RADIO TELEVISION

AND HOBBIES ★

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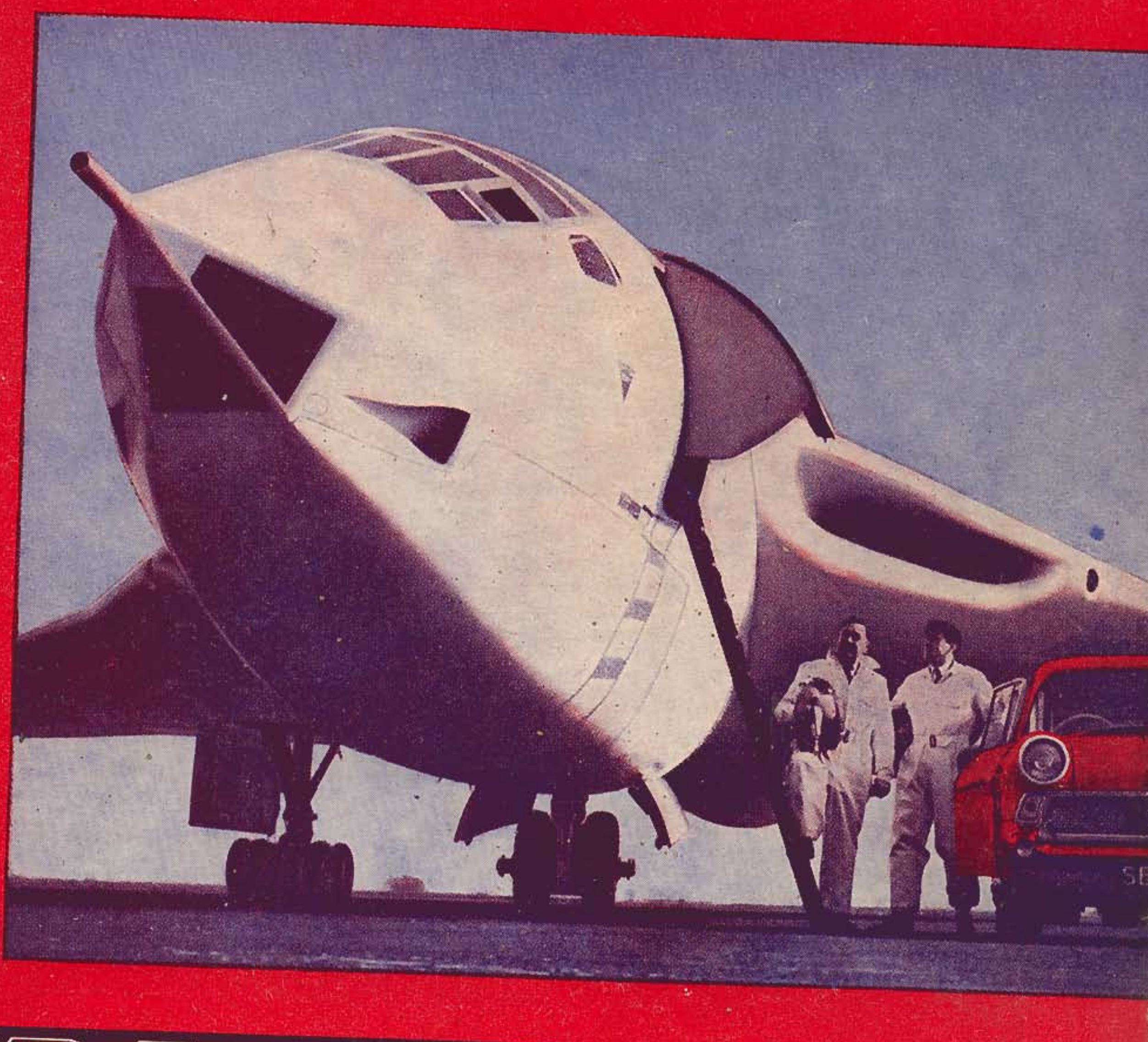

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EDITORIAL

THERE were no surprises in the reports of the Australian Broadcasting Control Board's Inquiry into FM.

Those who had something to gain from its introduction supported it, and those who would be obliged to spend money or incur risks against their wishes opposed it.

The A.B.C. would obviously like to use FM, the commercial stations were divided in their opinions and fearful of the cost, and the Australian Federation of Broadcasting Stations strongly opposed it on principle.

The federation claims that there has been no public clamour to replace the present 30-year-old system with FM. Of course, there hasn't. How can the public clamour for something about which it knows nothing? The experimental stations, with their limited and duplicated program material and their indefinite tenure, are no test at all of possible public approval. There just isn't any evidence about the public's indifference to FM.

It claims that if the system at present was unsatisfactory, a change would have been demanded. Once again, the public can't demand a change unless it understands the alternative. But technical members of the public who have this knowledge have been demanding a change for years.

The federation believes there is ample evidence that the public is satisfied with the present AM situation. There are plenty of radio listeners who will dispute this. Along the South Coast, in Woy Woy, at Bondi Junction. There is plenty of complaint even in my own salubrious suburb. I cannot receive 2BL without interference.

A fourth claim is that the growth in licences shows that the public is well served. It shows nothing, to my mind, except that our population is growing. Even if our radio was bad, which it isn't, people would still rather have it than nothing at all.

There is only one real objection to FM, and that is the financial upheaval it would cause in the present broadcasting structure. Most broadcasting stations admit this difficulty, and to make a case on other grounds is to skate on thin ice.

The whole thing reminds me very much of the debates when TV was proposed. Despite our fears, we are getting over that hurdle very nicely.

If there are people ready and willing to risk their money and give us FM programs, they should be given the opportunity to do it. We should not be denied any progress, merely to protect the interests of the present operators.

John Moyle

RADIO TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Britain's big, four-jet crescent wing bomber "Victor" has flown through the sound barrier without difficulty. Here it is with the two test pilots after a flight in which it exceeded the speed of sound.

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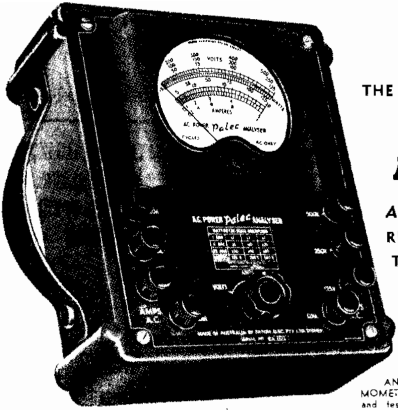

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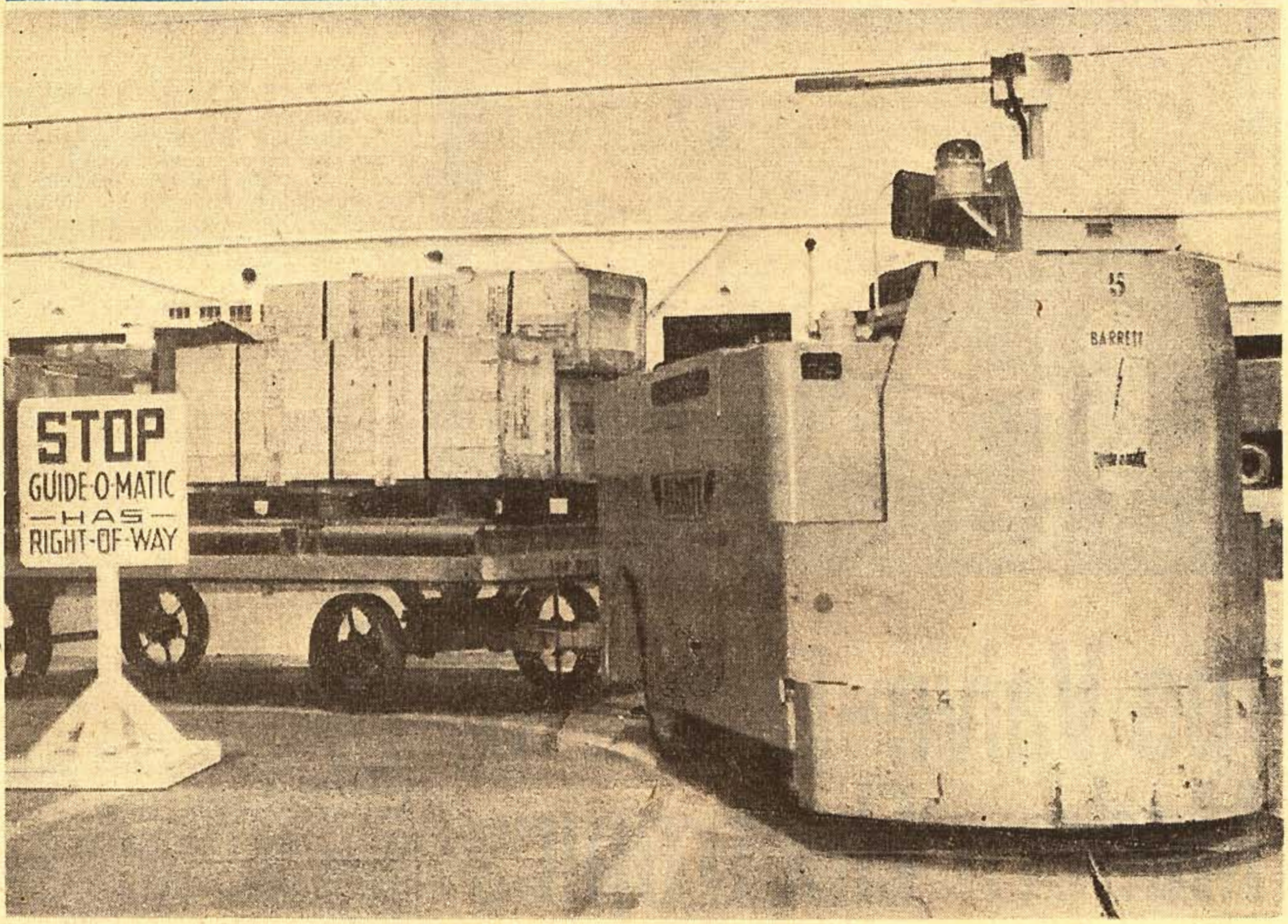
DRIVERLESS ELECTRONIC TRAIN



The electronically guided and controlled train takes a crossing.

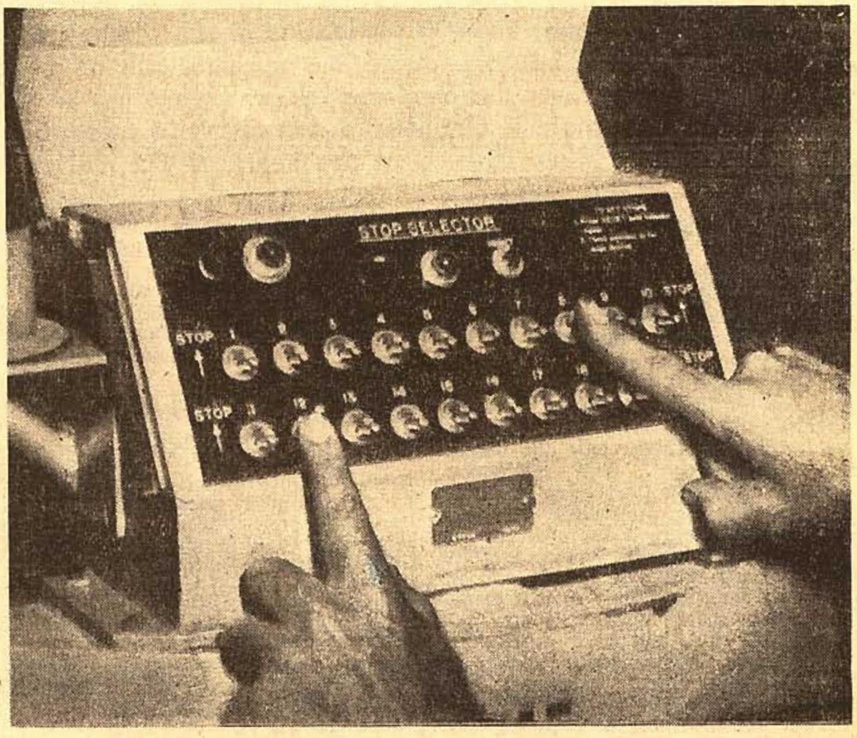
THIS amazing train at Kelly Air Force Base, Fort Worth, Texas, glides its way smoothly over three miles of track which takes in five warehouses, delivering and picking up goods. The surprising part is that there is no driver to guide it through the dark and narrow aisles of the warehouses, and yet it never gets lost.

Its secret is an electronic control system by which its path and progress can be pre-set at a switch box on the "engine." The dispatcher works out the plan for each run after receiving his instructions, and sends the train on its way.

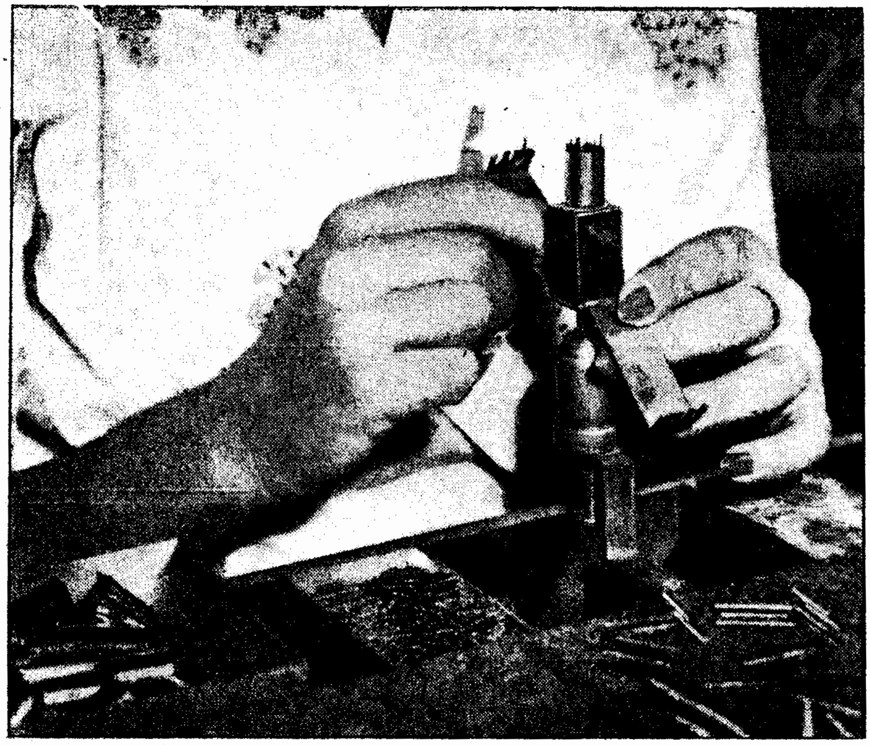
BURIED GUIDE TRACK

It has no rails—its path is marked out by a track of buried copper wire from which the guide signals are received which control its direction. One thing is important — it must have the right of way, because as yet there is no electronic eye to observe hand signals from other traffic.

When fully laden, the train is able to pull 29,000lb of freight over its route.



The control board by which the train's journey is preset.



The various elements of a modern miniature valve need careful assembly by skilled hands. In this picture, the operator has just fitted them together on a special jig. Note plates at the left, mica spacers in the frays, and ready-wound grid structures in the foreground.

The Valve-Father Of Modern Electronics

While historians may wonder whether to brand this age "Electronic" or "Nuclear," we valve makers have no doubt about it. In looking at the atoms we do not wish to see through the cloud of electrons into the mysterious nucleus with its frightful concentrations of energy. We seek to free the outer electrons by gentle heating so that they may do our bidding in free space or in metallic circuits; we do not try to provoke profound and terrible disruptions at the heart of the matter.

By D. M. SUTHERLAND
(Works Manager, A. W. Valve Co.)

PLAYING our part in the whole business of electronics, our strength is communication rather than explosion and the products of our factories find their most wide-spread use in bringing together men's thoughts in all circumstances of space and time.

