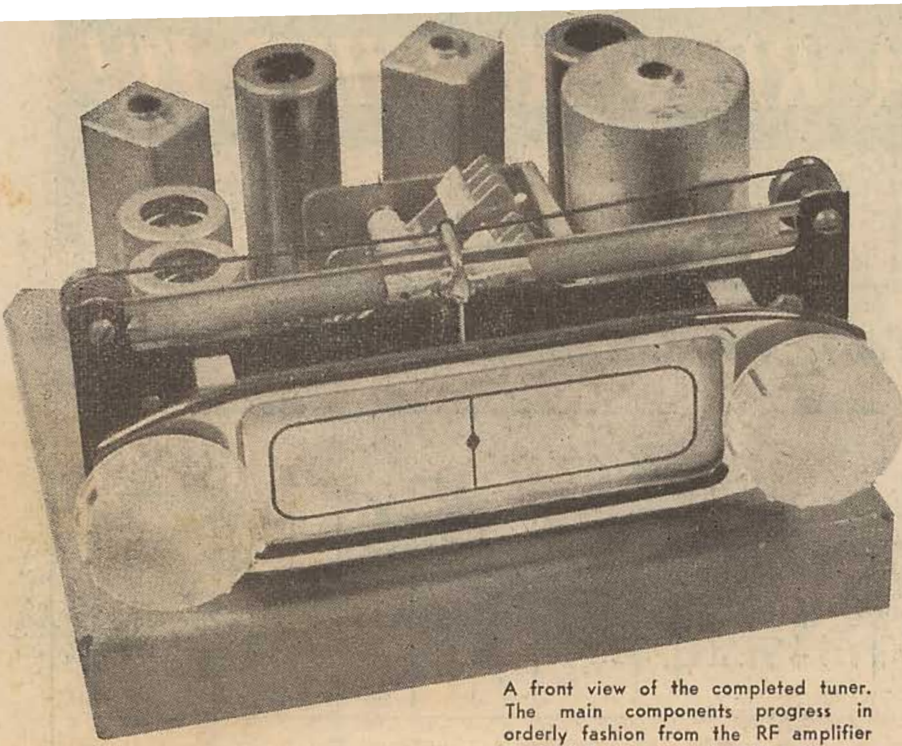
"This is good performance, especially as the battery was subjected to a number of momentary short circuits which are inevitable when testing and changing circuits.

"I would recommend this circuit to transistor fans and suggest that when more efficient transistors are available they could be substituted without extensive alteration to the circuit."

AN ANSWER TO A "NUTTY" PROBLEM



Here are a couple of hints for loosening awkward nuts. If the correct spanner is not available for an odd sized nut, pack a coin or substitute between one jaw and the nut. With a worn nut, where the corners have been rounded, pack with the end of a half-round file. For a nut that will not shift, try pouring petrol or similar and set alight for about 30 seconds.



A front view of the completed tuner. The main components progress in orderly fashion from the RF amplifier in the left foreground to the discriminator transformer in the large can.

A NEW FULL-RANGE FM TUNER

This new FM tuner should have an immediate appeal to high fidelity enthusiasts. Based on a design which proved very popular in England, it is easy to build and non-critical to adjust. Sufficient information is given for those who wish to wind their own coils and IF transformers.

THE frequency modulation stations in our capital cities have been in operation for quite a few years now, and although they have been purely for experimental purposes they have settled down to a pretty constant schedule of operation.

Their programs are drawn from those provided by the ABC and the tendency has always been to concentrate on those having the best musical and technical potential.

Apart from people who like making radio sets for the fun of it the FM stations have never attracted more than a token audience, mainly because of the difficulty and cost of special receivers intended for their reception.

From time to time we have published designs for FM tuners, of which quite a few have been built. But they could not compare with the popularity of equivalent designs for the broadcast band.

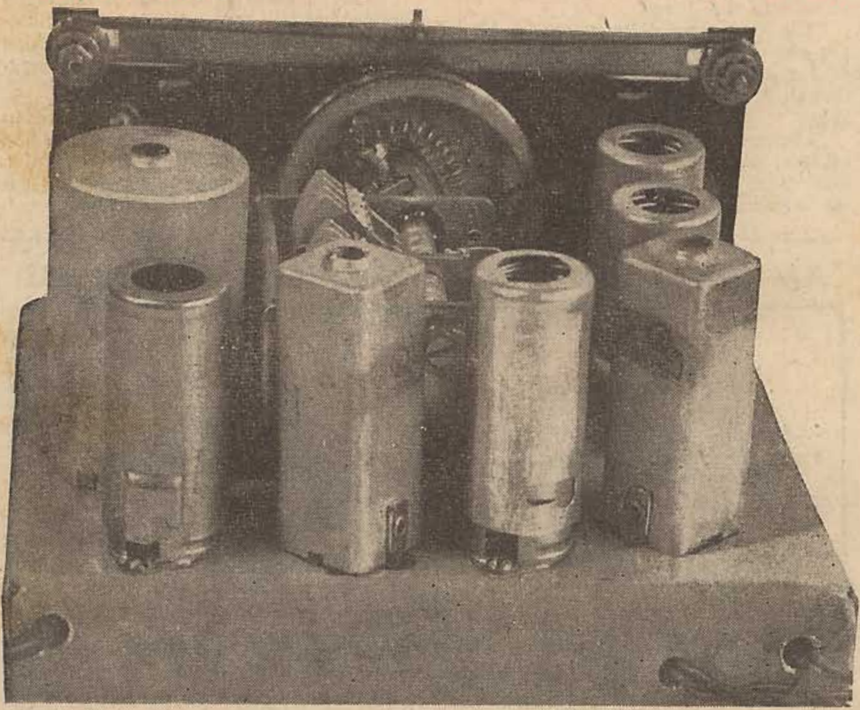
As time goes on, however, the case for an FM tuner grows stronger. There are now thousands of people who have invested in wide-range or hi-fi audio equipment, every one of whom is logically interested in using it for radio programs in addition to records. In fact, it has long been the lament of such people that the inevitable limitations of quality on the broadcast band render it of doubtful value when the results are played through a wide-range tuner.

Heterodyne whistles between stations can't be avoided if the tuner has an adequate bandwidth, although a "whistle filter" will greatly reduce them. But we can't do much about inter-station "monkey chatter", electrical noises from domestic and other equipment, thunderstorms and other sources of program interference which are all heard so clearly on wide-range playback equipment.

A correctly adjusted FM tuner can give you reception quite free from these things and, in fact, it is necessary to use such a tuner to appreciate just how good —or bad—the local programs can be. There is something about the quietness and wide dynamic range of an FM signal which is unmistakable to anyone used to hearing ordinary radio.

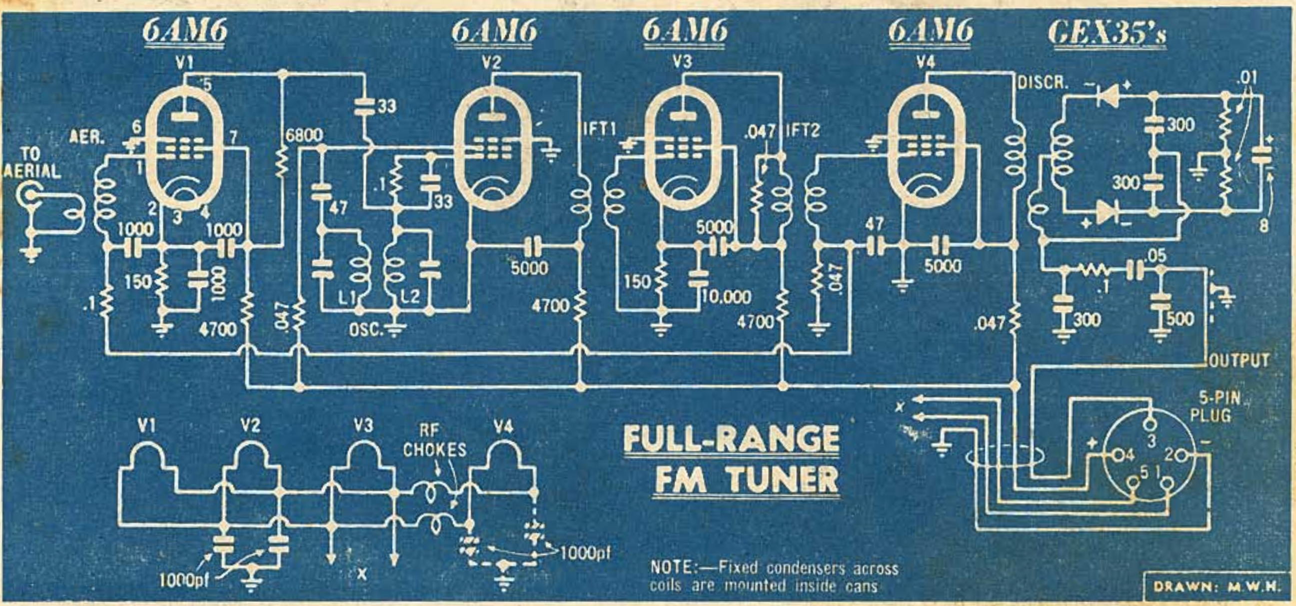
The fact that FM is used for TV sound in Australia is another reason why, from now on, more people will be taking an interest in it, for an FM tuner can be used quite readily to receive the sound channels of TV stations if adjusted to tune over the appropriate bands.

Although we know of no immediate plans for other FM stations to commence



This rear view of the chassis emphasises the compactness and simplicity of the tuner.

NEW CIRCUIT USES SELF-OSCILLATING MIXER



Here is the complete circuit diagram. Novel features include an aperiodic aerial input circuit and the use of a self-oscillating mixer valve. L2 is the normal tuned interstage coupling coil; L1 is a tuned feedback winding connected in the screen circuit of the mixer-oscillator. Full coil and IF transformer details are given on page 61, though at least one manufacturer plans to make them available commercially.

operations the subject is under continual discussion in the commercial field, and it may not be long before some of them prepare to take steps to radiate their programs on a second UHF channel with FM.

In Europe there are hundreds of FM stations operating, and more of them are being built. Soon they will carry the bulk of general radio entertainment. In England the setting up of a wide FM network has begun, and probably half a dozen stations are already on the air.

INTEREST IN BRITAIN

The interest in FM tuners in Britain is very great. Several manufacturers are supplying kits of coils and ready-built tuners, and they sell in thousands to people who use them either as converters for their present sets or for use with the very large numbers of hi-fi amplifiers which have been sold.

While in England last year I spent some time having a look at these tuners, for the results I observed with them indicated that they were even more successful than those we had constructed ourselves. It became obvious that their sponsors had put a great deal of work into them, and in several instances come up with designs which the average constructor could put together without trouble.

One of these, designed and manufactured by the Jason Motor and Electronic Co., impressed me as being a particularly good one, so much so that I bought a kit and made it up when I returned to Australia. Within three minutes of finishing the wiring it was lined up and receiving the Sydney FM station in excellent style.

As the details of this kit, including full coil winding instructions, had already been published in an English radio magazine I obtained permission from Jason to use the information on this tuner, for it is exactly the kind of thing I had been looking for to solve the problem of FM without tears.

As the components used in the original tuner are not easily available here a second version was built up in our lab, using coils wound to the instructions which are given with this article, and a two-gang condenser specially made for us by Roblan, which can be obtained either from stock or to order through your own component shop.

The second version is at present working just as well as did the original. It lined up without trouble, the discriminator balance was easily adjusted using an ordinary service oscillator and a multimeter, and it sounds really fine.

by John Moyle

It is quite the nicest little job of its kind I have yet handled, and no apologies are made for adopting it for our own purposes, with full details of its construction.

For the sake of convenience, it has been made up in a form suitable for connection to any of the Playmaster amplifiers, although it is equally suitable for any other types where a power source of up to 250 volts at 30 mills is available.

The circuit is quite similar to a number of other successful designs, but has sacrificed neither simplicity or performance. In brief, it includes an RF stage, a self-oscillating mixer, a stage of LF amplification, a limiter and a ratio detector using a pair of germanium diodes in place of the conventional double-diode valve.

The aerial circuit is not tuned, using a wide-band coil wound on an iron slug and broadly resonant near the centre of the FM band, which ranges from about 85-105 Mc. It has been designed for maximum gain rather than selectivity.

Both the aerial and the first grid circuit damp this coil, the two being equivalent to about 800 ohms across the coil. If the spacing of the aerial coil is set to minimise this damping a loss of about four times would be found. In order to improve the signal to noise ratio the maximum step-up is needed, so that the coil is wound directly on the slug and a single-turn aerial coupling coil wound as tightly as possible over it. This coil has a net gain of about three times, and although it provides no image rejection it is very effective in avoiding direct IF interference.

The RF stage provides useful gain, prevents any possible aerial radiation from the oscillator, and allows optimum conditions to be selected for both aerial coupling and coupling to the mixer.

The mixer itself is similar to the autodyne circuit which was popular many years ago for the broadcast band. It is favored by many designers as giving good conversion, stability and requiring only one cathode stream.

The oscillator section uses the screen as the anode, and the plate circuit provides coupling to the IF channel. The oscillator is a tuned-grid tuned-plate type. The coupling between the two coils is not critical, and one end of each

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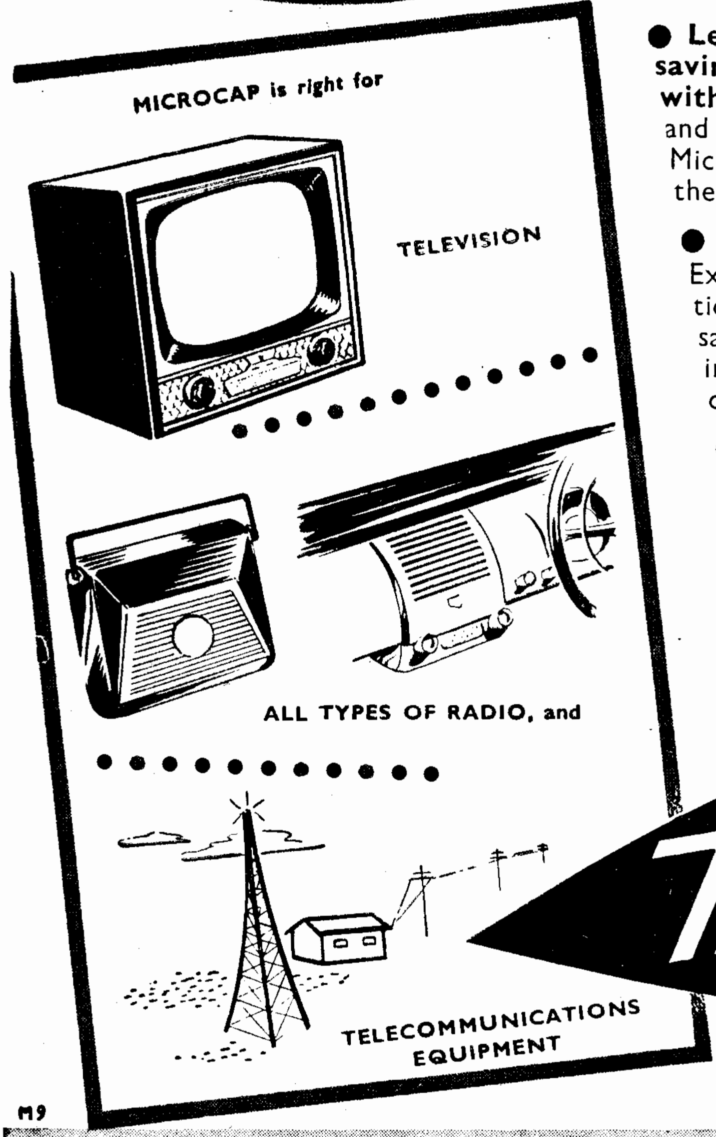

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is conveniently earthed. The five-turn coil is the main frequency controlling circuit, and as it has no grid capacitance connected across it, is very stable. A voltage of about five is built up at the grid, which is highly suitable for mixing. This stage gives a gain of about 15 which is much higher than many other types.

The IF stage is straightforward and the frequency is 10.7 Mc, which is now standard for such tuners. Automatic gain control is not used, as it is not necessary where only one station is normally involved, and the changes in valve input capacitance which could be caused would affect the frequency response of the IF channel.

LIMITER STAGE

The limiter operates most effectively, although many sets do not include such a stage with a ratio detector. It is, however, decidedly worthwhile, as the noise rejection properties of the ratio detector can only be relied upon when the set is in perfect adjustment.

The limiter avoids the necessity for meticulous care in the balancing of the detector, although, of course, this important point cannot be neglected. But it is an advantage to be able to use all components "off the shelf".

The ratio detector is perhaps the most favored type today and, as has been mentioned, provides a good natural rejection of impulse noises. Provided reasonable care is taken to follow the coil winding instructions to achieve good balance and low capacitances, circuit performance is excellent.

The operation of the ratio detector can be summarised as follows. An RF voltage appears across the secondary of the transformer which varies in phase as the carrier deviates in frequency. This voltage is halved, one half being added and the other half being subtracted from the RF voltage across a small coil tightly coupled to the plate of the previous valve. The latter is taken to have reference phase.

The two resulting RF voltages can be shown by a vector diagram to vary in amplitude, one decreasing and the other increasing as the frequency deviates from normal.

They are detected and the output circuit arranged so that the audio output is proportional to half the difference between the amplitudes of the two RF voltages.

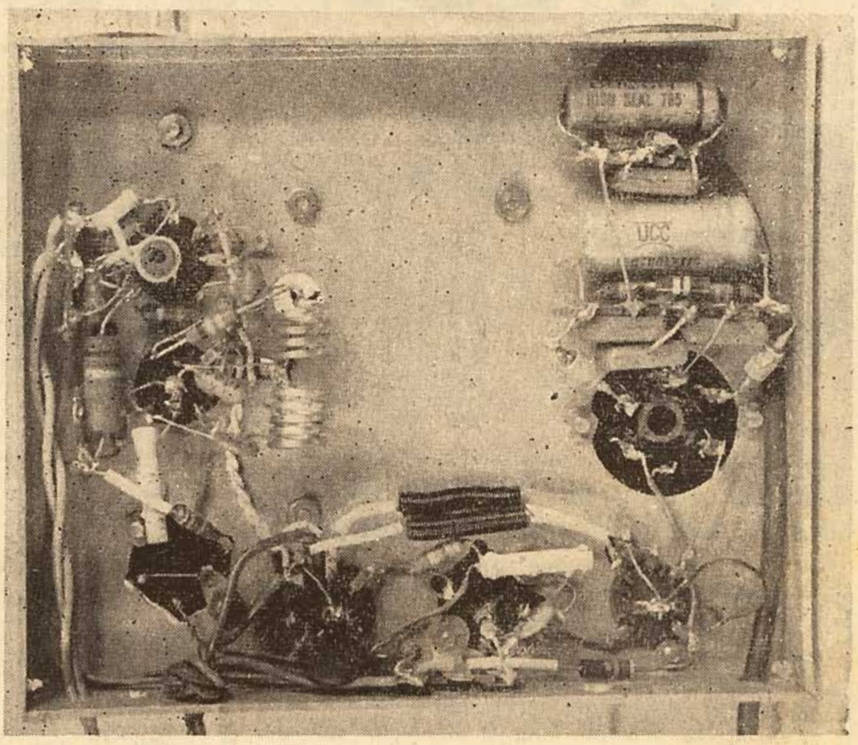
A voltage proportional to the sum of the two RF voltages is maintained at a constant value over a relatively long period of time by a large capacitor and therefore the difference voltage is closely proportional to the frequency deviation, a short-term change in the amplitude of the incoming carrier having little effect.

Germanium diodes are used in the detector because they are small, cheap, and avoid the possibility of heater hum being introduced into the output — a frequent source of annoyance with valves. As previously mentioned, there is no particular need to have these balanced to extreme accuracy, although if balanced diodes are available they should be used. Several types now on sale may be used here.

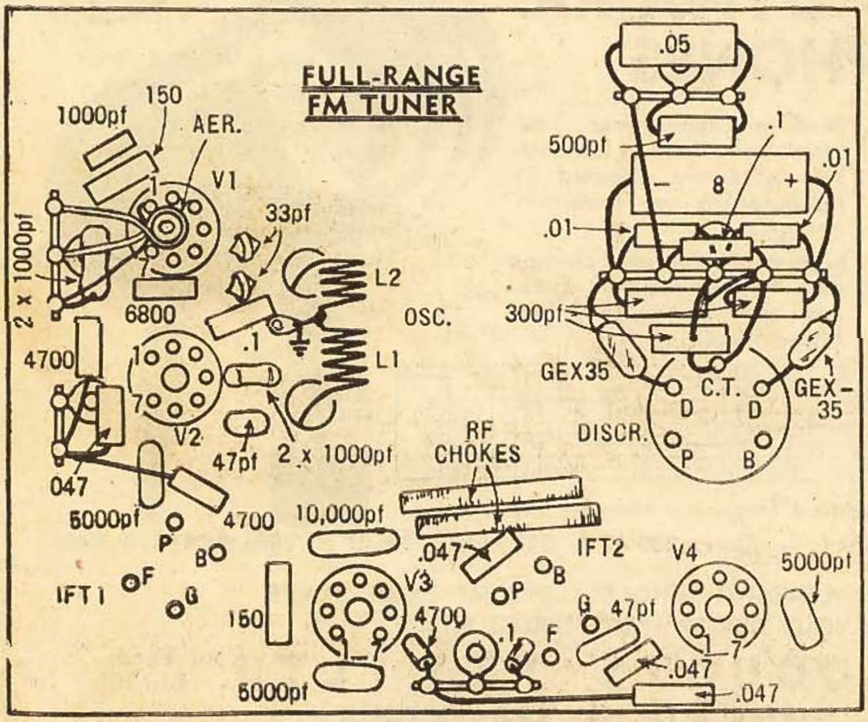
The tuning is accomplished by a twin-gang of about 25 pfd capacitance per section. The coils are wound from a single piece of 16 or 18 gauge tinned copper wire, the ends of which are taken through two chassis holes to the solder points on the gang. It is possible you may have an ex-disposals gang which will serve the purpose, but the locally made job we used has been specified for obvious reasons.

It is possible to do without a dial at all if a large knob is used and you have a steady hand. We used the baby Efco dial mainly to show how it is done, for

UNDERNEATH PHOTO & DIAGRAM



An underneath view of the tuner chassis. Note that miniature wiring parts are used throughout, both to conserve space and to ensure efficient operation at the high frequencies involved.



Compare this layout diagram with the photograph above. Readers not fully versed in VHF wiring techniques would be well advised to follow it in detail.

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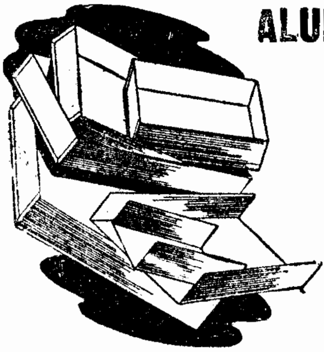

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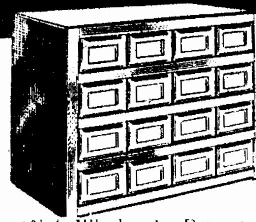

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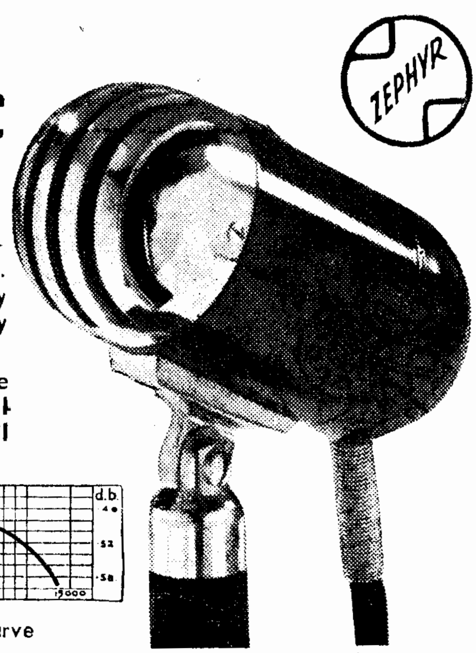

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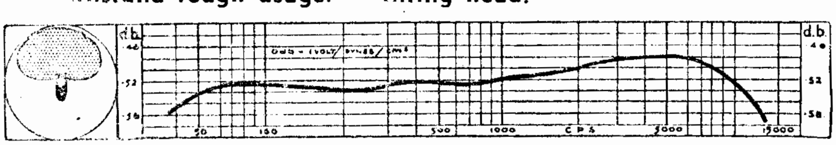

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The gang is mounted in the upside-down position, using the flange on its back plate. The spindle is removed to the opposite side, where space has been arranged for it. Naturally the scale is of no use. We printed a simple scale on paper and glued it to the glass, leaving a slit from side to side in the centre through which the pointer can be seen. The pointer is arranged to tune the FM station in the centre of the movement.

The layout is quite important.

Firstly, it is essential that no hint of instability shall appear when the set is adjusted, as this will spoil the bandwidth and make it impossible to correctly line up the set.

SHORT LEADS

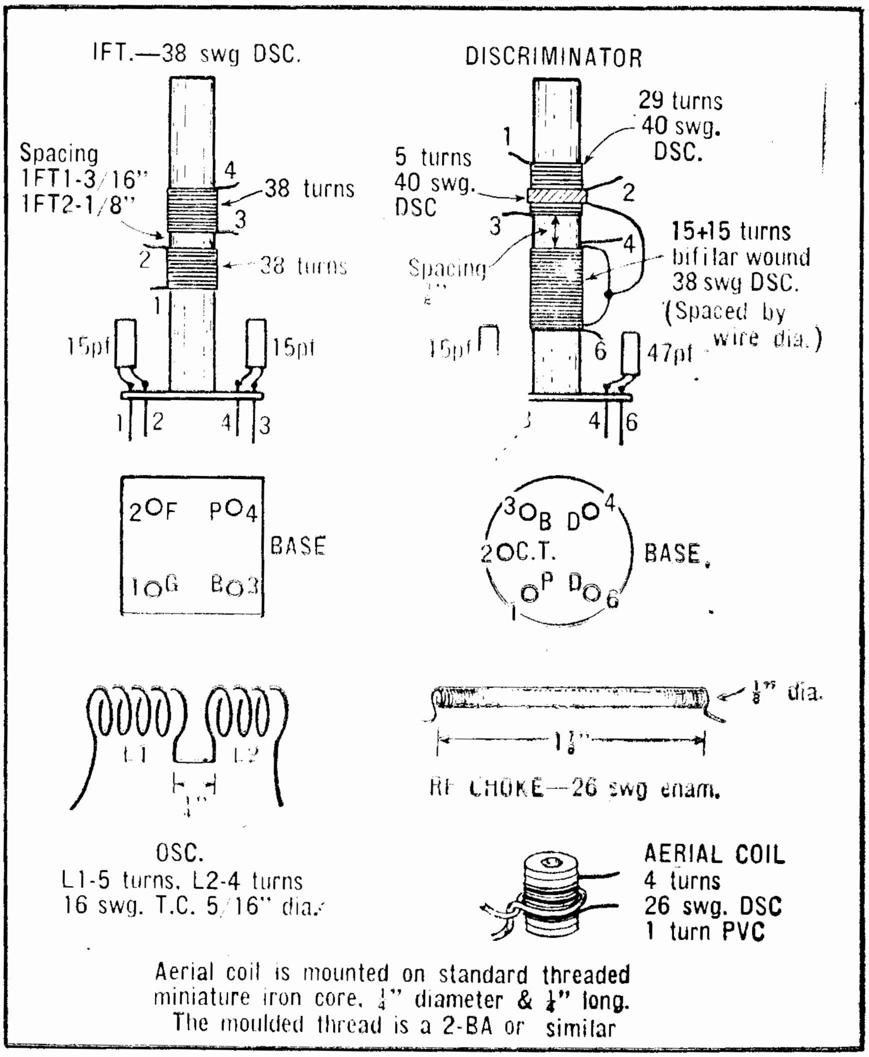
Therefore all the grid and plate leads should be kept short and removed as much as possible from other wiring. It is a good idea to push them down near the chassis but not actually resting on the metal.

The way we have arranged the various coils will look after this point.

Secondly, it is essential to avoid paper used capacitors which will almost certainly have too much self inductance. Silver mica should be used for all coupling capacitors, and either silver mica or ceramics for the bypasses. These condensers are gradually becoming more easily available and can be obtained for you if your store hasn't them in stock. They are standard now in all VHF equipment.

Thirdly, the earth point for bypass condensers associated with each stage should be made to a single point, which can often be the centre spigot of the valve socket or the solder lug to which it is earthed. This means that some of the small components will straddle across others and odd wires which may be already in place, but efficiency is all-important, and pretty wiring a thing of the past if it interferes with results. Clip the leads of all capacitors as short as you can consistent with reasonable grouping.

COIL & TRANSFORMER DETAILS



All the essential information is given here for those who may wish to wind their own coils and IF transformers. Suitable cans, slugs and moulded formers are now available on the market in at least two brands, interest in home-built television components having already prompted their release.

COMMON EARTH

The circuit is drawn so that these all-important earth connections are shown as joined to a common point in each of its sections.

We have grouped the components to the high voltage line, ratio detector, etc., so that they make a neat and logical progression in wiring. Note particularly the positioning of the detector components, which can mostly be mounted on the terminal strips before bolting these to the chassis.

Incidentally, we have added a little extra depth and height to our original chassis measurements in order to give a little more clearance than in the original.

The audio lead uses a piece of shielded co-ax which runs along the edge of the chassis and out through its own exit hole to avoid any coupling into the rest of the circuit.

The limiter grid resistor of .1 meg must be mounted right at the solder lug of its IF transformer, with the shortest possible lead to avoid radiation from this point into the circuit generally.

As the Playmasters have floating filament leads within the chassis, it is a good idea to use filament chokes to the limiter valve socket. Should any instability be noticed, try bypassing these filament terminals with two 1000 pf capacitors. The chokes should be kept away from the rest of the wiring, quite an easy matter with our layout.

The chokes themselves are wound with 26 SWG wire — enamelled will do — on an 1-8in drill or other suitable former, which is then removed. If you have some spaghetti which makes a close fit over the chokes, slip it on. The chokes are virtually self-supporting, and may be strengthened with coil dope.