Wide though this activity is, electronics has penetrated further into our lives. A review of the whole of its activities would go like this:—Through the broadcast receiver it brings into our homes news, entertainment, and instruction from near and far (and these are now enhanced by the miraculous televised image); it has spread the network of telephone and telegraph to the farthest places of the world; it has broadened the art of recording vastly so that man's creations in speech and music now belong to all time, not to a generation. Through the public address system it binds together great concourses of people for good or evil. With vehicular radio it brings ambulances to the injured, police cars to the distressed, taxis to the needful.

Without radar and such electronic aids ships would navigate uncertainly in dangerous waters and bad weather; planes fly blind. It is the sensitive tool of science, probing with the radio telescope into the depths of the stars, and detecting the minutest terrestrial phenomena. It provides medicine with powerful devices for diagnosis and treatment, of which the most vital is the X-ray. It has given industry versatile means for control and measurement.

It supplies heating of special kinds—it will case-harden difficult steel shapes, de-gas valve parts from outside the glass envelopes, preheat plastic pellets before moulding, assist in glueing ply; and it will even bake bread in ten seconds from the inside out, producing a loaf that is all crust or all dough, it is not certain which. Finally it plays an essential part in modern war.

Is there one key to all this development, one device which has made it all possible? Well, it is more complicated than that, but electronics has its most active and important component, the electronic valve. The valve has its genesis in the early days of one of the principal branches of electronics—wireless communication. Both Fleming's and deForest's inventions satisfied two pressing needs of that art at the time—reliability and sensitivity — and have continued to do so ever since, though the versatility of their descendants has immensely broadened their field of application.

THE FIRST TRIODE

The valve performs its best service to electronics as the active component of most circuits, taking energy from a source—a battery, generator, or "power-pack" and turning it at the bidding of a minute signal into a very much stronger signal of the same form.

We can form an elementary understanding of how it does this by thinking of the action of the first triode, in which the inventor interposed a grid of fine wires between the hot filament and the plate-like anode, with the idea of controlling the flow of "Edison" current from the filament to the plate—that current which Edison had discovered years previously, though he was vague as to its nature. The scientists of our time, while retaining their professional vagueness (admittedly of a lower order) have been able to tie in the happenings in the valve with many of the generalities of modern science, and with their ideas in mind we can attempt a slightly fuller description of the internal action of a modern receiving valve, which bears about the same relation to an original deForest triode as does a Chrysler Imperial to a motor buggy.

HEART OF THE VALVE

Looking at the valve from the very inside, we have a heated metallic base for the electron-emitting alkaline earth oxides. This base is a fine wire in battery valves, or a nickel cylinder with an internal heater for valves which are to be operated from the electric supply-mains. The oxides are in the form of a thin coating of crystals of mixed barium and strontium oxides, which when properly prepared in the manufacturing process—"activated" — have a small proportion of barium atoms interspersed throughout their lattices.

These atoms distort the crystal structure and alter the energy barriers so as to enable our friends the electrons in the outer orbits of the atoms to wander a bit more freely through the crystals, from atom to atom, and even, when they are agitated by heat, to jump out into free space quite easily every now and then.

This, the production of electrons in free space, is the valve engineer's "emission," his most frequently used term, and the key to the working of the valve.

This is so because we are able to control the flow of emitted electrons by means of electrostatic fields set up by metal structures — grids and plates — which although quite small are well within the compass of our mechanical skill. We have only to direct our controlled electron stream into a circuit of conductors via the leads through the valve envelope to have an electric current which can do the things we want it to do.

Before leaving the oxide cathode we should note that, though with mysteries still hidden from the physicist, it still provides the most abundant source of electrons with the greatest reliability and efficiency of all known cathodes.

GRID CONTROL

The electrostatic control we have mentioned can best be thought about in terms of the field of the positive, and therefore electron attracting, anode reaching through the gaps between the grid wires, and being more or less effective as the grid is made sufficiently negative, it can, as it were, choke off the anode field and stop the flow of electrons altogether.

The grid is very much closer to the cathode and the grid voltage need only be varied slightly to give appreciable control of the current flow to the plate—and from this comes the valve's sensitivity. As would be expected, the closer the grid is to the cathode the more sensitive the valve is, with the proviso that for close spacing it must be made of fine wires to give the anode field a chance of reaching the electrons emitted behind the grid wires at all, and these wires must be close together to retain full control by the grid.

Now, electrostatic control of current is related to one of the virtues of the valves, namely, that such control involves scarcely any expenditure of power; in the language of the circuit engineer, we have a device with a high input impedance

THE SCREEN GRID

This means that among other things, it can operate directly in parallel with tuned circuits of the kind widely used in dealing with radio-frequency voltages, without upsetting their characteristics. This virtue alone will go a long way toward preserving the life and the electronic valve against the inroads of its competitors.

Having mentioned radio-frequency, we can introduce the screen grid, which was the biggest single improvement to the valve after the oxide cathode.

The triode had quite a success early with r-f amplification, but there was a bit of trouble because of its sensitivity and its high input impedance, so much so that the small capacity between grid and plate gave positive feed-back and instability.

The best cure was to put another grid between the control grid and the plate—the screen grid—to act as an electrostatic screen.

Particularly when helped by yet a third grid mounted near the plate because of a little trouble with secondary electrons bombarded out of the plate by the original electron stream (this is the suppressor grid and gives us the triple grid valve, or pentode) the cure was most effective, and owing to the fact that the control effect of the anode was much reduced, conferred the added advantage to the pentode of a high output impedance.

And this all comes about because we have an electron stream out in free space where we can play with it.

We have sketched a few of the most important of the features of the valve's method of working. It will be interesting to dwell for a moment on its construction.

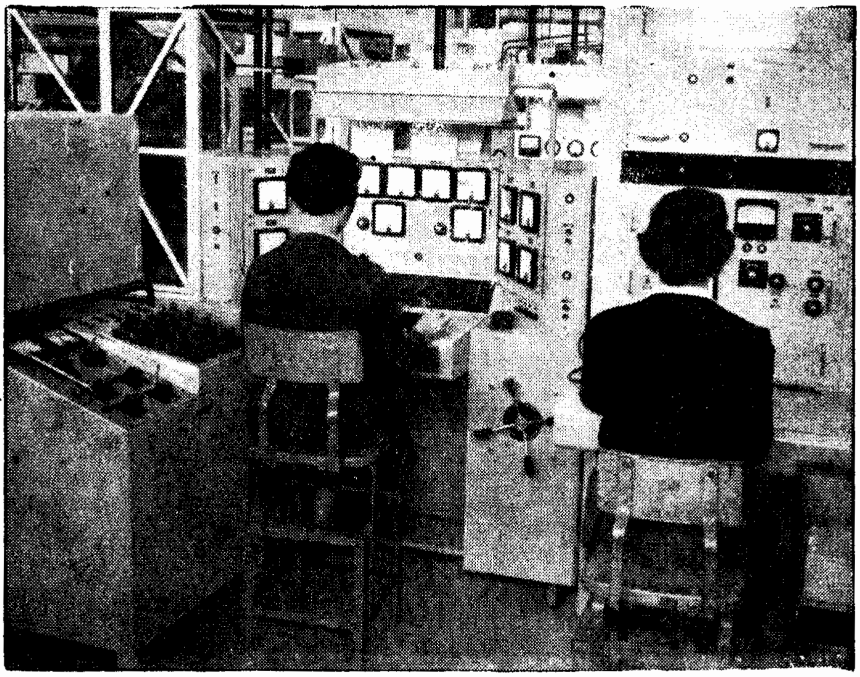
We have seen that its immediate parent was the electric lamp. Edison can be named the inventor of the incandescent lamp, deForest was closely in touch with his work and Fleming describes how he had the first samples of his valve made for him in a lamp factory.

VALVE CONSTRUCTION

The first valves were little more than incandescent vacuum lamps to which a grid was added by sealing in through the glass envelope. The valve has owed a lot to the lamp ever since. The early commercial types with a round glass bulb were almost indistinguishable from the lamp, in general appearance, and with their tungsten filaments glowed as brightly.

For a long time the valve used none other than the structure still standard for the lamp—the internal parts being mounted on a subsidiary glass tube sealed re-entrant-wise into the bulb, and the lead-in wires sealed in through the flat press, or pinch, at the top of this tube.

INTRICATE TESTER FOR QUALITY



Each valve is carefully checked in this complex machine, which detects both electrical and mechanical faults. Results are recorded on bank of meters.

It was only the search for better performance at higher frequencies, and for a cheaper construction that led to the use of the flat button stem and stiff leads as used so widely in the miniature tube today.

Many of the principal valve-making machines, such as the stem machine, and the Sealex, have been derived from their equivalent in the lamp factory. Our glass bulbs are blown on the same tremendous machines which blow lamp bulbs; we draw our glass tube from the same source; we use the same mechanical pumps. Admittedly we can claim to have gone further in the art of producing a vacuum, with our use of diffusion pumps, and refined gettering. But our factories have much in common, and lamp and valve men are quite at home in one another's environment.

FACTORY ATMOSPHERE

Industries have each their own atmosphere. You can walk into a valve factory anywhere in the world, and hear the sharp click-click of the exhaust pumps working against a hard vacuum and the rattle of the grid lathes; see the row of brightly lit assembly benches with skilful fingers at work, and watch the automatic exhaust machines at their critical tasks, and feel at home, if you are a valve man. As one of the escort to the famous Dr. Zworykin during his visit to our group of factories at Ashfield, it seemed to the author that he was most relaxed when he was in the Valve Company building, among the sights and sounds of an industry in which he has played such a prominent part.

We have been talking mainly about receiving valves. The very first valves were receiving valves, of course, and by far the greatest proportion of the seven thousand million valves which one authority estimates have been made in the world to date were for use in re-

ceivers. We must leave for another time any description of the many other marvellous devices based on the use of the electron flying in free space. We know that there are giant transmitting valves generating RF power measured in millions of watts: that ionised gases are used to carry larger currents or to give sought-after effects; that photoelectricity is pressed into service to accept a light signal; phosphors are used to glow under electron bombardment and give it back; that secondary emission is used to give amplification by many orders; magnetic deflecting fields are brought to the aid of electrostatic, and so on. Many are the marvels: but the greatest of them all is the receiving valve; and so firm is its position today, surrounded by its host of descendants, that we valve men know that the sound of the vacuum pumps will never cease to ring in our ears.

MANUFACTURING METHODS

There hasn't been much change in valve-making methods in the last 10 years. Since the establishment of the miniature construction, valve men have been occupied in turning out greater and greater quantities to keep pace with the expansion of Electronics as a whole. There has been an approach to automatic assembly, but it has been very slow. There has been some beautiful work with parts-making machines and their tooling, glass working is more scientifically controlled, chemical cleanliness is better applied, and so on; but nothing really fundamental in the way of changes, in the vast bulk of production, anyway.

There is, however, one general influence at work which, while it aims at producing a small number of valves of special quality, is quietly having its effect on many of the details of normal valve making. This is the movement towards what is called the reliable valve.

"Reliability"—this accusing word no longer distasteful to valve men who have learnt much from it—is a product of the great expansion in the use of valves, and the great dependence on them of affairs, civil and military, at critical times.

Two general problems seemed to be building up—the very large numbers of valves removed during servicing, and the growing complication of electronic equipment and its use of valves in hundreds in the one unit.

"RELIABLE" VALVES

Whilst analysis of returns showed that many valves were removed with no fault, and many others were faulty because they had been misused, there still remained a residue of trouble which was disturbing to designers who tried to compute the probability of failure of their equipment using a hundred valves.

And so it came about that most valve makers (along with the makers of the other components) were encouraged by users such as aviation to undertake work on "reliability" with the aim of producing the lowest probability of failure in equipments if only for a limited time.

This job has been tackled in two broad ways. Valve **designs** have been worked upon to give a properly made valve every chance, and the art of valve **production** has likewise been studied to give the utmost consistency to a batch of well designed valves with all that this implies.

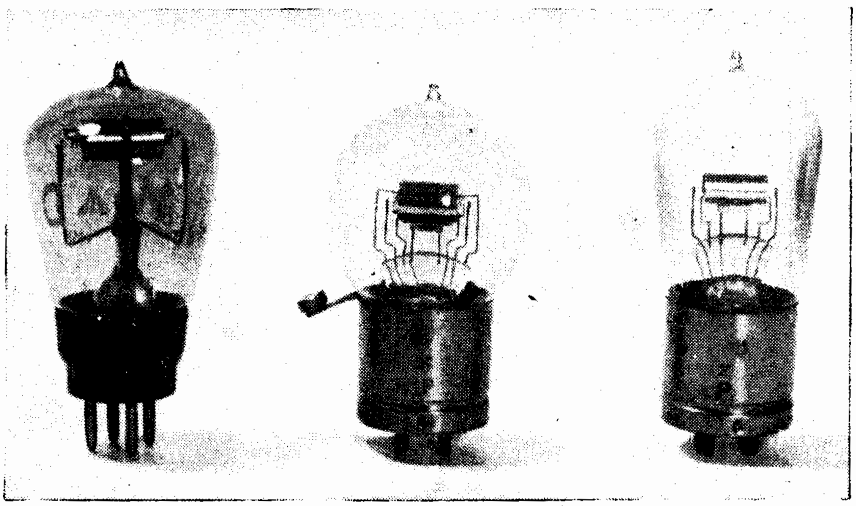
To illustrate: It was a point of design to replace alloy wire in cathode heaters by pure tungsten wire to stop creep in spiral heaters, whereby after many switching cycles they imitated the notorious Californian disappearing hoses and burrowed into the depths of the cathode sleeve; or else grew out of the sleeve like a Jack-in-the-box in slow motion.

On the other hand it is a production matter to eliminate **lint** from the inside of a valve assembly. Lint is a most interesting study. Ever since man emerged from the figleaf and bearskin eras, and started clothing himself in woven textiles he has been surrounded by an aura of thread fragments of all sizes and colours. In a factory such as ours, for example, frequented by a few hundred men and women there is normally so much lint in the air that our engineers have been able to measure a rate of deposition of the order of 300 pieces per square foot per hour. A collected sample makes an astonishing sight under the microscope, and after seeing all those little bits of thread it easy to understand how, after being carbonised in the processing of the valve, they can cause shorts between electrodes, which in modern valves approach to within a few thousandths of an inch of each other.

Fortunately, lint in the finished valve can be very much reduced by keeping parts once cleaned under cover before and during assembly, and using general vacuum cleaning. A more thorough attack involves air-conditioning, special clothing for operatives, and so on.

Strange things can happen in valve factories, however. I have another of our engineers as witness when I say that we saw, in a factory in which the "housekeeping" was excellent, a valve with a complete housefly enclosed in it. But it is possible that this was a put-up job . . . As was hinted above, the reliability valve programs are not only producing their batches of special quality valves but are having a beneficial influence on the art as a whole.

SOME VALVE TYPES OF THE PAST



Here are some old timers which will be recognised by some of our older readers. Left to right-1 A bright emitter Ediswan briode made for defence equipment with a 6 volt lamp filament. 2 An early bright emitter valve with a space-charge grid which allowed good results to be obtained with about 9 volts high tension. The extra grid was connected to the terminal at the side which was insulated from the base. The filament required 3.5 volts. 3 A standard triode valve of about 35 years ago— a 3.5 volt bright emitter triode. The dark shadows at the sides of the glass are caused by electron bombardment; this valve was subjected to gross overloads during its life. All these valves are still in good condition.

TOLL-TV NOT POPULAR

PROPOSED introduction of toll-television, or pay as you view, has aroused opposition in New York, where its possible introduction is being discussed.

Several such methods were developed a few years ago, but were not proceeded with.

Reactions to this system, in which viewers choose their programs by paying through a slot meter attached to the set, range from apprehension and indignation to indifference.

At present, unlike the British viewer who pays a Government licence, owners of the 40 million sets in U.S. get their entertainment free.

Toll-TV means that, instead of tuning to the normal free programs, viewers will be able to choose something different—if they can afford to pay for it.

This will be done through a small selector which can be plugged into the normal set in about five minutes at a cost of about £10/10/.

The viewer can choose his program and dial it, and the attachment, called a telemeter, will register how much it will cost.

The price may vary from about 7/ for a film to about 3/6 for a baseball game.

Correspondence received by one New York newspaper shows that viewers are against toll-TV by a ratio of 20 to 1.

Chief argument against toll-TV is that it will affect the family budget.

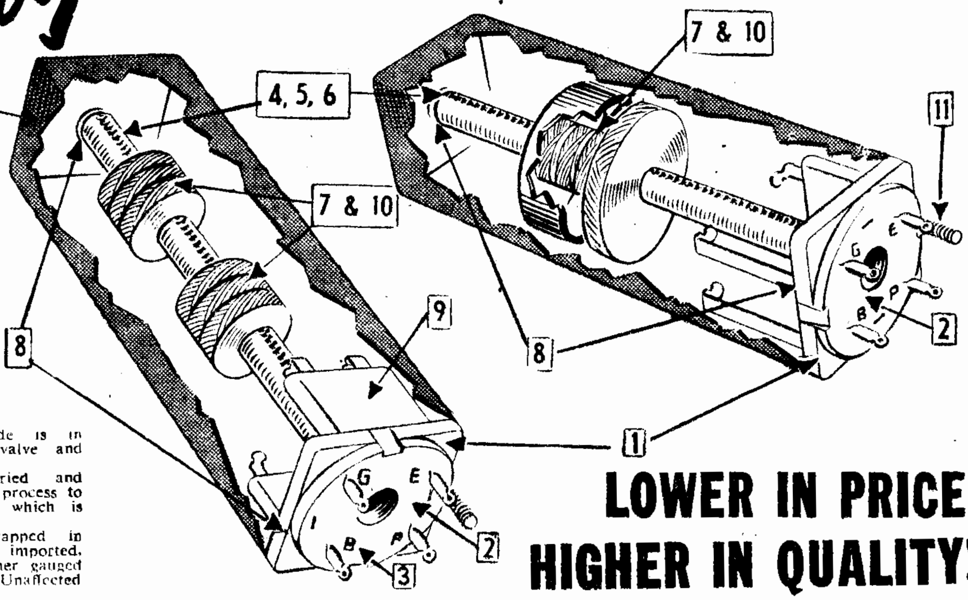
Supporters of the scheme say it is the American way of free enterprise and open competition, and that it should be given a chance.

THE HIGH IQ* OF THE NEW

AEGIS

Mighty Midgets

Above: Charles van Scoy, Chief Aegis Design Engineer



LOOK AT THESE AEGIS HIGHLIGHTS:

1. New low-loss bakelite base (will not melt).
2. Base specially shaped to symmetrically position all terminals within standard ¾in 9-pin valve socket hole to eliminate accidental short circuit to chassis.
3. Connection code clearly and permanently visible after unit is mounted on chassis. Code is in alphabetical abbreviations of valve and circuit elements.
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5. Former is specially spiral-wrapped in manufacture from best-quality, imported, resin bonded papers. Each former gauged and held to definite tolerance. Unaffected by extreme heat.
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10. Inductances completely dehydrated and thoroughly impregnated with Q-kote "B" to guard against moisture penetration.
11. Bright NEW-LOOK pure aluminium shield can with special eyebolts to match. Excessive thread length has been eliminated on these new models.

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* The high IQ — **INBUILT QUALITY** — of AEGIS component radio parts is convincingly evident **in the NEW MIGHTY MIDGET Coils and I.F. Transformers.** Each of these new units is individually prealigned in a conventional circuit and must pass its rated **gain check** before packaging. What's more, they're not just improved types but brand new 1957 developments.

CHECK these features of the AEGIS MIGHTY MIDGETS at the left again! These features PLUS INBUILT QUALITY, **attention** to detail, dependable workmanship and thorough research in design make AEGIS products the MOST RELIABLE on the Australian market.

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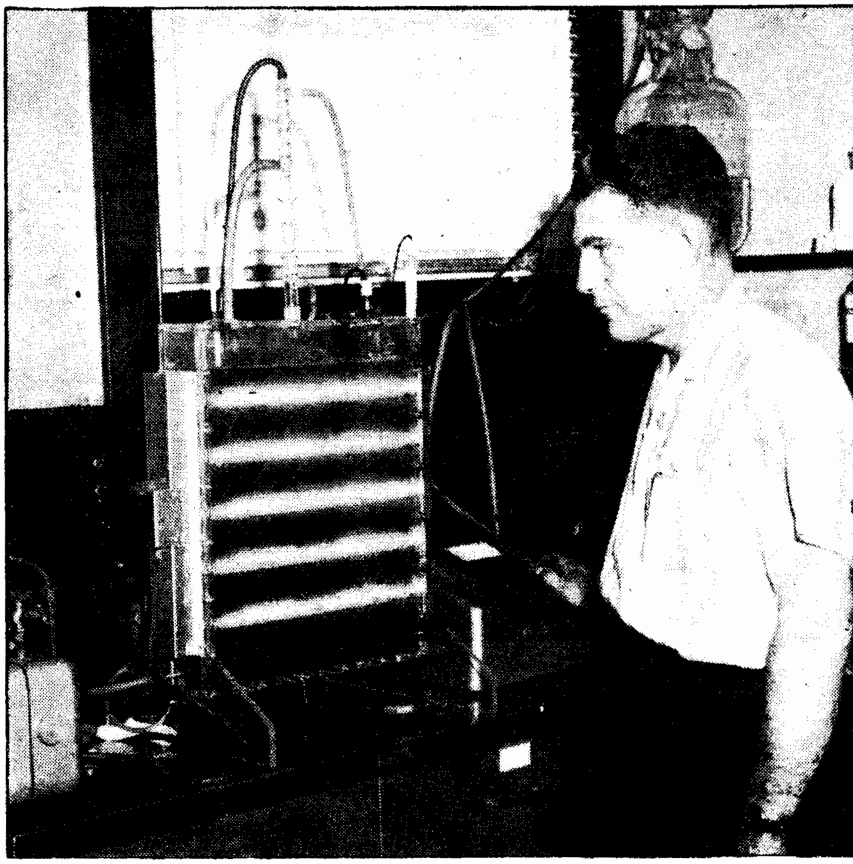
DAMAGED PLANTS EMIT LETHAL GAS

A fatal airplane accident has led U.S. Air Force investigators to the startling discovery that ordinary flowers and vegetables can be poisonous—and that travellers in space might therefore be menaced by their own air and food supply. The scientists who tracked down this uneasy information is Dr. Syrrel S. Wilks, a physiologist with the School of Aviation Medicine, at Randolph Air Force Base, Texas, whose finding was presented in a research report to the American Physiological Society, which recently held its annual meeting at the University of Iowa.



Dr. Syrrel Wilks has discovered that green plants like these algae, proposed as a source of food and oxygen in space flight, secrete deadly carbon monoxide gas. He suggests that they could raise a problem for future space-ship occupants.

THE evidence that put Dr. Wilks on the trail of toxic possibilities in common plants came to his attention as fortuitously as the mishap that produced it.

When a plane cracks up in the Air Force, killing the pilot, an exhaustive search for the cause is required. One item in the investigation is to send pieces of tissue from the flyer's body to the School of Aviation Medicine. There specialists examine it for clues to any abnormal condition that might have been responsible for the accident.

One such piece of tissue arrived in Dr. Wilks' laboratory several months ago. It was a specimen of muscle, in which some green vegetation had been embedded by the violent impact of the crash.

Studying it, Dr. Wilks noticed that it contained a surprising amount of carbon monoxide, the lethal gas found in the exhaust fumes of automobiles and gasoline-burning aircraft.

EXPERIMENT WITH PLANTS

But there was no reason to think that this particular victim had been exposed to carbon monoxide before his death. Dr. Wilks began to wonder whether the plant material could have something to do with the gas in the tissue.

He collected a random sample of leaves and other bits of greenery, and analysed them. To his surprise, he discovered carbon monoxide, in amounts ranging from a mere trace to as much as one part in 35 of plant material. The highest concentration happened to be in leaves of alfalfa.

Enough carbon monoxide was extracted from a pint or so of alfalfa to asphyxiate mice. From two pounds of a flour made with dried alfalfa leaves, he got sufficient carbon monoxide to kill an average man.

The gas was only released when the alfalfa flour was exposed to sunlight in a container with water and oxygen. Hence, Dr. Wilks theorised that it was produced as a step in the process of photosynthesis, which starts with carbon dioxide and water, converting them into oxygen and carbohydrates.

Furthermore, no carbon monoxide was released by healthy plants in their natural state. This led Dr. Wilks to conclude that when the plants were damaged, injuring the photosynthetic mechanism, carbon monoxide would accumulate instead of being used, and could be given off in lethal quantities of gas.

NOT TO BLAME

The results of Dr. Wilks' research had no bearing on their airplane accident. Its cause eventually was traced to other circumstances. The puzzling presence of carbon monoxide in the flyer's tissue was only an incident that started the Texas-born physiologist on his study.

But Dr. Wilks reasoned that conditions could occur where carbon monoxide, released by damaged plants, might be toxic. He thought of enclosed places like silos, containing large quantities of injured vegetation.

Moreover, the technique now proposed to keep future astronauts alive for weeks or months, in a manned Earth satellite or a rocket ship travelling in space, is a sealed cabin containing algae — green water plants — suspended in a liquid solution and exposed to sunlight.

BENEFICIAL EFFECT

The algae would absorb carbon dioxide given off by the flyers in breathing, and would return life-giving oxygen to the cabin air, by photosynthesis. Also the surplus algae grown in the cabin would supplement the flyers' food supply.

Dr. Wilks wondered: What if some of the algae in the space ship died or were damaged? The carbon monoxide released in the small confines of the cabin might well constitute a hazard to the occupants.

So, from an odd question arising out of an aeroplane accident investigation, Dr. Wilks has added one more problem to the already formidable list of difficulties in space flight.

The astronaut will have to keep a sharp eye on those iridescent green algae, shimmering in glass tubes against the sun. They might just conceivably go berserk, and poison him.

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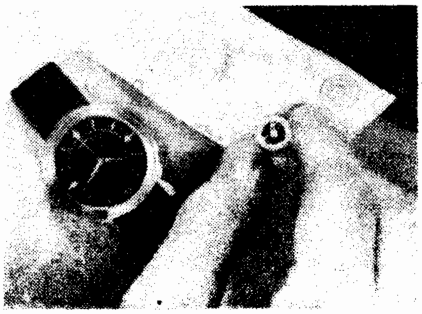
M48

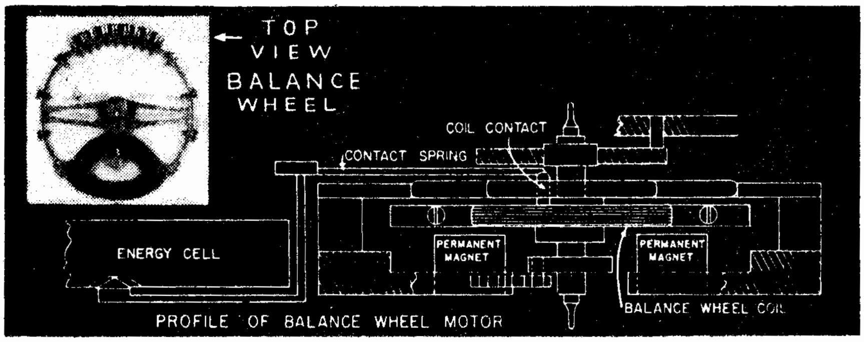
THESE WATCHES NEED NO WINDING

Nowhere has miniaturisation been a more fascinating process than in the field of watchmaking. Great grandfather used to wind his watch with a key, and his time-piece wasn't much smaller than some clocks. Today we make watches so small, using stem winders, that a magnifying glass is needed to observe the movement. But they all use springs as their source of power.



The electric wrist watch receives its power from a battery of shirt-button dimensions.

Comparison with a conventional watch (left) shows that electric watch is no larger.



Drawing of a movement suitable for an electric watch. A small coil on the balance wheel receives battery current and works against a magnet system.

THE nearest we have approached to the self-powered watch is the "self-winder," in which an eccentrically balanced wheel keeps the spring in a state of tension when the watch is moved about.

Unfortunately, if you don't wear your self-winder for a day, or perhaps a little longer, it will run down.

But the laboratory boys are catching up fast, and they hope before long to make available watches which will keep running for years without attention, and which require no winding.

Already watches of this type have been sold in limited quantities to those who can afford them.

Take, for instance, the Hamilton Watch Co. of U.S.A., which has announced a watch fitted with a tiny little battery about the size of a shirt button. It provides the electrical power to run the watch.

MICRO POWER

It has been calculated that the power taken from this battery would not light a 100-watt lamp for more than 3 seconds, assuming that all its power could be extracted at once.

It supplies tiny bursts of current which operate the watch's electrical circuits 75 million times in one year, and operate the balance wheel 150 million times in a similar period.

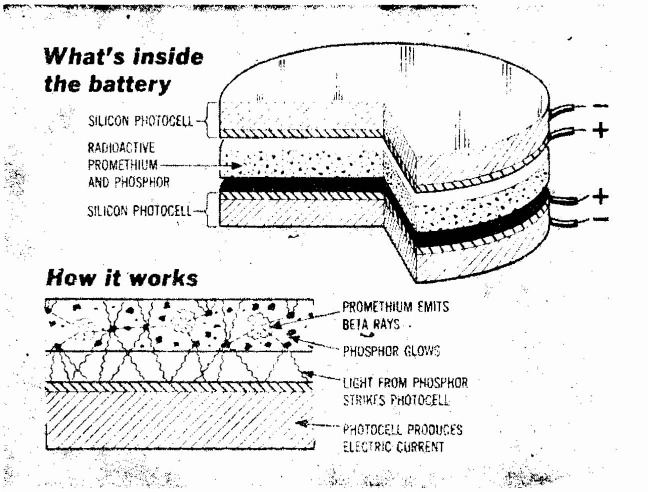
The battery and balance-wheel form what is really a tiny electric motor which will keep going for as long as the battery lasts. This may be quite a few years, and there is still much research to be done in developing batteries with even longer life.

According to Hamilton, the secret of the new watch is a miniature coil of insulated wire on the balance wheel, through which the current from the battery flows when tiny contacts make and break the appropriate circuits.

The magnetic field of the coil interacts with a pair of midget platinum-alloy magnets. The wheel, therefore, spins first toward one magnet, and then the other, operating an escapement and gear train more or less in the normal manner.

Combining the power with a balance wheel permits the flow of energy to be controlled, and the speed of the hands to be held to an accuracy of better than 99.995 per cent.

Windings on the balance - wheel coil are made with wire .0006 inch in diameter. Each wire is one-fifth the thickness of a human hair, and three or four strands can be easily threaded through a hole drilled in a human hair. Enough wire for 1,000 watches weighs only two ounces but would stretch across the English Channel from Dover to France. Screws holding some parts of the watch together are so small that it takes 80,000 such screws to make one ounce. The platinum magnets in the watch contain less metal than in a paper clip yet, ounce for ounce, these magnets are the most powerful known.



Sketch of a radio-active battery shows its layer construction in which radiation is converted to light, and light to electrical energy.

NEW BATTERY PRINCIPLE

Batteries for this type of watch employ entirely new principles. One such battery, developed jointly by the Elgin National Watch Co. and the Kidde Nuclear Laboratories, is really a radio-active unit of extremely low power, and is enclosed in a protective alloy which removes all possibility of danger to the wearer.

The radio-active element is promethium, a man-made material which does not occur naturally.

It emits beta rays from promethium-147 oxide, and when these impinge on a layer of cadmium sulphide, which is a light-emitting phosphor, the layer produces light. The light plays on a silicon photo-cell layer, from which an electrical power of 20 micro-watts is produced.

This power is sufficient to operate the tiny watch movement, similar in all probability to that used by Hamilton.