The IF transformers are quite easily wound on coil formers of suitable diameter, which again are available on order or request. The coil table nominates the wire used in the original kit, but enamelled wire of the same gauge can be used. See that plate and grid leads within the can do not run close together. Windings are exactly the same, and it does not matter which is the plate and which the grid. But the grid and plate connections should be made to the outside ends of each winding.

The discriminator is a little harder to make, but ours took about 10 minutes all told.

A common instruction in making bifilar windings is to wind on four wires side by side, and after applying coil dope, to strip off each alternate wire, thus achieving automatic spacing.

WNDING METHOD

This is the best method, but it is very fussy. We first wound on one winding, leaving enough space between wires to allow a second winding to be put on later, exactly between the adjacent wires of the first, leaving a spacing about one wire diameter between the turns of the finished job.

This isn't hard, if you anchor the starting end of each wire to one of the former solder lugs before you start, leaving enough loose end to make the necessary soldered connection later.

When the first winding is in place, spread coil dope over it, keeping tension on the far end, and wait a few minutes until the dope is dry. The wire will now stay in place and you can repeat the process with the second winding.

An extra blob of coil dope at the very ends will anchor the wires quite firmly

enough for you to handle them without fear of unwinding.

The bi-filar winding should be put on the former first, so that you can accurately measure the spacing between it and the primary.

This winding is another straightforward job. When it is finished, glue a layer of paper over it with coil dope, and wind on the 5-turn coil over one end. A further application of dope will leave the whole assembly quite rigid.

The two bi-filar windings are connected so that the end of one connects to the beginning of the other. Thus the whole winding is in the same direction throughout, but in two sections. Before the dope is bone dry, adjust the spacing between the turns so that it is as even as possible.

COIL DETAILS

Full details for coil winding are given in the diagram and coil table. It is best to use the gauges mentioned, but just to make sure, we used 38 enamelled wire as being perhaps easier to get, and found no trouble in obtaining alignment. In any case, the removal of a turn or two if it should be necessary is only a few minutes job.

To line up the set with home-made coils really calls for a simple service oscillator capable of tuning to 10.7 Mc and modulated for preference.

The oscillator output is applied by clipping the hot lead to the grid end of the 5-turn winding to inject the required voltage. An ordinary multi-meter is connected to the diodes so that an output voltage can be indicated, using a couple of .1 meg resistors (or thereabouts) to reduce the loading effect of the meter

The IF slugs are now adjusted one by one to give the maximum reading on the meter. The modulation is only useful as a means of locating initial output when the slugs are badly out of line — it should be switched out for final adjustment.

Having obtained a peak for each coil, reducing the oscillator output to the lowest practical amount, it is necessary to balance the discriminator coil.

To do this, the meter is connected between the chassis and the junction of the two condensers across the diodes, using the isolating resistor once more. Leave the oscillator connected and set to the same frequency as used for IF adjustment.

The core which tunes the bi-filar winding is now adjusted until the meter reads zero. On one side of correct balance the meter will give a positive reading, on the other side it will hit the negative pin. The setting for zero adjustment is quite sharp and is unmistakable when you reach it.

If you find any coils, including the discriminator, will not peak, turns should be added or subtracted, according to whether the slug is "all in" or "all out"

(Continued on Page 97)

PARTS LIST

1 Chassis 6x5x1½ inches
1 MSL/48 dial.
4 7-pin miniature valve sockets with shields.
1 Roblan FM 2-gang.
2 10.7 M/c IF transformers, (or materials to wind same, see text)
1 10.7 M/c detector, (or materials to wind same, see text)
1 length of 16 swg TC wire (to hand wind RF anode and oscillator coils)
1 length of 26 swg enamel wire (to wind RF heater chokes)

VALVES
4 6AM6
2 GEX35 germanium diodes.

CAPACITORS
2 33pf bead ceramics.
2 47pf bead or disc ceramics.
3 300 pf ceramic or mica.
1 500 pf ceramic or mica.
1 1000 pf tubular ceramic.
2 2x1,000 pf ceramics.
1 .05 mfd paper.
3 5,000 pf ceramics.
1 .01 mfd ceramic.
1 8 mfd 125 volt electrolytic.

RESISTORS
2 150 ohm ½ watt.
3 4,700 ohm ½ watt.
2 .01 meg ½ watt
4 .047 meg ½ watt.
3 .1 meg ½ watt.
1 6,800 ohms 1 watt.

SUNDRIES
Tinned copper wire, hookup wire, 1 5-pin plug, length of PT9M coaxial cable, nuts and bolts, solder lugs, 1 2-tag strip, 3 3-tag strips, 1 5-tag strip, 2 knobs.

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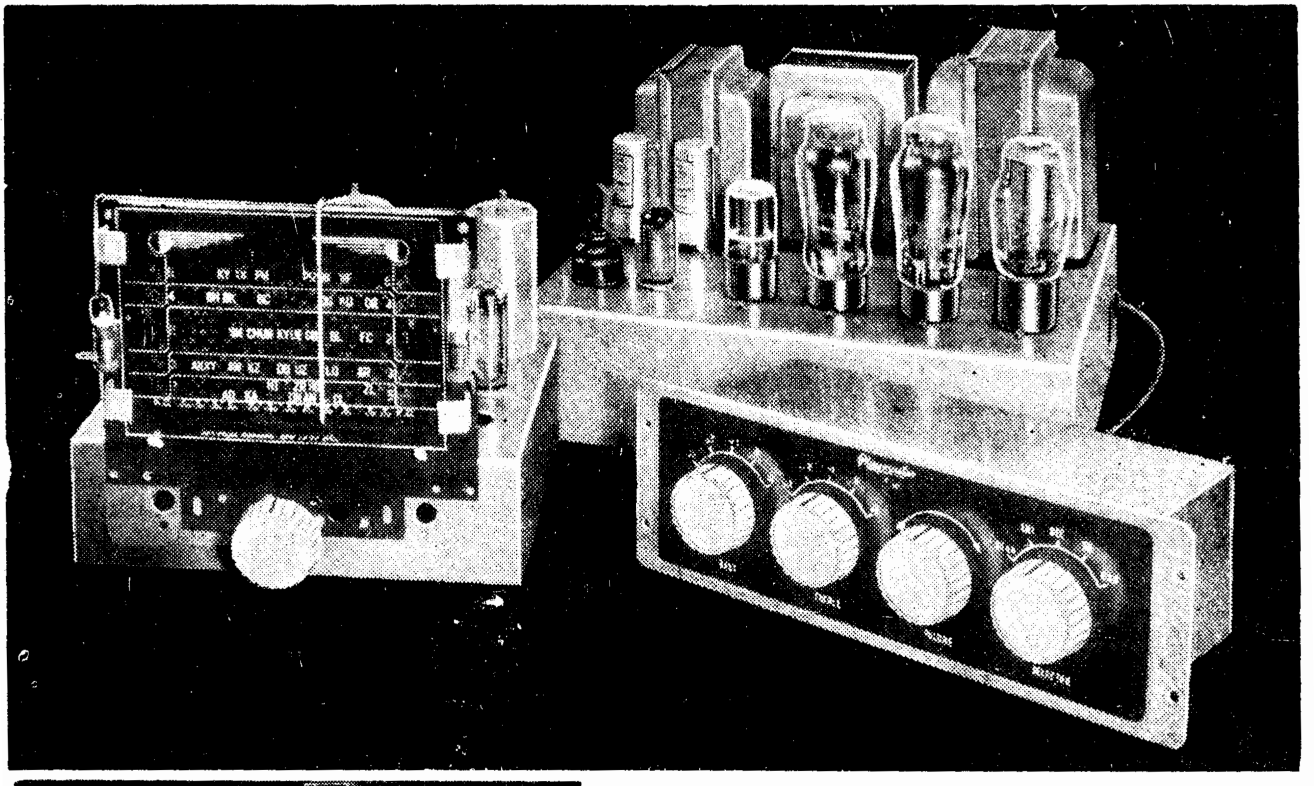

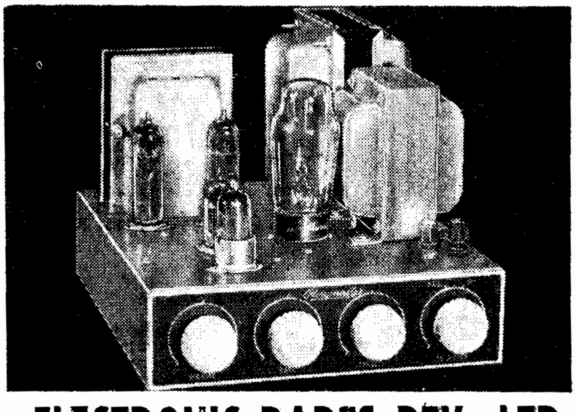

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PART SEVENTEEN—THE FM SOUND CHANNEL

In this month's instalment, we conclude the discussions of audio systems, as employed in television receivers. The matter of treble de-emphasis is examined, circuit design, speaker placement and the principle of "stacking", which is often used in receivers to save current drain, heat dissipation and first cost.

A QUESTION which arises with FM and television sound systems is that of treble de-emphasis.

As explained earlier in the series, the FM sound radiated by the transmitter is pre-emphasised, to quote the standards ...."in accordance with the impedance frequency characteristic of a series inductance-resistance network having a time constant of 50 microseconds".

In everyday language, this simply means that the higher modulation frequencies are boosted during transmission by the prescribed amount.

RECEIVER COMPENSATION

It is intended that a corresponding amount of treble de-emphasis (i.e., treble cut) be used in the receiver, to restore normal balance to the sound reproduction.

Naturally enough, any incidental noise and background hiss is attenuated along with the surplus treble response and the signal-to-noise ratio is thereby improved.

The standards specification in terms of two circuit elements and a time constant gives the basic information necessary to design a complementary de-emphasis circuit. Most readers will be happier, however, to see the information in the form of a response curve, which is given in figure 105.

It happens to be very like the de-emphasis curve employed with some microgroove records.

A basic de-emphasis circuit is shown in figure 106, comprising simply a resistor and capacitor in series. When R is large, C has to be quite small to give the required curve, typical values being 1.0 megohm and 50pf. If R is reduced to 10,000 ohms, C must be increased to .005mfd., to give the same curve or the same time constant.

In a practical television receiver, it is very seldom that the de-emphasis network appears in this simple basic form. Figure 106 assumes that the input voltage is constant or, at least, that the input source has a low resistance when compared with "R".

Such is not always the case, and "C" may have to be given a smaller value than expected, because the resistance of the signal source may appear effectively in series with "R".

Various other secondary factors may intrude as, for example, the shunting effect of the volume control across the output terminals, the presence of stray capacitance due to shielded wiring and the possibility that a designer may use less than optimum de-emphasis at the detector to make up for treble losses elsewhere in the circuit, or even in the speaker itself.

OVERALL RESPONSE

The basic requirement—which may or may not be observed in detail—is simply that the overall response of the audio system shall conform to the curve of figure 105.

It matters little whether this is achieved by a special de-emphasis network, recognisable as such, or by using deliberately large values in other bypass circuits. The choice of such components will be obvious enough to anyone familiar with audio practice.

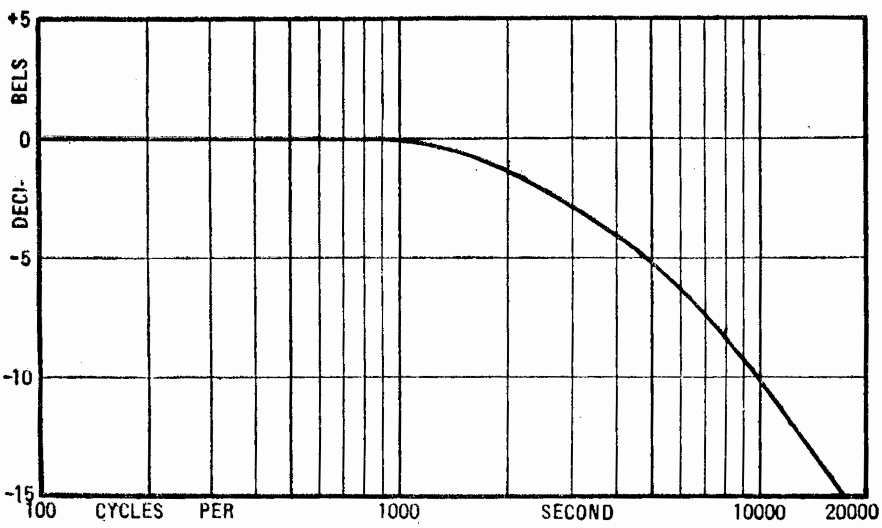

Figure 105: The optimum response curve for a TV receiver audio system designed to complement the 50-microsecond pre-emphasis in the transmitted FM sound channel.

In most other respects, the audio system of a television receiver is fairly straightforward and does not call for lengthy examination.

As a rule, a very simple amplifier is employed, generally a voltage amplifier, followed by pentode output valve, with feedback around the combination to minimise distortion.

Such an amplifier is capable of producing plenty of sound for an audience seated within comfortable viewing distance of the screen.

In everyday use of a TV receiver, the tendency is to operate the sound at a level which is not disproportionate to the limited size of the picture. Most of the time, the audio system is reproducing speech at low level and the chief requirement is therefore pleasant, crisp sound, free from obvious distortion.

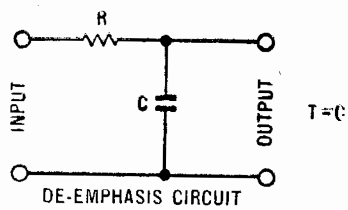

Figure 106: A basic de-emphasis circuit involving one resistor nad one capacitor. Practical circuits usually impose other R and C quantities which have to be considered.

Furthermore, since the sound is less likely to be used as a mere background to other unrelated activities, there is less urge on the part of the user to eliminate the high frequencies to render it less obtrusive. "Tone controls" are therefore not regarded as essential fitments in ordinary television receivers.

AUDIO LINE UP

As far as local receivers are concerned, some use separate audio amplifier and output valves as, for example, a 6AU6 and a 6AQ5. Components and circuitry are very similar to conventional AM broadcast receivers.

Where it is desired to conserve space or reduce the number of valves, a single multiple type can be used. A rather unusual example of this practice appears in the currently produced RCA Personal Portable TV receiver.

In this circuit a 6U8 triode-pentode, which normally serves as a frequency changer, performs a variety of functions.

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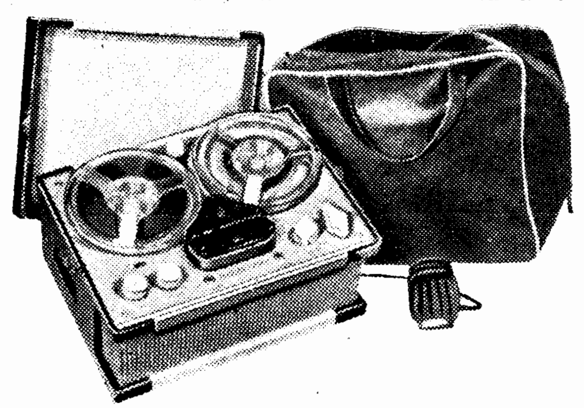

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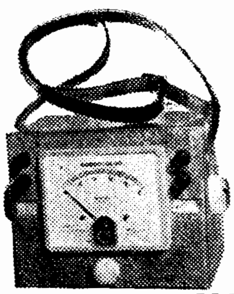

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SIMPLE AMPLIFIER FOR TV SET

The pentode section acts as a 5.5 Mc intercarrier IF amplifier, feeding a pair of crystal diodes as a ratio detector. The demodulated signal is reflexed into the same pentode for audio amplification, then passed into the triode, which serves as an output stage delivering about one half-watt to the speaker. This is presumably reckoned to be adequate for a portable receiver.

Much more impressive performance is available, however, for multiple valves more suited to the application.

Figure 107 shows the circuit details of an amplifier designed around the triode-pentode type 6BM8. This composite valve contains a triode with an amplification factor of 70 and a transconductance of 2200 mhos, well suited to use as an audio voltage amplifier.

For audio service, the second section has ratings typical of a power pentode, being capable of delivering up to 3.5 watts output at a current drain of approximately 40mA.

The large dropping resistor shown in series with the HT supply serves a double purpose, in that it reduces the valve operating potentials to the required figure and also provides a useful degree of additional hum filtering.

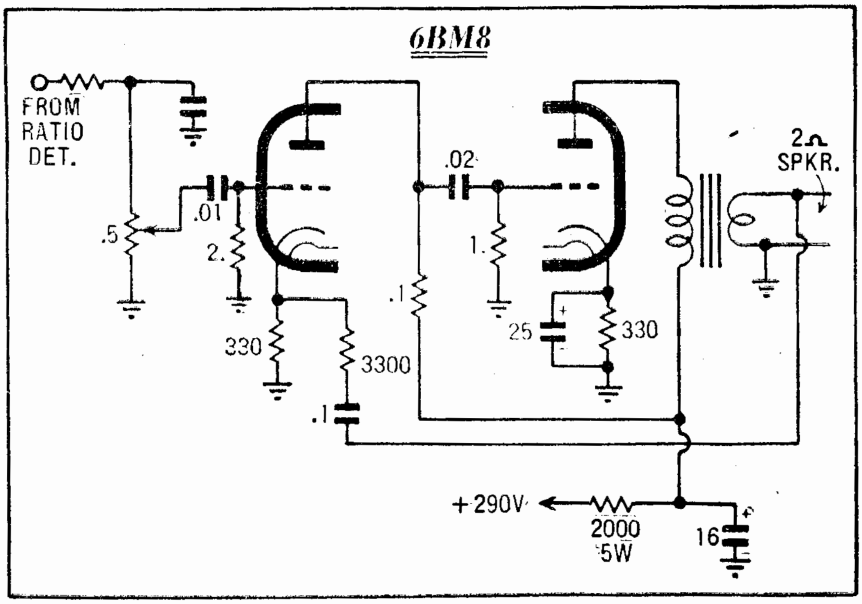


Figure 107: Circuit details of an audio-amplifier using a 6BM8 triode-pentode. Feedback is applied from the secondary winding and a series capacitor gives a small amount of bass boost below 100cps.

HT "STACKING"

In "economy" receiver designs, the power consumed by the audio amplifier and any associated resistors is likely to be viewed with some concern.

Any economies which can be effected in total current drain will reduce the size and weight of the power transformer and possibly simplify filtering problems. On this basis and on the assumption that 3.5 watts of audio is not essential, the principle of "stacking" has been considered by some designers.

Figure 108 illustrates the basic idea. Plate and screen of the audio power amplifier are connected, as normal, directly to the high tension supply line. However, instead of the cathode being at near earth potential, it is merely bypassed to chassis for audio frequencies by a suitable electrolytic capacitor.

The actual DC path is through a small decoupling resistor, thence to the B-plus supply point of the IF amplifier.

In most cases, the IF strip requires only a moderate HT supply voltage and would normally need to be fed from B-plus through a larger separate dropping resistor. By connecting the IF amplifier and the audio power amplifier in series, as far as DC is concerned, the available supply voltage is shared, two large dropping resistors are eliminated and the drain of the set reduced by about 40 milliamps.

LESS AUDIO POWER

The penalty is obvious enough in that an output valve with less than 150 effective volts cannot supply as much power audio as one with a higher applied voltage, unless it is specifically designed for this class of service.

The operating conditions of the audio amplifier and the IF section are also interdependent in that current variations in one, due to ageing, AGC action, &c., must affect operating conditions of the other. However, by establishing the grid potential of the audio stage, as indicated in figure 108, the distribution of voltage between the two sections of the receiver can be held fairly closely.

It is interesting to note, in passing, that the idea of "stacking", or connecting stages in series for DC, is used often in other sections of a television receiver.

The direct-coupled cascode RF amplifier is an example, the two triode units being connected in series across the full HT supply voltage.

In some tuners, the idea is applied also to the mixer and oscillator functions, the two sections of the frequency changer being connected in series as far as DC is concerned.

In all such cases, the series connection saves on HT current and also reduces the number and wattage of dropping resistors required. Thus, providing the various circuits can be made complementary in regard to voltage and current requirements, significant savings can be made in terms of HT drain, component cost and heat dissipation within the cabinet.

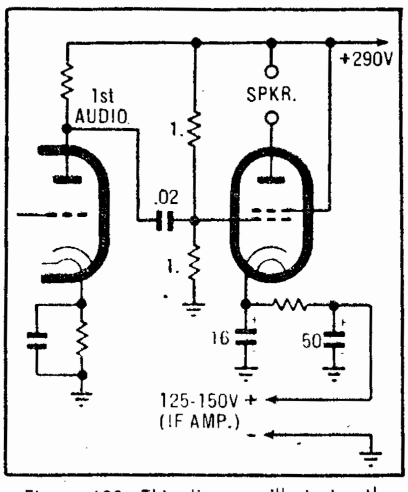


Figure 108: This diagram illustrates the principle of "stacking" circuits to conserve HT current drain and eliminate the need for large dropping resistors. Here the audio power amplifier and the IF system operate in series as far as DC is concerned.

So much, then, for amplifier design.

Placement of the speaker is often a problem, because the whole front face of the cabinet is frequently occupied by the picture tube, the controls and the attendant mechanism. Obviously enough, the speaker must be so placed that the senses can accept the sound as coming from the picture area.

In a full console receiver the problem is overcome by mounting a single large speaker behind a fret in the lower portion of the cabinet.

In "table" models, where no such space is available, a variety of arrangements has been used.

SPEAKER POSITION

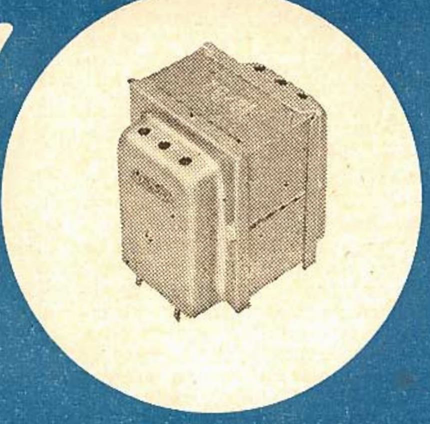
If the cabinet stands on legs, it is possible to have the speaker against the bottom of the cabinet facing the floor. Whether the higher frequencies are lost or heard depends largely on the floor covering, while the scheme obviously precludes the receiver from being placed on top of any other piece of furniture.

Mounting the speaker on one side of the cabinet is another popular scheme, although the arrangement may not always be the best for listeners seated toward the remote side.

Overseas, this objection is often met by mounting speakers on both sides of the cabinet, so that the source of sound is dispersed and masked.

A still further scheme is to have a small oval speaker inclined at an angle underneath the picture tube and radiating forward through a tunnel and a vent in the front of the cabinet. The success or otherwise of this scheme largely depends on how large a speaker can be

Ferguson



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PF 130F	230-240	285	100	6.3VCT/2A 6.3V/2A 5V/2A
PF 151	230-240	285	60	6.3V/2A 5V/2A
PF 151F	230-240	285	60	6.3V/2A 5V/2A
PF 152	230-240	285	125	6.6.3VCT/3A 6.3V/2A 5V/2A
PF 165	230-240	385	60	6.3V/2A 5V/2A
PF 170	230-240	285	80	6.3V/2A 6.3V/2A 5V/2A
PF 185	240	150	30	6.3V/2A
PF 201	240	225	50	6.3V/2A
PF 265	230-240	Secondary Volts		17 TAP 11.5. 10. 8.5/4.2A
PF 299	240	285	40	6.3V/2A 5V/2A

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PF 164	230-240	325	100	6.3VCT/2A 6.3/2A 5V/2A
PF 166	230-240	325	60	6.3/2A 5V/2A
PF 168	230-240	385	80	6.3V/2A 6.3V/2A 5V/2A
PF 169	230-240	325	80	6.3V/2A 6.3V/2A 5V/2A
PF 173	230-240	425	175	6.3VCT/3A 6.3V/2A 5V/3A
PF 174	230-240	285	150	6.3VCT/2A 6.3V/2A 5V/2A
PF 175	230-240	385	150	6.3VCT/2A 6.3V/2A 5V/2A
PF 545	240	Ext. 1000	2	6.3V/3A 6.3V/0.6A
		350	20	4V TAP 2.5/2A
PF 439	240	32V	60	240-32 STEPDOWN

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CF 103	30	420	60
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CF 109	20	225	150
CF 196	20	130	125

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OP 24	5	5000 SE	8.4 OR 2.1	30-15,000 C/S
OP 25	15	10,000 PP	15-3.7 OR 8.4-2.1	20-30,000 C/S
OP 44	10	5000-2500 SE	500, 250, 125	50-8000 C/S
OP 54	10	5000-2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7 2.3, 2.	50-8000 C/S
OP 58	15	10,000, 6600. 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	50-8000 C/S
OP 63	15	10,000 PP	15, 3.75	30-15,000 C/S
OP 112	6	10,000 PP	2, 8 SUIT	40-12,000 C/S
OP 113	6	5000 SE	2, 8 ROLA	40-12,000 C/S
OP 118	6	8000 PP	2, 8 12 OX	40-12,000 C/S

OUTPUT TRANSFORMERS SECOND PREFERENCE

CODE. NO.	WATTS	PRIM Z	SEC. Z	RESPONSE
OP8M	15	10,000 PP	500, 250, 160, 125, 100, 83.5, 75, 62.5, 55, 50	50-8000 C/S
OP 17	32	10,000, 6600, 5000 PP	500, 250,125	50-8000 C/S
OP 19A	15	5000 PP	12.5, 8, 2.3	30-15,000 C/S
OP 65	15	10,000 PP	8.4, 2.1	30-15,000 C/S
OP 67	15	5000 PP	15, 6.5	20-30,000 C/S
OP117	6	5000 PP	8, 2	40-12,000 C/S
OP119	6	6600 PP	2, 8	40-12,000 C/S
OP 60	32	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 7, 2.7, 2.3, 2.	50-8000 C/S

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VT 104	6	250	60	.004
VT 210	12	250	60	.006

VIBRATOR TRANSFORMERS SECOND PREFERENCE

CODE NO.	PRIM VOLTS	D.C. VOLTS	O'PUT MA	BUFFER FULL SEC.
VT 116	24	250	60	.005
VT 208	6	250	60	.01
VT 209	12	250	60	.02
VT 211	32	250	60	.005 ea. half

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TELEPHONES
JA 8491 (6 LINES)

Engineered TODAY for TOMORROW'S requirements accommodated and on the inescapable acoustic properties of such a tunnel.

To avoid this limitation, some overseas receivers carry only a very small "tweeter" speaker at the front of the cabinet, with one or two larger speakers at the sides, handling the low frequency components. This arrangement is claimed to give the illusion of sound coming from the picture area, while not limiting response of the system at the lower frequencies.

Where a special order of fidelity is required, as for selected musical programmes, the obvious course is to provide connections for an external speaker or, better still, an audio take-off point from which the signals can be fed to a remote high-fidelity installation. Under such circumstances, the divorcement of sound and picture may be accepted willingly.

SOUND IF

Two points require comment before concluding this discussion of TV sound systems.

The first is the means by which the intercarrier beat at 5.5Mc. is diverted from the video detector to the sound IF channel, yet is prevented from reaching the picture tube grid. It involves the use of tuned acceptor and "trap" circuits and will be discussed later in connection with video detectors.

The second point has to do with the phenomenon called "intercarrier buzz", which is a frequent topic of discussion in overseas journals covering TV servicing.

A complete discussion of this subject is not called for at this juncture, but a passing reference is justified.

Intercarrier buzz occurs when, for any reason, the 50-cycle frame frequency becomes audible in the sound channel. The term "buzz" is appropriate because the frame signal, irrespective of its source, is an angular waveform and therefore rich in high order harmonics.

The adjective "intercarrier" is not so easily justified, as will be evident from the following remarks. Not all "buzz" type interference is attributable to intercarrier effects, even though they are so described. Nor are they peculiar to receivers which utilise the intercarrier principle of reception.

Buzz is often evident when the sound and picture carriers are intermodulated in the wrong proportions or at points in the receiver other than the video detector. The result is a disproportionate content of AM in the sound carrier, which may not successfully be rejected by the limiter and/or FM detector.

It follows, by the way, from this remark that, even though the root cause of intercarrier buzz may be found in other portions of the receiver, an intercarrier sound system which has a high degree of discrimination against AM components will be more proof against "buzz" than one which is limited in this respect.

CAUSES OF BUZZ

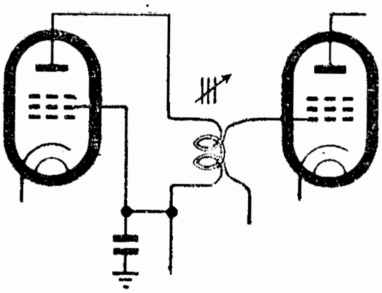
Disproportionate mixing of carriers may be due to mistuning, either inadvertent or because drift has placed the correct tuning position outside the range of the fine control. Such mistuning may place the picture carrier unfavorably in the overall response curve, reducing its apparent strength in relation to the sound carrier.

BIFILAR-WOUND IF TRANSFORMERS

A method of interstage coupling is being employed in the IF channels of locally-built receivers, which was not discussed in part fourteen of this present series.

The method involves the use of transformers with a very high degree of coupling between primary and secondary windings.

Such transformers are normally made by running a pair of wires on



to the former in a single operation, the ends then being separated for connection to the appropriate lugs. In effect, the primary and secondary are completely interwound, turn for turn.

The resulting transformers are described as "bifilar-wound" or "unity coupled".

Because of the high degree of mutual coupling the two windings cannot exhibit separate resonance effects and merely behave as a single tuned circuit, with lumped values of inductance and capacitance.

A single internal slug is normally used to peak the double winding at the required frequency of resonance.

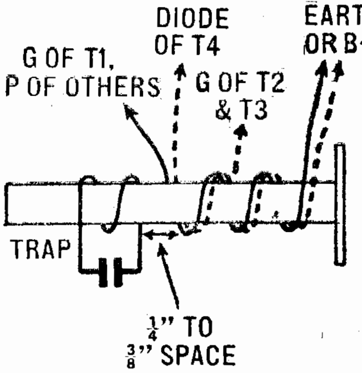
In some schematic circuits, the presence of a single slug is the only hint that an interstage transformer is bifilar-wound. In other cases, as per the accompanying illustration, the schematic is drawn to indicate intimate coupling between the primary and secondary.