The Elgin-Kidde nuclear battery is said to be immune to heat, cold, and self-damage by radiation. Short-circuiting it does no harm, and power drawn

(Continued on Page 119)

TRACKING MISSILES IS NEW ART

"A missile was fired at the Air Force Missile Test Centre's Cape Canaveral launching site today. Shortly after the launching, the missile exploded. There were no casualties. Valuable information was gained as a result of the test." This terse announcement by the U.S. Air Force recently was widely interpreted as heralding a new era in warfare—the era of the awesome Intercontinental Ballistic Missile (I.C.B.M.)

THE test missile, though not specifically identified by the Air Force, was reported by the Press to be the 5,000-mile, ocean-spanning Atlas on its first flight from the Missile Test Centre in Florida. This "ultimate weapon" would bring American retaliatory striking power within a scant 20 minutes of Russia.

Intermediate Range Ballistic Missiles (I.R.B.M.), designed to cover some 1,500 miles, are also launched at the Test Centre where the R.C.A. Service Company handles the planning, engineering, installation, maintenance and operation of the electronic and optical instruments used to track the missiles.

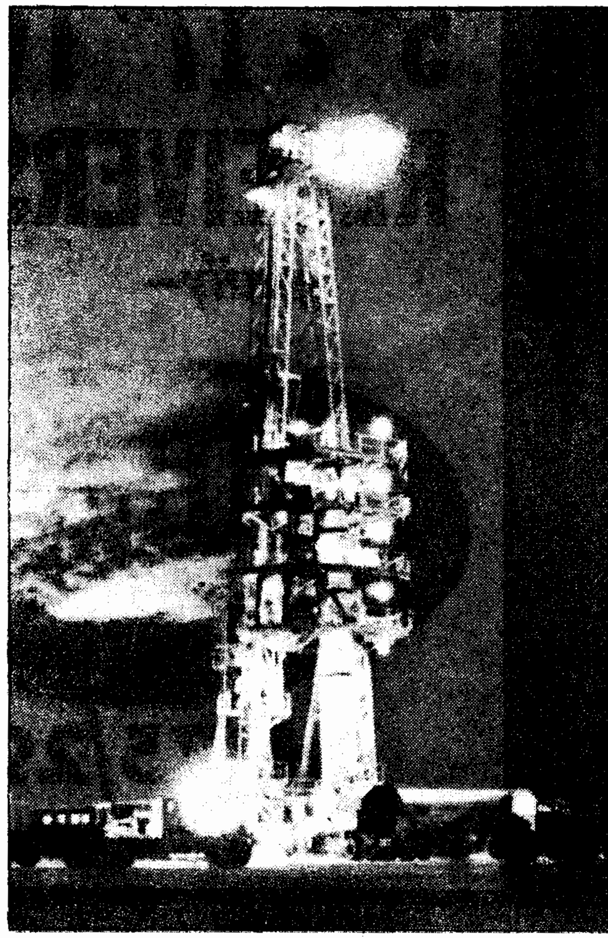
The I.R.B.M. ad the I.C.B.M. have brought requirements for new instrumentation, capable of tracking over greater distances and with greater accuracy. Monopulse radars that can follow a missile for hundreds of miles are being developed for the specialised tracking problems of high-altitude trajectories. New optical systems, combining radar and astronomical telescopes, are being introduced as ballistic missiles become more numerous.

UP TO 5,000 MILES

The test range itself is being extended from its present 1,500 miles to 5,000 miles. Construction crews have begun work on Ascension Island, which up until World War II had been a mere dot in the ocean known only to the British and Rand-McNally. The air strip is now being reclaimed from the sooty terns—those birds who used to strafe Army tractors during the war—and eventually Ascension will become the final tracking station on the range.

Plans call for tripling the present program capabilities over the next two years. The work-load now is about 250 tests a month. Only a small percentage, of course, are actual missile firings. The rest are simulated flights to check a missiles guidance system or some of its other features.

The "birds" are fired out over the Atlantic Ocean, and tracked by camera, radar, telemetry and other means along a range of islands stretching south-eastward across the Bahamas, the Dominican Republic and a corner of Puerto Rico.



The massive tower at Air Force Missile Test Centre in Florida where one giant bird is being prepared for flight.

Some idea of the importance of electronics in missile tracking may be gained from the fact that more than 100,000 electron tubes are used on the test range. They are a vital part of communications, timing, position-measuring and other equipment. To assure that all this electronic gear will function properly, it is necessary that the radio frequency bands be clear of outside interference.

"You can't take any chances on having a 'ham' radio operator in Daytona Beach cut in at a critical time," one engineer explained.

CLEARING THE CHANNELS

It is the job of the Interference Control Unit to detect, analyse and locate any electromagnetic radiation developing in the channels assigned for missile operation. This requires a close watch and a cool head, and the engineers and technicians handling the assignment take their work seriously. But in between missile firings, they have found a highly practical application for their specialty. By monitoring the ignition radiation of the coffee truck, they are able to get a head-start on their fellow workers and beat them to the front door of the building for first coffee service every day!

R.C.A.'s job at the Missile Test Centre has two main aspects. The first is recording the "raw" flight test data. The

Fixed motion picture camera equipped with telescopic lens, records missile flight at Patrick Air Base.

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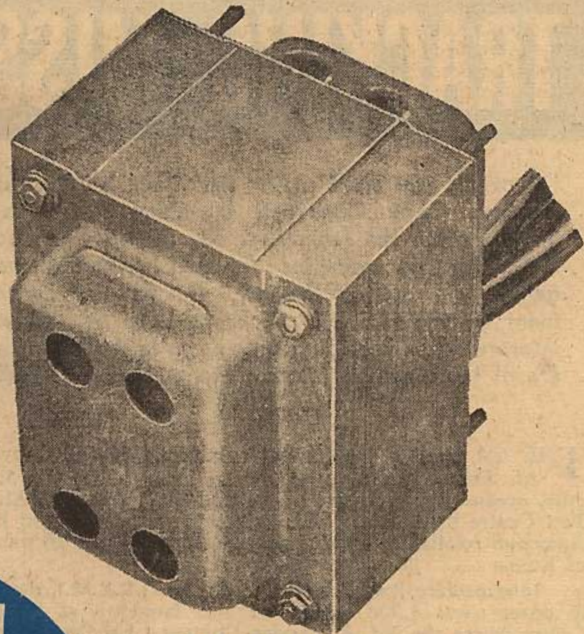

TRANSFORMER RH275/295
Dimensions (upright mounting)
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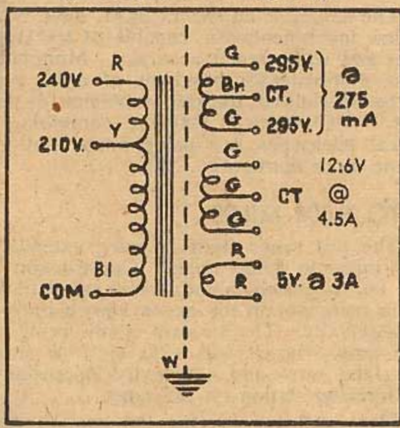

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second is processing this data into a form readily usable by the missile contractor's engineers.

From the moment a missile leaves the launching pad, electronic and optical devices record its speed, flight path, altitude, rate of climb, fuel consumption and other key factors.

The missile's take-off is recorded by as many as 75 special cameras, some of them no further than 12ft from the launching point. These close-up cameras, of course, are operated by remote control. With telescopic lenses and supersensitive film, they can follow the missile to an altitude of about 20 miles and pinpoint its position with startling accuracy. Every once in a while there is a "camera casualty"—the violence of the launching is so great that it demolishes the equipment.

RADAR TRACKING

Huge radars at the launching site begin tracking the missile. Then as it moves down-range each station, in turn, takes over the job. Never is a missile out of range of one or more radars during its flight.

Inside the missile, a small radio transmitter sends back information about the flight to telemetry stations where tape recorders make a permanent record. On a single missile flight, telemetry has furnished more than 400 separate pieces of information on details like air speed, engine r.p.m., gyroposition and so on.

The radar and other information on the missile's flight is funnelled into the main Operations Room at the launching point. Radar data can be read instantly on large automatic plotting boards. The information flowing into the Operations Room keeps the Safety Officer posted on where the missile is and how it is behaving at all times. If it should veer off its precisely planned course and become dangerous, the Safety Officer can press a red "Destruct" button that will end the flight immediately. This Command Destruct System, as it is called, is a precaution against a missile's suddenly taking a right turn and landing in the swimming pool of the swank American Hotel in Miami Beach.

FLIGHT ANALYSIS

Once a missile test is completed, the recorded data from down-range stations as well as from the launching area are rushed to the Technical Laboratory. There, some 50,000ft of photographic film and more than 100,000ft of magnetic and punched tape, together with meteorological observations, are assigned to appropriate groups for processing.

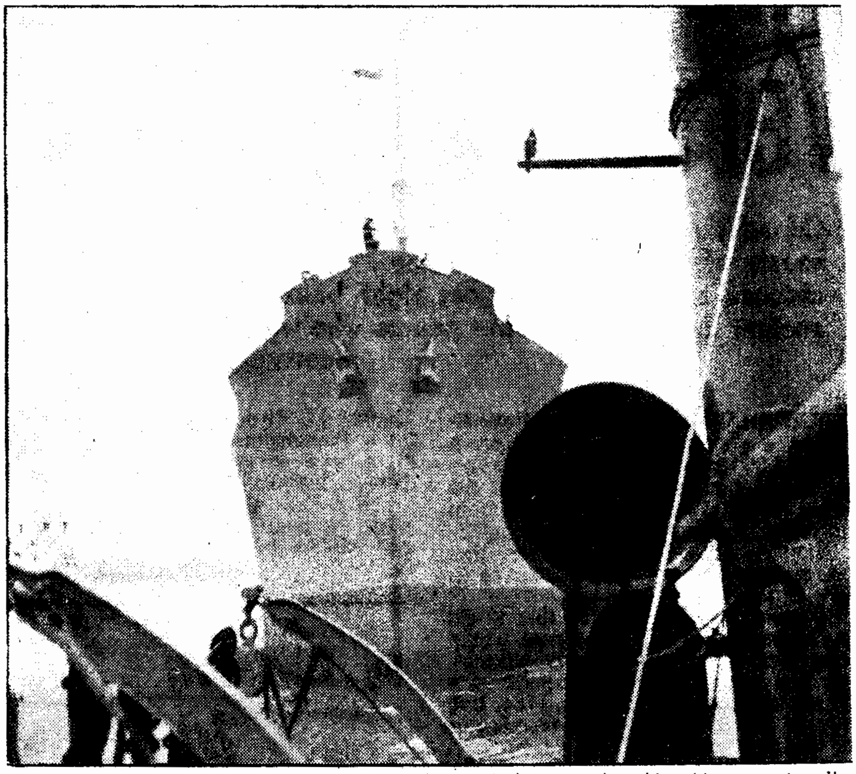
The end product of the testing procedure is a Flight Test Report of 50 to 100 pages, telling how well the missile's guidance system, engine and other equipment functioned. Development engineers then analyse the report and decide what changes to make in the missile's design before the next test firing.

The presence of the Missile Test Range has brought about some amusing changes in the living pattern of residents of the area. One old fishing captain became annoyed at having to get his boat out of the way every time there was a missile firing. So one day, with considerably more daring than discretion, he offered to make a deal with Air Force authorities.

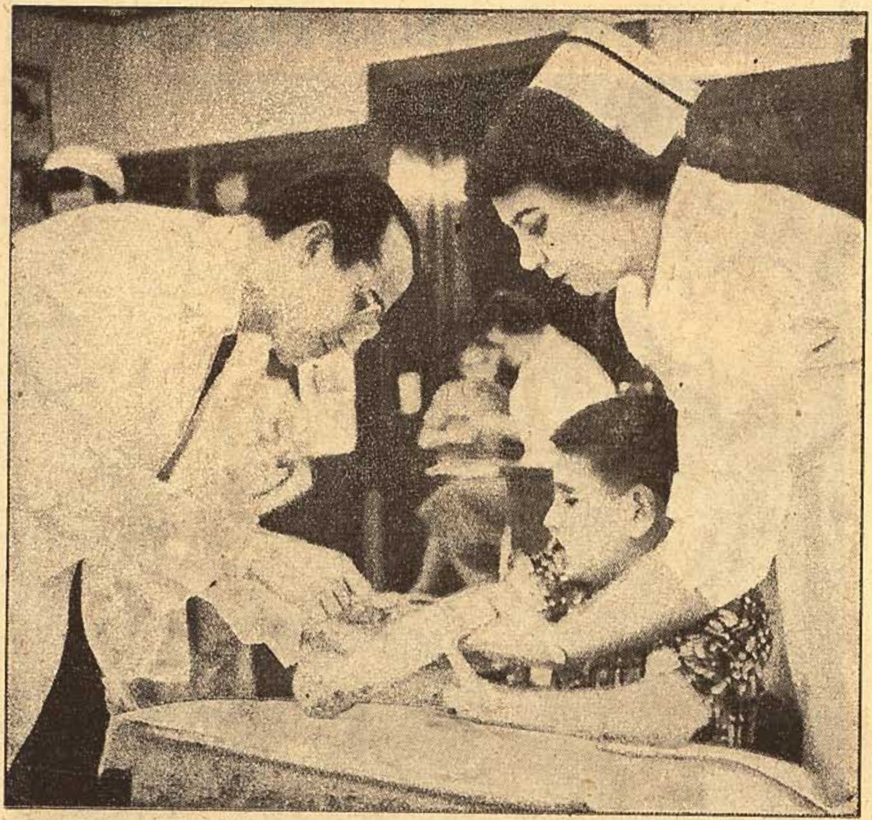
"Listen," he said, "you just tell me where your target area is and I'll go there and wait. That's the safest place I know during a missile test!"

RADIOPHONE HELPS DOCK SHIPS

Melbourne is using radio-telephones between tugboats and ships, pilots to aid berthing operations. Pictured above is the tugboat master in his wheelhouse.



The pilot takes a 15lb portable equipment with him to the ship. He operates it from the bridge.



Dr. Salk gives an inoculation of his now famous vaccine during his early experiments. This little boy from Pittsburgh probably didn't know that he was helping to make medical history.

The Salk Vaccine Versus Polio

Of all the diseases which attack mankind, poliomyelitis has struck more terror into the hearts of people than any other. Yet it is not a new disease. Evidence shows that the incidence of the disease goes right back into antiquity. The paintings and murals of the ancient Egyptians illustrate people who were suffering from the crippling which, at times, accompany the malady.

by Calvin Walters

ARCHEOLOGISTS have also discovered a skeleton which they claim is almost 4,000 years old, in which the formation of the bones indicates that the owner of the skeleton had suffered from the crippling effects of polio.

There is no evidence, however, that the disease assumed epidemic proportions in those early days.

It seems most improbable that it did so, because such an occurrence would have been mentioned in early writings. The first actual recording of polio as a disease was made in the year 1784, but, even at that time, there is no mention of an epidemic.

As has been pointed out by Dr. Thomas M. Rivers, of the American National Foundation for Infantile Paralysis, there is a strange paradox about the disease, inasmuch as the more cleanly a nation lives and the more progress is made in sanitation, the greater is the susceptibility of its people to polio epidemics.

It seems that the disease is so widespread that most people get it at some time or another. This, however, is no cause for alarm for, in most of us, it causes no serious illness at all. It may not even be recognised as polio. We are not aware that we have the infection or perhaps, with no more symptoms than a few minor aches or gastric symptoms, we put it down to a slight "cold." The symptoms pass off and we have had our attack of polio.

It has been estimated that, by the time a person reaches the age of 18 or so, they have, by means of these slight attacks, become immune to the disease.

This immunity has been brought about by the mechanism of the blood stream which becomes possessed of protective substances called antibodies, against the particular type of germ which has invaded our bodies.

Of those people who contract the disease to the extent where it is "reportable" as polio, half recover without any bad after effects, 30 per cent contract some muscular weakness, 14 per cent are paralysed to the extent of disablement, and less than 6 per cent die.

SMALL PERCENTAGE

It must be remembered however that, by comparison with the vast number of people who contract the disease in a minor way as shown above, only a very very small percentage display the symptoms where the disease becomes clearly recognisable.

This high incidence of minor attacks and subsequent immunity against further attacks, explains the paradox as mentioned earlier.

In early history young children and babies were exposed to all kinds of infections. Although most of these were of a minor nature they nevertheless conferred an immunity early to those who enjoyed longer life. The death rate was very high, of course, and there is no doubt that many of the children died of polio.

Nevertheless the important fact is that, during those early times when sanitation and cleanliness had not made much progress children were exposed to infection early in life and became immune. While polio was present, it did not reach epidemic proportions because of this almost universal immunity among such communities.

With the advent of improved sanitation and hygiene it is obvious that more children escaped the early exposure to the disease and thus were not provided with the antibodies in their blood stream which protected them against future attacks. They became more susceptible to the disease later in life and, among children who have acquired no defence, polio spreads with great rapidity. In addition it also takes on more virulent forms at times.

So it was that nations which were pioneers in hygiene and sanitation were the first to be struck with epidemics of polio. They occurred first in Germany and the Scandinavian countries.

It was first recognised as a specific disease in 1789 by the English Doctor Michael Underwood. Then Dr. Karl Landsteiner, of Austria, in 1908, took the spinal cords of children who had recently died of the paralysis. He ground these in salt solution and injected the solution into monkeys. Within a few days the monkeys contracted the disease and died.

This was the first time that science had a tool to work with, namely an animal similar to humans which could be infected.

Later these experiments proved that the disease was caused by a virus.

Then in 1916 a vicious epidemic struck America when the disease killed 6,000 people and paralysed 27,000.

COSTLY RESEARCH

The epidemic occurred year after year and tremendous amounts of money was spent in research to try and find a vaccine which would be effective against the disease.

A lot was known about the power of vaccines to confer immunity against a specific disease. These vaccines are really sterile emulsions of the germ causing the disease in question.

Thus in 1935 two different vaccines were produced which gave scientists great hope that at last a defence against the disease had been found.

These were abandoned after a trial on 17,000 children gave rise to suspicion that the vaccine was itself unsafe.

Later evidence showed that the basis on which the experiment was made was unsound as will be shown.

Then in the four years 1949 to 1952 came three important discoveries which finally led to the now famous Salk vaccine.

In 1949 three doctors at the Harvard Medical School in America found that they could grow the polio virus on non-nervous tissue, namely the kidney tissues of monkeys. Thus the great bottle-neck to research was overcome. Previously the virus was grown only on the spinal cords and brains of infected monkeys or mice.

ABUNDANT SUPPLY

This new discovery meant that there could be an abundant supply of virus with which to experiment. Experiment also proved that the virus could enter the body through the mouth, multiply in the intestines and from there spread to the nerves.

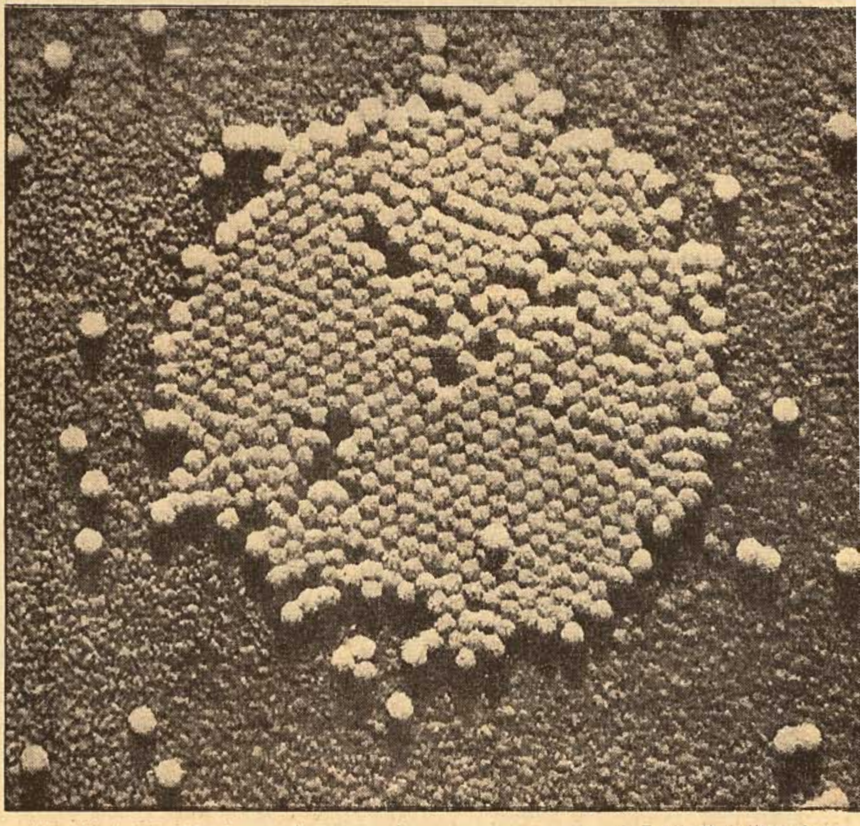
The second important discovery was made in 1951 when it was proved that there are three main types of virus which could cause paralysis. These are now named Type 1, 2 and 3. There are also a great variety of strains within each group. Each group is also able to cause the different forms of polio.

This meant that if a vaccine was to be effective it must contain the virus of all three types and three types only.

Trying to find the three most effective types required the testing of over 100 strains, the use of 30,000 monkeys and an expenditure of 1,375,000 dollars in three years.

Then, in 1952, it was proved that the polio virus first enters the bloodstream

MICROPHOTOGRAPH OF POLIO VIRUS



Magnified 180,000 times, this is a cluster of one strain of Type II polio virus. This picture was made by means of an electron microscope.

and stays there for a time before it enters the nerves and attacks them.

These three great discoveries proved why the first two vaccines of 1935 were useless. Each contained one strain only, which obviously made them of no use against such a tricky enemy.

A virus is different from an ordinary germ and functions in a different manner. They are much smaller and, unlike the ordinary germ, which is a separate living entity and can multiply when it finds an environment in body fluids or tissues, the virus, outside the cell, is inert. It is apparently not alive.

It is quite harmless until it penetrates to the inside of a living cell. Then it becomes active, multiplying rapidly and damaging or destroying the cell itself.

The polio virus has a peculiar liking *for the cells of nerves*, and it is quite evident what happens when a nerve cell is destroyed. Paralysis or death usually results.

DRUGS NO HELP

Many drugs have been tried against the virus, but even the wonder drugs of today are powerless against the virus once the latter enters the cell. Any drug or vaccine must attack the virus before it enters the cell.

In 1951 encouraging results were obtained with a substance called gamma globulin, or G.G. for short. This is a protein substance in the blood, which acts as a vehicle to carry the antibodies which the blood acquires when exposed to disease.

It was reasoned that because most adult people have acquired the antibodies, through natural exposure to one or more of the polio virus types, it followed that if the gamma globulin, which can be extracted from blood, were mixed from a lot of different adults, the mixture should contain the antibodies of all three types of polio virus.

It was further reasoned that if the gamma globulin mixture was injected into children it should confer immunity against the three types.

PROMISING RESULTS

The first experiment in 1951 on 5,000 children showed good results. Then about 50,000 more children were injected during the next summer. The experiment was successful and next year over one million doses were given. It saved a *tremendous number of children from polio.*

Unfortunately, G.G. was hard to get. It required one pint of blood to provide one dose of G.G. To make matters worse, the effect was only temporary, as the G.G. lasted in the blood stream for only five or six weeks. In addition, it had to be given before the child became infected with the virus. This was difficult, if not impossible, to determine.

One of the great needs of scientists and doctors is a simple test to determine whether a person is really suffering from polio or from some other disease.

What is needed is a quick test. There are tests to show whether the virus is present or whether antibodies are present, but they take some time to carry

out—up to a week, and anything can happen in a week.

One test is a colour test, based on a mixture of monkey kidney cells and phenol red. If the cells are healthy and continue to grow they produce an acid which turns the phenol red into a yellow colour. If the cells are being destroyed by the polio virus the acid is not formed and the mixture remains red.

In practice the kidney mixture is placed in a test tube and some secretion from the patient's intestines added. If the virus is present the cells are destroyed and the red colour prevails.

This test takes about a week and can also be used to determine whether polio antibodies are present in the blood.

NATURE OF TEST

Some blood and virus are added to the kidney mixture. If the antibodies are present they prevent the virus from attacking the kidney cells, which, not being destroyed, continue to make acid and the mixture turns yellow. By testing against all three types of polio virus, it can be found which one the patient is immune to.

It must be borne in mind that the turning point in the research which led to the development of a vaccine for polio was the typing of the polio virus and the culture on non-nervous tissue. It remained only for some brain to devise a suitable method of making a vaccine.

The brain was that of Dr. Jonas Salk in the Virus Research Labs of Pittsburg University.

Dr. Salk decided, with the aid of his team, upon a line of research which was to take months of the time testing experimental vaccines, calculations and improved ideas.

The essential technique in the making of the Salk vaccine starts with monkey kidney tissue. This is minced and placed in bottles with a nutrient fluid needed by the cells to support them and allow them to grow.

After about six days the cell mixture is tested, to make sure all is well. The bottles are placed in a machine which rocks them for six days, during which the cells grow, after which the first nutrient medium is drawn off and the cells tested for the absence of germs and viruses.

FURTHER TEST

Two cubic centimetres of a strain of a specific type of polio virus is added. The viruses grow rapidly and a few days later the mixture is again tested for contamination and potency to make sure that there is a large quantity of living virus.

The virus is now exposed for about 13 days to formaldehyde at controlled temperatures. This is carried to well above the point, where all the virus is killed, and is unable to cause infection. The virus is still able to stimulate the blood stream to produce the required antibodies.

During this exposure to formaldehyde the virus passes through extremely fine filters to break up clumps of viruses, so that those on the inside do not escape exposure.

The virus fluid is now tested against monkey cell tissue, as explained above, to make sure that no live virus remains.

Each separate batch of each type of virus one, two and three, are then mixed together in equal quantities, and the final vaccine goes through extremely rigid tests to make sure that no live viruses remain and the vaccine is then ready for injection.

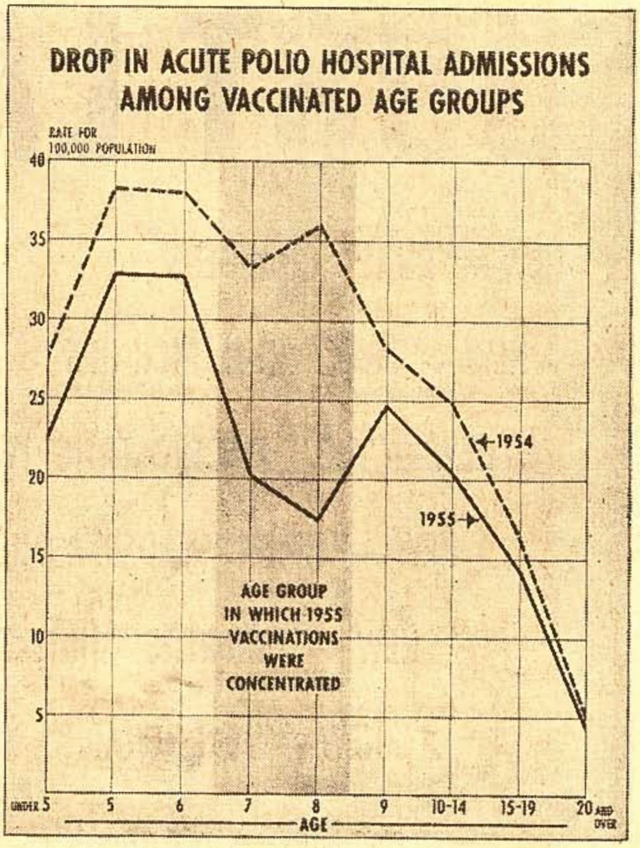
A dose of vaccine equals a cubic centimetre, which is about one five-hundredth of a pint, and each dose contains about one hundred-million dead viruses.

The testing of the vaccine was an undertaking of vast magnitude, and one which the average person outside of America, where the testing took place, little realises.

☆

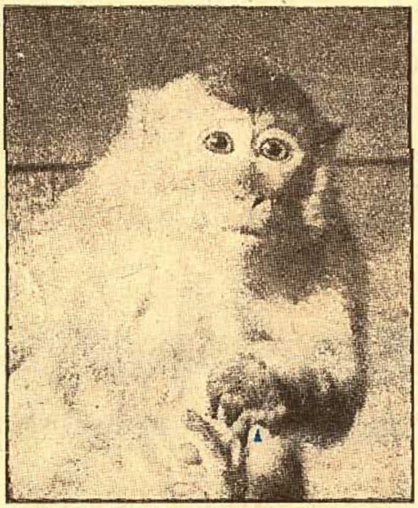
This chart clearly shows the sharp drop in hospital admission for polio among children, ages 6 to 9 years, who received the vaccine in the year 1955.

☆



One million eight hundred and thirty thousand children were involved in the experiment. Many were given the three shots of the vaccine and the remainder a dummy shot of an inert fluid. None of the parents or children knew which was the real thing or otherwise.

The experiment spread over 44 States among children of all ages. It required the co-operation of 40,000 registered nurses, 14,000 school principals, 50,000 teachers, and 200,000 citizens who volunteered.



The Rhesus monkey which receives the initial polio injections to test the safety of the polio vaccine.

Polio Pioneer buttons were awarded to all children whose parents allowed them to volunteer. Of these 40,000 contributed three samples of blood at various stages of the trial for testing to watch for the formation of antibodies. Certificates for Bravery were awarded these children.

A Polio Evaluation Centre under the directorship of Dr. Francis at the University of Michigan was set up. About 150 million separate pieces of information were analysed by statisticians, stenographers and clerks. Everything was double checked: There were secret codes telling what were real and dummy shots. The towns, States, names and ages of children, their reactions and the results all had to be collated and analysed.

It must be noted that the injections were given during the summer, the time of epidemics.

THE WORLD WAITS

Then on April 12, 1955, all the world waited on the result of the investigation. Only one man could give it, Dr. Francis.

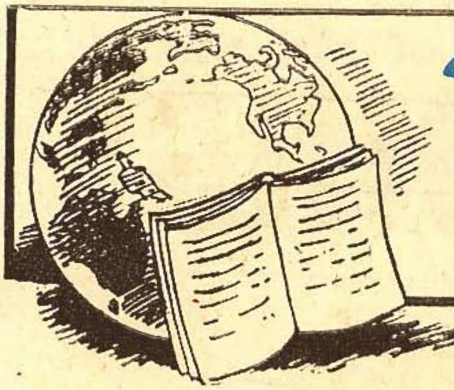
At the University of Michigan 500 scientists and doctors, together with 200 newspaper, radio and television reporters met to hear the report.

The result of the report sent reporters madly to telephones and set people dancing in the streets.

Of 440,000 children vaccinated only 71 contracted polio. Of the unvaccinated (dummy shots) 445 became paralysed by the disease.

There were only 113 children who

(Continued on Page 119)



Technical Review

VIDEO TAPE RECORDER USES REVOLVING HEADS

Low tape speed and extended high-frequency response are achieved in magnetic tape recorder by revolving four recording heads transversely across tape while tape moves only fast enough to keep successive tracks from overlapping. Recorded tapes have signal-to-noise ratios of 34 to 36 db with better than 300-line resolution and high contrast ratio. This article by Ross H. Snyder, of the Ampex Corp., California, is a summary from "Electronics."

THREE ways to extend the upper frequency response of magnetic tape recorders have been investigated. The brute force technique pulls the tape past the heads fast enough so a 4 Mc/s signal appears on the tape as a wavelength, about the same as the shortest used in audio. A second approach uses a number of channels in a time-multiplex arrangement. Both methods present mechanical difficulties.

This article describes a third approach that revolves the head rapidly across the tape, while the tape moves only fast enough to keep successive transverse tracks from overlapping one another. This method presents a series of problems which are unique, but which are soluble in a practical manufacturable machine.