Bifilar-wound transformers are often used in IF channels, in association with double-tuned over-coupled types, to give the desired overall response curve.

*As far as **alignment procedure is** concerned, bifilar - wound transformers can be treated as single-tuned coupling circuits, having simple resonance curves and capable of being stagger-tuned, as already described in connection with figures 87 and 88.*

*Compared with single-tuned coupling coils, **bifilar-wound transformers eliminate the need for interstage coupling capacitors and resistors, since the windings themselves provide the necessary coupling and DC return circuits for plate and grid.***

*A further point is that the windings **do not need to have a strict 1:1 turns ratio, so that more satisfactory coupling can be made between stages***



involving unsuitable values of valve impedance or valve capacitance.

A simple application of bifilar-wound transformers is found in the article on page 64 of our last issue. The construction of a bifilar transformer is illustrated on page 64 (reprinted herewith), while the circuit of a video IF amplifier using several such transformers is shown on page 67.

It is interesting to note the associated trap circuits and the bifilar principle applied to the construction of a ratio detector transformer.

Another frequent cause of the trouble stems from excessive signal strength, which may overload one of the later IF stages. The chance of such trouble is accentuated by an inadequate AGC system or by the unwarranted use of a high-gain aerial system in a high signal level area.

In the presence of such overload, intermodulation of the signals is inevitable and it is a matter of chance as to what the proportions will be and how the resultant will add to that produced separately in the video detector.

In critical cases, misalignment of the IF channel may aggravate the trouble or even frequency discrimination effects in an aerial system or its feeder cable.

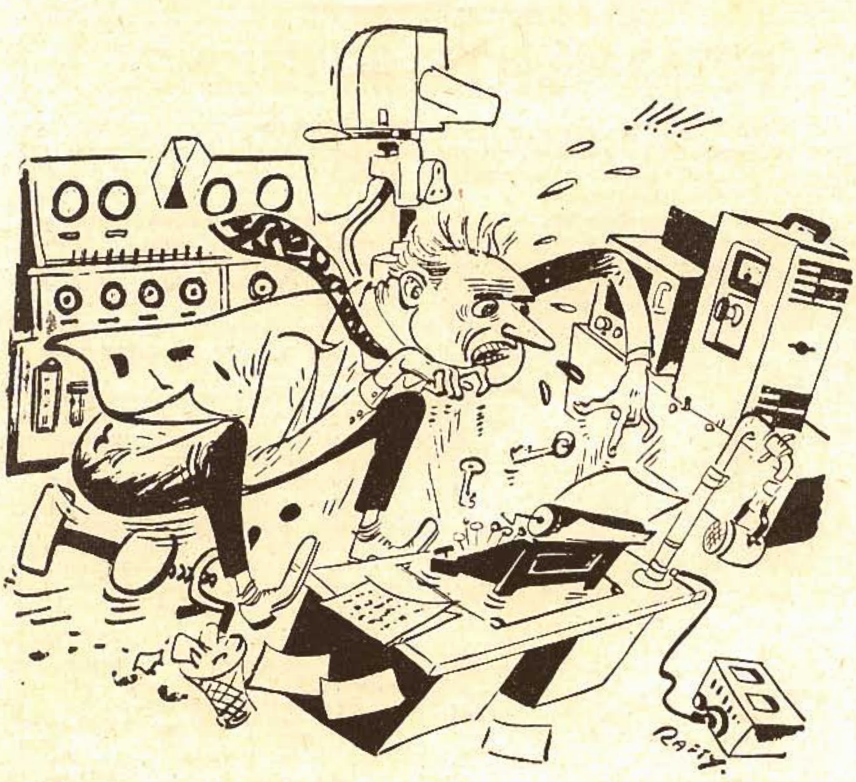
Distinct from these effects, which stem mainly from the transmitted signals is the possibility of interference from the receiver's own frame circuits.

Shortcomings in the layout of the chassis may allow energy from the frame deflection circuits to be induced into the actual audio circuits. Alternatively, depreciation of filter or decoupling capacitors may allow coupling through the power supply, sufficient to cause trouble.

Occasionally, these various effects can operate in reverse, allowing sound energy to penetrate the picture channels. The picture may then contain a background of random patterns which vary in sympathy with the sound modulation.

These are possible problems which warrant mere mention at this stage. How to identify and correct them would belong more correctly to articles dealing specifically with servicing television receivers.

(To be continued)



Let's Buy An Argument

A couple of weeks ago, a member of our technical staff walked into the office with a puzzled look on his brow and a textbook two inches thick in his hand. "Tell me", he said, "Am I mad, or the fellow who wrote this book?"

by Neville Williams

Seeking the right word for the occasion, I simply told him that I'd have to consider the matter carefully before offering a final opinion. In the meantime. I didn't think there was cause for immediate alarm and that his rate of mental deterioration did not appear to have increased unduly during the past weeks.

Why his present agitation?

A STICKY ONE

With shaking fingers he opened the book about one-third the way through and indicated a section dealing with screen-grid valves.

It was an old book, written when screen-grid valves were much younger, but a book that even a modern student might take seriously.

I began to read, without any special reaction. In quite conventional fashion, the writer emphasised the presence in triode valves of grid-plate capacitance and showed how it led to oscillation troubles when such valves were used in tuned RF or IF stages.

The discussion was supported by a diagram something like figure 1a.

It was then pointed out that the capacitance and the tendency to oscillation could be reduced, as in the screen-grid valve, by the interpolation of an additional electrode (the screen) between grid and plate.

So far so good.

What had rocked our friend was the explanation of how the screen came to produce this most desirable result. I quote:

> **"This reduces the effective capacitance between the plate and grid . . . by the same reasoning that connecting condensers in series reduces their effective capacity."**

I looked at the paragraph, at the accompanying diagram (figure 1b) then at my questioner.

"Tell me," he said . . . "If I have a simple air-spaced capacitor and push a metal vane between the two plates without touching either, what effect will it have on the capacitance?"

I could only suggest that such a manoeuvre must increase the capacitance between the original plates, provided their spacing remained unaltered and the additional metal vane was left "floating" in the electrical sense.

"Exactly," he agreed. "That's why I asked the question."

On this reasoning, the simple interpolation of a screen grid would INCREASE rather than decrease grid-plate capacitance. In other words, the explanation given in the textbook was incomplete, misleading and, to all intents and purposes, wrong.

The sanity of our worthy staff member was vindicated; either that or we were both mad!

CAPACITOR ACTION

Let's look again at this manoeuvre of inserting a metal vane betwen the plates of a simple air-spaced capacitor.

Such a capacitor is illustrated in figure 2a, just two plates of given area and separation, with a **mutual** capacitance shown as C1.

In figure 2b, the plates are undisturbed but a third metal vane has been inserted midway between them. The capacitance between the two original plates can now be regarded as the series resultant of C2 and C3.

But is this less than the original C1? Ah no!

Since the original spacing has not been disturbed and since the central vane must have finite thickness, the separation between adjacent surfaces in figure 2b must be LESS THAN HALF that in 2a.

Since capacitance is inversely proportional to spacing, C2 and C3 must each be more than double C1. Therefore their series value, equal to half either one, must itself be greater than C1.

The capacitive coupling between the two outer plates would be greater in (b) than in (a), the centre vane following a signal potential about midway between the other two.

IT'S FALLACIOUS!

What is true of figure 2b must be true also of 1b, so that the explanation of the screen's action in terms of series capacitance is plainly fallacious.

Even if, for other reasons, the interpolation of a screen allowed grid and plate to be separated by a greater distance, the decrease in grid-plate capacitance could only be proportional to the change in distance, representing a factor of perhaps three or four times.

Yet if we compare a triode with a pentode of like order and construction, the grid-plate capacitance may be found in one case to be 2pf, in the other .005pf —a ratio of 400:1. That's just too much to be explained away in terms of a simple series-capacitance effect.

In actual fact, this "series-capacitance effect" has very little to do with it and the real explanation is found in figure 2c. The vital difference is that the centre vane is now shown as being earthed or, in more general terms, connected to a point of zero potential with respect to the other two plates.

The capacitance quantities C2 and C3 still exist and their series resultant would be unaltered but there is a very practical difference as compared with 2b.

EARTHED VANE

If an alternating potential were introduced on to say the left-hand plate in 2c, displacement current would flow through C2 to the centre vane. But this vane is earthed and it therefore cannot acquire any potential at the signal frequency.

Furthermore, since the centre vane is unable to vary in respect to earth, it cannot communicate any signal voltage to the right-hand plate through C3.

Obviously, if the centre vane was made large enough, there could be no coupling between the outer plates. In the dynamic sense, there would be no capacitance between them, despite the presence of C2 and C3.

This is precisely the situation in a tetrode or a pentode valve. If measurements were made on a conventional capacitance meter, quite obvious values of capacitance could be discovered between grid, screen and plate.

However, in practical circuits, the screen of a tetrode or pentode is not permitted to vary at the signal potential. It cannot therefore be party to the transfer of signals between grid and plate, but rather acts as a shield between them.

Being of necessity an open spiral, the screen cannot provide complete shielding and some residual transfer of energy takes place by capacitive coupling through the spiral and around the ends of the electrode assembly. The coupling is small, however, being equivalent to that produced by a capacitance of .008pf, or thereabouts, in an ordinary pentode.

In a normal valve structure it is not practicable to place a fine-spiral screen between grid and plate and simply connect it to earth or cathode. The almost certain result would be to prevent the plate from attracting electrons, with the result that little or no plate current would flow.

To prevent this rather disastrous result, it is customary to apply an intermediate value of HT voltage to the screen, so that electrons emitted from the cathode are initially attracted toward it through the turns of the control grid. On approaching the screen, however, most of the electrons are then attracted to the more positive plate beyond.

This "two-stage" movement of electrons is important in understanding certain other characteristics of a pentode or tetrode, as we shall see later.

The fundamental shielding action of the screen is preserved by connecting a bypass capacitor between screen and chassis. The bypass has to be of sufficiently large capacitance to prevent the screen from varying its potential at the signal frequency.

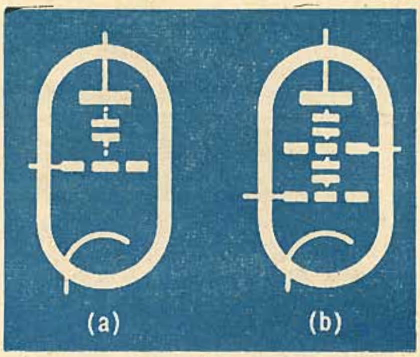


Figure 1: These diagrams, similiar to the ones in the original textbook purport to show how interpolation of the screen between grid and plate in a valve operates by virtue of the "series-capacitance" effect.

It's just a question of time constant and storage effect. If the signal frequency is high, as in an RF or IF amplifier, a quite small bypass capacitor will often suffice. In an audio stage, particularly where the screen is fed through a low value resistor, a much larger bypass may be necessary.

So much for the shielding effect of the screen, but the story doesn't end there by any means.

In audio service, the effect of grid-plate capacitance is not very important in terms of circuit stability, though it can have a roundabout effect on treble frequency response.

In such service, one is usually much more aware of the effect of the screen on other valve characteristics.

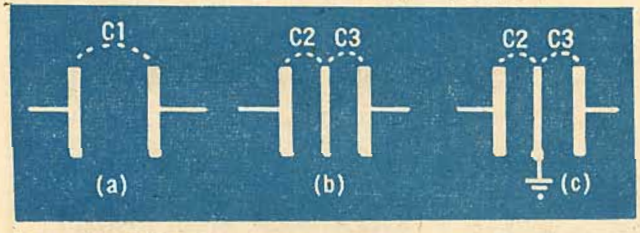


Figure 2: Three steps in the discussion. Diagram (c) is the important one in relation to screen-grid valves.

For example, the attractive force which operates initially on electrons emitted from the cathode is largely proportional to the screen voltage. The plate is much more remote from the cathode, electrically, and only has a second order effect on the number of electrons attracted from it.

In fact, it is possible to vary the plate voltage of a pentode or tetrode over quite a large range without making much difference to the plate current.

By definition, the internal plate impedance of a valve is dependent on the proportion of a small change in plate voltage to the change in plate current which it produces, all other voltages remaining fixed. It's just a straight application of Ohm's law to the plate circuit of a valve.

When we state, as in the previous paragraph, that a large change in plate voltage causes a relatively small change in plate current, we are simply saying that the valve concerned has a high effective plate resistance.

And that is a fact. Whereas plate resistance figures for triodes run from about 1000 to 100,000 ohms, the figure for pentodes and tetrodes runs from about 50,000 ohms to several megohms.

The curves look quite different, too, as indicated in figure 3. Whereas the plate current of a triode rises in fairly linear fashion with increasing plate voltage, the pentode and tetrode curve rises sharply, then flattens off. Over this region, the major useful portion of its curve, plate current is very little affected by plate voltage.

MORE GOOD GEN

Such is the story of pentode plate resistance, as I have come to understand it. But alas, in the aforementioned textbook I found this "enlightening" explanation:

"Incidentally, the alternating plate resistance of the screen-grid tube will also be greatly increased by the reduction in tube capacitance. . . ."

The clarity and logic of the statement appealed to me in much the same way as a little ditty I remember that runs something like this:

"The elephant is a wondrous bird
That flits from bough to bough;
It makes its nest in a rhubarb tree
And whistles like a cow."

Finally, and for good measure, I came upon this shattering statement:

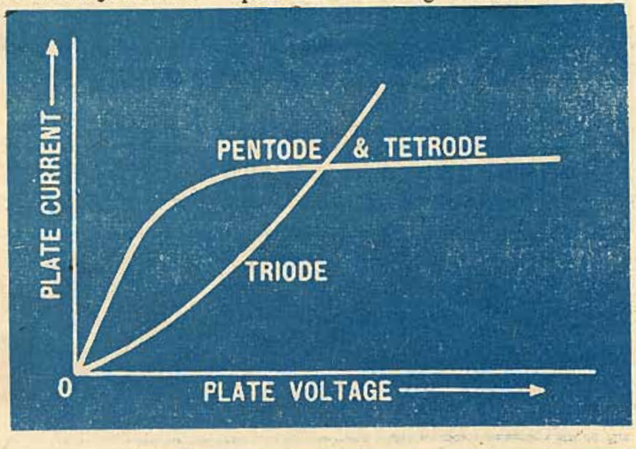


Figure 3: Presence of the screen in a pentode or tetrode completely changes the plate current characteristic. This results in very high values of plate resistance and amplification factor—a very different story from the one told in the textbook under discussion.

"Also, in view of the greatly reduced electrostatic field within the tube, the amplification factor, or mu, of the tube is greatly increased . . ."

If this statement is true, then I'm a Dutchman!

Thans Zullen enkele, in de platentechniek veel gebruikte, begrippen onder de loupe worden genomen.

(Anyone wishing to repeat this gag can have a piece of the Dutch mag. from which I copied the above sentence.)

Just what is amplification factor?

According to definition, it is the ratio of a change in plate voltage to a change in grid voltage necessary to effect a given change in plate current. Thus, if a 20-volt change in plate voltage produces the same effect on plate current as a 1-volt change in grid voltage, then the amplification factor must be 20.

BACK TO THE CURVE

Well, now, if you look at the pentode case, as illustrated in figure 3, it is apparent that quite large changes in plate voltage are necessary to effect a given change in plate current. If this same change in plate current can be brought about by a small change in grid bias, then the amplification factor, as per the definition, must be high.

To attribute the difference directly to valve capacitance is just plain "hooey"—or am I mad, after all?

Changing the subject, a letter from South Australia takes us to task about an omission from the article on Television Standards in the November issue. Why didn't we explain the reason for the post-synchronising pulses?

This is a clear case where confession is good for the soul.

When the article was in the course of preparation, we had quite a confab about these selfsame pulses, and frankly could not see why they were necessary. So, forthwith, we grabbed the phone and started throwing the question at all the prominent lecturers and engineers we could think of.

The answers didn't help us much:—

"Dunno, mate."

"Search me."

"Man, that's quite a question!"

"Ay um nodd doo zertun. . . ."

"I say, old chap, I really don't know!"

We suspected that it might have something to do with controlling recovery time in the frame oscillator.

Someone else suggested that presence of the pulses was all part of the mechanism at the station for trying in accurately with the half-line synch.

LEAVE THEM OUT?

Station engineers denied this and said that they could put in the post synchronising pulses or leave them out at will.

Furthermore, they had tried doing this while watching the pattern on typical modern receivers, and had noted not the slightest difference.

Their only interest in the matter was to conform with standards.

There was reason to believe that some types of time base required equalisation and control after the frame pulses, but what they were and whether still in use was not immediately obvious.

At about that time, the Editor came in, full of purpose and determination, and made a quite eloquent speech about Press dates, blank pages and such like.

Since the point didn't appear to be very important, it was therefore bypassed with just the mere hint that it was not very significant in current receiver design.

We still haven't had time to chase it up, and why should we, with G.T. just bursting to put pen to paper?

Go to it, G.T., and tell us all!

ABOUT POST-SYNCH. PULSES

Dear Sir,

Perhaps I can "Buy An Argument" or something.

In your article "Australian TV Standards" in November issue, page 74, you make no attempt to explain the existence in the synch. wave form of "post" equalising pulses.

Of course, this puts you in the same class as other authorities such as Fink, Chinn and about 20 other authors of textbooks which I have been through. They all ignore the subject except a couple who give it a vague sentence about discharge time constants of the integrating circuit.

This is right off the beam. They all explain pre-equalising pulses and then go on to blanking or something.

Your heading . . . "Synchronising signals, a subject not always well understood" is apparently very true.

If you really don't know the reason for their existence, I would be only too pleased to explain it to you.

As a clue to work it out yourself, some receivers would operate perfectly without any post equalising pulses, but others would only give sequential scanning, depending upon the type of vertical timebase used.

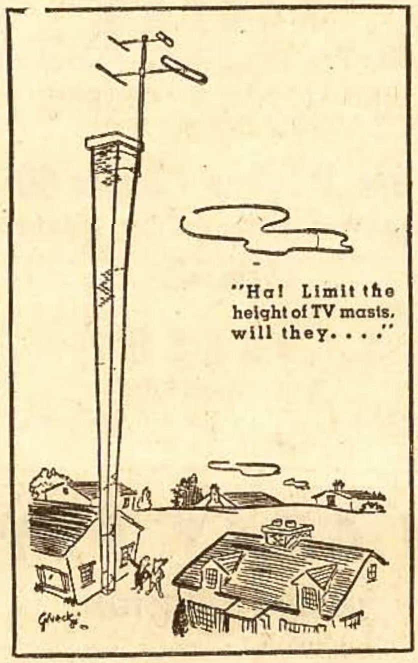
If you do know, you may be able to tell me why nobody prints any information on the subject.

Yours faithfully, G.T.

TV DISTORTION

Last month I made some remarks about the distortions of one kind and another, which are apparent in many receivers currently being sold. In case you didn't notice, the remarks were couched in vaguely humorous terms, though having real point behind them.

After an examination of a few more screens and test patterns, I'm not so sure about the funny side of it.



As one of his observations from overseas, the Editor warned us to expect distortions and maladjustment as all part of the television scene. His warning looks like being amply justified.

In a group of five new receivers inspected only 10 minutes before writing these remarks, not one of them could be said to have a first-rate picture.

In two receivers the hum level was sufficiently high to produce an intensity change drifting slowly downwards across the face of the screen.

In another receiver, the intensity was constant enough, but hum was apparent as a ripple running gradually down the vertical lines of the test pattern.

The fourth receiver was relatively free from these effects, and may have been capable of first-class results, but the test "circle" had all the shape and character of a decorated melon.

FIXING

A salesman who happened to overhear a remark on the point, made a series of apologetic gurgles, whipped open the trapdoor covering the picture adjustments and "fixed" things by increasing the picture height.

The "melon" changed from the water to the jam variety; but, of course, the outer fringes and the corners of the picture disappeared behind the mask.

When we discreetly suggested that perhaps he should have reduced the width instead of increasing the height, he fumbled a bit more and discovered that the width control was already at minimum setting!

Perhaps his remark about "sets varying all over the shop" was justified in more ways than one.

As for the fifth receiver, the least said the better. The brightness was set to the point where flicker was painful; the picture was "crawling" with noise, and the whole thing so blown up that only the middle portion of the test pattern showed through the mask.

Perhaps I should have made my little story about the singer more elaborate. There's certainly plenty of scope.

Simon Gray
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WHAT MAKES IT WARM MY HANDS?

This is the first in a series of articles designed to explain the elementary theory of radio and electronics. Although there will be continuity between them, each article will be complete in itself, and designed to help more particularly those who are just beginning their interest in the art. The series should be completed in about 12 issues of the magazine.

☆

He doesn't know it, but this little chap is warmer through the movement of electrons

☆

ALL good stories of our childhood began, it seems, with the phrase, "Once upon a time." In like manner, most elementary radio textbooks begin with a discussion of the electron theory—and surely that is the logical place to make a start.

One can never hope to understand the principles of modern radio and electronic apparatus, without a working knowledge of electrons and their behavior.

Once having grasped the idea of electrons in motion, the question of electrical current ceases to be a mystery. You will see immediately the significance of terms like conductor, insulator, resistor and so on.

Let's start then with a little bit of chemistry or physics—call it what you like.

Scientists tell us that all matter, whether it be solid, liquid or gas, is composed basically of minute electric charges, of which there are two main varieties.

First of these is the ELECTRON, which may be defined as the smallest possible quantity of negative electricity. Its opposite number is the more massive PROTON, which is an electric charge of the same magnitude, but of opposite or positive sign.

ELECTRIC CHARGES

Just what electrons and protons are is the subject of much discussion but, for our purpose, it is sufficient to define them as electric charges, and to use the term without further qualification.

Electrons and protons do not normally exist alone but are naturally associated in a combination, which bears striking comparison with the planetary system of which our world forms a part.

If it were possible to peer into these sub-microscopic realms, we would behold a host of miniature planetary systems. In each, we would see a proton, or a group of protons and electrons, forming a nucleus and, whirling around them, a number of single electrons.

In actual fact, each tiny planetary system constitutes an atom of a particular substance. And, from our chemistry, we know that an atom is the smallest particle of any substance obtainable by chemical separation, or capable of entering into chemical combination. One hundred million of them, arranged end to end, would just about equal in length three words of this type.

Although no one has ever seen a single atom, or the electric charges which compose them, scientists have been able, by roundabout means, to deduce quite a lot of information about them.

They know, for example, that the simplest of the lot is the hydrogen atom, which has a single proton as a nucleus, with a single electron spinning around it. A helium atom has two protons with two planetary electrons. An atom of lithium has three protons in the nucleus, two electrons whirling on an inner orbit and a single electron on an outer orbit.

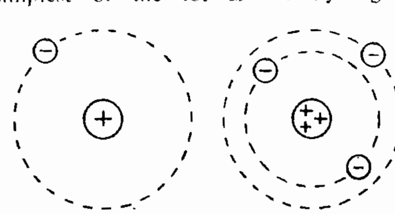


Figure 1 Atoms consist basically of one or more electrons revolving around a positively charged nucleus. The sketch is not to scale.

Every atom is electrically balanced in its normal state. The three examples just quoted contained respectively one, two and three positive and negative charges each.

This state of affairs is maintained in even the very complicated atomic structures. An atom of copper, for example, has 64 protons and 35 electrons grouped in the central nucleus; but the excess positive charge here is exactly balanced by the 29 electrons which revolve on various orbits around the nucleus.

IDENTICAL ELECTRONS

It is important to note that the electrons and protons comprising the various atoms remain simply electric charges. An electron associated with a hydrogen atom is identical to one in a copper atom, even though it may be placed differently in the structure.

The particular combination of protons and electrons determines to what chemical element the atom belongs. The number of basic chemical elements is believed to total 92, which means that there are 92 different atomic structures.

Theoretically, at least, some atoms can exist in the solitary state and exhibit all the chemical properties of the element in bulk; typical are the atoms of the rare gases helium and neon. Such atoms may also be referred to as MOLECULES.

In the case of other elements, the atoms, for chemical purposes, are normally found in groups of two or more, and these atomic groups are also known as molecules.

A third variety of molecules is that belonging to a chemical compound, in which unlike atoms are found in combination.

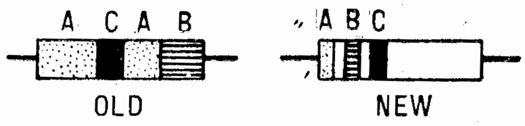
In short, a molecule can be defined as "The smallest portion to which any given substance can be divided, without altering its chemical properties".

The chemical compounds in existence are without number but they are all produced by varied combination of the 90-odd basic elements; they are built from the 90-odd atomic "bricks".

It is hard to realise that the most un-

If you can memorise at least the commonest resistor values and their color codes, much time will be saved when building up your radio gear. A standard chart is given at the right.

RESISTOR COLOR CODE



A—Color for 1st significant figure.
B—Color for 2nd significant figure.
C—Color for No. of noughts.

COLOR	SIGNIFICANT FIGURE	No. OF NOUGHTS
Black	0	—
Brown	1	1
Red	2	2
Orange	3	3
Yellow	4	4
Green	5	5
Blue	6	6
Violet	7	7
Grey	8	8
White	9	9

EXAMPLES

47000 ohms	Yellow-4	Violet-7	Orange-000
1000 "	Brown-1	Black-0	Red-00
68 "	Blue-6	Grey-8	Black —

interesting, the most inert substance one can imagine is composed of countless atoms, with their numerous swiftly moving electrons. Indeed, the speed with which each individual electron revolves in its orbit is enormous, despite the fantastically small circumference of even the largest atom.

But there are other matters of more immediate interest to the reader of this article. The outer electrons in many types of atom are rather wayward in certain conditions and it is not uncommon for them to wander rather aimlessly into the structure of an adjacent atom.

This leaves the original atom short of an electron so that, for a very brief interval, it may have an excess positive charge. In other words, the loss of an electron has upset its electrical balance.

ATOMS AND IONS

Atoms in this state are known as IONS. They are said to be positive ions if they have lost an electron, and negative ions if they have perchance acquired an extra electron.

A fundamental principle of electricity is that like charges repel and unlike charges attract. (See figure 2.) The operation of this principle soon corrects the state of unbalance created by a meandering electron. The positively-charged atom (ion) immediately attracts an electron from elsewhere, while the negative ion quickly disposes of one surplus electron.

Naturally, nearby atoms are disturbed in the process, so that there may be a continuous and random movement of electrons within the confines of the particular piece of material.

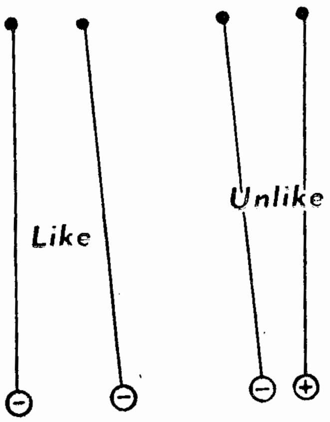


Figure 2. Illustrating the principle that unlike electric charges are mutually attracted, like charges repel.

This movement can often be greatly accentuated by the application of heat and the agitation can actually become so violent that some electrons momentarily jump off into space.

Such movement is purely random in character and the average movement of electrons in one direction is exactly balanced by electron movement in the opposite direction.

However, it is possible to alter this state of affairs so that there is a defined movement of electrons in a certain direction through the substance. Any such clearly defined electron movement in a given direction through a substance is known as an ELECTRIC CURRENT.

All readers will have handled an electric battery at some time or other, in one of its many forms. This general subject will be treated in detail in a later article; it is sufficient to state just here that a battery is a device which, by electro-chemical action, can produce a surfeit of free electrons at one terminal and positive ions at the other.

Between its terminals is built up an electric pressure which, in electrical parlance, is known as an electro-motive force (EMF) or, more simply, a potential.

In figure 3, we see a piece of copper wire connected between the terminals of an electric battery. We can expect the positive terminal to exercise a strong attraction for the outer electrons in the nearest atoms. This, indeed, is the case and a definite movement of electrons becomes evident in the direction of the positive battery terminal.

At the other end of the wire, the negative battery terminal is quite ready to part with some of its excess electrons, and these go to replace those lost to the positive terminal. The potential or EMF of the battery thus initiates an electric current through the copper wire, the electrons moving from the negative to the positive terminal.

Unfortunately, in making this statement, we run up against an apparent contradiction. The early pioneers knew nothing of electrons, although they could observe the effects of electric current and potential. So charges were labelled "positive" and "negative" for identification, after which they reasoned that current must flow from positive to negative.

WRONG CONCEPTION

Unfortunately they were wrong and we can do no better than brand their ruling as the "conventional" direction of flow. But, for our own clarity of thought, let us remember that true electric current is a movement of electrons, and that is always from negative to positive.

Electrons are far too minute to be useful as a measure of current flow, and the standard unit is the AMPERE, generally abbreviated to the AMP.

Actually a standard ampere is defined as "The unvarying electric current which, when passed through a solution of silver nitrate in water deposits silver at the rate of 0.001118 gram per second". There is no point in trying to remember this definition but it has served as the standard by which measuring equipment could be adjusted.

For purposes requiring a smaller unit than the ampere, we have:

1 milliampere equals .001 amp.

1 microampere equals .000001 amp.

Conversely:

1 amp equals 1000 milliamperes

1 amp equals 1,000,000 microamperes

These relationships should be mem-

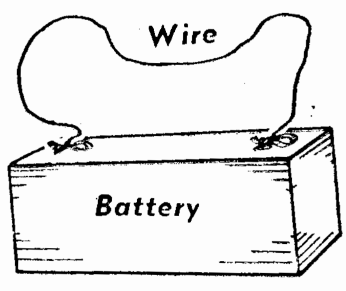


Figure 3. When an external agency causes electrons to move in a specific direction through a conductor, the phenomenon is described as the flow of an electric current.

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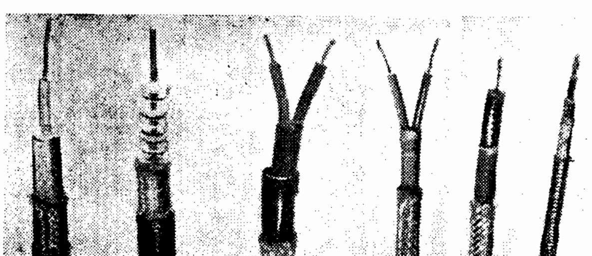

WIRES AND CABLES

The following ex Disposals cables are available. They were manufactured for use mainly in Aircraft but they are useful for Radio and Automotive use also.

(A). Coaxial cable, solid polystyrene insulator, copper braided with plastic outer covering, 70 ohms impedance, at **2/3 yd.**

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(F). 7-core plastic insulated cab-tyre cable with rubber outer insulation. Easily stripped of outer covering to make ordinary radio 7 010 hook-up wire **Only 1/6 yd.** Each yard makes 7 yards of hook-up wire.

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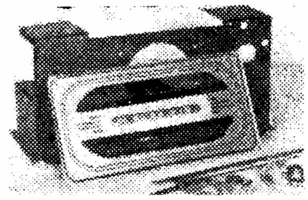
(H). Single core, multistrand copper wire with plastic insulation. Ideal for car wiring, caravan wiring etc. **Price only 4d yd., or 25/- 100-yard reels.**

(I). 7-core plastic insulated wire with lacquered cotton outer insulation. Price only **1/6 yd.**



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Consists of: Chassis, dial movement, dial glass. Chassis is drilled for standard components. Size of chassis 15in long and 6¼in wide, 7¼in high. This kit is well worth £2/10/-. **Our price is only 19/11.**

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2. Reinartz coils, brand new and perfect. Normal price 8/6. **Our price 4/- each.**

3. Ribbed bakelite coil formers, 1¼ inches diameter. Ideal for short-wave coils.
4-pin .. .. **2/- each**
5 pin .. .. **2/3 each**
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4 IF Transformers, 455 Kc, brand new. Worth 15/. **Our price, 7/6 each.**

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6. ½ meg. Switch pots. Worth 8/6. **Our price 4/11.**

7. 7C7 Valves, suitable for use as RF or AF pentode 6.3 volt filament. Brand new and boxed. **Price only 3/6 each.**

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12. AIR DIELECTRIC TRIMMER CONDENSERS. 19 plate ceramic insulation, capacity 10pf to 100pf. **Only 2/6 each.**

13. 250 ohm rheostats, 25-watt wire wound on mica former with porcelain insulation. **Price only 4/6 ea.**

14. P.M.G. type relays, DC resistance of coil 250 ohms, 1-SP and 1-SPDT switch on each. **Price only 7/6 each.**

15. TELEVISION AERIALS, folded dipole type supplied complete with 6ft dural mast, impedance of aerial 300 ohms. A really good aerial **sacrificed for £3/19/6.**

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18. BAKELITE SUITCASE HANDLES. Very strong and comfortable, brown, ivory and walnut colors available. **Price only 2/6 each.**

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The accepted unit of electro-motive force (EMF) or potential is the VOLT. A battery may typically be defined as having an EMF between its terminals of, say, 1.5 volts. Alternatively we may state that its VOLTAGE is 1.5, or any other figure which might apply.

Larger and smaller terms for defining voltage are:

1 kilovolt equals 1000 volts
1 millivolt equals .001 volt
1 microvolt equals .000001 volt

Alternatively:

1 volt equals .001 kilovolt
1 volt equals 1000 millivolts
1 volt equals 1,000,000 microvolts.

Coming back to figure 3, we must not imagine that the path of any individual electron through the copper wire is unimpeded, like a meteor through outer space.

It leaves the negative terminal and collides with the first atom in its path. It may take its place in the planetary system of that atom, while the electron it displaced moves off toward the positive battery terminal. An instant later it may itself be displaced, allowing it to move on again. So each electron moves along in a bumping, hectic fashion, like a man trying to hurry through a dense, milling crowd.

By its very structure therefore the copper offers some resistance to the passage of the current.

CONDUCTORS

For all that, the current passes easily enough, so that copper is one of the substances classified as a CONDUCTOR of electricity. Into this general classification fall the various metals, carbon and certain other substances and liquids. Some offer more resistance to current flow than others, but all are conductors.

In another group are a large number of substances in which there is practically no transfer of electrons from atom to atom, either with or without external electric pressure.

USE OF INSULATORS

Substances which will not pass electric current, or do so only to a negligible degree are generally known as INSULATORS. Some substances are very useful in this respect, maintaining their insulating properties despite heat and extreme electric pressure.

Other insulators can withstand only moderate heat or electric pressure before charring takes place, with a complete breakdown of the insulating properties.

Typical insulating materials are ebonite, mica, shellac, silk, oil, and dry air, and most modern plastics.

Insulating materials are used to support, isolate or contain conductors which are part of an electric circuit. Because no appreciable current can flow through the insulating materials, their presence does not—or should not—affect the operation of the circuit.

A good illustration of conductors and insulators in combination is seen in the plug and socket arrangement in figure 4. When the two units are fitted together, current can flow via each individual pin and its contact. The surrounding bakelite provides the necessary mechanical support, but does not allow appreciable electron transfer between individual pins.

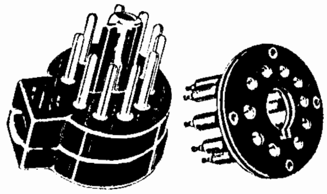


Figure 4. Electrons can move along conductors but not through insulating materials. Each therefore has an important part to play in electrical apparatus. Illustrated above is a plug and socket.

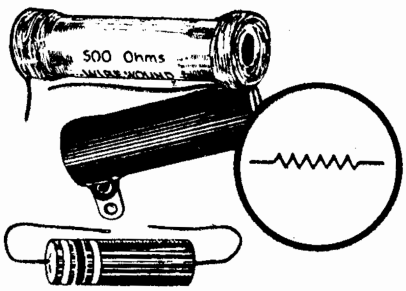
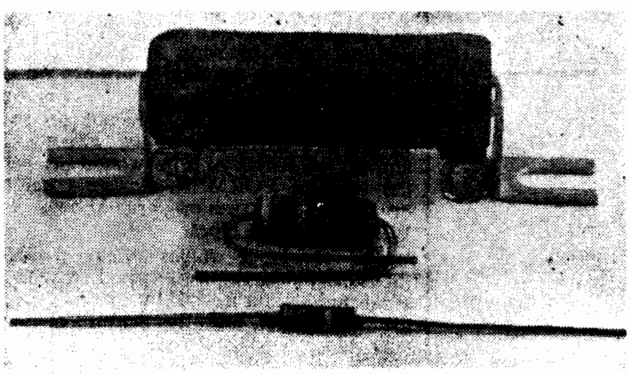


Figure 5. A group of resistors, each offering a specific degree of opposition to the flow of an electric current. The schematic symbol is shown in the circle.

As we shall see in late chapters, there is a very definite place in electrical circuits for substances which can be classed as neither good conductors nor good insulators; in other words, for substances which offer considerable resistance to the passage of current through them.

The connection of a copper wire between the terminals of a battery, as in figure 3, would result in a heavy flow of current, sufficient probably to discharge the battery.



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This picture shows some standard type resistors used in today's radio equipment. The resistor at the back is a 20-watt type, the smaller ones in front being 1 and ½ watt.

☆

A longer connecting wire would tend to reduce the current by reason of the longer path the current would have to traverse. Substitution of a finer gauge wire would have the same effect, since much reduced cross-sectional area is available for the electron movement.

By substituting an iron wire for the copper, still greater resistance would be evident, with a consequent reduction in current flow.

In other words, by deliberately introducing resistance into a circuit, it is possible to limit or control the current flowing, exactly as a tap controls the flow of gas in your domestic range.

Actually, there are other uses for this property of resistance in an electrical circuit, but the above remarks will be sufficient for the time being.

UNIT OF RESISTANCE

The basic unit of resistance is the OHM, which is that amount of resistance which will limit the current through a circuit to exactly one amp, when the applied EMF is 1.0 volt.

For very high values of resistance, it is more convenient to speak in terms of MEGOHMS.

1 megohm equals 1,000,000 Ohms.

Resistance values up to about 10,000 ohms are generally expressed directly in ohms but, between 10,000 and 500,000 ohms, they are commonly expressed as decimals of a megohm. It is easier to say and write 0.1 meg. than 100,000 ohms, although both terms mean the same thing. Above 500,000 ohms, megohm values are used almost invariably.

Coming to the practical side of the matter, many substances exhibit sufficient opposition to the passage of an electric current to suggest their use in a circuit as a resistance element; naturally their physical adaptability is also an important consideration.

Certain metals and alloys, for example, exhibit quite high resistance, compared to copper, and lend themselves for the purpose. Carbon, too, is the basis for some resistance elements.

RESISTORS

To facilitate the inclusion of a specific amount of resistance in an electrical circuit, component manufacturers produce small units knowns as RESISTORS. For resistance values up to a few thousand ohms, these units consist generally of a length of so-called "resistance" wire, wound spirally on a tube of cardboard, glass, porcelain or other suitable insulating material.

The wire is joined to a terminal at either end, or to a lug or bare copper lead, to facilitate soldered connections. The resistor is then coated with lacquer or enamel to protect and locate the individual turns of wire, and it is finally branded with its nominal resistance value in ohms.

The actual resistance depends on the nature and the gauge of the wire used, and on the length of wire wound around the tube or FORMER. Resistors made up after this fashion are known as WIRE-WOUND types.

For resistance values above a few thousand ohms, the wire-wound type presents manufacturing difficulties, owing to the fine gauge and the nature of the wire which would have to be used, and, also the bulk of the finished component.

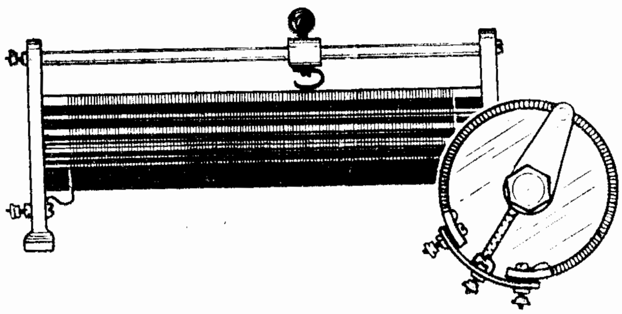


Figure 6. The usual variable resistor incorporates a fixed resistance element and a moving arm to make contact at any point of its surface.

As a result, an alternative type of resistor is generally used. Finely divided carbon or similar granules are mixed with a non-conducting binding material and moulded into small rods. The proportion of carbon and binder and the physical dimensions govern the ultimate resistance of the small rod. This basic element may be moulded into a bakelite tube for further protection or simply coated with lacquer or enamel.

Some carbon resistors are made by spraying a carbon compound on to the surface of an insulating rod, the nature and thickness of the coating determining the resistance of the layer.

Two copper "pigtails" for soldering, complete the assembly of these so-called CARBON RESISTORS. Like the wire-wound types, they may be branded directly with their nominal resistance value

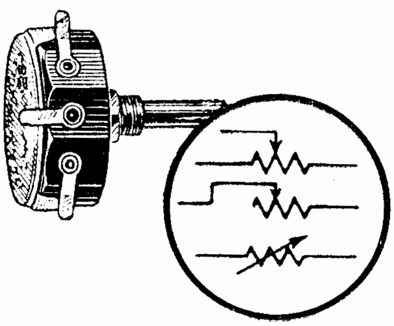


Figure 7. A modern potentiometer and the schematic symbols for two- and three-connection variable resistors.

or distinguished by means of a color code.

The standard RMA color code is included for reference. It will be seen that the color of the body, the color of the end and of the band (or dot), all have a special significance.

When current flows through a resistor, the erratic movement of the electrons and the resulting electron friction absorb energy from the source of current, which is made evident in the resistor as heat.

Without being more precise just here, the heat generated can be expressed in WATTS. The amount of heat which any resistor can DISSIPATE is closely related to its physical size and to the ability of the associated insulating materials to withstand the effects of increased temperature.

Resistors commonly used in radio work, and illustrated in figure 5, range from one half to two inches long and carry dissipation ratings of from .25 to 20 watts. Larger resistors are available for special purposes.

The association of resistance and heat is best illustrated by certain common household electrical appliances.

LIGHT GLOBES

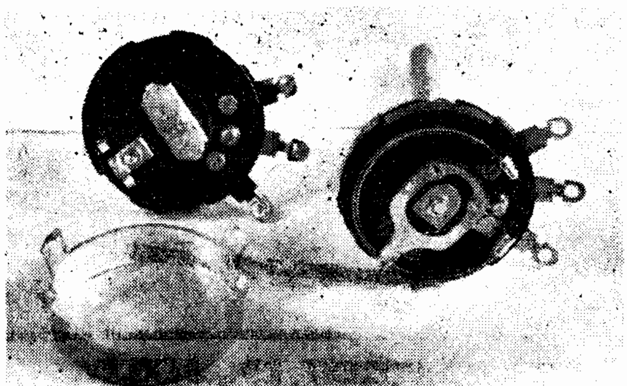
In the ordinary electric light globe, the filament is, in reality, a small but carefully designed resistance element. When connected to the specified EMF or voltage, a current flows which is of sufficient magnitude to raise the temperature to a white heat; the exclusion of oxygen from the glass envelope prevents the filament from disintegrating chemically.

In the electric radiator or toaster, the resistance element is more bulky and is designed to dissipate from 500 to 1000 watts, glowing at red heat in the process. This red hot glow supplies the desired warmth.

In figure 5 you will note a circle containing the first of many rather mysterious symbols. The zig-zag line is actually the schematic symbol for a resistance.

When electrical or radio engineers are depicting an electrical circuit, solid lines represent wires or connecting links. This is simple enough, but it would be a nuisance to have to sketch a resistance in detail whenever one had to be shown in a particular portion of a circuit.

(Continued on Page 109)



☆

An exploded view of two types of potentiometer, one a carbon strip type for higher values and the other a wire-wound type for values below about 10,000 ohms

☆

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NEW BOOKS

HI-FI YEAR BOOK, editored by Miles Henslow. Soft cover, 180 pages. 15/- posted.

This is an English publication—a matter of some importance to the Australian reader, since he is already familiar with much of the equipment described.

The first chapters are devoted to a brief history of the phonograph and of grooves and styli, and this in itself makes most interesting reading. This is followed by a description of the making of a modern LP recording.

Then follow two chapters on acoustics and a chapter devoted to the eternal question: What is hi-fi? As if to answer it, the next chapter sets out to define the requirements of hi-fi. The following two chapters discuss styli and pickups.

After the general discussion on pickups comes a manufacturer's directory in which are listed a selection of high-quality pickups along with their manufacturers' technical specifications. This procedure is followed for the chapters on motor units, amplifiers and control units, radio tuners, speakers, tape recorders, and individual components for the home-builder.

The data contained in these directories is a valuable addition to the general information discussed in the preceding chapter, making a very complete record for reference purposes.

There are also chapters devoted to the BBC FM services, FM tuners and broadcast tuners, as well as stereophonic reproduction, home construction, and even a chapter on how to solder.

Altogether this is a most comprehensive book, well written and profusely illustrated. The microphotographs of grooves and styli are particularly worthy of mention, as are some of the reproductions of old phonographs. We cannot imagine any true hi-fi enthusiast passing it by.

Our copy from Technical Book and Magazine Co., 295 Swanston St., Melbourne.

★ ★ ★

HOW TELEVISION WORKS, by Phil MacMahon, Charm Publications, stiff cover. 80 pages. Price 17/6.

A major point of interest about this work is that the author is an Australian who has compiled the book around the Australian TV scene. It is therefore, not necessary to re-orientate one's ideas, as is so often the case when referring to overseas publications.

This book may be best described as an effort to present the Australian television scene to the man in the street; to answer, in the simplest possible terms, the innumerable questions posed by everyone from the potential buyer of a set to the public figure faced with a TV audition.

The early chapters give a brief description of the Australian TV system, standards, administration, &c., and then go on to explain—very simply—how a TV picture is possible.

The next chapter discusses the receiver in the home, covering such points as: choosing a set, placing a set, how to use it, simple faults and interference, and the care of the set.

Following this is a large section on the production side of TV, covering subjects ranging from station personnel to the technical problems of outside broadcasts. This will appeal to anyone who has any connection with the program side of TV, such as actors, scriptwriters, advertising copywriters, as well as those who may aspire to these and other occupations in the TV industry.

A small section is devoted to TV advertising in Australia and the making of TV advertising films.

With the exception of a few minor points, the technical explanations are well presented within the scope intended. They should certainly help the raw beginner with no previous knowledge of the subject.

The only "sour" note is the brief discussion on color TV. This is rather a jumble, implying that color wheels are still the only practical system, yet quoting the production of color tubes as 20,000 weekly. It suggests—correctly—the TV color systems are "additive", yet quotes the colors as red, yellow, and blue. Finally it suggests that the only requirement for compatible color TV is to retain the same number of lines.

However, taking the work as a whole, this is only a minor criticism. Provided it is realised that it is not in any sense an electronic textbook, the user for whom it is intended will undoubtedly find it a useful reference book, as well as a means of making his first acquaintance with the finer points of this new entertainment medium.

Our copy from the publishers, Charm Publications, 218 Old South Head Rd., Vaucluse. (P.G.W.)

> Some of the books reviewed in these columns come to us, as indicated, direct from the overseas publishers. Where not available locally ex-stock, we suggest you seek the guidance of your nearest technical bookseller, re importing direct or on order.

★ ★ ★

MAINTAINING HI-FI EQUIPMENT, by Joseph Marshall. Gernsback Publications. Soft cover, 223 pages.

As its name implies, this book is directed mainly at the serviceman who wishes to specialise in the maintenance of high fidelity equipment. In this respect it differs from the English publication referred to elsewhere, which is intended as a guide to the assembly and use of typical commercial equipment.

The first chapter deals with high fidelity standards, covering such matters as frequency response, transient of phase, distortion (in its various forms), power output, sensitivity, &c.

The next chapter deals with typical test instruments, such as audio generators, test records, CRO's, &c. It is followed by a chapter on typical high fidelity circuits, including such well-known circuits as the Williamson and its variations.

Then follow chapters of preliminary diagnosis, distortion, high level distortion, low level distortion, bass and treble faults, and common audio troubles.

A chapter on pickups and styli contains much useful information on the relative merits of the various forms of styli, including the diamond, with comparison of rate of wear. It is followed by a discussion of turntables and equalisers, with attention to rumble, wow, tracking, &c.

Both FM and AM tuners are discussed along with the various problems they create and the faults normally encountered in them. The final chapter covers the adjustments to be made to a complete installation to produce the best possible results. It covers such subjects as overall response, speaker response, speaker damping, overall balance, &c.

All in all, this book will appeal to both the professional serviceman and the audio enthusiast who is keen to build and test his own equipment. It is well written and profusely illustrated.

Our copy from the publishers, Gernsback Library, Inc., 154 West 14th St., New York 11, NY.

★ ★ ★

HOW TO LOCATE RADIO AND TV INTERFERENCE, by Fred D. Rowe. A Rider Publication, soft cover, 122 pages.

This should prove a very valuable textbook to any serviceman faced with the problems of fringe area TV reception or country radio reception. It is obviously written by someone who has had considerable experience in these matters and the mere fact that so many possible causes of trouble are listed between the covers of one book will make it a valuable reference.

The first chapter is devoted to a discussion on interference in general, the importance of signal-to-noise ratio, and so on. Then follows a chapter on antennas (aerials), covering the respective merits of indoor and outdoor types.

The following chapters cover such subjects as: Basic interference sources, interference locating equipment, appliances as noise sources, locating the source, &c.

A chapter of particular interest to country servicemen will be that devoted to power line interference, also the following chapter on filters and other methods used to minimise the trouble. Anyone who has ever battled against this type of interference will certainly appreciate the author's suggestions.

There is a chapter devoted to eliminating interference at the source, and another to fluorescent lamp interference. TVI from amateur and commercial transmitters is discussed—with suggestions for cures—and the final chapter deals with adjacent channel interference in TV receivers.

Anyone reading this book will immediately realise that the possible sources of interference are so numerous, and the possible cures so varied, that it is virtually impossible to carry all the data in one's head. A reference of some kind appears to be essential and this book would be an ideal way to start.

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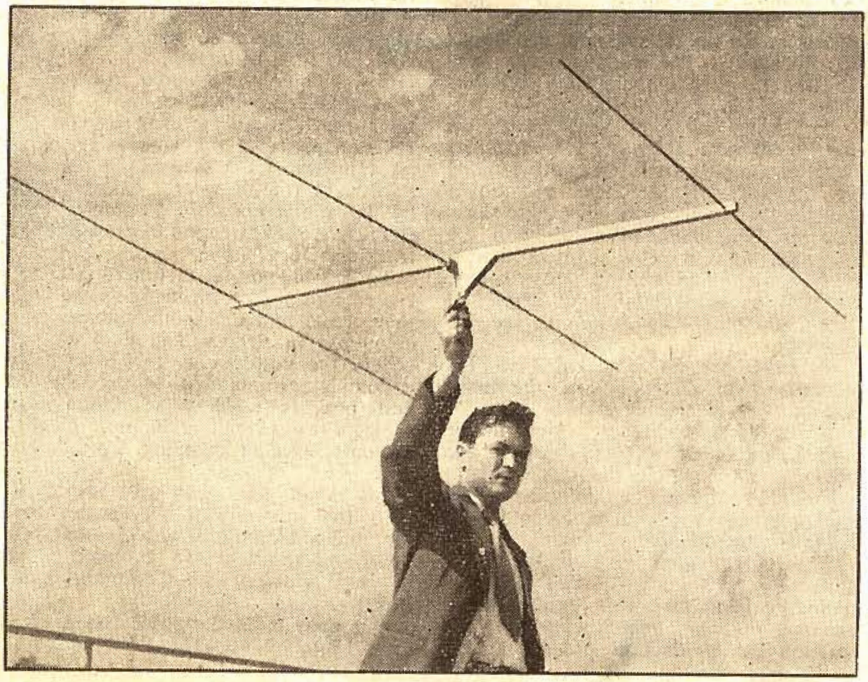


This three-element beam is so light that it can be supported on a couple of fingers. It would be adequate for FM reception in less favourable areas. Closer in to the station a two element beam or even a simple dipole would give plenty of signal for a tuner such as the one described elsewhere in this issue.

SIMPLE AERIALS FOR FM TUNERS

Readers who have built—or are planning to build—an FM tuner, will need a suitable aerial. This article suggests ways and means of mounting simple dipoles or beams on light wooden structures. The ideas are applicable to simple aerials for TV reception in favorable signal areas.

by The Editor

Almost any old piece of wire will do for an aerial with most modern broadcast band receivers, particularly when comparatively close to the stations concerned. Although most of us know that an aerial strung high in the air will pick up strong signals and help discriminate against local electrical interference inside the home, few of us bother these days to put up masts as we did when radio was young.

POSITION ON VHF

On the very high frequencies, as used for FM and TV, the position is rather different, and odd pieces of wire can be almost useless as efficient pickers-up of energy.

TV and FM sets work best with a very strong signal fed to their input terminals, and except when very close to stations, an outside aerial mounted in the clear should always be used.

Morever, because the length of a wave is only a few feet, it is very easy to strike an odd aerial length when a picture-rail type of aerial is used, and this could easily ensure little or no signal at all, through an incorrect electrical termination at the equipment itself. Even within cooee of a station, where an indoor aerial is permissible, it is always best to use either a resonant type such as the "rabbit's ears", or to cut and try for a length of wire which gives the best results.

There is, however, no need to sidestep the job of obtaining a good outside aerial, either because the cost is too high or because it is too hard to make.

The design of TV aerials needs some thought, because of the wide band width of the TV station. The construction of such an aerial was dealt with in some detail in our last issue.

The purpose of this article is to give some further hints on making simple aerials primarily for use with the FM tuner described elsewhere, but useable in many cases for TV also. We will be concerned mainly with the physical construction of the aerials rather than their design, although we will include later on some suggested dimensions for various frequencies of operation.

The simplest of all VHF aerials is the plain dipole—a rod equal in length to an electrical half-wave at the frequency being used, broken in the centre, and connected to a length of 72-ohm coaxial cable or twin lead.

In most suburban areas, and particularly where there is virtual line of sight to the station, such an aerial will generally give all the signal strength desired. It can be used for both FM and TV, subject to the correct element length being selected.

BETTER AERIAL

Where the distance is greater, or where there is an appreciable mass of land between the station and the listener, some reinforcement of the received signal is often worth while and, in such cases, an extra parasitic element can be added either as a director or a reflector.

Where still more gain is wanted, a third element can be included to make up a standard three-element beam, possibly the most useful of VHF aerials for single-band operation. The band width of such an aerial is rather narrow and multi-band construction becomes difficult. Thus for TV reception, something more like last month's design would be better.

Let us assume, however, that we want an aerial for the FM station on about 92.5 Mc, and wish to start first of all with a simple dipole.

The only point of any difficulty with a dipole is to find some easy way of supporting the two aerial rods, each a quarter-wavelength long, so that the connecting feedline can be connected easily. The rods at this point must, of course, be insulated from each other although, as the impedance is very low, the RF voltage is low also and the quality of the insulation need not be of the first class.

BASIC IDEA

It is quite permissible, for instance, to use a piece of dry wood for the purpose, particularly if we take the trouble to seal it against moisture by a coat of ordinary lacquer.

As you will see from the illustrations, the construction of these aerials centres around a small T-shaped piece of wood, as, for example, plywood ½in or ⅝in thick. Waterproof plywood can be worked easily without coming to pieces and will not easily warp. A plain piece can be used if you can work it.

The stem of the T is used to fasten it to the upright aerial "mast", in our case a length of oregon of 1in square cross-section, which comes down almost to ¾in when dressed. The width of the stem is therefore made the same as that of the mast.

The cross-piece of the T is conveniently made the same width, and supports the two aerial rods. These are made of brass tubing ¼in outside diameter so that they can be pushed as a close fit into holes drilled in the cross-piece with an ordinary wood bit of ¼in diameter.

The inside ends of these rods must be connected to the feedline, and must therefore be made accessible so that you can solder the line to the rods.

A hole about ½in in diameter is therefore cut through the junction of the T so that, when the rods are pushed through the holes drilled in the arms of the T, they will emerge inside the hole where the necessary join can be made.

DIMENSIONS

The length of the stem we made 3in, with 4in between the extremities of the cross-arm. Both these dimensions will give plenty of support for the aerial rods on the one hand, and for the junction between the arm and the mast on the other.

When making up the arm, mark it out carefully on the scrap of plywood and after cutting out the shape, drill the hole at the junction. Take care to get this hole in the centre so that the arm isn't weakened. A ½in hole is plenty large enough.

Next mark on the cross-arm a pencil line along the path of the holes you are going to drill to take the elements. Clamp the arm in a vise, and take care to drill the holes perfectly square along the pencil guide line. If you don't, the aerial rods will project at odd angles, and although a little off-centre won't affect their performance, they will look much better if they approximate a straight line from end to end.

It is also easier to solder the feedline to the inside ends if they are settled symmetrically inside the ½in hole at the junction.

Although the rods will fit quite snugly into the wood, it is wise to fasten them so that they cannot work loose.

HOW TO SECURE

This is done by drilling two ⅛in holes through the cross-arm from one side to the other, passing through the rods as well as the wood.

You can now slip an ordinary brass ⅛in bolt into the hole, and screw it down with a nut. The arms are now firmly held in position, and if you use a washer under both bolt head and nut, they will also serve to strengthen the cross-arm at these points.

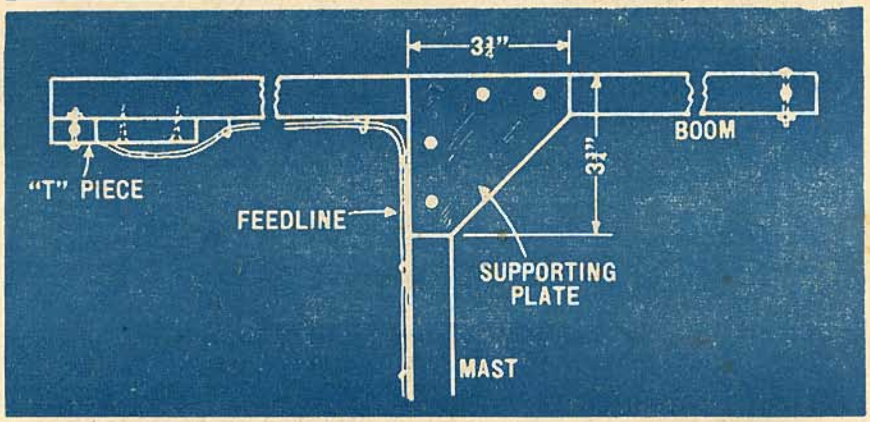
To mount the assembly to the mast, the stem is bolted or screwed to the top, as shown in the diagram, so that the top of the mast is level with the top of the cross-arm.

This will seal the ½in hole at the junction on one side to keep out the rain and a small metal or wooden plate can be tacked and glued to the other after the feedline has been connected. You will have to dig or file out a groove for the feedline to pass under the edge of the plate so that it can lie flush with the surface of the wood.

In our case, we cut away a section at the top of the mast so that the cross-arm was recessed into it for further support. The joint was glued before screwing up, and the final job was quite neat and strong.

When finished, a coat of white lacquer on the arm and the mast made the whole thing weatherproof.

TWO AND THREE ELEMENT BEAMS



Suggested assembly for a two-element beam. The boom sits on top of the mast and is held in position by a pair of aluminium brackets. The "T" piece attaches horizontally to one end of the boom, representing the front or rear of the array, depending on whether the remaining element is a reflector or a director.

TWO-ELEMENT BEAM

The two-element beam requires a horizontal boom to support the aerial at one end and the parasitic element at the other. This boom is another length of 1in cross section oregon of the same stock as used for the mast.

The aerial is mounted in a T-piece as already described, and is screwed to the under side of the boom just as previously it was to the mast.

The parasitic element is mounted directly into the boom by drilling a ¼in hole at right angles to its length, and pushing the parasitic element through. Another 1-8in bolt and nut passing through both boom and element will keep it in place just as it did in the case of the aerial elements.

The boom must be mounted horizontally, which means that it must be attached to the top of the mast and at right angles to it.

We managed this by the use of two triangular brackets cut from scraps of aluminium screwed to both boom and mast. A long wood screw through the boom and into the top of the mast can be used as an extra, but it isn't really necessary.