As illustrated in Fig. 2, the Ampex recorder has four heads mounted at the outer circumference of a rotating disc, with their gaps parallel to the disc axis.

MECHANICAL

Each head is spaced as nearly as possible to 90 deg. from the next on the disc. With a disc diameter of about 2in and a rotational rate of 14,400 r.p.m. (240 r.p.s), the writing speed or relative head-to-tape velocity is about 1,500 ips.

The recorded tape has three separate upon the width of the tracks which are to be laid down, one after another, transversely on the tape and upon the necessary space between them. These tracks are 10 mils wide, with an edge-to-edge separation of 5 2-3 mils and a centre-to-centre spacing of 15 2-3 mils. It is thus possible to obtain a great reduction in tape speed and to operate at the familiar 15-ips velocity. Using thin tape, 64 min of recording are obtained on a 12½in diam. reel of 2in wide tape.

A 120 deg. arc is described during the complete sweep of a head transversely across the tape.

Since all four heads are fed the same currents during recording, there is a duplication of information towards the end of one track on the tape and at the beginning of the succeeding one. Advantage is taken of this duplication in the switching system used to deliver continuous transient-free signals during replay.

With four heads performing 960 sweeps transverse to the tape each second or each 15in of tape, one frame occupies ½in of tape longitudinally and the 525 horizontal lines which make up one full TV frame, are recorded on 32 successive sweeps or tracks on the tape. Each track carries 16 or 17 horizontal lines of television information.

SEPARATE TRACKS

The recorded tape has three separate but synchronised magnetic tracks as shown in Fig. 1. The first (Fig. 1A) is the series of transverse video tracks; the second (Fig. 1B) is the sound track that accompanies the picture, which is impressed at the top of the tape; the third (Fig. 1C) is a signal that comprises a record of the alternating currents which feed the rotating disc motor during that recording.

During recording the sound track is wiped clean by the preceding erase head, for maximum signal-to-noise ratio.

The transport mechanism used is similar to that found in many professional magnetic audio recorders. As illustrated in Fig. 3, the tape is supplied from a reel on the left; it is stabilised in its motion by passing around an idler, whose motion is dominated by a heavy flywheel. It passes by the rotating video head assembly then goes on to a stationary pair of heads on one stack.

Of this stack, the upper one is an erase head which clears a 100-mil strip at the upper edge of the tape. The lower head records the control track in a similar strip along the bottom edge of the tape, without erasure. The tape then moves to a second stationary head stack which contains only the combina-

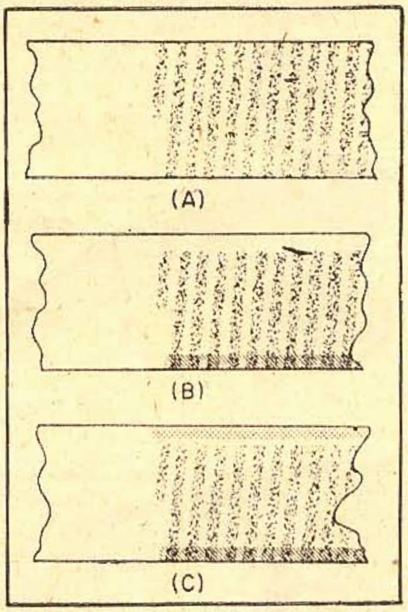


Figure 1. Signal pattern after passing video head drum (A), paired audio-erase and control-track record heads (B), and audio record head (C).

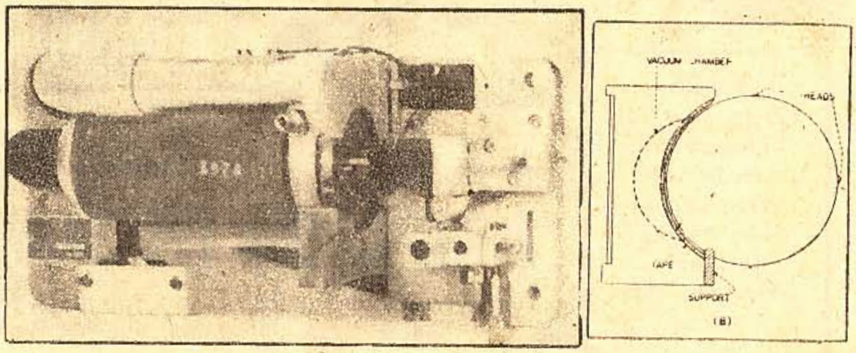


Figure 2 Head sub-assembly (left) includes rotary heads motor, commutator and vacuum guide chamber (right) to align tape.

tion audio track record-replay head.

The tape next passes between a drive capstan and its pressure idler, around a take-up idler and on to a tape take-up reel at the right. The erase, audio, and control track magnetic heads are stationary.

Guiding of the tape past the rotating disc is accurately yet delicately controlled by the concave guide, shown in Fig. 2, which is used to cup the tape around the disc. The relation of tape to rotating heads must necessarily be intimate and good head contact at nearly constant pressure is required. This is accomplished by maintaining the fit of the concave guide within small tolerances to the exact path of the rotating heads and through the use of vacuum applied from the guide side of the tape.

OVERALL SYSTEM

The recording system is shown in block form in Figure 4.

During both recording and replay, an intimate relation must exist between the rotation of the revolving heads and that of the capstan. This process begins at the time the signal is recorded.

While recording, the 60 c/s power-line frequency is first applied to a frequency multiplier, which produces a 240 c/s signal. This signal drives a three-phase power amplifier during the original recording which in turn supplies 240 c/s power to the synchronous motor which drives the rotating disc.

A portion of the revolving mechanism is coated half black and half white. A light source is focused on this revolving black and white disc and reflected into a photo cell to produce a 240 c/s square-wave output. This is passed through a frequency divider, coming out at 60 cycles. The signal is then passed through a filter, whose output is a clean 60 c/s sine wave, which in turn is fed to a power amplifier, whose output drives the capstan motor.

The whole chain is electrically analagous to a mechanical gear train, coupling the rotation of the capstan firmly to the rotation of the head disc. Neither the head disc motor nor the capstan motor are driven directly by the 60 c/s power line frequency, although the power which is supplied to the disc-driving motor is directly derived from the incoming 60 c/s signal.

SYNCHRONISING HEADS

The power supplied to the capstan is generated from the actual motion of the revolving heads, enslaving the capstan to the head disc. Thus, during the recording process, the tape is moved precisely 62.5 mils longitudinally during each complete revolution of the head disc. During this period, four lateral tracks are recorded, one for each head, each track being separated from the next by a centre-to-centre space of 15 2-3 mils.

During this process, the 240 c/s output of the photocell is also fed, through a bandpass filter and a series of amplifiers, to the control track head, which records the signal longitudinally on the control track at the bottom of the tape. (Fig. 1B). This control track becomes the magnetic equivalent of the sprocket-holes of a sprocketed film machine. Since the 240c/s signal is derived directly from the revolving heads, the signal on the control track bears a direct relation to the spacing of the lateral

BLOCK DIAGRAM OF RECORDER

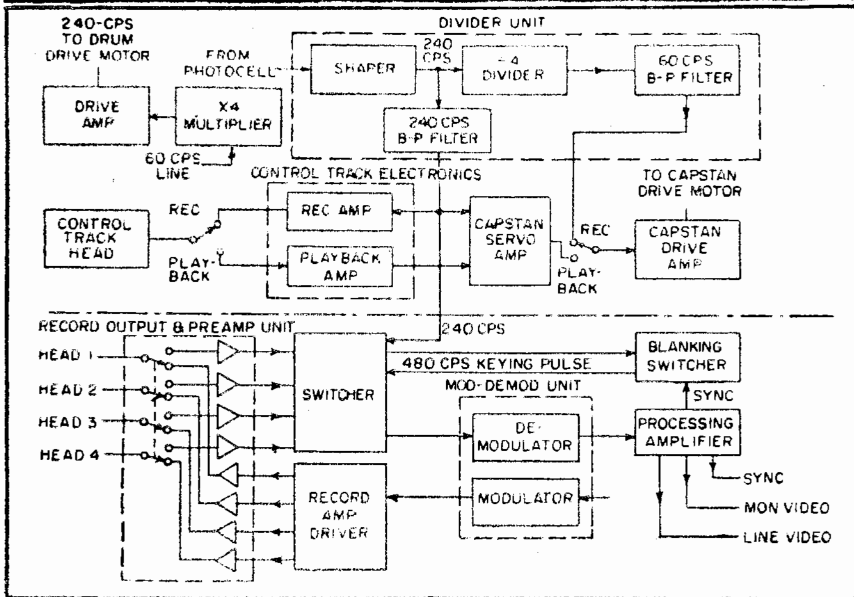


Figure 4. System block diagram is divided into control system (top) and video (bottom).

tracks on the tape and this information is available as a reference to control the relative positions of the head disc and capstan shaft during replay.

When the recorded video tape is to be played back, power line frequency is again multiplied to 240 c/s, amplified and fed to the head disc motor, driving it at a rate which is at least approximately correct, for the purpose of tracing the previously recorded magnetic tracks. Again, the photocell produces a signal corresponding to the revolutions of the disc, this signal, once more being fed through a 240 c/s bandpass filter and then, not to the control track recording head, but instead as one of two 240 c/s signals to a phase comparator in the capstan servo amplifier chassis.

The second of these two 240 c/s signals is that derived from the recorded control track, which is simultaneously

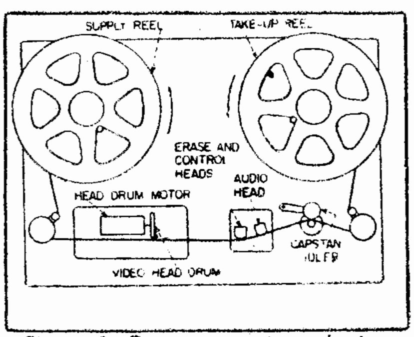


Figure 3. Tape transport mechanism.

amplified and fed to the phase comparator. The resultant signal is a function of the phase difference between the two signals. This is applied to a low-pass filter and then to the grid of a reactance tube which is one of the frequency - determining elements of a conventional Wien bridge oscillator.

The oscillator functions nominally at 60 c/s, but is slightly modified, up or down, by the correction-signal from the phase comparator. This signal is then fed to the power amplifier, which drives the capstan in the same relation to the rotating disc, within narrow limits as it did during the recording process.

Once the disc is adjusted on centre to the tracks at the beginning of replay, the servo system holds the relation constant and the revolving heads indefinitely trace accurately the recorded video tracks.

The output of the photocell can also be used to determine in advance, the approximate moment during playback when it will be necessary to switch from one playback head to the next.

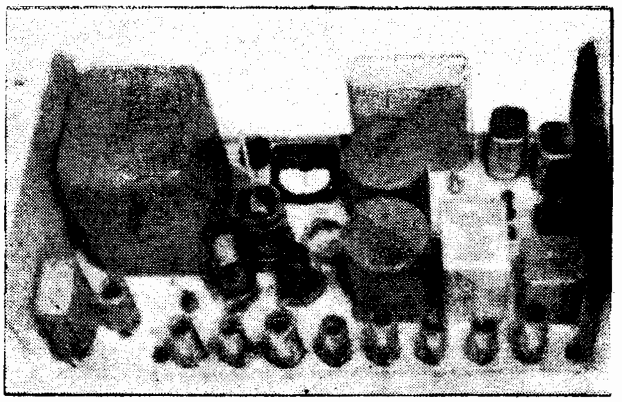
EDITING

There is a means of identifying that line on the tape which represents a vertical synchronising pulse. The tape is wiped with a harmless solution that renders the magnetic recording visible. Since the vertical pulses have a characteristic and recognisable appearance, they may be located with precision. In equipment of more recent development they are used to identify the line along which the tape may be cut and spliced to another tape similarly cut.

It was necessary in the development of the recorder to seek a means of recording and reproducing the range from DC to 4 Mc/s or more and not just the upper end of that spectrum. A modulation system came naturally to mind, an FM system being immediately appealing and ultimately adopted, in an unusual form.

Classically, it is assumed that the highest modulating frequency used in an FM transmission system will not exceed one-tenth the carrier frequency and that deviation will be large compared with maximum modulating frequency. This implies a carrier of 40 Mc/s, so the use of FM would have to be abandoned, if these conditions were to be observed.

Recording the 40 Mc/s carrier frequency requires either a large increase in head-to-tape velocity, or a large reduction in the shortest wavelength handled or both. It seemed as if a low-frequency carrier might do. Since it was desired that the range of modulating frequencies be large, compared with the total transmissible bandpass, it was



Rack-mounted capstan-drive servo control chassis supplies 240 c/s driving signal to capstan.

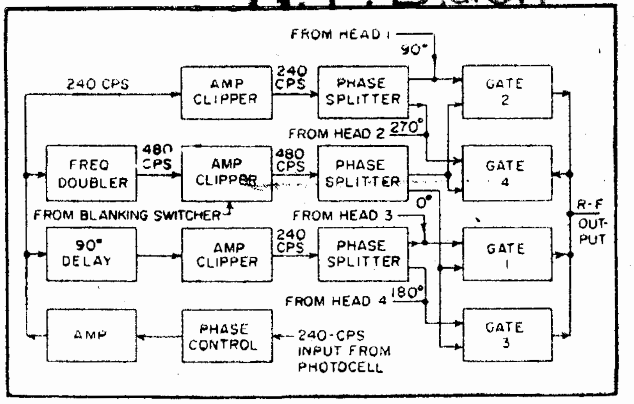


Figure 7. During playback, electronic switcher derives output from one head at a time.

evident that it was also desirable to use an FM system in which the frequency of deviation was small with relation to the frequency of modulation. Thus, both classical assumptions in FM transmission were to be violated.

In FM, when the ratio of deviation to modulating frequency is large, the bulk of the transmitted energy is in the sidebands and the noise rejection capability of the system is greatly superior to that of AM systems. As this ratio is decreased the advantage decreases and finally disappears entirely when the FM sideband energy is less than that which is obtained in 100 per cent amplitude modulation.

NOISE LEVEL

In the video-tape recording system, the deviation is 1 Mc/s or less, giving a ratio of 0.25 or less. This results in a wide-band signal-to-noise ratio which is less than that which would be obtained with an AM system. It was found that by holding within the tape velocity figures which were the aim, a signal-to noise ratio well in excess of 30 db was attained over the 4 Mc/s band width.

The classical assumption that carrier frequency in an FM system should be 10 times the highest modulating frequency or more, was made to avoid the distortion which the higher modulation frequencies must suffer as they approach the carrier frequency. The effect of distortion of video frequencies in the band above 1 Mc/s in the video-tape recorder is a certain amount of zigzagging of closely spaced vertical lines.

EYE IS TOLERANT

Not only is this effect evident only on such visual material, but the effects of the blurring is greatly reduced by the nature of human vision. When images thus distorted are viewed by the eye, which integrates its experience over a substantial period of time, the result is entirely acceptable, even for images representing a horizontal resolution of 300 lines or better.

The circuitry employed in the modulator and demodulator of the video-tape recorder is lacking in novelty. Where deviation does not exceed a megacycle, and with carriers which do not exceed perhaps 6 Mc/s, a multivibrator type of oscillator whose frequency is controlled by direct application of video to its control grids, is entirely satisfactory and simple to maintain.

As shown in Fig. 5, two 6CL6 tubes are connected as a multivibrator, with special attention to switching time; the grids of the 6CL6 tubes are driven by one section of a 5687. The multivibrator output is amplified through conventional wideband video amplifiers and then applied in parallel to the two 815 tubes which drive the heads. Each section of the 815s drives a single head continuously during recording.

REPLAY

During replay, the output of each head is fed to its own preamplifier; the four channels feeding into a switcher. From the switcher a single channel of FM RF is fed to limiters. The last of these feeds into a bifilar coil, shown in Fig. 6, with a grounded centre-tap. This coil resonates outside the system bandpass and the slope of the resulting response curve forms an FM to AM translator.

The resulting AM is rectified through full-wave diodes, which feed a variable resistor acting as a balance control for the carrier. A low-pass filter, next in the chain, further reduces the level of carrier in the output.