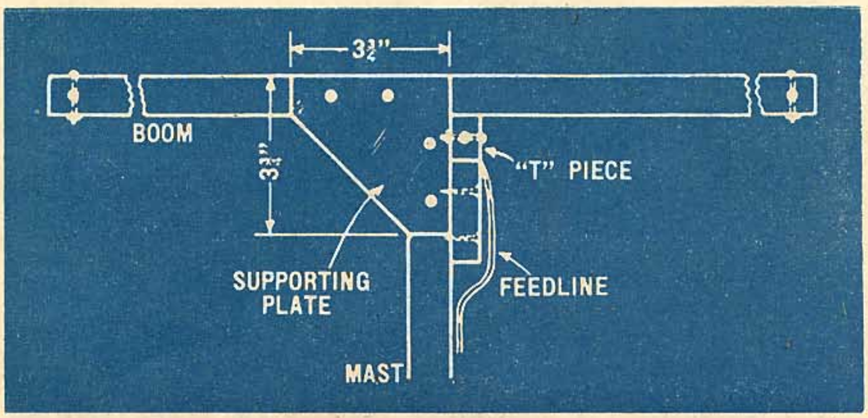
The feed line was lashed to the underside of the boom up to the mast, after which it was led down the mast and into the house.

The mast is joined to the boom at its point of balance, which is near enough to its centre point.

The three-element beam requires a longer beam with a parasitic element at each end and the aerial in the centre.

BOOM OR CROSS-ARM

To make it up, the cross-arm is fabricated as a unit in the same manner as previously described, and is attached to the top of the mast flush with the top. It is best not to recess the arm into the mast, as this may make the attachment of the boom a little more difficult.



For a three-element beam, the "T" piece attaches vertically against the mast and directly underneath the boom. As before, metal brackets hold the boom square and secure. Reflector and director should be a tight push-fit through the boom being locked in position by a thin bolt.

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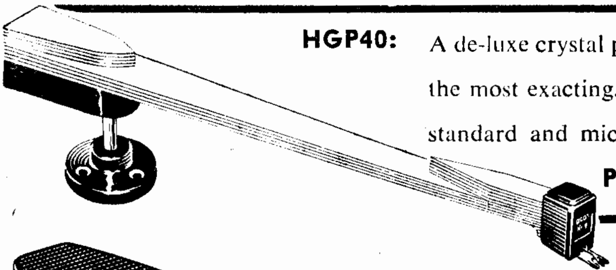

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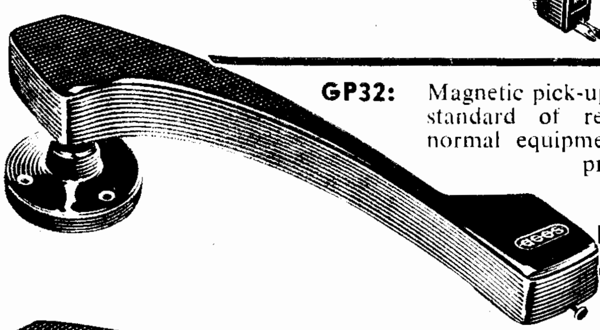

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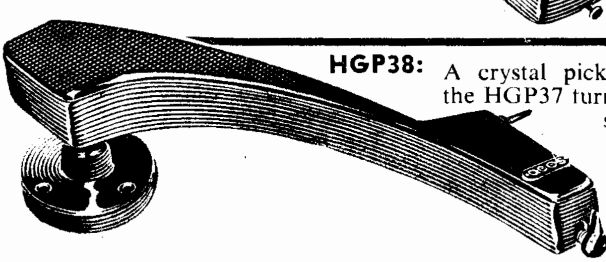

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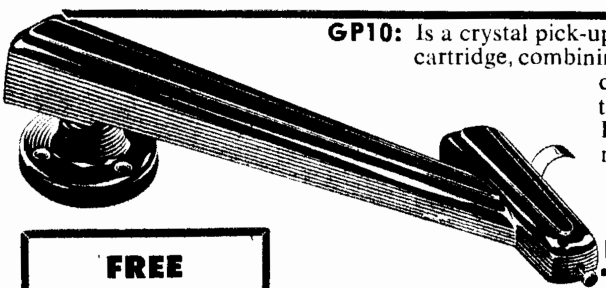

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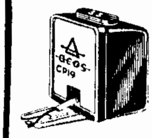

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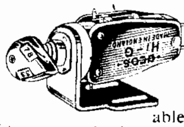

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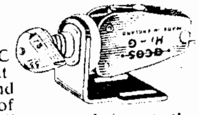

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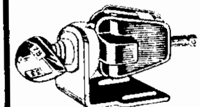

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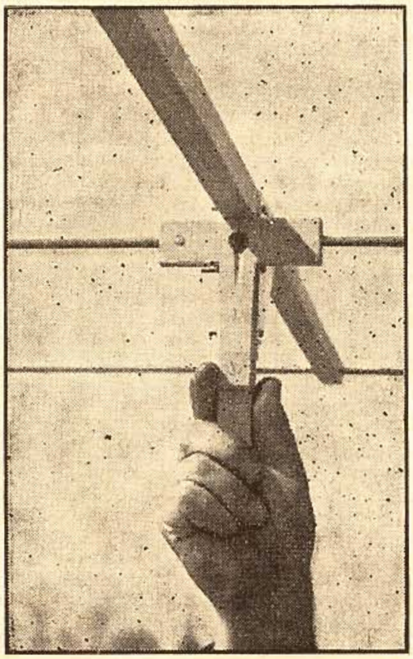
The boom is now fastened to the mast as previously described, using the aluminium brackets.

The amount of work required to make up even the three-element beam is quite trifling, and ours took no more than a couple of hours from go to whoa. The material cost is also very small, and many of the materials might be lying around.

As previously mentioned, the dimensions of the elements and their relative spacing will depend on the frequencies concerned.

The accuracy of measurement is not critical to a half-inch, but there is everything to be gained by having them correct.

The general method for finding the length of the aerial is to divide the frequency into 5540, which will give the length in inches. This method is quite near enough to ½-inch tubing. Thus for 92.5 Mc the aerial length will be almost exactly 60 inches. This is made up by



A close-up of the centre section of the three-element beam. Note the recess for the feed-line, which was not connected when this photograph was taken

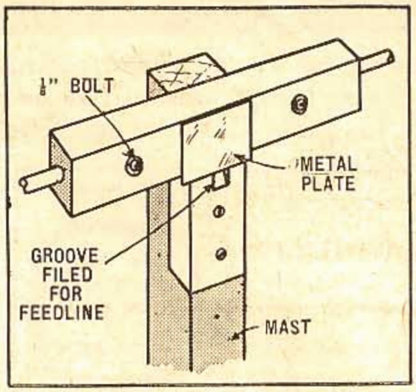
two rods each 30 inches long and separated at the centre ends by about ½-inch.

The band over which such an aerial will operate reasonably well would be several megacycles for reception, and it would be quite feasible for a TV aerial in strong signal areas.

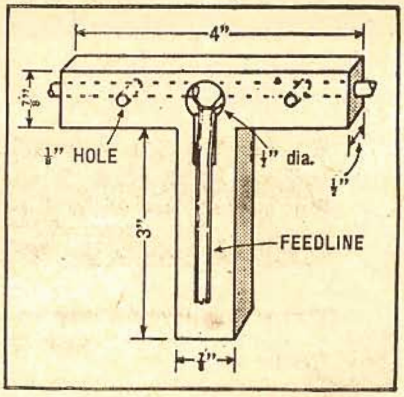
As a 2-element beam, the extra element can be used either for a director or as a reflector, and in practice there is not much to choose between them. The amount of gain over a simple dipole is quite appreciable, and the extra directivity tends to reduce any possible interference which might be received from directions other than that to which the aerial is pointing. (This would not apply, of course, to TV signals on a completely different frequency from the FM stations.)

The best general spacing between aerial

FURTHER DETAILS OF ASSEMBLY



For a simple dipole, the "T" piece attaches to the top of the mast. A metal plate, as shown, will seal the junction of the feedline to the ends of the dipole. The line should be strapped to the mast at intervals to prevent fracture in a high wind.



This detail sketch shows how the "T" piece is cut from close-grained wood or waterproof ply. After shaping and fitting it must be carefully sealed and painted to make it weatherproof. The feeder attaches to the ends of the dipole elements inside the centre hole.

and parisitic element is one quarter-wave, or half the length of the aerial itself. Spaced by this amount, the director should be made about 5 pc shorter in length than the aerial. Actually the parasitic length and its spacing from the aerial are inter-related functions which can become quite complicated, so we suggest you keep to our recommended safe dimension. The reflector can be a little shorter than suggested above, but it should not be longer.

TYPICAL FIGURES

For 92.5 Mc the length works out as 57 inches, and it can be as low as 54 inches.

If a reflector is used it should be about 5 pc longer than the aerial, or 63 inches, and can be as long as 66 inches.

For a 3-element beam, the dimensions mentioned above can be used in all particulars and this aerial will give more gain than will one of two elements.

One point should be remembered about parasitic element lengths when tuning over a wide band. The reflector must always be appreciably shorter than the aerial. If we tuned down to a frequency at which its length became greater than a half-wavelength at the operating frequency, it would operate as a director, and completely upset things.

Conversely, if we tuned to a lower frequency at which the director became a reflector, the beam would not work.

ONLY ONE STATION

This isn't very important at the moment, because on the FM band there is only one station, and it is therefore permissible to cut the aerial to suit it.

It is, however, one reason why two and three-element beams are not the best for TV, which requires a bandwidth of about 7 Mc even for one station, and special precautions must be taken in the selection of element lengths to allow for this.

As a matter of interest, here are the dimensions of an aerial which works quite well over the whole FM band in the event of extra stations coming into operation.

Aerial length, 60 inches; director length, 52 inches; reflector length, 64 inches. Aerial to reflector spacing, 32 inches; aerial to director spacing, 19 inches.

All these aerials can be fed either with 72 ohm co-axial cable or with 72 ohm twin lead. The presence of parasitic elements does affect the aerial centre impedance to some degree, but not enough to be serious. This is one reason we have used the quarter-wave spacing between elements, as even the 3-element beam should not fall below about 50 ohms.

FEED-LINE

Some care needs to be taken with the feedline for both mechanical and electrical reasons.

Although flexible enough to withstand ordinary handling, feedline will soon fracture if it is constantly being blown about by the wind. This is particularly true of the flatter varieties, which whip like lengths of ribbon.

The feedline should, therefore, be strapped to the mast or passed through eyelets every couple of feet. It should also be supported and protected where it passes around obstructions entering the house.

The aerial mast should not be more than about 10ft long, and is best fastened to a convenient chimney. Metal straps are good for this purpose, although wire can be used if you are careful to insert right angle metal plates at the chimney corners to avoid any risk of the wire cutting into the mortar between the bricks. This will mean that not more than about 4ft of the mast will be unsupported—if it is, the cross section may have to be increased to say 1½ inches for extra strength.

The whole assembly, however, is extremely light, and can easily be bounced about on your little finger.

NOTES ON THE 5BPI TV CIRCUIT

Here are some additional notes on the TV receiver circuit information given last month. They include suggestions for a chassis layout, one or two amendments and some additional ideas for those keen on experimenting.

THE matter of chassis layout is always a complex one in a television receiver, for the reasons outlined last month. Leads have to be kept short, circuits have to follow one upon the other in logical fashion and controls kept in orderly array along the front face of the cabinet.

Some readers may choose to ignore this latter requirement, particularly those who are constructing a receiver on a chassis—or chasses—which previously carried radar or similar equipment. In such a case, controls may have to fit where there is room for them, without any pretence at convenience or appearance.

Our own suggestions, last month, were made on the assumption that the receiver would be built on a near-rectangular chassis, with the speaker to one side, as in conventional commercial TV receivers.

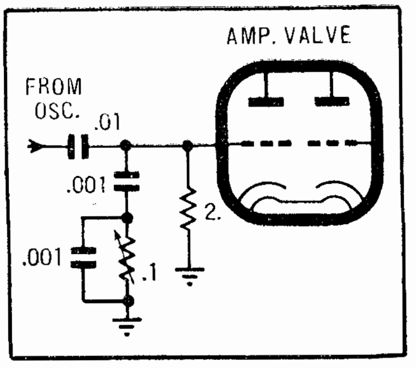


Figure 3: A suggested circuit modification for adjusting the linearity of the line oscillator, which determines the linearity of the picture in the horizontal direction—from left to right.

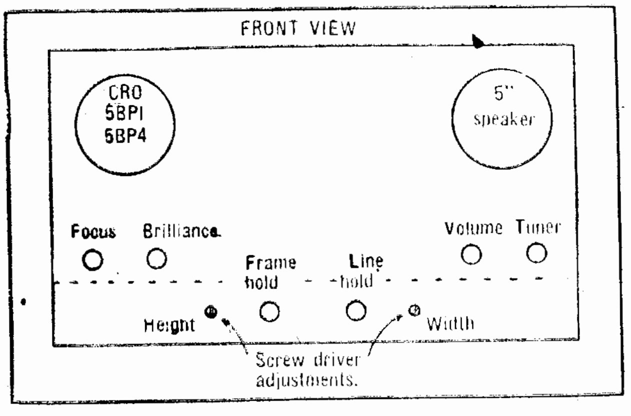


Figure 2: The layout as suggested in figure I would give this arrangement of the operative controls. Most of them mount conveniently on the front face of the chassis but the focus and brilliance controls could be set back as indicated and operated through extension shafts and couplings.

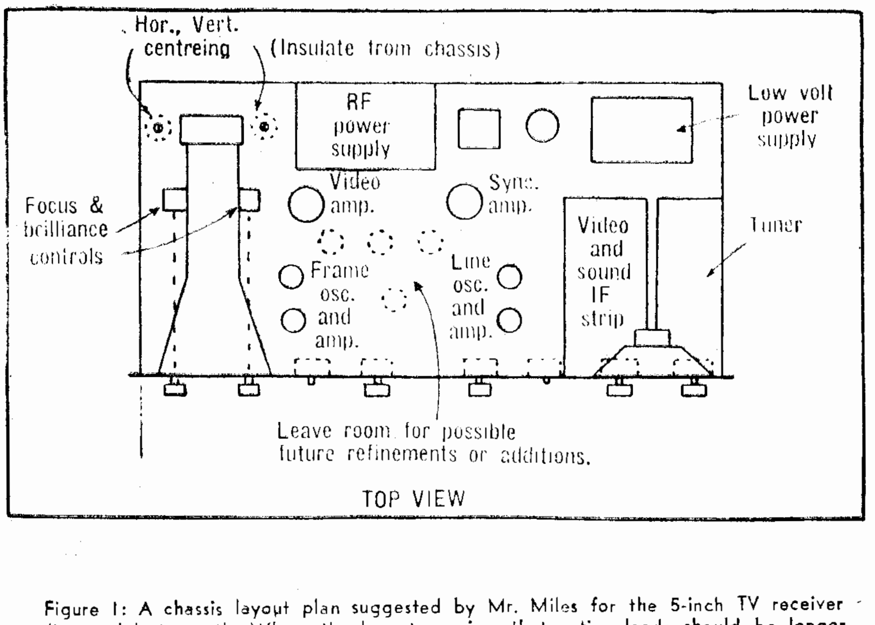


Figure I: A chassis layout plan suggested by Mr. Miles for the 5-inch TV receiver discussed last month. Where the layout requires that active leads should be longer than really desirable, they should be isolated as far as possible from other circuits.

Mr. Gil Miles, contributor of last month's article, suggests here an alternative arrangement, which allows the tube and the speaker to face forward, at either end of a rather wide chassis.

The suggested sequence of stages on the chassis and the position of controls on the front panel are shown in the accompanying diagrams.

In any such layout, a compromise has to be struck between convenience and electrical requirement. Where active leads are rather longer than desirable, as a result, they should be kept away from other circuits, with which they could interact.

PERFORMANCE

As intimated last month, the performance of the original receiver in terms of trace linearity appeared to be quite adequate for the size of picture involved, and, on ordinary programme material, image distortion appeared to be quite negligible.

Some idea of the results to be expected can be obtained from the accompanying photographs.

However, for the sake of those who may wish to experiment further, the author suggests the modification shown in figures 3 and 4.

The change, in both cases, simply involves connecting an adjustable time-constant network in the coupling circuit between the respective oscillators and amplifiers. The two potentiometers could be mounted on the chassis adjacent to the relevant circuitry and pre-set for optimum linearity in both vertical and horizontal directions.

The station test patterns can be used as an accurate guide when setting these controls.

As well as experimenting with the time bases, some may care to do extra work with the video amplifier, although the resolution of ordinary 5BPI tubes sets a limit to the ultimate picture detail which can be presented.

PEAKING COIL

The frequency response of the video amplifier can be varied and extended by the additional of an extra peaking coil and shunt resistance, as shown in figure 5.

Readers not in a position to work out the probable effect of different inductors are recommended to try and to observe the effects of any inductors on hand of values between 50 and 500 microhenries. Shunt resistor values can be varied between 2000 and 30,000 ohms.

After further experiment, Mr. Miles suggests that one or two minor amendments to the circuit may improve general performance.

In the lower diagram of page 65 (last month) a .005 mfd by-pass can be added in parallel with the 2000 ohm resistor forming the load for the diode clipper. The bypass will eliminate IF components from the circuit without unduly affecting the Sync. pulse shape.

In this same diagram, the coupling capacitor from pin 5 of the Sync. amplifier can well be increased from 100 to 300 pf.

On the oposite page, in the circuit of the line oscillator, the grid resistor should be increased from 2200 to 10,000 ohms.

As distinct from these recommended changes, two errors occurred in the circuit drawing of the sound IF amplifier on page 65.

DECOUPLING RESISTOR

The decoupling resistor of the first valve should be 10,000 ohms, not 1000 ohms as shown. Also, the polarity of the 10mfd. electrolytic terminating the ratio detector should be reversed.

It is suggested that readers make these amendments to the diagrams given last month, to avoid possible future confusion.

A point has been raised concerning the polarity of pulses fed from the Sync. amplifier to the respective oscillators. It will be seen from the diagram that the polarity of the line pulses will be reversed from that of the frame pulses by reason of the additional amplifier stage.

Mr. Miles agrees that such is the case but says that he used the circuit as shown for reasons of simplicity and that, in actual fact, no difficulty whatever is experienced in maintaining correct synchronisation for both oscillators.

Readers' observations about the performance of different tubes continue to be rather divergent.

One reader, who has apparently experimented at some length with type 5CP1 tubes, says that he cannot agree with the stated opinion that these tubes can be used successfully with the post-accelerator anode connected to the same 2000-volt potential as anode 2 and the deflector plates. His experience has been that the image is not then as good as from an ordinary 5BP1.

If the cathode is at minus 2000 volts and anode 2 at earth potential, it is some help to return anode 3 to the B-plus line. Results continue to improve, however, as it is brought nearer to plus 2000 volts, making the total potential across the tube equal to 4000 volts.

A few 5BP4 tubes appear to be in circulation from various sources and reaction to these also varies. While it is true that good samples give an excellent black and white picture, other samples give rather poor results, probably due to deterioration after long periods of storage.

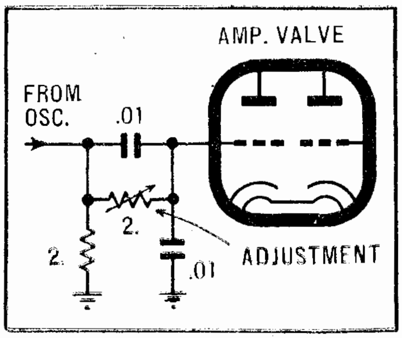


Figure 4: A linearity adjustment circuit for the frame oscillator, which determines picture linearity in the vertical direction. The author suggests these circuits, although he feels that few constructors will deem them necessary.

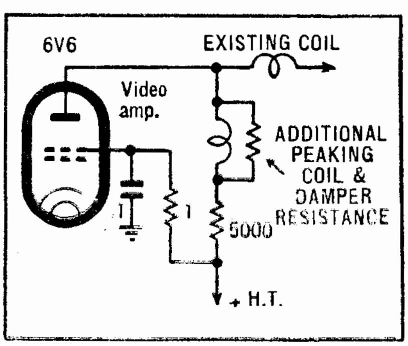


Figure 5: The frequency response of the video amplifier can be varied by using additional peaking in series with the regular plate load. In some cases a deliberately peaked HF response may be prefered to "level" in the video output circuit

TYPICAL PICTURES FROM 5BPI

These two pictures, reproduced at approximately original size, were photographed directly from the screen of a 5BPI and have not been retouched.

Both pictures, particularly the second, have suffered a considerable loss of definition due to photography and printing. The limited light from a 5BPI screen makes a long exposure necessary and leads to trouble with subject movement. Further loss occurs due to film grain and to the screen used in the printing block.

OFF THE RECORD — NEWS & REVIEWS

Now that Gieseking is dead, we will, I hope, treasure even more keenly the music he has left behind. He was not only one of the few remaining representatives of the classical school of master players — he was possibly the finest all-round pianist of them all. Of him it could truly be said, he touched nothing he did not adorn.

By John Moyle

HIS playing was made up of great stature, fine technique, scholarship, sincerity and humanity.

Only a man with these qualities could prove such a master of so much music, for although he is known in later years largely for his wonderful Debussy playing, he was also a great interpreter of the mightier composers, particularly Beethoven.

He had no affectations—his success lay in this devotion to the music he played. As he has said more than once, he liked best the music he had played last.

We are fortunate that so many records exist which give us a picture of his genius. Fortunately, too, there is little evidence of deterioration in his standards even in his latest work, although advancing years cannot fail to leave their mark in some way, and the unhappy events of recent times must have been a severe blow to him. Some of the crispness and decision might have suffered, but the glowing tone and marvellous touch always remained.

The late Walter Gieseking

RAVEL—Complete Piano Works. Played by Walter Gieseking. Columbia 330LX 1350-52.

Remembering his fine recordings of Debussy, it isn't easy to look at this Ravel without imagining some carry-over from them, particularly when his classic examples have been so closely studied and quoted.

Others, noteably Cassadesus, have recorded some fine Ravel, but although they have often shown greater brilliance and sharper lines, I don't think they have greatly exceeded Gieseking's sense of style without which Ravel can sound bewildering and even dull.

I, at least, admired his clean and certain sonic moulding and beautifully proportioned dynamics.

The recording engineers have avoided close miking which could have threatened the atmosphere so needful to build and preserve Ravel's musical texture.

Particularly fine are the tonal effects of 330CX 1352 in which are found the famous Pavane, Jeaux d'Eau, Alborada del Gracioso, La Vallee des Cloches to name only a few.

This disc contains the cream of the collection.

The surface throughout is almost perfect.

With the set goes a well produced booklet containing several excellent articles and historic pictures of Ravel together with a note written by Gieseking which so adequately explains his own approach to the composer.

TURINA — Sinfonia Sevillana. JOHN ANTILL—Corroboree Ballet Suite. Played by the Sydney Symphony Orchestra, conducted by Sir Eugene Goossens. HMV OALP 7503.

I have been waiting for this record for a long time. The wonder is that it was not issued a long time ago, as the original Turina recording dates back to 1952, both selections being issued previously on 78's.

Not only would we have heard the two best recordings of the Sydney orchestra, but it would have been much kinder to have released them in LP form before competition from more modern techniques became so fierce.

Neither side can compare with the best from a technical viewpoint. Balance is not good. The instrumental placement shows big contrasts between far and near, so that even the reverberation characteristics are not the same.

Corroboree, recorded well before the Turina, suffers most in this respect, and the obvious manipulation of mixing controls, while no doubt improving the overall effect, makes these contrasts the greater. I suspect that a dubbing has been made from 78's, although it is a mighty good one, and may have squeezed by without notice but for some obvious join-ups and variable levels.

SOME GOOD MOMENTS

But although it is only fair to mention these things, which will be apparent to even the casual listener, I must also note that the Turina, which I heard during its recording session, has some good moments, and is a really lovely piece of work. I don't think it has been recorded before.

Corroboree comes through its metamorphosis much improved over the original 78's, which had many faults. It is without doubt a vivid and exciting work, and this version is well worth preserving.

Playback curves are a problem. I found the EMI best with some bass reinforcement, although some background traffic rumble from the University Great Hall limits the amount which can be used.

PERGOLESI—La Serva Padrona, a One-act Operetta with Rosanna Carteri, Nicola Rossi-Lemeni and the Orchestra of La Scala, Milan, conducted by Carlo Maria Giulini. Columbia 330CX 1340.

This opera is more important for its

historical association than for the music alone.

It pre-dates the work of Mozart and others, and is the best-known example of the short Italian style of operetta which was in such contrast with the elaborate and unrealistic French compositions of the day.

Its story is quite simple—of the bachelor, henpecked by his serving maid, who decides to end it all in matrimony, only to find that the maid has outwitted him so that she marries him herself.

Presumably the henpecking is now a life sentence.

MUSICAL DIALOGUE

Most of the time is occupied with musical dialogue between these two—there is only one other character—and its success depends upon their ability to sustain the comedy.

This they do very well, although as most of us don't know enough Italian to follow what is being said, parts of it become a trifle tedious.

But to anyone with a special interest in the music of the period, it will come as a complete gem, for the characterisation is splendid if the singing sometimes doesn't equal it. The recording is first-class.

Rossi Lemeni is hardly recognisable as the singer I thought most unimpressive in an earlier operatic set. It is obvious that this kind of thing is his long suit.

Very high marks in its class.

SIBELIUS—Symphony No. 2 in D major. Played by the Philharmonia Orchestra conducted by Paul Kletzki. Columbia 330CX 1332.

Last month I had the Sibelius First Symphony played by the same orchestra and conducted again by Kletzki.

I commented then on the wide differences in interpretation in contrast with other conductors such as Collins and Beecham.

The same remark is valid here, although I have too many versions to undertake a detailed comparison between them all.

The obvious competitor is Collins. When I first heard his performance. I was struck with its vitality and force—I think I accused him at times of being mildly theatrical.

Now Kletzki clearly outstrips Collins on both counts. Each man has captured the essential moods of Sibelius and the north land atmosphere most admirably, but Kletzki has added a passionate, almost disturbing tension I found most moving.

His contrasts are more violent, they smoulder and rumble like a volcanic fire which bursts into a white-hot blaze when breaking point is reached, the effect giving great contrast with the quieter melodic moments of each movement.

DYNAMIC LIMITS

Collins never reaches such dynamic limits, fine though his efforts are.

Nor has Decca's recording such vivid instrumental color. This, I think, is because of the great strides made in the last twelve months or so in recording realism, and the Philharmonia is an outstanding example of it.

Kletzki's better recording and greater dynamic range tells against Collins more than does the performance, for there are moments when he extracts more from the score than does Kletzki.

Noteworthy is his insistence on the percussion being heard in passages which Kletzki passes over. To the latter, they are mostly valuable as aids to explosions in which they so often play an important part.

Mechanically, this disc is superb. I couldn't fault it except for a few faint clicks you'll have to hunt for in the last movement. On first class gear it sounds magnificent.

Sibelius No 6.—Two Versions

SIBELIUS—Symphony No. 6 in D Minor Opus 104; Symphony No. 7 in C Major Opus 105. Played by the Philharmonia Orchestra conducted by von Karajan. Columbia 330CX 1311.

SIBELIUS—Symphony No. 6 in D Minor Opus 104; Pelleas and Melisande Suite Opus 46. Played by the London Symphony Orchestra conducted by Anthony Collins. Decca LXTA 5084.

More and more Sibelius, making the field of available versions harder than ever to separate.

I received the Collins Sixth before the Karajan and was greatly impressed with it. Rarely have I heard a better combination of all that makes a fine record. The more I heard it the more I liked it, and no doubt was conditioned to it by the time the Karajan came along.

In preferring the Collins I do so knowing that many will see it the other way. But I think he shapes it better than Karajan, the procession of ideas seems to fall more easily into place and their significance is clearer. Collins has a tautness and sharp line which never sags—it merely highlights more unmistakably subtleties in scoring which Karajan plays through.

If you compare the third movement of each disc you will find there a perfect example of what I mean.

In each the sound is extremely good. The Philharmonia is the better orchestra, but the differences are balanced in each case so that it is mildly silly to beat out one's brains about them when more sensibly we should be thankful for both.

Karajan scores in his inclusion of the Seventh Symphony on the reverse, making two on one. It is every bit as good as the Sixth, if not better. Karajan is particularly successful in his handling of the long, sonorous scale passages and slow interplay of themes which make up so much of it. Here the warm, strong tone of the Philharmonia is most striking, and unequalled in any other version.

But again my own preference is for Collins, although his orchestra is still fractionally inferior and there is some surface noise, where as Karajan suffers only one such lapse right near the end, and it might be only on my copy.

Altogether these are fine and important records—among the high spots in the growing collection of impressive Sibelius. For both the RIAA curve is good.

GIGLI AT CARNEGIE HALL—Excerpts from three concerts sung by Beniamino Gigli with Dino Fedri accompanist. HMV OALP 1329.

One of the saddest records I have ever heard. Gigli sings 22 songs and operatic excerpts, all recorded during three concerts in Carnegie Hall in April, 1955.

As a record for those who would sooner hear Gigli in his decline than not at all, it will be welcome.

But those who remember his peerless singing of years ago, and expect to hear anything like it, will be bitterly disappointed, if not shocked, at what is at times a caricature of past greatness.

Gigli is now a man of 65, and not all the enthusiasm of the audience can persuade us otherwise. It is a moot point whether the hammering of his piano accompanist is an attempt to guide or to conceal.

Although some of the simpler songs still have their appeal, I can only leave this disc to your memories and your charity.

CHOPIN — Sonata No. 3 in B minor Opus 58. Enesco—Sonata No. 3 in D major Opus 24. Played by Dinu Lipatti, pianist. Columbia 330CX, 1337.

Lipatti's reputation as a Chopin player is legendary, as you will very quickly observe from this piece of musical evidence.

Every pianist—well, nearly every pianist — plays Chopin, and most of them think they are good at it.

But, in truth, there are only a few who are able to master more than a portion of his music. I have now numerous versions of Preludes, Waltzes, Ballades and the like, done by some of the best alive, and there are times when all of them are obviously out of touch.

Lipatti, on the other hand, always knows what to do with Chopin—he has a kind of mental kinship with the composer so that we accept his air of complete authority without question.

SOUNDS RIGHT

Whatever he does sounds right.

He is never guilty of using the music for display purposes only, a temptation which is the downfall of so many. His dazzling technique is produced only when it is required to dance, to sweep down the keys like an arc of falling water, or to strike with that nervous power which is in the hands rather than the arms.

It enables his touch to keep pace with his quick and sensitive imagination, his judgment of form, his appreciation of light and shade.

You could call this a kind of keyboard magic if you like, for other words are hard to pick to describe anything as indefinable as Lipatti's touch.

There is nothing profound about it, but how lovely it sounds!

By contrast, Enesco's uneven and woolly work does not show up well, nor is the recording good. It sounds like an indifferent dubbing from 78's. If this is also true of the Chopin, it is not at all obvious—here the piano is remote but clean and bright.

Any Lipatti Chopin is a treasure. What a pity it is not coupled with a better work.

RESPIGHI—Fountains of Rome —Brazilian Impressions. Played by the Philharmonia Orchestra, conducted by Alceo Galliera. Columbia 330CX, 1339.

This record is the only clear rival of the RCA-Toscanini released last month.

The difference between the two is mainly that of Columbia sound versus RCA sound — British versus American. In most other particulars, their virtues balance out.

RCA's record is more forceful and bright, sharper in pitch — rather too much so if anything—but the customers over there like it that way.

Its contrasts are also sharper. Toscanini works his men to a tremendous pitch when he calls on them, and, no doubt, the mixing panel has also added its bit.

The Columbia on the other hand is another of those Philharmonia efforts which are rapidly getting me in. There is something about their general sound distribution which combines a luscious clarity with a subtle airy atmosphere totally lacking in the RCA.

FINE DETAIL

If the highlights are not as sharp, the quieter moments of detail are the strong point. In this, despite many good things achieved of late by other studios, the Philharmonia records have set a standard all their own.

I don't think any of the other "Fountains" are as good as either of these, although they are all of high standard. Where they do score is that they all have the "Pines of Rome" on the other side, to my mind, a more interesting coupling than the "Brazilian Impressions." Maybe closer acquaintance will bring better appreciation, certainly performance and recording are high class. But the "Fountains" and the "Pines" go so naturally together that any separation seems strange.

I've no fault to find with the engineering. It's just the way I like it. Use the RIAA curve.

BEETHOVEN—Concerto No. 4 in G major. Played by Claudio Arrau and the Philharmonia Orchestra, conducted by Alceo Galliera. Columbia 33OCX1333.

The opening bars of the piano, some of the most eloquent which Beethoven ever wrote, tells us immediately that this is to be no hit-and-run event, no tear-away display piece, but a serious performance, a determined effort to settle once and for all the search for the best-ever version.

And, to tell the truth, I rather think it does.

Firstly, the quality of the recording is outstanding. The piano is extremely forward, at times to the virtual exclusion of the orchestra. But it is so clean and free from any stress or strain that I can only admire even when I feel that Arrau is getting more than his fair share of the limelight.

His powerful piano is made more pardonable by irreproachable playing. Always a fine technician, Arrau is now a force among the ranks of distinguished modern pianists. Here his beautiful tone and noble conception of the music are outstanding. Only for a few bars near the end of the first side is there any hint of deterioration, and then probably not noticeable except on good equipment.

The fine strings of the Philharmonia have rarely been heard so well, although the whole orchestra shines in its complete accord with what the conductor and pianist have set out to do.

Although the tempo throughout is steady, rather than vigorous, it does not lack vitality or strength, or sensitivity either, as the lovely second movement-interlude will demonstrate.

Only in the last movement did I feel the want of a lighter touch. There is a hint of the portentous where greater gracefulness might have been better.

Technically, it is as good as Columbia has ever released. The sound is full and strong, catching at the same time many delightful touches from individual instruments in admirable proportion.

You can forget surface noise, and even the slight blemishes in piano tone cannot mar a first-class job.

For its many good qualities, therefore, this record would get my vote as the version most likely to be played most often.

MOZART—Concerto for Violin and Orchestra No. 5 in A major, K219. Played by David Oistrakh and the Dresden State Orchestra, conducted by Franz Konwitschny. DGG 16101P.

Every now and then a record comes along which, from the first note, "hits a spot". Not so much for any one virtue, as for a combination, so blended together that criticism, even when it may be levelled, seems out of place.

Such a record is this one. It came near the end of a rather long listening session, when even the most conscientious reviewer may be excused a certain weariness of appetite; when only something really good can stir him to enthusiasm.

In a world of brilliant sound, this record isn't particularly remarkable. The violin has been heard in sharper relief, the bite of the bow elsewhere can put it to shame for sheer realism, nor is there anything much to excite the hi-fi fan.

MOZART AT BEST

But, for all that, this is some of the loveliest Mozart I have heard. The material is there, of course; few things in music equal the beauty of this concerto, and Oistrakh is a violinist from whom we can always expect a fine performance.

And so I listened to this performance in which so much has gone right—the warm, firm tone of Oistrakh, so certain in intonation, in the turn of each phrase, in his handling of light and shade. To the orchestra, never overweight, in perfect tune with the soloist, unobtrusive where required, matching the violin in mood and melody.

And, at the end, I said to myself—this is the stuff of which the solid core of fine records is made, this is the kind of music we can hear time and again with the same feeling of finality and fulfilment, one which will suffer any competition on its own claim to be completely satisfying.

I can only advise you to hear it, and see if your reaction is the same as my own.

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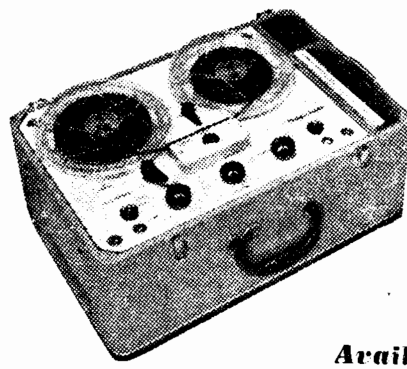

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TCHAIKOWSKY—1812 Overture Opus 49 (original scoring) played by the Minneapolis Symphony Orchestra conducted by Antal Dorati with the University of Minnesota Brass Band and effects. Mercury MG50054.

Mercury's flair for unusual records is continued here with probably the most ambitious rendering of the celebrated warhorse yet placed on records.

It comes complete with brass band, bells, and real cannon shots.

Nor are they just any old cannons. Mercury hunted out a genuine article from the West Point Academy, a gun made in 1761 in Strasbourg, France. They loaded it up with various weights or charges, experimented with mike placings, and ended up with some really imposing bangs.

TAPE EFFECTS

In order to simulate the bells of the Kremlin as they were intended to sound, they got to work with a tape recorder at Yale University, where the bells of the Harkness Memorial tower were recorded as is, and then mixed with the same tape played at twice normal speed to give brilliance.

Added to the efforts of the orchestra and the band, and presumably recorded out of doors, the 1812 takes on a new life.

At the end of the performance, Deems Taylor tells us how it was all done, illustrated by sections of the gun and bell recordings before they were mixed into the final version.

You can use the result to blow your speaker apart, to pulverise your nerves, or just to hear the overture more vividly than I have ever heard it before.

A bright Capriccio Italien makes up the weight as a straight item, equally impressive in sound and execution.

Both sides have a good surface which, as with all recent Mercury's, is a vast improvement on the first Australian releases.

BEETHOVEN—Symphony No. 6 in F major Opus 68 (Pastoral) played by the Detroit Symphony Orchestra conducted by Paul Paray. Mercury MG50045.

Brightness, vim and vigor are good things in their way, but I feel they have been overdone here.

If there is a symphony of Beethoven where warmth and relaxation should be looked for it is the Pastoral—it is inspired by thoughts of the countryside, and definitely not of Fifth Avenue. Paul Paray and his band have no time to lose. Their first movement sounds more like thoughts inspired by a steam train hurrying them away, itself an anachronism for there are no steam trains left in America.

This brusque treatment continues all the way through, and although the performance is deft and well defined, it sounds rushed and perfunctory.

Otherwise it comes cleanly from the stylus, particularly the third movement, although I expected a much stronger entry into the storm scene. It is as though the recording engineer unwittingly turned down the gain control before running for cover in apprehension of what might happen!

I prefer some other versions in which this pastoral interlude leaves me with more breath and a less hasty holiday.

BRITTEN — Young Person's Guide to the Orchestra. TCHAIKOWSKY.— Nutcracker Suite Opus 71a. Played by the Minneapolis Symphony Orchestra conducted by Antal Dorati. Commentary by Deems Taylor. Mercury MG50055.

The Young Person's Guide is one of the best compositions for the instruction of the newcomer to orchestral music, whether young or old.

It has good entertainment value, too, being based on a theme by Purcell, as noble and grand as any man ever wrote. It is used to demonstrate what the players can do, in groups, as individuals, and finally as a complete combination.

The Nutcracker Suite is treated the same way, except that Deems Taylor, the narrator, tells the story of this lovely ballet instead of talking about the instruments.

The suite contains those favorites from the ballet which we have come to regard as the highlights, and thus is not a competitor of the complete version issued previously by Mercury, although the selections might well have come from it. I haven't had time to verify this, but conductor and orchestra are the same.

Technically the disc is clear and vivid on both sides, rather on the sharp side, and closely miked, but not excessively so. If it means anything, all my friends who have so far heard it have taken its number! If you have a juvenile music lover in the family, you might well do the same.

Deems Taylor has an easy-to-take homely style, even if he is not the world's best announcer.

Surface noise is barely audible.

British Television

THE relative range and popularity with the British public of the television programs broadcast by the BBC and by the program companies operating under the Independent Television Authority has been the subject of much speculation and survey.

Facts about the BBC and ITA television audiences are given in the BBC's latest Quarterly Review of Listening and Viewing Trends.

The number of adults who can watch BBC television in their own homes is now about 17,200,000, and of these about 5,300,000 can also watch the ITA transmissions.

This difference is partly due to the fact that the BBC is nationwide, whereas ITA transmissions cover only part of the country. About 6,300,000 of the 17-million people with sets in their own homes live in areas where no ITA transmissions are yet available. In addition, of the remaining 11-million people, rather more than half have neither had their sets adapted nor bought sets on which they could receive ITA transmissions.

The average evening audience watching television during the quarter was about 5,700,000, and of these about 4,500,000 were watching BBC programs and 1,200,000 were watching those of the commercial companies.

Those adults who had provided themselves with the means to receive commercial programs spent 37 pc of their time watching BBC and 63 pc of their time watching ITA.

Bell Co. Shows Picture Phone

A "PICTURE PHONE" using standard telephone line was unveiled recently by Bell Telephone Laboratories, at a joint meeting in Los Angeles of the Institute of Radio Engineers and the West Coast Electronic Manufacturers' Association.

The pictures that were transmitted along with the sound varied in size from 1 x 1½in to 2 x 3in.

This picture phone system over ordinary telephone line is made possible by slowing down the rate of transmission of picture information so that the required bandwidth can easily be handled.

The raster is made up from 60 lines, each of which may have a maximum of 40 dots.

Thus a complete frame may be considered to contain 60 times 40 or 2400 dots.

If a single frame were transmitted each second, an overall bandwidth of 1200 cycles per second would be necessary. With the Bell system, one complete frame is transmitted each two seconds, requiring a bandwidth of only 600 cycles per second.

Since the 600-cycle video band contains very low frequency components, which may be severely attenuated over phone lines, a carrier system is used in which the video signal amplitude modulates a 1200-cycle carrier.

The transmitted signal is then a conventional AM double sideband signal with a frequency range of 600 to 1800 cycles per second, which is about optimum for telephone line transmission.

The picture equipment is still undergoing development and is not ready for manufacture or commercial use.

A further and completely different application of TV and allied technique is assisting the world's largest telescope at Mount Palomar.

Here an image booster is in use consisting of a vacuum tube containing a photo-cathode, which emits electrons when exposed to starlight. The electrons are focused and passed through an opening only a few millionths of an inch thick. A photographic plate behind the opening records an image

The booster is able to provide a tenfold increase in sensitivity because the weak light rays are better able to operate on a photo-cathode than directly on a photographic plate.

A NEW FULL-RANGE FM TUNER

Continued from Page 63

for the best meter reading. If the core works best all out, you have too many turns, and vice versa. It is extremely improbable that you will be incorrect by more than one turn either way.

The adjustments completed, remove the meter and the oscillator, and you should tune in the FM station with the tuning condenser plates nearly fully meshed. Fine adjustment of both IFs and discriminator balance may be made with the meter, but using the station itself as a source of input. Do not attempt this with too strong a signal, and always balance the discriminator after altering the lining of the IF channel.

Optimum adjustment to the tuning coils is made by connecting the meter across the discriminator grid resistor and chassis, using an isolating resistor of .1 megs. The adjustment consists of opening out or compressing the 4-turn winding to give the highest meter reading, retuning the gang each time you make a change. The chances are that very little alteration will be needed.

TUNING PROCEDURE

When tuning to a station with everything in order, a soft rushing sound will be heard on no signal. As you approach the station, a weak and distorted signal will be heard, then a slight point of extra distortion, followed by the clear station carrier. Tuning out the other side, the reverse should take place — a distortion point, a second weak signal, and, finally, the original rushing noise. The more accurately the discriminator is adjusted the more symmetrical will be this tuning phenomena.

A few second spots of communications channels in the 70-80 Mc band will almost certainly be picked up across the dial, and possibly the second spot of the TV station sound channel near 70 Mc. None of these should give you any trouble when tuned to the FM station, which is strong enough to blanket out any interference.

A simple dipole aerial is probably all you will need in the suburbs within 20 miles of the station, provided you have reasonable line-of-sight. For the 90 Mc frequency or thereabouts used for FM, this dipole will measure 30 inches for each arm, making 5ft in all. Brass tubing about ¼in diameter is good, and either 70 ohm co-ax or twin lead can be used.

An article describing a suitable aerial appears elsewhere in this issue.

BACK ISSUES

FOR those who may have missed instalments of the "Course In Television" or other features, back numbers of Radio, Television & Hobbies are available from and including May, 1956. Prior to that date, only odd copies are available in limited numbers.

Back issues are available on application or by post for 2/- each.

SHORT-WAVE NOTES BY ART CUSHEN

INDONESIAN RADIO 30 YEARS OLD

Interesting facts on the history of radio in Indonesia are given in the latest issue of "Indonesia Calling" which dates the first broadcasts from Indonesia as mid 1925

A PRIVATE Dutch organisation first began shortwave broadcasts from Djakarta (then Batavia) in 1925 using the abbreviation of the organisation, BRX.

This station was followed by the establishment of the Dutch Government sponsored Netherlands Indies Radio Omroup, known as NIROM which operated from 1934. Indonesians established a radio organisation of their own including the VORO in Djakarta, the VORL in Bandung, the SRV in Solo, and the MARVO in Jogjakarta.

These stations were partly sponsored by the Dutch or, in this case, the Netherlands Indies Government. The Indonesian radio organisations merged into one body in March 1938, with its head office in Djakarta.

This was the situation during 1942 when the country fell to the Japanese. March 18, 1942 saw the surrender of the Dutch and the commencement of the Japanese operated stations, which were so often heard in this area, with broadcasts from Batavia. These were regularly monitored in this area and were a means of receiving messages from the many civilian internees in Java.

The end of the Pacific War found the NIROM again in operation, and this was the case from August 14, 1945. Three days later Indonesia proclaimed her independence, and from then to 1949 the Indonesian station operated from the internal areas of Java.

All other stations were often heard in this area and more surprising was the receipt, during the days of the hostilities, of a verification from the Indonesian station at Jogjakarta.

The Republic of Indonesia was established in late 1949 and so the Radio Republic Indonesia came into being. The station is operated by the Ministry of Information, and the listeners' letters and reports to the station are much appreciated and verified from Box 7, Djakarta.

The RRI with 100 and 50 Kw overseas service transmitters, also operates many stations for local coverage ranging in power from 150 watts to 20,000 watts. A stormy period of radio in the Indonesian area has been experienced in the past 30 years, and we can now look forward to the ever increasing strength of the signals of the Indonesian stations.

RADIO TAHITI VERIFIES

LISTENERS on both sides of the Tasman will be pleased to learn that Radio Tahiti at Papeete is now verifying reports with a card. The card shows an outline of the island group and gives station details. The station has been widely reported on 6130 Kc. where it is heard with English news at 5.30 pm, and closes the transmission 5.45 pm. The verification was received after an International Reply Coupon was enclosed with the listener's report.

Some interesting facts about the station were published in "The NZ Listener" which reports that the station is housed in modern studio building, and that the staff is made up of six *permanent and two part-time* members, who do announcing, technical and programming.

The station carries some 45 minutes each day of commercial programs in both French and Tahitian, and the news from Paris is rebroadcast each evening. It operates from 8.00-9.00 am and 1.30-5.45 pm.

The country has some 10,000 radio receivers but no radio licence is payable. The station is maintained by the French Government with some help from the commercial income. The Director M. Espinasse, was formerly with Radio Saigon, and the English-speaking announcer is Charles Petras.

IBRA VERIFIES

A BRIGHT verification card from the IBRA Radio which is transmitting to Europe from the Radio Africa transmitters at Tangier confirms reception by card. The red band across the top is overprinted IBRA RADIO, and the front also includes a drawing of the transmitter building and aerials.

Verification details on the reverse side state the station uses 10 Kw. with directional aerials beamed toward Northern Europe; consequently the radiation power is multiplied. IBRA Radio is a missionary Voice, and reports should be sent to Box 821 Stockholm.

Notes on readers' reception should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are Australian Eastern Standard time.

DAMASCUS USES 17865 Kc.

TRANSMISSIONS from the seldom-heard Damascus station, with a broadcast in English, have been providing good signals on 17865 Kc. The broadcast includes a news session in English and then a program in Arabic music to the sign-off at 7.30 am. The broadcast starts one hour earlier than this, and the sign-off includes the announcement "This is the Syrian Broadcasting System. We have concluded our broadcast for this evening and invite you to tune in tomorrow night for a further broadcast from Damascus."

ATHENS USING 15345Kc.

THE Sunday afternoon transmission from Athens, which has been heard opening at 3.30 pm, and reported recently on 11937 Kc. has made a frequency move to the 19-metre band. The broadcast is of a church relay and the program is all in Greek. An interval signal of bell precedes the program. Signals are received strongly but the severe interference from the *AFRS Los Angles transmitter on 15340 Kc.* does much to spoil an otherwise good signal. The signal is found to retain strength to after 5.30 pm after which it gradually fades out.

FLASHES FROM EVERYWHERE

IBRA transmitter which broadcasts from Tangier, North Africa has made a frequency change and has replaced 15020 Kc. with a channel of 8010 Kc. This new outlet, as can be expected when transmissions are off the regular shortwave band, has very severe morse interference. The station opens transmission at 3.00 am on the new 8010 and 11516 Kc. with the usual religious broadcasts, the opening program being in Swedish. The Deutche Welle DX session reports that a series of verifications are issued by the station, a different color and language being sent to the listener for each language transmission he solicits a report of. The address is the IBRA station, Box 821, Stockholm, Sweden. English broadcasts are presented from 7.15-7.45 am.

PORTUGAL has a new 100 Kw transmitter which came into service at the end of 1956 and two English broadcasts are now carried; 11.30 pm-12.15 am, on 21495, 17895 Kc. directed to India, Pakistan and Persian Gulf; 3.00-3.45 am on 17895, 21700 Kc. to South and South East Asia.

SWITZERLAND'S Red Cross Radio, in Geneva, which has been reported for some years with its annual test on 7210 Kc. has, due to the Hungarian crisis, been brought into daily operation for the purpose of passing messages in Hungarian. These are presented daily 4.00, 9.30 pm, 1.00, 6.30 am, all on 7210 Kc.

CYPRUS which we reported as the home of the Voice of Britain in the last issue, has been heard in English and French newscasts, as well as the usual Arabic transmissions. The old Sharq el Adna transmitter uses the same frequencies, and English is released at 1.40 am and 6.30 am, while French is broadcast at 3.45 am. A further newscast in English is announced as being given at 9.30 pm. The frequencies of 11720 and 6790 Kc. have been heard in Europe with this broadcast.

SAIGON is now broadcasting to Europe on the Radio France Asie channel of 17785 Kc. and wants reports on this transmission addressed to Radio Vietnam, Saigon, reports the Deutche Welle DX Session. The broadcast is daily except Sunday, 7.00-9.00 pm in both French and English, using a 25 Kw. transmitter.

CANADA'S CHNX which has been heard in the past summers opening at 9.00 pm on 6130 Kc. is again a possibility, though the interference from the Port Moresby station on the same frequency is severe. CHNX is operated by the Maritime Broadcasting Company, Broadcasting House, Box 400, Halifax, Nova Scotia, has the schedule of 9.00 pm-2.15 pm daily, but on Sunday sign on is at 11.00 pm. The station uses 500 watts on the 6130 Kc. frequency and relays CHNS on 960 Kc.

SAN FRANCISCO'S KGEI which was operated by the General Electric Company, and well known for its many broadcasts during the last war, was removed from service last December. The station has been operating under private capacity since it left the VOA service to South America. The GEC transmitter was first verified by the writer in 1939, when as W6XBE, the station operated from Treasure Island, in San Francisco Bay at the site of the World Fair of that year. The station became KGEI when *the old numeral prefix was dropped in 1941*, and soon had a sister station KGEX, which was frequently heard in the 1941-1945 period.

NORTH VIETNAM broadcasting from Hanoi, using a new frequency 9462 Kc. operates from 12.45 to 1.10 am in English news and native music. World Radio Handbook list the new schedule as; Home service, 8.45-11.30 am, 2.30-3.30 pm, 9.00 pm-12.45 am on 6100, 7408, 7425, 9462, 9840, 12000, 15020 Kc. The foreign service is broadcast on the same frequencies, 1.00-2.30 pm, 3.30-4.00 pm, 7.30-8.00 pm, 12.45-1.15 am. French is at 3.30-4.00 pm.

POLAND ENDS JAMMING

THE announcement by the Polish authorities that they have discontinued the jamming of the broadcasts from countries in the Western Europe area, will be welcomed by all shortwave listeners. The decrease in jamming has been noted already, and this follows the announcements from Moscow some months ago that they had ended the practice of jamming the transmissions from the West.

PEKIN NOW USING 16-METRE BAND

THE 16 metre band has been used by Radio Peking, Peking, China, in the transmission of English news, directed to this area at 7.00 pm daily. The transmissions are now carried on 17760, 17835, 15195, 15105, 15315 Kc.

The English news sessions are now broadcast at 1.00 pm, 7.00 pm, midnight, 5.00 am and 5.30 am, the latter broadcast being heard on a new 41 band channel, 7295 Kc. on Sundays. At 5.00 pm a session lasting nearly an hour of news in English at dictation speed has been heard on 17750 Kc. but has not been heard on other days of the week.

Peking Home Service frequencies have been changed and the first program is carried 7.45 am-12.30 pm, 1.30-3.30 am, 3915, 3960, 5970, 6100, 6300, 7170, 7500, 9054, 9735, 10,260, 11,835, 11,900, 11,935, 15,240, the power used ranges from 20 to 300 Kw, the latter power we presume is one of broadcast band transmitters. The second network is operating, 8.55 am-10.30 am, 1.55 pm-1.15 am, on 5880, 9972 Kc. Power here ranges from 20 to 150 Kw.

Third program transmitted is on broadcast band only. The Taiwan service operates 7.55-11.30 am, 12.45-4.30 pm, 7.25 pm-2.00 am. The first transmission is on 5860, 7485, 9170, 9340, 9390, 9460, 11,455, 11,515; second transmission, 11,515, 11,600, 15,480, 15.590/15,710/-15,880, 17,450, 17,533; third transmission 15,480, 15,590, 15,710, 15,880, 17,450, 17,490, 17,533, 17,605; last transmission to 2.00 am on 7260, 7770, 9170, 9340, 9390, 9460, 11,515, 11,600 Kc.

THE HAM BANDS WITH BILL MOORE

NEW OPERATING RULES FOR 1957 BERU CONTEST

DX Contest operating rules are varied from time to time to simplify log keeping and to make the event as attractive as possible to competitors. The arrangements for the 1957 BERU contest have been completely changed with these points in view.

THE Twentieth BERU Contest wil be held during the usual month of January. The scoring system has been simplified and it is hoped that, as a result, a greater number of logs will be received.

The old sliding scale of point scoring has been eliminated and replaced by a bonus for each new Empire area worked. The RSGB'S contest committee hopes to see a large increase in events over previous years.

The following are the rules of the contest:—

1. The contest is divided into two sections, namely: A. Senior—maximum licensed power; B. Junior— maximum input 25 watts.

2. The contest (both sections will start at 0001 GMT on Saturday, January 26, and conclude at 2359 GMT on Sunday, January 27, 1957.

3. The contest is open to all fully paid-up members of the RSGB within the UK, to all British subjects outside the UK but within the British Empire, and British Mandated Territories, and to members of British Forces of Occupation operating properly authorised stations. All entrants agree to be bound by the rules of the contest.

4. Only the entrant will be permitted to operate the station for the duration of the contest.

5. Entries must be set out as shown using one side of the paper only. They must be postmarked not later than February 11, 1957, and must be addressed to RSGB Contests Committee, New Ruskin House, 28/30 Little Russell Street, London, WC1. The closing date for acceptance of entries is March 31, 1957

FIVE BANDS

6. Operation is restricted to the following bands 3.5, 7, 14, 21 and 28 Mc/s. Transmissions must be of Type A1 (pure CW) only and frequent tone reports of T8 or less may result in disqualification.

7. Entrants must operate within the terms of their licences. The input to the valve or valves delivering power to the aerial must not exceed 25 watts in the Junior Section.

8. Contacts may be made with any station using a British Empire or DL2 callsign except contacts within the entrant's own call area.

British Isles stations may not work each other for points and contacts with unlicensed stations in places where licences are obtainable will not count for points. The decisions as to whether or not a station is valid will rest with the RSGB contests committee. Only one contact per band with individual stations will count for points.

9. Each completed contact will score 5 points, in addition a bonus of 20 points may be claimed for the first contact with each new Empire call area on each band. All British Isles Stations (G, GC, GD, GI, GM, GW) count only one call area.

10. Serial numbers must be exchanged and acknowledged before a contact can count for points. The serial number of six figures is made up of the RST report plus three figures which may start with any number between 001 and 100 for the first contact and increase by one for each successive contact.

11. A trophy or miniature will be awarded to the winner of each section, and certificates will be awarded to the first three entrants in each section.

In addition a certificate will be awarded to the leading entrant in each call area, regardless of the number of entrants in his call area, provided that his score exceeds 1,000 points in the senior section or 500 points in the junior section.

A certificate will be awarded in each call area in which there are 10 or more entrants to the runner-up, providing his score exceeds 1,000 points in the senior section or 500 points in the junior section.

CALL AREAS

For the purposes of scoring the following call areas are recognised:

G, GC, GD, GI, GM, GW — as one call area, MP4 (Bahrein, Muscat and Oman), MP4 (Qatar), MP4 (Trucial Oman), VE1, VE2, VE3, VE4, VE5, VE6, VE7, VE8, A-L (Yukon Territory) VE8M-Z (N.W. Territories), VK1 (Australian Antarctic), VK1 (Heard Is.) VK1 (Macquarie Is.), VK2, VK3, VK4, VK5, VK6, VK7, VK9 (Norfolk Island), VK9 (Papua), VK9 (New Guinea, Bismark, Admiralty Is.), VO VP1, VP2 (Leeward Islands), VP2 (Windward Is.), VP3, VP4, VP5 (Jamaica),) VP5 (Cayman Is.) VP5 (Turks and Caicos Is.), VP6, VP7, VP8 (Falkland Is.), VP8 (Grahamsland), VP8 (Sandwich Is.), VP8 (South Georgia), VP8 (South Orkney Is.), VP8 (South Shetland Is.), VP9, VQ1, VQ2, VQ3, VQ4, VQ5, VQ6, VQ8 (Chagos), VQ8, (Mauritius), VQ9, VR1 (Gilbert and Ellice Islands), VR1 (British Phoenix Island), VR2, VR3, VR4, VR5, VR6, VS1, VS2, VS3, VS4, VS5, VS6, VS9 (Aden), VS9 (Maldive Is.), VU2, VU4, ZB1 ZB2, ZC2, ZC3, ZC4, ZC5, ZD1, ZD2, ZD3, ZD4, ZD6, ZD7, ZD8, ZD9, ZE, ZK1, ZK2, ZL1, ZL2, ZL3, ZL4, ZM6, ZS1, ZS2, ZS3, ZS4, ZS5, ZS6, ZS7, ZS8, ZS9, AP, ST2, 4S7, DL2.

Logs submitted should contain full station details and sheets showing date, band, time GMT, station worked, report out, report in, points claimed for contact, bonus points listed, in that order.

A declaration covering the contest rules and operation in accordance with licence requirements must also be supplied.

Points will be awarded on a 3, 2, 1 basis for 1st, 2nd, 3rd in all the section's contests

The participant with the highest tally over 12 months will be awarded the trophy.

Frank Fowler, VK2APF, of Tamworth has been heard in Sydney by Roy Hart VK2HO when he operated from a lookout near the town. It is another link in a State-wide 144 mc/s net, the distince covered 170 miles.

JA's again appeared on 50 mc/s in mid November when Jack Hill, VK2ADT, of Inverell heard one station for quite a long period. He was apparently working cross-band and not listening on 56 mc/s. Undoubtedly the 50 to 56 mc/s contacts between JA and VK of last year will be repeated

In excellent weather the NSW VHF section enjoyed their first Blue Mountains outing — the XYL's voted it the most enjoyable amateur radio event ever attended. If the XYL's are in accord on such a subject it augurs well for future days in this location.

Three field events were conducted. The Walkie-Talkie scramble was won by John Miller, VK2ANF, with Perc Healy, VK2APQ in second place.

The blindfold hidden transmitter event was finally a victory for Neville Wilde, VK2ZBK. There were heats, semi-finals, etc, before Neville was declared the winner.

The 144 mc Mobile Hidden Transmitter search proved to be the most difficult competition, and the location was found only by old-stager, Bob Winch, VK2OA, and it took him 55 minutes.