Good linearity is readily achieved, so that grey-scale transfer is substantially undistorted.

During replay, it is necessary to derive the amplified output signal from

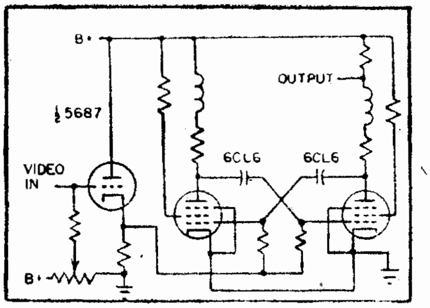


Figure 5. Basic modulator used for recording.

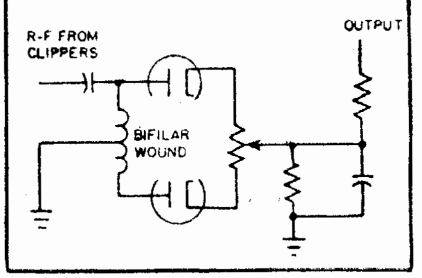


Figure 6. Basic modulator for playback.

one head at a time, switching from one preamplifier to the next at a moment in the transmission when minimum disturbance will be introduced into the reproduced picture and later to demodulate the amplified RF output of the playback heads. The electronic switching arrangement shown in Fig. 7 was developed for this purpose.

A network of coincidence gates is employed with a get-ready signal sent to each gating tube in turn from the 240 c/s photocell source; a go signal is delivered with precision to each gating tube from the television signal itself. Switching occurs only on the back porch of a horizontal pulse. Therefore it does not appear in the reproduced picture, even as a transient.

The 6BN6 gating tubes pass the RF signal to their plate circuits only when each of two grids are raised to a predetermined level of bias. Thus the coincidence of two positive bias signals is used to trigger each of the four gates, consecutively.

CIRCUIT DETAILS

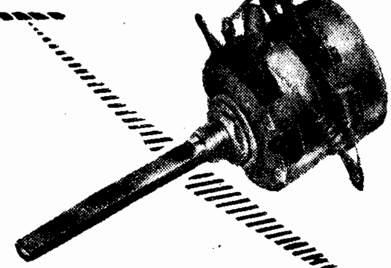
The photocell output is delivered to the sequential switcher, as well as to the servo amplifier control system. This 240-c/s signal, whose phase is directly related to the instantaneous position of the rotating head disc, is fed through a vernier phasing control to a 90-deg. lag network that controls two related channels in conjunction with other signals. The same signal is continuously fed to a frequency doubler and an in-phase network.

The in-phase 240-c/s signal is clipped and fed to a phase splitter, which produces two signals, one in phase and one 180 deg. out of a phase. These two signals are applied to the gating tubes, the in-phase signal to one of the grids of gate 1, the opposite phase to one of the grids of gate 3. These are the same grids to which the amplified RF from heads one and three are fed.

SIGNAL TREATMENT

The 240-c/s signal, which is fed through a 90-deg. lag network, is similarly clipped, fed to a phase splitter, and applied to the control grids of gates two and four. In the same way, these gates receive the amplified RF output of heads two and four at intervals of 90 and 270 deg.

To cause these gates to pass RF at the desired times, appropriate positive swings of a 480-c/s square wave are applied to the coincidence grids of these gating tubes. The necessary 480-c/s square wave signal is obtained from a



LOUDNESS CONTROL

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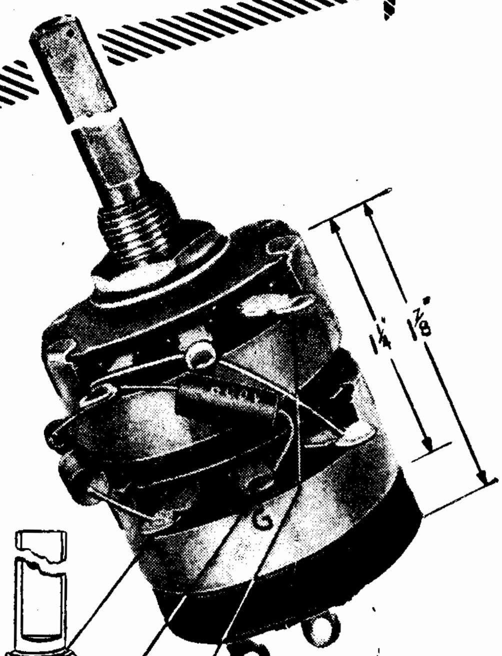
(Patent Applied for No. N11262)



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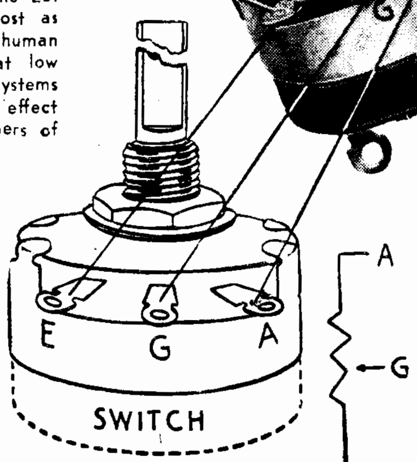

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frequency-doubler whose input is also fed from the common 240-c/s source.

Symmetry of the 480-c/s signal is controlled, permitting the instant of switching to be adjusted with vernier accuracy to the desired angular position of the heads on the tape. With a rise time of about 0.05 usec. this 480-c/s square wave gives the final go signal to each switching operation, so that interruption of the composite signals is exceedingly brief.

The 480-c/s square wave, like the two 240 c/s control signals, is fed through a phase splitter, one phase going to gates one and three, the other to gates two and four.

The sequence of operations, then, begins with the appearance at the control grid of gate 1 of the RF signals from head 1. The 240-c/s control signal is at this time going positive. The phase of the 480-c/s square wave is such that it too goes suddenly positive at one point in the rotation of the head disc. At this moment, the gating tube begins to conduct RF.

All four gating tubes are parallel in their outputs, and an RF video signal is fed to the input of the demodulator, which follows the switcher.

About 90 deg. later in the rotation of the head disc, the 240-c/s delayed signal goes positive at the control grid of gate tube 2. This tube is fed from the opposite phase of the 480-c/s control-signal from gate 1, so it too goes suddenly positive at the screen grid of this second gate and the tube conducts.

GATING SEQUENCE

Since this rapid occurrence is coincidental with the negative phase of the 480-c/s signal at gate 1, the gate ceases to conduct at the same moment that gate 2 begins to conduct. Gates 3 and 4 are both in the negative-going portion of the 240-c/s control signal which is applied to them, so that gate 2 is, at this moment, the only one conducting. The same sequence of events occurs next at gate 3, as the rotating head disc reaches approximately another 90 deg. of rotation.

Since approximately two television lines of information are duplicated from track to track on the magnetic tape, the bottom of one line contains the same information as the top of the succeeding track. A rearrangement of the get-ready, go signal procedure is desirable to locate the moment of switching.

If the line carrying the 480-c/s wave is opened before it feeds the corresponding phase splitter, and this signal is delayed momentarily in accordance with the synchronising information in the television signal, the switching can be done during retrace when the C.R.T. beam is off the television screen. The arrangement used is shown in Fig. 8. The retrace switcher control unit, shown in Fig. 9, contains a 480-c/s multivibrator oscillator, which is locked jointly to the 480-c/s photocell-derived signal and to the synchronising pulses in the demodulated RF video signal. Over a relatively narrow range, this oscillator's frequency may be varied, effectively delaying its output with respect to the 480-c/s switcher signal, so that the exact moment at which the outgoing 480-c/s square-wave goes positive may be made to coincide with a desired point in the controlling video signal.

As illustrated in Fig. 10, the switching time may be positioned on the back porch interval, which places the switching transients on the extreme left-hand side of the reproduced picture, out of view. Should the video signal fail, the multivibrator oscillator in the retrace switcher will continue to send triggering pulses to the 480-c/s multivibrator, insuring continuous output regardless of the nature of the incoming video's signal.

If, for example, a synchronising pulse should be missing from the train coming

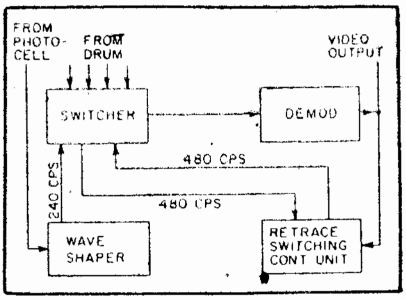

Figure 8. Retrace control switcher prevents overlap of information in playback.

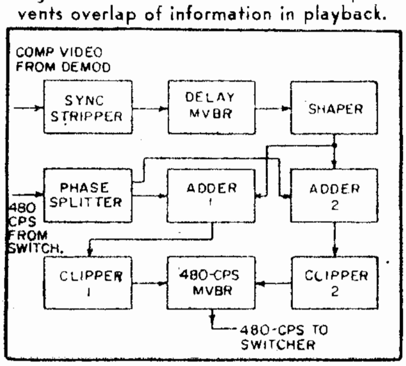

Figure 9. Elements of retrace switching control unit.

off the tape and the time should arrive when switching must occur from one head to the next, the unit will wait for a brief interval. When no synchronising pulse appears, the unit will switch to the next head anyway, with minimal loss in signal from the tape.

The 480-c/s signal, which originates in the sequential gating switcher, is thus modified and suitably delayed by the retrace switching control unit, so that, upon reinjection, it will cause the gating tubes to switch from channel to channel only at such a point in the sequence of video signals that there will be no visible effect.

Performance of the video-tape recorder, in the form in which it exists in

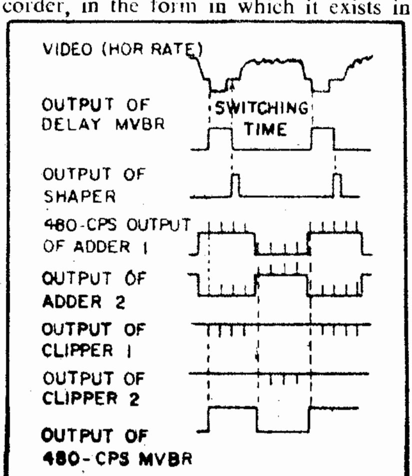

Figure 10. Waveform relationships in retrace switching control unit.

1957, has considerably improved over that obtained from the experimental unit first displayed in 1956.

The development of special tape, horizontally oriented, with surface smoothness much finer than that normally provided (or needed) in audio tape, specially formulated oxides of particularly good shortwave length resolution capability and improved mechanical characteristics have all combined to make possible the routine realisation of signal-to-noise ratios of 34 to 36 db., with occasional attainment of ratios as high as 40 db.

Head manufacturing techniques have also been refined, reducing the abrasion effect, both on the tape and on the heads, to the point where a substantial number of heads have proved usable well beyond the 100 hours which were originally considered a practical norm. Tape, too, is proving capable, under these improved conditions, of being reproduced many more times without deterioration and of being recorded and re-recorded for an aggregate of well over the 100 passes of the revolving heads which at first were thought to be the practical maximum.

HEAD LIFE

Deterioration in heads due to wear does not produce deterioration either in resolution or in the linearity of grey-scale transfer; in fact, resolution improves slightly as heads wear and only the eventual increase in noise tells of the approaching end of the useful life of the heads.

The same is true of tape. Neither resolution nor grey-scale linearity are affected by the gradual abrasion of the tape which occurs in use. Instead, the signal-to-noise ratio slowly begins to deteriorate, signifying the end of the useful life of the tape.

Linearity of grey-scale is an inherent advantage of the video-tape recording process, due to the modulation system used. There are no operating controls on the recorder which are capable of affecting the linearity of the grey-scale transfer characteristic.

Differential gain measurements typically give readings of under 10 per cent; this remains constant, being quite independent of head or tape condition. The live appearance of the video-tape reproduction is as much due to linear grey-scale transfer characteristic as to any other operating characteristic of the machine.

PERFORMANCE

Resolution of better than 300 lines, with high contrast ratio, is readily obtained.

Experience with the recorder in daily network operation has established the practicality of making duplicate tapes from an original. While there is no method of making copies except by connecting one or more video-tape units as recorders, while another is used as a replay machine, the number of copies which may be made in this manner is substantially unlimited.

First-generation copies of an original video-tape recording are deteriorated in hardly any visible way; resolution and grey-scale linearity being substantially identical to the original. A slight rise in noise occurs, but if this is already well below visibility in the original, the copy will appear virtually the same as the original.

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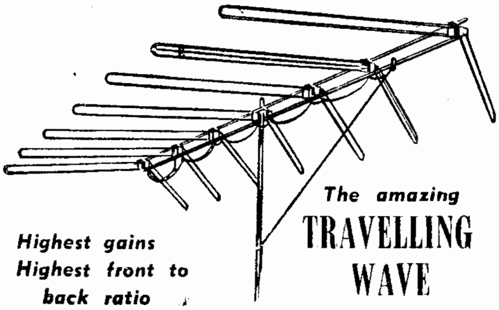

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We stock A. & R. Transformers—Matched Kit for the Mullard 20 watt Amplifier, comprising: Output Transformer 921, Power Transformer 1783, Filter Choke, 1092.

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12 WR	£7/9/7	2/11	4/4
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Dual Type 12 PQCB,	£19/5/-	4/8	8/-
Woofer 12PQ/15	£6/18/-	3/8	6/-
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ROLA			
12UX Hi Fi	£28/19/6	4/8	8/-
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Axiom 150 Mk. 11,	£26/8/3	Freight forward	
Axiom 80	£36/16/6	"	"
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Co-Axial	£16/17/6	3/8	6/-
CM120FM	£8/5/-	2/11	4/4
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Aegis-Mullard 5-10 .... £59/-/-

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Thorens E53N-PA £35/-/-
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Philips AG2005 .... £57/15/-
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● NEWS FLASH . . . SCOOP PURCHASE

We have made a scoop purchase of the following Transformers made by a well-known maker.

	Postage Vic.	Int.
40 milliamps 225V A-side 6.3 volts — Usually 50/8 — **Now 38/-**	2/11	4/4
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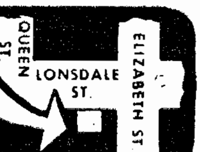

OPEN SAT. MORNINGS

TRADE ALSO SUPPLIED

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NEWS AND VIEWS OF THE MONTH

Big telescope

A £10,000 steerable radiotelescope, the biggest of its type in Britain, was demonstrated recently for the first time at the Royal Radar Establishment at Malvern, England.

It is designed to work down to wavelengths of 10 centimetres—half the length of those capable of being picked up by the giant £750,000 steerable radiotelescope at Jodrell Bank, Cheshire.

The Jodrell Bank telescope is claimed as the biggest radiotelescope in the world, and has a 250ft diameter reflector.

The radiotelescope at Malvern has a 45ft diameter aluminium reflector.

Space travel soon

SPACE travel is only 20 years away according to Mr. H. Ward, director of the N.Z. Physical Laboratory.

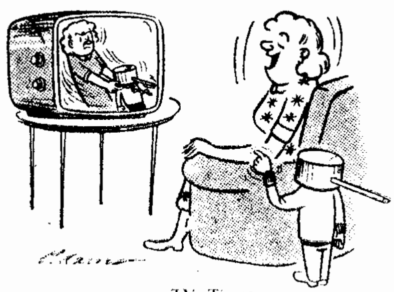
Mr. Ward, who is a member of the New Zealand International Geophysical Committee, said that although earth satellites to be launched shortly were only 20in in diameter, larger satellites of three or four feet were already under consideration.

Mr. Ward said general theories on outer space were now being considered by scientists as wrong.

More information was coming to hand which proved that the earth had a greater effect on outer space than scientists previously believed possible.

Some elements of the earth's atmosphere existed up to 15,000 miles, although not in the huge amounts existing at the planet's surface.

It was possible that these conditions existed between the sun and the earth, but by the earth's standards, it would be a state of "high vacuum."



— TV Times

New height record

LAST month, an Air Force doctor, sealed in a pressurised capsule, soared nearly 19 miles into the sky.