Ladies' prizes were presented to Mrs. VK2OA and Mrs. VK2APQ amid some side comment of "stewards".

Country visitors included VK2ZBK, VK2ZAN, VK2NS and VK2IE, from Blayney and Bathurst

The organisation of the day was the combined effort of Blue Mountains amateurs Syd Williams, VK2AVK, and Wal Cromie, VK2MZ, and from general appreciative comment it will not be the last event conducted there.

VK2WI 144 Mc/s, Sunday evening broadcast was presented by group president Perc Healy, VK2APO from a mobile transmitter 3000ft up at Wentworth Falls, 50 miles out from Sydney

Geophysical Year —WIA to co-operate

THE program for US radio amateur participation in the International Geophysical Year is taking shape and Mason Southworth WIVLH has been appointed ARRL-IGY Project Co-ordinator. The work will run by the ARRL under Air Force contract (financed by the service).

Observations on VHF propagation will be in three main catergories, Trans-equatorical scatter on 50 mc/s, Auroral communication on an amateur frequency above 50 mc/s and Sporadic E skip.

In order that no interesting phenomenon is missed, details of any VHF work over unusual distances will be solicited.

The initial work in the propagation fields mentioned was performed by radio amateurs and it was the "wrong" time 50 mc/s contacts across the equator that first gave the scientists working out the scope of the IGY program the idea of co-opting radio amateurs.

The reporting program is conducted as under: All contacts and stations heard which are suspected to have resulted from any of the propagation types outlined, will be listed on special forms supplied. At bi-monthly intervals these reports will be forwarded to the ARRL for listing and analysing.

The IGY will run from July 1, 1957 to December 31, 1958, but to ensure efficient working of the amateur observing scheme it has been decided to collect data from January 1, 1957, six months early.

In Australia the WIA has the IGY co-operation scheme well in hand and already names of amateurs willing to co-operate on VHF observations have been collected and forwarded to the IGY convenor, Professor H. C. Webster, of Queensland University.

Further volunteers are required for this work and names should be sent to WIA Divisional secretaries.

FIELD-DAY ACTIVITIES IN N.S.W.

ALTHOUGH the venue of the Olympic Games was many hundred miles away, the NSW Division's Annual Woy Woy Field Day was affected by the event. The torch on the way from Cairns to Melbourne, travelled from Newcastle to Sydney passing Woy Woy on the day of the field day, seriously cutting the attendance due to road congestion.

As usual the efforts of locals Johnnie Walker, VK2GA, and Cec Hardman, VK2KR were largely responsible for the success of the day

It was incidentally a 3 am affair cleaning up before the field day commenced at 10 am Don Pollard VK2ASW, Stan Bourke, VK2EL and Barry White, VK2AAB were responsible for registration and general organisation; Dave Duff, VK2EO, and Major Collett, VK2RU were also prominent.

Bad propagation conditions seriously restricted operation in the 7mc scramble but Harold Whyte, VK2AHA and Geoff Partridge, VK2VU, recorded 14 and 11 contacts respectively.

The other field event, the 144 mc/s hidden transmitter search was won by Lindsay Douglas, VK2ON, in 29 minutes, second Dick Norman VK2ZCP, third Ken Mitchelhill, VK2ANU. The transmitter was operated by Perc Healy VK2APQ, and Harry Papthorne, VK2HL.

The normal Sunday VK2WI broadcast was presented by State President, Jim Corbin, VK2YC, from the QTH of local amateur John Fullagar, VK2AJY, at Booker Bay.

Next year should see a return to the usual large attendance with no serious interference from outside sources.

RESULTS of the NSW VHF section's Spring Field Day were as follows:— 29 stations were active and some 900 messages were sent and received.

In the portable section John Miller, VK2ANF, was the winner, second VK2AFM, third VK2OA Home station winner Jim Cuming, VK2ZBD, second VK2APQ, third VK2ZAL.

Country station winner Neville Wilde VK2ZBK, of Blayney, second VK2VU Singleton, third VK2ADS.

The section's nocturnal 144 mc/s transmitter search prior to the November meeting saw Dave Andrews, VK2AWZ, first to locate the fox, Charlie Fryar VK2NP and Harry Lapthorne VK2HL. In the future DF hunts will be held on the Wednesday evening prior to the monthly meeting. The section has instituted a new contest on an annual basis for the President's trophy.

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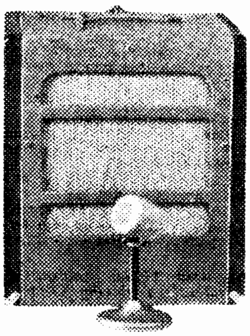

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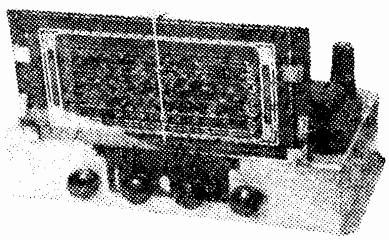

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RSGB Emergency Net

THE Radio Amateur Emergency Net of the Radio Society of Great Britain received considerable impetus from the official announcement by the Postmaster General that messages may be now handled for the British Red Cross Society during emergencies and simulated emergency exercises.

In most parts of the world, as in Australia, amateur radio nets are officially recognised and UK amateurs were pleased to see such official backing granted after such a long period.

The RSGB had been negotiating for such recognition over a number of years. The change will substantially increase amateur support for the RAEN as there is specific work for members to perform.

Amateurs are public minded citizens and willing to serve as has been demonstrated so often. The regulations have been varied to allow such operation.

General instructions for commencing net operation is as follows:—

In an emergency it is not necessary to wait until the telephone, police, fire, ambulance or civil defence communications systems are immobilised before going into action. In such an event, and at the request of the Red Cross Society, members can commence operation once the local telephone system is congested.

Overseas visitors

CURRENT visitor to our shores is well-known Californian amateur Bill Elich, W6AL. Bill, famous cattleman, is no stranger to VK-land. Only a few years ago he was here on a similar trip. Prior to that, earlier in the century he was a regular caller as wireless operator on the well-known trans-Pacific liner the Ventura and introduced one of the first vacuum tubes to this country.

He was granted the second licence on the West Coast prior to World War I and at its conclusion was licenced as W6AL. Bill is wel-known to Australian amateurs via his amateur radio station and has met many personally during his trips. He runs many schedules with VK's, a rhombic 375ft on each leg of the diamond is centred on Australia and really makes an impression on all bands.

Bert Pritchard, VK3CP, is contacted weekly for many hundreds of QSO's, he operates also as W7CJJ from his ranch in Austin, Nevada.

Bill travelled north to Queensland on the first leg of his trip, meeting many on the way including VK2LX, VK2YL, VK2ASJ, VK2XO, VK4TX, VK4RX, VK40R, VK4EA, VK4HX, VK4TN, VK4NC. Leaving early in December for the south he will again visit many amateurs including VK2APP, VK3KR, VK3BG, VK3CP and VK3PA.

The QSL card of W6AL provides a picture of his impressive antenna array. Yagi's on 13, 21 and 28 mc/s range in height from 57 to 71 feet. The Rhombic is 71ft high and is energised with a Collins 1 kw rig.

Bill's impressions of Australia are well worth hearing especially on the service at some of the pleasure resorts he has visited. He is a great advocate for our country and expresses his appreciation of the hospitality afforded him by the many VK amateurs visited.

Civil defence

NSW WIA president Jim Corbin, VK2YC, attended the Commonwealth School of Civil Defence at Macedon, Victoria, from November 25 to 29. He was invited to represent the radio amateur and the NSW Division WIA.

Jim was able to fully explain the value of amateur operation to the communication system of the civil defence organisation.

Many points were clarified on the value and availability of radio amateurs for this type of working. Civil defence organisation will eventually become essentially a function of individual State Governments.

It was fitting that Jim with his wide emergency working experience, was in a position to express the amateurs' viewpoint and to define the range of operation of the WIA's emergency nets.

In the future amateurs through the Wireless Institute of Australia will be advised how they can assist in this important national project.

Listener Award

THE RSGB recently announced the issue of a new operating award for SW DX listeners.

The "DX Listeners Century Award" will be granted to persons who comply with the following requirements.

1. The award may be claimed by any person not holding an amateur radio transmitting licence who submits evidence that he has received signals from amateur radio stations located in at least 100 countries.

2. The award will be issued free of charge to members of the RSGB and to non-members on the payment of the standard fee.

3. The list of countries for which cards may be submitted will be the same as that used for the ARRL DX Century Club Certificate except that cards from Ruandi-Urandi (OQO) and Sicily (IT) will be accepted. Cards from unlicensed foreign stations operating in British Antarctic Territories will not be accepted.

4. Stickers will be available for every 25 additional countries confirmed.

5. The general rules governing RSGB certificates and awards will apply to this award.

The RSGB standard fee for the issuance of certificates to non-members has been increased to 7/- sterling — this will cover increased production and postage charges.

Home for VK2WI

THE Dural "Home for VK2WI" project is nearing completion and shortly VK2WI will be in operation from the site using the transmitter presented to the Institute by Chas Maclurcan, VK2CM.

An appreciation must be recorded of the work of Councillors, Ed Hulme, VK2EN, and Harry Pickett, VK2AHP to ensure the success of the scheme.

Both have given unstintingly of their time, not only during weekends but during the week.

Other amateurs have assisted and given more than their fair share of time, but the efforts of these two on behalf of the radio amateurs of NSW was outstanding.

World Cruise

DANNY WEIL VP2VB/P etc., rescued from his yacht Yasme by the aid of amateur radio operators is at present stopping near Sydney with Mac Hicks, VK2ADV.

Danny hopes to contiue his world trip on acquiring a suitable craft. Amateurs wish him the best in his quest and will be pleased to welcome him back to the amateur bands especially from those rarer prefixes from which he is prone to operate.

DX Notes

THE VK1 DX problem will soon be solved when the Australian Antarctic amateurs use their new VKO prefix. It will certainly be a relief to the overseas DX fraternity who have been confused in their quest for the rarer VK prefixes by the VK1 allocation to ACT amateurs. Quite a number of overseas DX stations complained of wasting operating time trying to identify the location of VK1 stations.

A true indication of how our bands really perform was shown during November when the W's conducted their annual sweepstakes contest. Prior to this event the occasional W was to be heard during the evenings on 7mc/s but during the Sweepstakes Weekend the band was full of American stations.

Other than on 14 mc/s it is difficult to follow conditions, as often a dead band is due to lack of stations operating rather than poor propagation.

DX Awards

TWO new DX awards were recently announced, the first rather difficult for either VK or ZL amateurs to acquire.

The Radio Society of East Africa presents "The Worked all VQ Areas Certificate", available to all amateurs that submit the following confirmations: One from VQ1, 10 from VQ2, 5 from VQ3, 20—VQ4 5—VQ5, 1—VQ6, 1—VQ8 Chagos, 1—VQ8 Mauritius and 1—VQ9.

Five extra cards from any VQ area may be submitted for any one missing card.

Confirmations should be sent to VQ4RF, Box 264, Nakuru, Kenya, together with six shillings sterling or 20 IRC's to cover return postage on QSL's and certificate.

The OH award is offered by the Finnish Society to amateurs who can prove contact with Finnish fixed stations in the call areas OH1 to OH0 since June 10, 1947. Non-European applicants must work 15 OH stations in five areas.

Contacts may be on one band, but 3.5 Mc/s QSO's will count as two contacts for other bands.

C.W., phone, or both, are allowed with minimum reports of RST 338 or RS 33.

Applications together with a check list and 5 IRC's should be addressed to the OHA manager, Box 306, Helsinki, Finland.

If worked before June 1, 1954, the following stations count as OH9—OH8's, ND, NJ, NS, NV, NX, OA, OB, OC, OG, OI, ON, OP, OQ, OR, OU, OX, OZ, PA, PB, PD, PF, PL, PM, PQ.

The suffix "/P" on Norwegian call signs now indicates that such stations are operating in the Norwegian arctic area—Jan Mayen, Hope island, Svalbard, &c. The suffix "/G" is to be used to designate installations operating in antarctic areas—Peter and Bouvet Islands, all countries on the rare list.

In the VP8 area VP8AO, VP8BP and VP8BO are at Vahsel Bay, VP8BR in Grahamland, VP8BL Port Stanley, VP8BS at Admiralty Bay, South Shetlands, VP8BT at Signey Island, South Orkneys.

What is a Country?

OVERSEAS various discussions have been centred on DX "Country Lists" in respect to what really constitutes a country. With the number of expeditions to remote parts being conducted each year the lists are growing and many amateurs interested in DX working are concerned with this trend.

The number of "countries" available for DX rating is approaching the 300 mark and among them are many that would not faintly resemble the dictionary definition of a country.

Radio amateurs with time to spare for a vacation are looking for additional locations to emit an elusive DX signal. These spots are, however, running out. Latest expedition was that of XE4A to Socorro, off the coast of Mexico; he tallied some 2000 contacts.

It is considered by a number of amateurs that the subject of country lists should be re-examined and that countries are countries, not a mud-flat or atoll off some coast or other. Quite often some of our "countries" are not listed in a good class atlas.

There must be some logical limit to the country increases. The ARRL make every endeavor to assure that their DXCC rating is formulated along recognised lines.

Some of the countries on the list currently, however, would hardly rate any better than the States of Australia if all aspects were re-examined.

At least each of our States boast of their own governments and Tasmania was listed as a separate country years ago.

TRADE REVIEWS AND RELEASES

NEW TAPE RECORDER FROM BYER

The Byer "66" general purpose tape recorder. Several versions are available with different tape speeds.

Byer Industries Pty. Ltd. have recently announced the release of a new medium priced general purpose tape recorder. Designated as Type "66" it offers flexibility, high performance, professional appearance, and all the worthwhile features of modern design.

THE following are some of the specifications of the instrument: Although basically a single speed machine it can be supplied as a two speed type at slightly extra cost. Any two adjacent speeds may be supplied in a range from 1 7/8in/sec to 120in/sec.

A three motor drive system is employed, high torque motors being used for take-up and re-wind spools, and a synchronous motor with integral flywheel being coupled directly to the capstan.

At 7½in/sec the frequency response is given as 35 to 12,000 cps. plus and minus 4 db. Total wow and flutter is better than .2 pc, and the signal to noise ratio not less than 45 db unweighted at normal recording level.

The amplifier has a power output of 6 watts and the total harmonic distortion is less than 1 pc at zero level (plus 8 dbm). Frequency of the bias oscillator is 55 Kc.

Operation is by press button and the instrument is equipped with all the necessary electro-mechanical interlocks to provide simple operation.

The list price, including sales tax, where applicable, is £247/10/-. An inbuilt radio tuner is available for an additional £21/7/6.

Further details from the makers, Dorcas St., South Melbourne, Victoria.

TV Valve Book

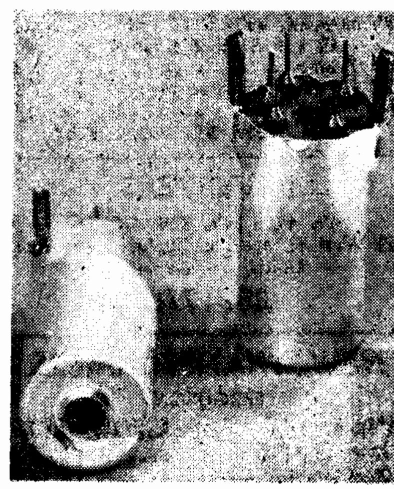
A new data booklet released the Amalgamated Wireless Valve Co. Pty. Ltd. will be handy for servicemen and experimenters. Priced at 3/-, it gives socket connections and salient electrical data for the preferred Radiotron television types. The booklet also includes data on Radiotron deflection components. (Mailing address, 47 York St., Sydney, postage sixpence.)

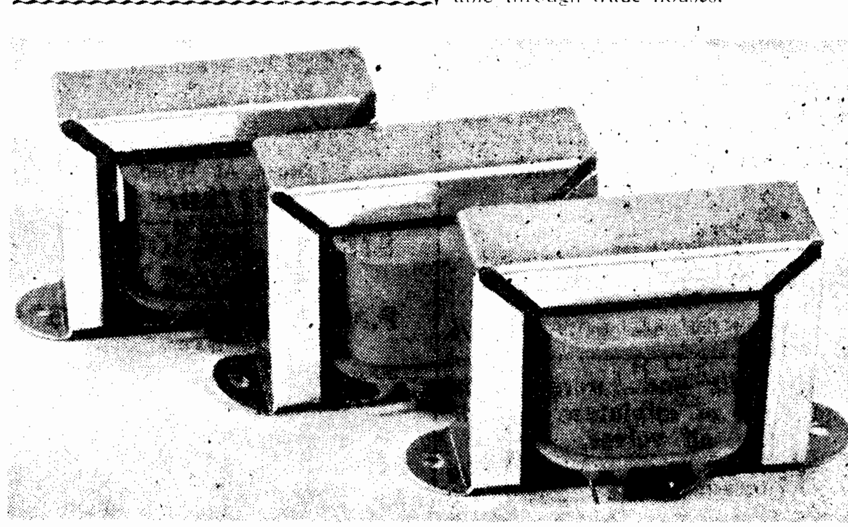
RCS COMPONENTS FOR TV SETS

Home constructors of TV sets, experimenters, "hams", etc will welcome two new releases from the well-known firm of R.C.S. Both items have previously been in the "hard-to-get" class.

THE first is a series of coil formers and cans, as normally used for RCS coils, but intended for the experimenter who needs to wind his own. They are available in four or five pin base types, are fitted with iron cores, and coil dope is also available.

Item two is a series of filament transformers having high voltage insulation as required by CRO's and small TV sets. Insulation is rated at 5000 volts and units are available giving 2.5, 4, or 6.3 volts. Supplies of these items are available through trade houses.





The three filament transformers suitable for high voltage operation. The variety of voltages covers such valves as the 2X2, AV11, VCR97, 511B, 5BP1, 5CP1, 6X2 etc. Types are: TP60 (2.5V), TP61 (4V), TP62 (6.3V).

ADVANCED HIGH FREQUENCY CRO FROM COSSOR

The wide experience of the Cossor organisation in the production of television, radar and test equipment is reflected in the workmanship and performance of the Model 1058 Single Beam Oscillograph, which we were recently able to test in our own laboratory.

THE functions of the controls may require some study at first. It is much the same as in the case of driving a new car, and after a few minutes' practice the required pattern can be obtained without hesitation.

Having mastered the controls, we found the fine focus and rock-steady synchronisation of the 1058 made it a pleasure to handle.

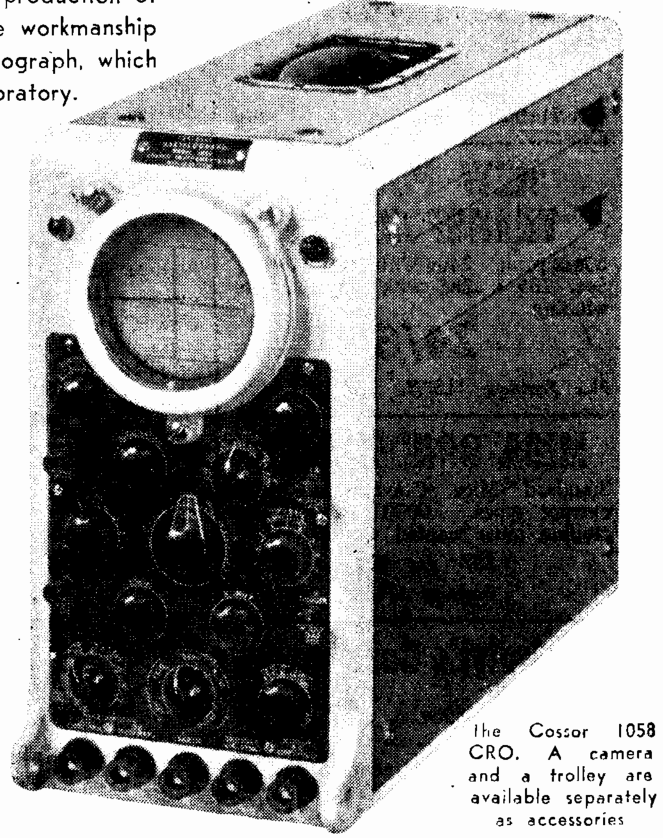
The instrument is fitted with a 3½-inch flat-screen cathode ray tube so that the useful screen area is greater than with most 3½-inch CR tubes. An overall acceleration potential of 1.75 KV assists in maintaining fine focus when medium to high brilliance is required.

The vertical amplifier is direct coupled throughout the upper half power point being at 4 Mc/s. The undistorted output is about 2½ inches up to 6 Mc/s, at which frequency the gain is about 50 pc of the gain at medium frequencies. An AC input terminal is provided for measurements where the DC component is not of interest. Through the coupling capacitor the lower half power point is at 20 c/s.

MILLER TIME-BASE

Consistent with the quality of the instrument, a Miller time-base giving good linearity and capable continuous or triggered operation is included. The sweep can be expanded up to five times for detailed examination of portions of the trace. A calibrated time scale allowing measurements to be made by a shift method is a valuable feature in an instrument for developmental work. The synchronising amplifier ensures a rock-steady pattern.

The dimensions are: Height 15½in, width 8in, length 21in and weight 42lb. The price is £229 net, FOR, Sydney. The instrument reviewed was supplied by Jacoby, Mitchell and Co. Pty., Ltd.



The Cossor 1058 CRO. A camera and a trolley are available separately as accessories

NEW VALVES

IQ5	9/6	6K8G	11/6	6F6	9/6	EZ82	9/6
IT4	13/6	71A	7/6	EL32	9/6	117N7	15/-
IR5	15/-	EK32	15/-	12A6	12/6	4307A	10/-
IS5	15/-	6J8	15/-	6J7	8/6	5Y3GT	12/6
3S4	15/-	6K7	7/6	5U4	12/6	12SR7	3/6
3V4	15/-	KTW62/6U7	7/6	954	5/6	1H6	7/6
IK5	2/6	EF8	9/6	955	5/6	1J6	7/6
IL5	9/6	7C7	3/6	VR65A	2/6	1D8GT	10/-
IC7	9/6	7A6	3/6	EBC33	9/6	1D5	9/6
6U7G	7/6	78	7/6	AV11	5/-	9001	5/-
6G8G	11/6	6AG5	10/6			81	15/-
6SA7	9/6	6B8 Metal	12/6				
6SQ7	9/6	32	5/-				

ALL VALVE PRICES PLUS POSTAGE

RELAY-TYPE COUNTERS

("Mercury" American Made) These relay counters register from 0 to 99,999. Can be supplied with 250ohm coil. 24v D.C. operation.

25/-

Plus Postage.

NEW 5-VALVE D.W. VIBRATOR CHASSIS

These Chassis, by leading manufacturer, are new but shop-soiled. Are supplied in working order and complete with valves, Rola 6in x 9in Oval Speaker. Slide Dial and Vibrator, supply (6v).

List Price over £40.

SPECIAL PRICE,

£15/15/- F.O.R.

Ideal for Boat, Caravan, etc.

NEW AMERICAN INDICATOR-UNITS

Containing 12 Valves.
1. 3 B.P.I. in Separate Shield, 7-6SN7, 1-2x2, 1-6x5, 1-6H6, 1-6G6.

£8/17/6 F.O.R.

T.V. COMPONENTS

All RCS Television coils, formers and transformers in stock.

A.C. AMP. METERS

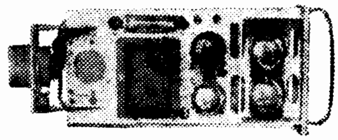
A.C. Amp. Meters (ex-County Council). A necessity in any electricity workshop.

RANGE: 0-5 amps. (can be extended by shunts). DIAMETER: 7½ inches.

28/6 F.O.R.

By Rail or Air Freight Only
Too heavy for Post

FOUR-VALVE AMPLIFIER



Four-valve audio amplifier, made in America. Supplied with two 7C5, one 7F7 and one 7Y4 valves, trans. res., etc, mounted in brocaded finished case.

Post N.S.W. 5/6
Int. 7/6 **38/6**

NEW AMERICAN BOX KITES

These kites are constructed of Silk with Metal Frame
SIZE 15in square x 3ft long.
Originally used for Aerials for Lifeboat Transmitters.

30/-

Post. 2/-.

NEW 1000 K.C. CRYSTALS

For Bendix Frequency Meters.
Made by General Electric.
American Octal Base.

£7/15/-

P.M.G. TYPE RELAY-COUNTER

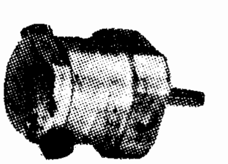
0—9,999

1,300 ohm coil **15/-**

NEW ENGLISH T.C.C. HIGH VOLTAGE PAPER TUBULAR CONDENSERS

	Each	
.01-1000V	1/9	All
.02-1000V	1/9	plus
.05-1000V	1/9	postage.
.02-1500V	2/-	
.05-1500V	2/-	
.1-1500V	2/6	
.05-2000V	2/6	

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 **32/6**

Packing and postage: N.S.W., 1/6; Interstate, 2/6.

A.T.5 TRANSMITTERS

Complete with Valves, 2-807, 2-6V6.

£4/17/6 F.O.R.

LESS VALVES:

£2/17/6 F.O.R.

PILLO-FONE
EXTENSION UNIT

IT'S A REAL MINIATURE WITH ROLA UNIT.

Install it anywhere, in the sick room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The 'PILLO-FONE' IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3½in Diameter by 1¾in deep.

POST FREE **22/6**

NEW 12V GENEMOTORS

American Manufacture.
Input 12V, Output 240V at 100 M.A.

£4/15/-

CERAMIC TRIMMER CONDENSERS

Small 7-plate O-20 PF 3/6
Small Tubular, O-20 PF 2/-

Please address all correspondence to 479 Parramatta Road, Leichhardt, N.S.W.

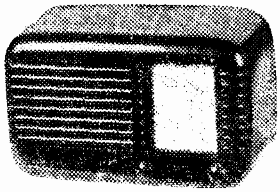
METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, N.S.W
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, N.S.W. PHONE LM3610

MAKING UP THE "LITTLE GENERAL"?

—THE IDEAL PRESENT—



£12/17/6

Post and Packing N.S.W., 14/6. Interstate, 25/-.

Complete kit of parts for the 1956 "Little General" as featured August R & H including attractive bakelite cabinet with slide dial. Price includes valves and Rola 5F speaker and kit is complete to the last nut and bolt. (Set wired and tested £2/15/- extra). Cabinet size 11½in long, 7in high, 6in deep.

Foundation Kit for above comprising Bakelite Cabinet, Chassis and Dial Assembly 57/6

MIDGET CONDENSERS

New seven plate midget condenser, ceramic insulation, standard single hole mounting ¼in spindle 0-30pf. 5/6

NEW SWITCHES

D.P. S.T. Rotary 2/6
Yaxley 3 x 3 SB 3/3
Oak 3 x 2 2B 4/6
Alpha DP/DT 3/3
Oak 1 x 2 SB 1/9
Oak 1 x 3 SB 2/-
Oak 4 x 2 SB 3/6
Post extra.

PUSH-BUTTON SWITCHES 20/-

Five pole push-button switches .. .. New control box fitted with above switch also 5 bezels with globes and multi contact key switch.
Post N.S.W., 2/-; Interstate, 3/-.

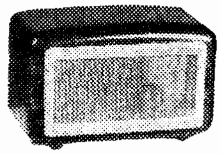
NEW B.S.R. MOTORS

These English B.S.R. Motors as used on most tape decks, also have many other uses. Size of motor 3in x 2¼in x 2¼in with 3 16th shaft, for 240 or 110 volt AC operation.
NEW 39/6
Used, but in good condition 27/6
Post, N.S.W., 3/-; Interstate, 4/6.

NEW GRAMO-MOTORS

New H.M.V. spring gramo. motors, less turntable. Adaptable for many uses 19/6. Postage N.S.W., 4/6; Interstate, 7/6.

Carbon microphone transformers, new, 4/6
Post extra.



Post and Packing
N.S.W. 10/6; INT. 16/6

NEW ROLA EXTENSION SPEAKERS

Rola 6-9L Oval Speaker, mounted in attractive bakelite cabinet with matching metal grille and complete with volume control.

£3/12/6

METAL RECTIFIERS

90 volt 200m.a. metal rectifier, suitable for operating relays, etc. 9/6

THROAT MICROPHONES

New American throat mikes. Per pair, 3/6

SIGNAL LAMP GLOBES

Lucas signalling lamp globes, 10v, 6/- doz
PRE-FOCUS GLOBES
12v, 420 watt 7/6
Post extra

CREED-RELAYS

New creed relays supplied with mounting base £3/10/-

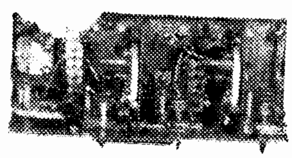
OIL FILLED PAPER CONDENSERS

15mfd 600v 10/-
2mfd, tapped at .5mfd, 110v AC 7/6
1mfd 400v. 2/9
.01mfd 500v. 7/6
3MF 2000v. 17/6
1 x 1 400v 2/6
Post extra.

I.R.C. WIRE-WOUND RESISTORS

650 ohms 50 watt adjustable 5/6
2,500 ohms 5 watt, 1/6 or 10/- doz
4,800 ohms, 5 watt 5 p.c., 1/6 ea or 10/- doz
200 ohms 20 watt 10 p.c. 2/3 ea. or 15/- doz
5,000 ohms 20 watt 5 p.c. 2/6 ea. or 20/- doz
1,000 ohms, 20 watt 2/6 ea. or 20/- doz
750 ohms 30 watt 5 p.c. 2/6 ea. or 20/- doz

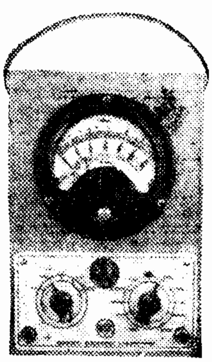
H.F. TUNING-UNIT



25/-
Plus Postage

These H.F. tuning units which are suitable for the 144Mc band contain three slug tuned coils, 7 plate ceramic trimming condensers, three acorn sockets (ceramic) and 3 new 954 acorn valves.

NEW UNIVERSAL-MULTIMETER



Manufactured by Robinson Electronics Laboratories, Incorporating 4½in World Famous American Weston Meter and High Stability Resistors.

This high-grade instrument is fitted in a durable and attractive Hammerton-finished case with self-contained batteries and supplied complete with test prods.

D.C. Ranges	A.C. Ranges	D.C. Current Ranges	Resistance Ranges	Output Ranges	PRICE
0-12V	0-12V	0-1.5MA	0-5,000 ohms	0-12V	£12/17/6
0-60V	0-60V	0-12MA	0-50,000 ohms	0-60V	Plus 12/6
0-300V	0-300V	0-60MA	0-500,000 ohms	0-300V	PACKING &
0-1,200V	0-1,200V	0-300MA			POSTAGE

Also Decibel Scale—minus 18 to plus 5db

Please address all correspondence to 479 Parramatta Road, Leichhardt, N.S.W.

METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, N.S.W.
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, N.S.W. PHONE LM3610

WHAT MAKES IT WARM MY HANDS?

Engineers use these symbols to simplify both the drawing and the reading of schematic circuit diagrams. The subject will be explained later in more detail; just remember that a zig-zag line in a circuit normally represents a resistor.

One more point, and your reading of chapter 1 will be complete.

There are various applications where it is necessary to vary the amount of resistance in circuit; this brings us to the term VARIABLE RESISTOR.

The most elementary form of variable resistor is a wire-wound type with a small guide rail mounted above it; the guide rail carries a spring contact which presses down on the coil of resistance wire. One terminal or lug is connected to one end of the wire and the other to the adjustable contact. By simply moving the contact along the guide rail, the whole or part of the resistor is effective between the terminals. (See figure 6.)

As an alternative, a simple clip may be fixed around the resistance element, so arranged that it can be moved along as required, then tightened to make contact with the wire.

FLAT STRIP

Where ease of adjustment is important, it is possible to have the resistance wire wound on a flat insulating strip, bent into about a three-quarter circle. A spindle is located at the centre point of the arc, carrying a radius arm. As the spindle is rotated, this radius arm moves over the resistance element, making contact, as it passes, with each individual turn.

One terminal connects to one end of the resistance element and the other terminal to the contact arm. Any value from zero to maximum resistance may be effective between the terminals, depending on the setting of the contact arm.

(Continued from page 81)

In the earliest controls of this type, the wire-wound resistance element was left exposed, but present practice is to house it in a moulded bakelite case for appearance and protection.

For resistance values in excess of a few thousand ohms, the resistance element is usually a carbon mixture, moulded into the required shape.

Some of the earliest variable carbon resistors merely contained loose carbon and mica granules, or carbon impregnated discs, which were pressed together by the action of a screw; this decreased the resistance as required.

The appropriate schematic symbol for a variable resistor is the central one in figure 7. It depicts quite clearly the resistance element, with its end connection and the moving contact.

The bottom symbol also depicts a simple variable resistor, but it is less precise, in that it does not differentiate between the moving and fixed contacts, nor does it show the unused portion of the resistance element. Variable resistors having just the two connections are commonly known as RHEOSTATS.

THREE CONNECTIONS

Modern practice is to provide a variable resistor with three connections, one to each end of the resistance element and one to the moving contact. Such a unit is generally referred to as a POTENTIOMETER and all three connections are normally employed in modern circuit practice.

In cases where only two of the three connections are used —one moving and one fixed—the unit is said to be employed as a rheostat. The appropriate symbol for a potentiometer is the top one in figure 7. It shows quite clearly the two end connections and the moving contact.

Watch for a further article in this new series next month.

GUESSWORK IS ON THE WAY OUT

(Continued from Page 7)

they broke down—which always happened a long way from a garage. Again, they don't always go straight away, but linger to give faults which don't appear to be the coil's fault.

One gadget now used extensively supplies an intermittent DC power supply to the coil at the correct voltage — 6 or 12 volt—with 200 breaks a second, which on a four-cylinder engine represents a speed of 6000 rpm. The output of the coil—which may be as high as 20,000 volts — is measured by a vacuum tube voltmeter across a 4 meg fixed resistance to simulate the coil load. Since coils get hot with work, and when failure is imminent it happens with a hot coil, the coil is heated to working temperature by the incoming current before tests are made.

And condensors, too:

Condensors in distributors are tested three ways by one machine. The meter has three scales—one for a 500 volt DC leakage test, another for a low voltage AC capacity test and the third for a series resistance test, for which current is supplied from an RF signal generator.

This doesn't exhaust the list. There is equipment for testing generators and starter motors, for electrically checking advance and retard, for determining vacuum in manifolds, pressure in fuel pumps. Not the least important is the electric battery check, which gives accurate readings of the specific gravity of the electrolyte, a test ignored by the old style prod testers. Garages find it the only practical solution to on-the-driveway battery tests.

GARAGE USE?

Readers may wonder where the cathode ray tube comes into engine testing. In general, it doesn't for garage use. Reading visible trace patterns and interpreting them is, as the design engineer for one of our large equipment laboratories says, something for the electronics man, not for a mechanic. However, he points to Du Pont in America, who have produced a cathode ray ignition tester which provides simultaneous patterns for each spark plug and point opening on four, six and eight-cylinder engines.

One thing we can be sure of—if the cathode ray tube method (already used in one Australian-designed crankshaft balancing machine) gives a solution, readily understandable to mechanics, of something which has got to be solved and can't be at present, then one of our test gear manufacturers will make it. For competition is brisk and Australian electronics are well up with the leaders.

240 AC SUPPLY FROM A BATTERY

(Continued from Page 45)

introduce unwanted resistance. We used 5 mil automotive wiring cable. These leads are anchored to the chassis by a suitable bracket bent up from a scrap of aluminium. Wrap a few layers of friction tape around the leads under the bracket to avoid a possibility of the insulation being frayed.

ACTIVE LEAD

The active lead is soldered to a lug on the top of a short length of threaded mounting pillar. The pillar is in turn attached to the bolt which clamps the lead retaining bracket to the chassis. The RF filter choke is mounted between this point and a lug on the 7-lug strip.

The RF choke consists of 23 turns of 16 swg enamel covered wire, wound on a half inch mandrel. This choke will have to rest on the chassis, and it is wise to slip a bit of light card under it, to avoid a possible short, through the enamel being scraped off.

The transformer leads are sorted out, according to the color code, primary leads are anchored to the appropriate lugs on the 7-lug mounting strip. The various wiring runs are then made from those lugs. The centre lug is an earth lug, and is used as the common earth point.

Secondary leads are anchored to a 3-lug strip, which is centrally mounted at the transformer end of the chassis. The buffer condensers are connected between these lugs and the common earth.

Well, that completes the story except for a word of advice: When using the unit to operate a set elsewhere than in a car, attach an earth wire to the set to help eliminate hash interference.

ANSWERS TO CORRESPONDENTS

D.P. (Lane Cove, NSW) sends in a query concerning a loopstick and a reaction winding, as mentioned in the text of a "Reader Built It" page.

A. Thanks for the query, D.P., which we shall not answer on this page, since we feel it would be more suitable for the "Answer Tom" columns. We shall do our best to include it as soon as possible.

I. W. (Bensville, NSW) submits a circuit of a one-valve amplifier which he uses with a crystal set.

A. Thanks for your letter, I.W., and for the enclosed circuit. We have put it aside for possible use in the "Reader Built It" page.

R.B. (Gladesville, NSW) says that he built up the reflexed superhet circuit mentioned in the "Reader Built It" page for November, 1947. He has found that it performed extremely well and suggests that we should describe such a set as a full-scale project.

A. Thanks for your letter and for the report on the set. Actually we did build up a set along these lines, which appeared in the October, 1950, issue. It did perform very well but was not a particularly popular design. The point seems to be that a straight four is good enough for local listening. In more remote areas, constructors are inclined simply to put in extra valves and not bother with fancy circuitry.

I.J. (Balgownie, NSW) relates a couple of "mysteries" In one case a receiver played, even though the speaker was disconnected. In another case touching a cord connecting earphones to a set altered the volume of short-wave stations or caused the set to squeal.

A.—Neither of these circumstances present any real mystery although they can be puzzling at first encounter. When a receiver is disconnected from the speaker it can cause trouble in the output valve if this latter is left without plate voltage. However, if the speaker transformer is on the chassis, removal of the speaker leads merely leaves the transformer without a load on the secondary. Very high-peak voltages may appear at the transformer, causing laminations to rattle or to vibrate other parts of the chassis. This might even occur, of course, with the speaker in operation, but minor rattles would not then be heard. With the speaker disconnected and the volume turned up the result will be more or less inevitable. Regarding the effect of the phone cord, it seems evident that it was acting partially as an aerial or counterpoise so that touching it affected the signal level in the receiver. Perhaps if the receiver had had a larger aerial or an earth, the effect would not have been noticeable. A bypass on the AF amplifier system may also have made a difference.

B.T. (Leichhardt, NSW) would like to see us publish a simple chart for variable capacitors showing the relationship between the capacitance and the number of plates.

A. A lengthy article on the subject was published in the October, 1943, issue and more recent reference, from time to time, has been made in the "Answer Tom" feature. However, the point of the matter is that there is no simple relationship between the number of plates and the capacitance, the rating being effected also by the size of the plates and their spacing. With particular brands this idea could apply since the plate size and the spacing is constant. However, other capacitors might have the same rating with more or fewer plates owing to a difference in size and spacing. Therefore, one chart would not apply to all the different brands.

R.T.J. (Carlton, Vic.) has been having trouble with his set in that it develops an oscillation on odd occasions when tuning between stations.

A. You did not mention, R.T.J., whether the set has just recently developed this fault. If this is the case, we suggest you test the circuitry for a faulty capacitor, particularly AVC or screen by-passes, when the set is oscillating. It would appear that while tuned to a station the developed AVC voltage prevents the oscillation, as may random noises between the stations, giving the effect that the fault occurs occasionally. A badly earthed valve or coil shield could also be responsible for the condition.

F.S. (Glen Iris, Melbourne) wants to know whether one plate of an 80 rectifier could be used to rectify 6 volts AC.

A.—You do not say what you have in mind, F.S., but we suspect that you want the DC output for battery charging or perhaps to operate a filament circuit of a car receiver. The idea you suggest would be completely impractical for any of these purposes. Firstly a rectifier like the 80 is only rated to pass a current of 60 odd milliamps per plate; secondly, its internal resistance is such that there is a very large drop across it when passing even this order of current. As a result, with an input of 6 volts AC, the DC output would be of little practical use in terms either of voltage or current.

We can't be more precise than this F.S. because you haven't told us what you are trying to do. However, we trust that you can follow the general idea behind our reply. If you do want something like 6 volts DC output at more than a few milliamps, it will be necessary to use a metal rectifier and a transformer delivering considerably more than 6 volts AC input. Have a look at our battery charger as an example. of the Power Supply For Personal Portable Receivers

C.I.T. (Penang, Malaya) forwards a renewed subscription and raises several queries relating to amplifiers and tape recorders.

A.—Many thanks C.I.T. for your renewed subscription, which is being attended to by the subscription department. Most of our tests of speakers, records, etc., are carried out, these days, on one or other of the ultra-linear amplifiers in a home Acoustic conditions in an average laboratory are far from ideal and only initial tests are carried out in this situation.

Standard practice in U-L output transformer design is to provide screen taps at from 17 to 20 per cent of the impedance ratio. Actual values may vary in this range with different manufacturers, due mainly to the methods of winding, etc.

A number of books dealing with various aspects of magnetic recording have been available from technical booksellers. Not being able to indicate whether any particular titles are in stock, we suggest that you contact one of a number of firms handling technical literature.

An article explaining "Hi-G" in very simple terms, was featured in the May, 1954, issue. Cosmocord Ltd., the makers of Acos pickups, subsequently approached us for permission to reprint this article. The result was an attractive little booklet, which should be available from Messrs. Amplion (A/asia) Pty. Ltd. of 88 Parramatta Rd., Camperdown, Sydney, the Australian agents for Acos products.

E.V.H. (Blacktown, NSW) writes to say that he has connected a microphone to a five-valve mantel set, but it refuses to work.

A. As you have not supplied any information as to the type of microphone you have used, nor as to how you have connected it, we can only assume that either the output from the microphone is too low to be of any use or that you have connected it incorrectly. The only microphone that is likely to have any useful output for such use is a carbon type, which should be used with a battery and a step-up transformer. The transformer secondary should be connected across the pickup terminals of the set or, if these are not provided, across the volume control, which most likely forms the diode load or part of it. Provision should be made for breaking the connection between the diode and the audio grid circuitry. Only if the audio system of the set has high gain would useful output be obtained from a crystal microphone.

M.H. (Brisbane, Q), writes to tell us about an interesting experience concerning the electrical system of a car which he considers may be of interest to other readers.

A. Many thanks for your letter, M.H., and we will pass your letter on to the Serviceman for possible use at a later date. In the meantime we can only comment that such a situation could have been extremely dangerous, being associated as it was with the petrol tank. Doubtless many unexplained fires in cars could be traced to similar defects if all the facts were known.

M.F. (Gympie, Q) submits a design for a simple cross-over network.

A. Many thanks for your letter, M.F. Your circuit may be of interest to our readers and we are filing it with a view to possible inclusion in a future issue in the Reader Built It section of the magazine.

No Name (Wynnum Nth., Brisbane) would like to know the date of publication of the All-Wave Battery Two and submits a circuit of a two-stage transistor set for possible comment.

A. The All-Wave Battery Two was featured in the March, 1954, issue. The Teach Yourself Radio series should be of help to you but the issues are no longer available from this office. Your transistor circuit is quite conventional in design and we can offer no suggestion for improvement unless you wish to add an extra stage. If you are interested, we refer you to the Transistor Set No. 3 featured in the July, 1955, issue of R. TV & H.

J.G. (Murrumbeena, Vic.) asks if we think that the one valve "Reader Built It" receiver described in October, 1956, would be suitable for him. He is 12 years of age.

A. Yes J.G., building a little set of this type is an excellent way of becoming familiar with the general principles and gaining some experience in wiring and circuit reading. Make sure that you know how the solder joints should be made and study the layouts of similar small receivers before you start work. Given a sensitive pair of headphones you should be able to receive many stations from your location at good strength.

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.

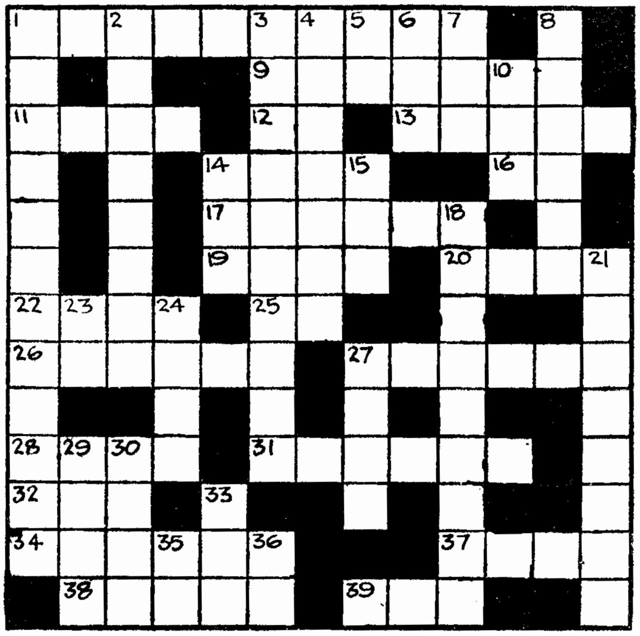
Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

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.

THE R. T. & H. CROSSWORD No. 32



ACROSS

1. Variation of frequency, phase or magnitude.
9. A plant with leaves in three parts.
11. Component of a TV picture.
12. Symbol for Titanium.
13. To drag behind.
14. Part of the foot.
16. Symbol for neon.
17. Special flag or emblem.
19. Dumb, silent.
20. Freedom from awkwardness.
22. Type of hard wood.
25. Audio Engineering (abbrev.)
26. Highest quality.
27. Weighed down.
28. Smooth.
31. Of circular movement.
32. Wheeled vehicle.
34. Three element valve.
37. Mid-day.
38. Town in N.S.W.
39. Tasmania (abbrev.)

DOWN

1. Prominent in high gain triodes (2 words).
2. Type of oscillator.
3. Device for control of signal level.
4. Port on the Adriatic.
5. That is (abbrev.)
6. Frequently, often.
7. Conjunction meaning "and not".
8. Small pincers.
10. Boy's name.
14. Border of a piece of cloth.
15. To tell an untruth.
18. Tube for obtaining negative resistance (pl.)
21. Another word for Auto-heterodyne.
23. Prefix meaning two.
24. Gas used in glow-discharge lamps.
27. Stringed musical instrument.
29. Change.
30. Lake in America.
33. To say further.
35. Above and touching.
36. Electrical Association (abbrev.)

Solution and further crossword next month.

D.W.L. (Manly, NSW) asks us to compare the power consumption of radio and television receivers.

A. Your figure of 100 watts for the power consumption of a broadcast receiver is on the high side. Large sets with high power audio stages would use more, of course, but most 5 valve domestic receivers require about 50 watts. The consumption of a typical television receiver would be of the order of three times that of the broadcast receiver, or at least 150 watts.

A.W.M. (Hectorville, SA) writes to tell us of the success he has had in building the Twin-tune crystal set. However, it appears that after the initial good performance, the set was moved to another room and connected to a new aerial and earth. From then onward it would only work with earth disconnected, either in the new location or the old. A.W.M. would like an explanation of this behaviour, also the meaning of the abbreviation D.C.V.W., as used on fixed capacitors.

A. The fact of a change in performance with the moving of the set, seems to indicate that a fault may have developed in the process of moving. We suggest that a possible cause of the trouble may be open or shorted turns in the windings of the coil. In numerous cases however, the successful operation of a set with or without an earth depends on the locality, and it is quite legitimate to operate a set without an earth, if the performance is improved thereby.

The abbreviation D.C.V.W. stands for D.C. volts working, and signifies the voltage at which a capacitor could normally be used. Usually capacitors are capable of withstanding the application of peak voltages well in excess of their working voltages. However, if operated under these conditions for any length of time, their life will be prejudiced.

U.S. (Kensington, NSW) is bothered by interference problems from the electrical systems of cars. U.S. would like to know why some cars have more interference than others, whereas some have none at all, using the same system. Also whether any attempt has been made to design an interference-free system, rather than use suppressors.

A. We agree with you in that cars with seemingly identical electrical systems have varying degrees of interference. Due to a number of variables involved, it is impossible to give a direct answer. Generally, the variations in interference arise from variations in wiring layout and bonding of the body components. This effect is more noticeable in older model cars than in the newer chassis-less types.

We have never known of a car to be completely free of interference, and take it that you may have meant the ease with which interference may be eliminated from certain cars with the simplest of suppressors. The use of suppressors, at the present time, seems to be the most economical method of interference suppression, since it does not appear to interfere with the correct functioning of the electrical system. Incidentally, for further useful information on this subject, we would refer you to an article on the Installation of the "Kar-set", in the December '56 issue.

R.L. (Nangiloc, Vic.) has been comparing the Playmaster 9 with the Audio section of the 1955 Radiogram and is confused by some of the differences in circuit values.

A. The major cause of your confusion is the assumption that these two audio systems are the same. The 1955 Radiogram was developed from the Playmaster No. 10 (August, 1955) and we would refer you to this article for a detailed explanation of the values used. Briefly, the bias resistor for the 6AU6 is not the same as that required for the EF86, while the gain and feedback requirements of the two circuits are quite different.

D.W. (Earlwood, NSW) wishes to construct a flashing light to operate at 50 flashes per second and suggests a resistor-capacitor combination operating from a 12 volt power source.

A. We are afraid the 12 volt supply is the stumbling block D.W., and we doubt whether such a scheme would be practicable. Unfortunately you do not say for what purpose the light is intended or how bright it needs to be. Also, why the voltage must be limited to 12. If you could provide this data we might be able to help you further. If 12 volts is a limit figure, you may have to resort to some form of motor switch.

P.A. (Mackay, Q.) is troubled by his local station appearing at more than one point on the dial, also by intermittent faults in a couple of receivers.

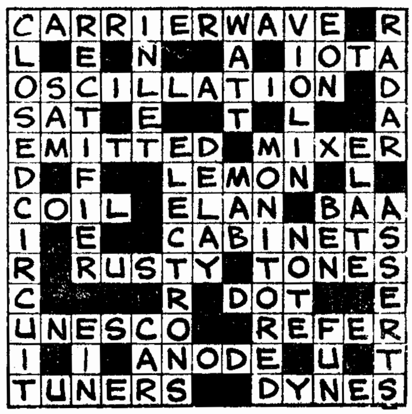
A. The appearance of the station in a second spot is not unusual in such circumstances P.A. and is generally due to overload of the early stages, particularly the converter. It is not a true second spot as is generally understood by the term and its position does not necessarily bear any relation to the IF. If it is troublesome it is generally most easily cured by either reducing the size of the aerial or fitting a wave trap tuned to the offending station. The latter scheme is particularly effective. The cause of intermittent performance in your set could not possibly be diagnosed without an examination of the chassis. However, since it is such a definite fault it should not be hard to find if the set is operated out of the cabinet and various parts of the wiring and components subject to gentle tapping. Much the same applies to the other set you describe, although finding the trouble may not be so easy.

K.B. (Mitcham, SA) writes to express his appreciation of R.T. and H. and to enquire about a circuit for a simple 5 valve D/W receiver. He also makes some enquiries about the Reinartz Portable and the Switch Tuned Oscillator.

A. Many thanks for your kind remarks regarding the magazine and we are glad to learn that you have had so much success with the projects you have tried. For a five valve dual wave receiver we suggest the D W Battery Five (February, 1956) and we can supply copies of this circuit if the copy is not in your files. It should be possible to substitute the 1Q5 for the 3S4, the only major change being in the grid voltage required. This is only 4.5 for the 1Q5, as against 7 for the 3S4. Reducing the bias resistor 1000 ohms should be sufficient. We have not tried either the alternative coil you suggest or the 1T4 for the Switch Tuned Oscillator. However we feel that it is likely that either or both of these changes may lead to erratic performance. At the same time, if the components can be borrowed for trial there is no objection to experimenting along these lines.

W.J.H. (Preston, Vic.) has built the Simple AC Inverter described in Radio and Hobbies some year ago, but complains that the frequency of the power is 60 cps instead of 50 cps, which he requires. Apparently the unit is used to drive an amplifier and a popular brand of record player.

A. It is much more likely that the frequency is 100 cps rather than the 60 cps you suggest W.J.H., since the frequency is governed by the type of vibrator cartridge used and that specified would operate at 100 cps. We imagine that the record player is running fast, but not as fast as the frequency increase would suggest, thereby giving the impression of a 60 cps supply. The only resource is to obtain a special cartridge designed for 50 cps operation and this should be available for special order from the same manufacturers who supplied the original unit. You would probably find, however, that the original 100-cycle transformer would not be suitable for 50-cycle operation. In short a completely new design would be required. When discussing inverters of this general type, we have normally made the point that they are not suitable for use with synchronous motors. A further article on the subject, which has been prepared since your letter was written, may answer any other questions you have.



Last Month's Solution

Printed and published by Sungravure Ltd., at the registered office; 21-29 Morley Avenue, Rosebery, N.S.W.

Answers to Correspondents

P.A.H. (Terang, Vic.) sends in an idea for a probe type absorption meter, built for use with a signal generator.

A. Thanks for your letter and the idea P.A.H. We have put it aside for possible use in the "Reader Built It" page.

J.M.A. (Melbourne, Vic.) writes to express his appreciation of the variety of articles covered in our magazine and to suggest some articles which he would like to see.

A. Many thanks for your comments and suggestions J.M.A. and we will keep your ideas about lacquers and painting in mind. We will also consider your suggestion regarding the electronic flash article, though we cannot quite agree that the previous articles have left too much to the imagination. The fact that a large number have been successfully built by amateur photographers with only a smattering of radio knowledge suggests that the problem is not quite as difficult as it may appear at first. If you are really keen to build one we suggest you go right ahead on the design already published.

Peter Randles (Surrey Hills, Vic.) is interested in the circuit of Handie Talkie for Amateurs.

A. Would you please send us your full address, and we will post the circuit to you.

G.K.W. (Perth, WA) has a soldering iron transformer rated at 5 volts, 30 amps and wants to know if it is possible to convert this to 5 volts 30 amps DC.

A. There is no easy way you can obtain the power you want G.W.K., and, in fact, such a conversion would require a perfect rectifier having no losses. Such a rectifier does not exist and you would have to assume some voltage as wasted across the rectifier. At such low voltage it would probably amount to half of the existing voltage, or even more, so that it would hardly be a proposition. It should also be realised that the 30 amp rating of the transformer is probably an intermittent one and this current could not be drawn continuously without overheating. Since we do not know the purpose you have in mind for this power supply we cannot help you further.

G.H. (Fitzroy, Vic.) says he has built the Baby Mantel Receiver and is having trouble with hum when he advances the reaction control.

A. Your trouble sounds very much like modulation hum G.H., probably due to the major portion of your signal being brought in via the mains. We suggest a short direct earth (not to the mains earthing system) and some filtering in the power supply. The latter could be in the form of a .01 mfd 600v capacitor from each rectifier plate to chassis. This may reduce the available signal strength but it must be realised that any signals picked up from the mains are likely to give this and similar troubles. We assume that the volume control needs to be retarded only because of the hum level. Otherwise the fact that it had to be retarded would merely indicate very strong signals.

G.B. (Clayfield, Q.) writes to thank us for previous information on the New Fireside Five. Having completed this receiver, he would like our help as to the cause of "a sudden burst of static and oscillations" after the initial warm up, after which the set apparently becomes normal. He also points out that with the volume control turned off, the set plays at a normal listening level.

A. Many thanks for your kind remarks, G.B. In reference to the fault of the volume, we would advise you to check the wiring around the volume control, making sure that the "earthy end" is in effect earthed as per the diagram through the earth pickup terminal or through the shield on the grid lead. This could be the cause of the instability of the receiver. However, the fact that the instability occurs only at a certain period of warming up could imply that a certain intermittent fault is prominent in a valve at a particular temperature. You may perhaps be able to ascertain this by substituting for the valves one by one, if you can borrow duplicates.

WANTED TO BUY, SELL OR EXCHANGE

Cost of Classified advertisements in this section is 3/- per line, approximately five words to a line. Closing date for February issue of Radio, Television and Hobbies is Tuesday, January 8.

FOR SALE: Palec SG1 RF signal generator and T.V. alignment oscillator see last month's issue. **W. J. Watson, 2 Redcourt Ave., Armadale, Vic.**

FOR SALE: Three "Presto 1c" disc-cutterheads with extended frequency range (25 c/s-17 Kc/s) specially wound to 15 ohms matching impedance to match all modern amplifier outputs, £30 each. **W. J. Watson, 2 Redcourt Ave., Armadale, Vic.**

FOR SALE: Two "Presto 1c" 500 ohm disc-cutterheads, high fidelity, with extended frequency range to 16 Kc/s and extremely low-distortion, £29 each, all cutterheads are genuine American. **W. J. Watson, 2 Redcourt Ave., Armadale, Vic.**

FOR SALE: Model Steam Engines. Large range, see 5/- list. **Bolton, 72 King Street, Sydney.**

FOR SALE: Back Nos. of R. and H., 2/6 posted anywhere. **A. J. Cox, 13 Glover St., Belmont, NSW.**

SELL: Aegis Hi-Fi tuner guaranteed new condition. New price, £31, will take £15 for quick sale. **V. Hannah, 156 Villiers St., Grafton, NSW.**

WANTED TO SELL: Radio parts, chassis, speakers, 2 volt valves and batts, or exchange for records or mags. **N. Rose, Martin Rd., Salisbury, SA.**

EXCHANGE: 5v Port. AC-DC Kries. Radio for Camera Altix V. Iloca "B" Tele Lens, Praktica St. Ca Lens or Robot Jun. **G. Taylor, Scottsdale, Tasmania.**

WANTED TO SELL: TV Chassis complete, uses VCR 97, may be seen working. *Phone WM484 (Melb.).*

WANTED: Record, HMV DB3497 "In Vain My Beloved" (Roi d'Ys), Richard Crooks. Pay to 30/- depending on condition. **R. Stinson, 5 High St., Concord.**

WANTED: Mine or mineral detector suitable for gold and silver, quote and details to McPhee, Box 2, Bell, Qld.

EXCHANGE: PF201 for PF185 transformer. **Watkins, 4 Power St., Balwyn, Melbourne.**

SELL: Printing. Special Offer:—100 Business or Visit Cards, 30/-; 100 Letterheads, 30/-; 200, £2. Sent anywhere by mail. Do it now. **W. Hiley, 841 George St., Sydney.**

ALL Back Issues R. and H., 2/- per copy, posted, large stock to be cleared. Quote for quantity. **T. Weir, 56 O'Connor St., Haberfield. UA2569.**

SELL: 3-speed Dual 1002/F Changer and Micro. Condition as new. £13. Has HF Head. **J. Dunne, Morgo St., Urunga, NC, NSW.**

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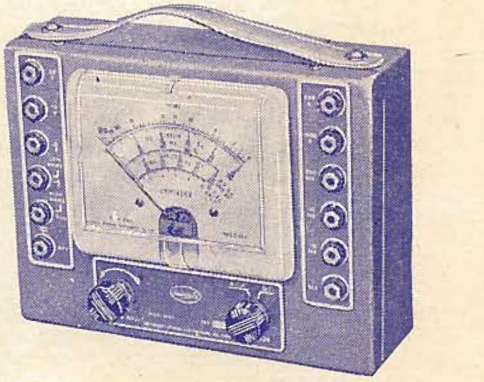

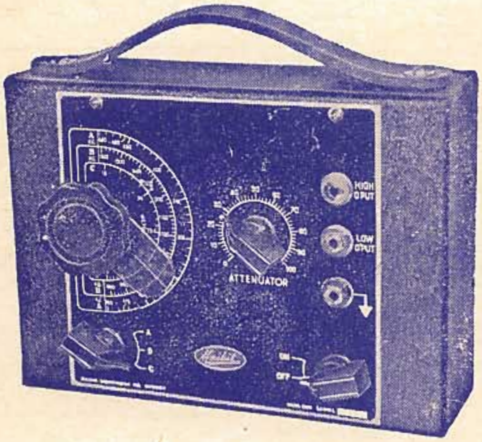

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