This is a new altitude record for a manned balloon.

Major David Simons left the earth in a small cabin dangling from a huge balloon.

Two hours later, the balloon had carried him 100,000 feet over Minnesota — 4,000 feet higher than the previous record.

Highest altitude man has ever been known to reach is 126,000 feet, in a U.S. experimental rocket plane nearly a year ago.

Major Simons' venture into space was to last 24 hours.

He entered his eight-foot-high, three-feet in diameter capsule more than 10 hours before he took off, to get used to life in isolation.

He took a supply of sweets, fruit juices and pears with him.

One purpose of the flight was to record the effects of cosmic radiation on the human system.

POPULAR SCIENCE QUIZ

Q: What are X-rays?

A: X-rays are transverse electromagnetic waves, of similar nature to light and radio waves except for wavelength and frequency.

Q: What are some of the properties of X-rays?

A: Fluorescence is excited in many materials, such as calcium tungstate, barium-platino-cyanide and others.

Photographic emulsions are affected by X-rays, which provides an excellent method for the study of the radiations.

Electric charge is lost when objects are irradiated with X-rays.

Various objects are more or less transparent to X-rays, the differences in transparency providing the basis for the study of the internal structure of objects which are opaque to visible light.

X-rays can be collimated with slits or pin-holes, showing that the radiations travel in straight lines, like light.

Magnetic fields do not deflect an X-ray beam, showing that X-rays are not a stream of charged particles.

Refraction and reflection of X-rays occur only to a very small degree.

Q: How were X-rays discovered?

A: Some of the effects of X-rays mentioned above were first noticed by Roentgen in 1895 and reported in papers published by him in 1896. At the time he was investigating electrical discharges through gases and the effects of cathode rays.

Roentgen noticed that a fluorescent screen outside the discharge tube would light up, even when the screen was shielded from the direct light of the discharge. Within a few months of the announcements of the discovery X-rays were being used in medical diagnosis and it was not long before the rays found application in many branches of science and technology.

Q: Why were they called X-rays?

A: Simply for want of a better name. The symbol X is frequently used to identify an unknown quantity and for some time after the discovery of the rays relatively little was known about their exact nature.

Q: How are X-rays generated?

A: X-rays are generated whenever a beam of electrons strikes an obstacle. However, they are generated more efficiently when the obstacle has high atomic weight.

In order to make the electrons move at high velocities they must be accelerated through a high voltage and provision must be made for them to strike a target. Finally the X-rays so produced must be brought out from the generator to a point where it is convenient to use them. Also some means must be provided for detecting them.

Some of the earlier X-ray tubes made use of a gas discharge tube without a heated filament. The current through the tube was controlled by controlling the anode voltage. However, after use, some of the gas in the tube is absorbed by the walls and in order to maintain the required current it is necessary to increase the accelerating voltage.

Later tubes make use of a heated filament as a source of electrons and the tube current can be varied by varying the heating power applied to the filament. The filament voltage is easier to control than the high tension voltage and varying the latter has the further disadvantage that the wavelength of the X-rays produced also varies with the intensity.

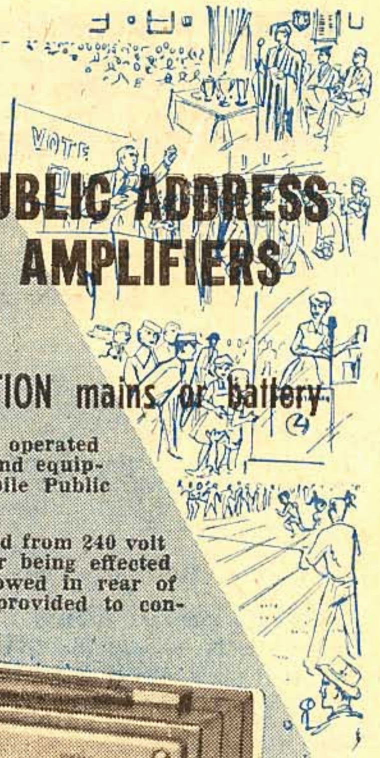
Where a variation in the wavelength of the rays is not a disadvantage the alternating voltage direct from the secondary of a high voltage transformer can be applied direct to the tube.

Q: What is the effect of X-rays on the human body?

A: X-rays cause ionisation in body cells and have an effect on the number of white cells in the blood. Radiation units, or Roentgen units, measure the energy absorbed per unit mass and are significant in measuring the effect on the body of radiation.

The body is able to repair damage caused by radiation if it is received over a sufficiently long period but if it is received quickly the results may be serious. For example, 600 Roentgen units spread over 30 years would have no observable effect but would almost certainly be fatal if received in a single day. It is generally considered that the greatest dose which can safely be received continuously is 0.1 Roentgen unit per day, although occasional doses greater than this may not do any harm.

New Release



PUBLIC ADDRESS AMPLIFIERS

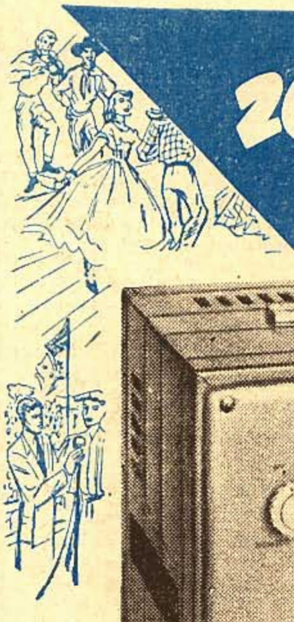
DUAL OPERATION mains or battery

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

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

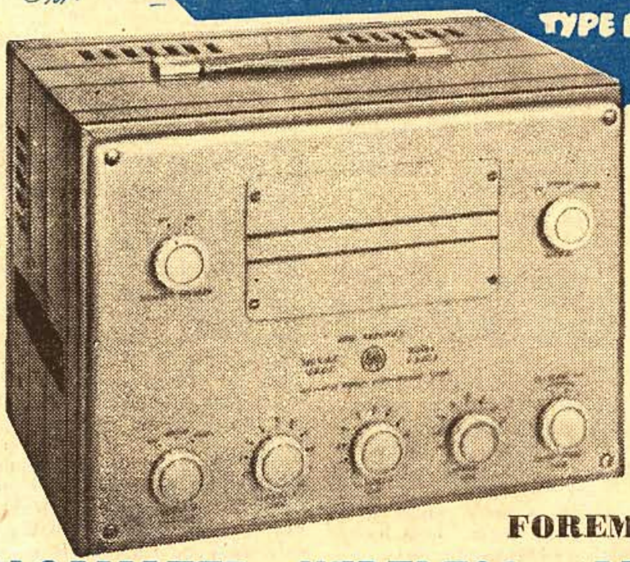
5 WATT AMPLIFIER

TYPE PA 828



20 WATT AMPLIFIER

TYPE PA 829



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

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

FOREMOST IN SOUND

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

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

Drugs for dogs

SYDNEY dogs — even mongrels — are developing complexes.

Such tranquillising drugs as chlorpromazine are now used by Sydney vets for treatment of neurotic dogs.

"The use of tranquillising drugs is to separate the patient from his problem," a Mosman vet. said.

"Sometimes dogs become terrified of cars or aeroplanes.

"They fret and become hysterical — very like humans — and need similar treatment.

"When the drug is administered, they become more relaxed and contented.

"They are not dopey — just happy."

The vet. said the drugs were also given to pets recovering from an operation or boarding at kennels while their master was away.

Atom ice-breaker

THE world's first atomic-powered surface-ship will be launched at Leningrad before winter.

The 16,000-ton V. I. Lenin will be the world's largest icebreaker.

The Lenin is designed to blast through the thickest ice with water cannons which deliver a thin, steel-hard stream of water to cut through the ice like a knife.

The ship also will carry two helicopters to find the easiest passage.

Behind the Lenin will come ships carrying supplies to the port cities that have sprung up along Russia's Arctic shores, and to carry out grain from the interior and the immense mineral wealth of the region.

The icebreaker for the first time will eliminate the Russians' complete, year-round dependence on such waterways as the Suez Canal, the Bosporus Straits between the Black Sea and the Mediterranean, and the shallow waters past Denmark and Sweden that lead out of the Baltic Sea.

From Murmansk to Vladivostok via the Northern Sea route is about 4,000 miles; from Murmansk to Vladivostok by the North and Mediterranean Seas, Suez Canal and Indian and Pacific Oceans is about 15,000 miles.

The Lenin will be the largest ice-breaker ever built.

It will be 440ft long and will have a 90ft beam.

Tunnels of ice

RAILWAYS and roads tunnelled deep under ice may one day service underground communities in the Arctic.

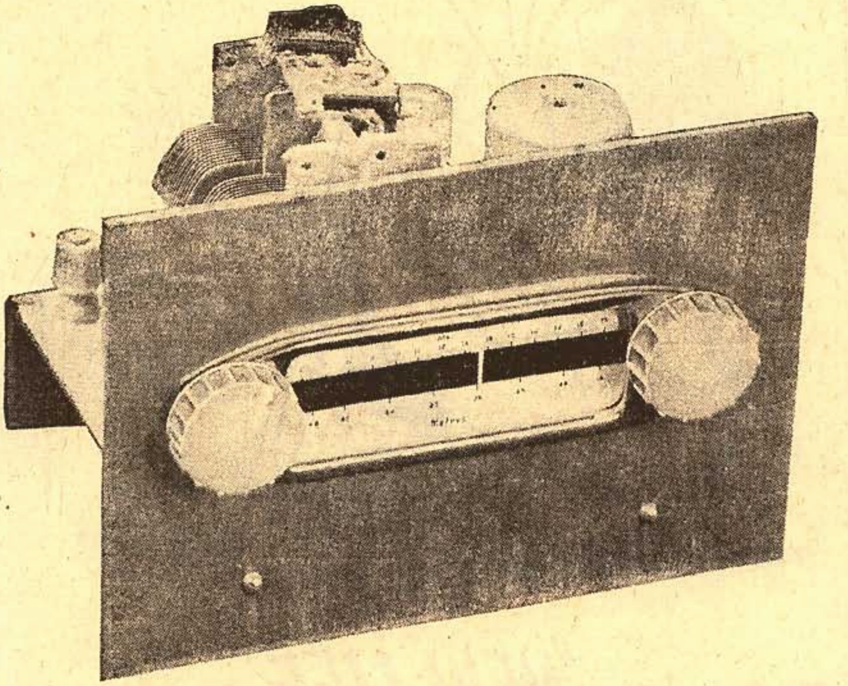
A Swiss plough is being tried by U.S. engineers on the ice cap in Greenland to build roofed-over highways 8ft wide.

The plough powders ice and compressed snow, throwing it aside as the machine progresses at about a mile a day.

The powder is shovelled back over formes bridging the cut. Here it freezes hard and the formes are removed.

Sunlight penetrating this translucent ceiling gives a myriad rainbow effect.

Because the 12,000ft thick ice cap is shifting, "life" of the tunnel so created is given as 10 years, but as it is cheap to build, it can easily be replaced.



The finished converter, ready to house in a suitable cabinet. There are only two controls; tuning on the left and B/C S/W selector on the right. The unit can be left permanently connected to the regular B/C receiver.

A Single Band S-Wave Converter

If you are keen on short-wave reception, but have only a broadcast set, this little converter should solve your problem. It covers the normal short-wave band, is simple and economical to construct and used with your present set should out-perform the average dual-wave receiver.

THE previous series of short-wave converters which we described (June and July, 1955) were fairly elaborate designs, incorporating RF stages and multiple channels. Although capable of excellent performance and extremely popular, they are inclined to be a little too elaborate for some readers—particularly beginners—who may therefore hesitate to venture into this field of activity.

READER DEMAND

Realising this (from recent requests in our mail) we set out to produce something less elaborate, but something which would still provide excellent short-wave listening for anyone with an average five-valve broadcast receiver. Of course, if you have a set with the RF stage—so much the better.

By abandoning the RF stage in the converter and concentrating on a single band, it is possible to simplify the design considerably. At the same time, the performance is still good enough to permit reception of most signals worth hearing, while the coverage is equal to that provided by the conventional dual-wave set. The result is a unit which should appeal to a great many enthusiasts.

A short-wave converter is basically a simple device. It is merely a frequency converter stage of a short-wave set, consisting of a single valve, tuning capacitor, coils, and a few minor bits and pieces. The only major difference is that, instead of converting to the conventional 455 Kc, it converts to a frequency somewhere in the broadcast band.

The converted signals are then fed to the aerial terminal of the broadcast set, the set tuned to the selected frequency and, from then on, is regarded as a composite IF channel. The fact that the signal is again converted by the set, this time to 455 Kc, does not upset things in any way. In fact, if we select the first IF with care, we can improve the overall performance to a worthwhile degree, making the set-up into a double-change superhet.

by Philip Watson

This is mainly useful in suppressing unwanted images, and a few words about the "why and how" of this may help our beginners to get a clearer picture of things.

Images are a problem common to all superhets and are due to the fact that any one station will produce the required intermediate frequency when the local oscillator is tuned either higher or lower than it by the intermediate frequency. Alternatively, stations both higher or lower than the local oscillator (by the IF) will generate IF signals and will be heard.

SIMPLE EXAMPLE

Thus, on the broadcast band, if we tune to a station on 600 Kc, we will automatically set the local oscillator to 1055 Kc (600 plus 455). But 1055 is also 455 Kc lower than 1510 Kc, and any station on this frequency should therefore have as much chance of being heard as the one on 600 Kc.

The only reason it does not in practice is that the aerial tuned circuit is sufficiently selective to reject a signal so far away from the wanted one. It is also easy to appreciate that the difference between the wanted and unwanted station will always be equal to exactly twice the intermediate frequency.

Although images are not a problem on the broadcast band (for the reason already stated) it was not always so. In the days when an IF of 175 Kc was very popular the image was only 350 Kc away and a single tuned circuit was not sufficient to reject a strong local signal. For this reason, such receivers invariably employed an RF stage to provide the necessary additional pre-selection.

HIGHER IF

The use of a higher intermediate frequency was a simple solution to the problem, and, as can be seen, is always to be preferred as far as reduction of image response is concerned. If this were the only factor, we would simply make our IF as high as possible and the image problem would cease to be.

Unfortunately, it isn't as easy as that. While raising the IF helps the image problem, it reduces the performance of the IF channel as regards both sensitivity and selectivity, so that we must normally select a compromise figure.

In the case of the broadcast band the present figure is an excellent compromise, but the short-wave bands present greater difficulties. Whereas we would frequently like to use a lower figure than 455 in order to provide adequate gain and selectivity, there is very little preselection possible by one, or even two, tuned stages ahead of the converter. This is due to the low value of the image frequency —910 Kc—relative to the signal being received, say 10 Mc or higher.

As a result, almost any moderately strong signal can appear at two spots on the dial, with the ever-present possibility that the image will coincide with the genuine signal from some other station, causing severe interference.

The best solution to this problem is the double-change superhet. In this the incoming signal is first converted to a relatively high IF, something between 2 and 5 Mc being a popular choice. This change contributes little to the sensitivity, its sole purpose being to place the image signal far enough away (4 Mc in the case of a 2 Mc IF) to allow the pre-selection stage to reject it.

SECOND CONVERSION

Having achieved this much, we then convert the signal again. This time it is to a frequency which favours gain and selectivity, as in a conventional superhet, and which may be anything from the usual 455 Kc down to 50 Kc.

Thus we no longer have to compromise with a single frequency, but choose each of the two to favour the otherwise opposing requirements. In short, we have our cake and eat it too! (Though not without some additional circuit complexity.)

And what has all this to do with our little converter? Simply this: If we select the highest possible frequency for the first IF (the IF which the converter itself produces), then we have in effect a double-change superhet and a worthwhile measure of the advantages already described.

Since the highest IF will be determined by the broadcast receiver in use, it is unlikely that we will be able to make this much above 1600 Kc, but this is still worthwhile. It will place our image 3.2 Mc away, a considerable improvement over the .91 Mc we can expect with a conventional dual-wave receiver.

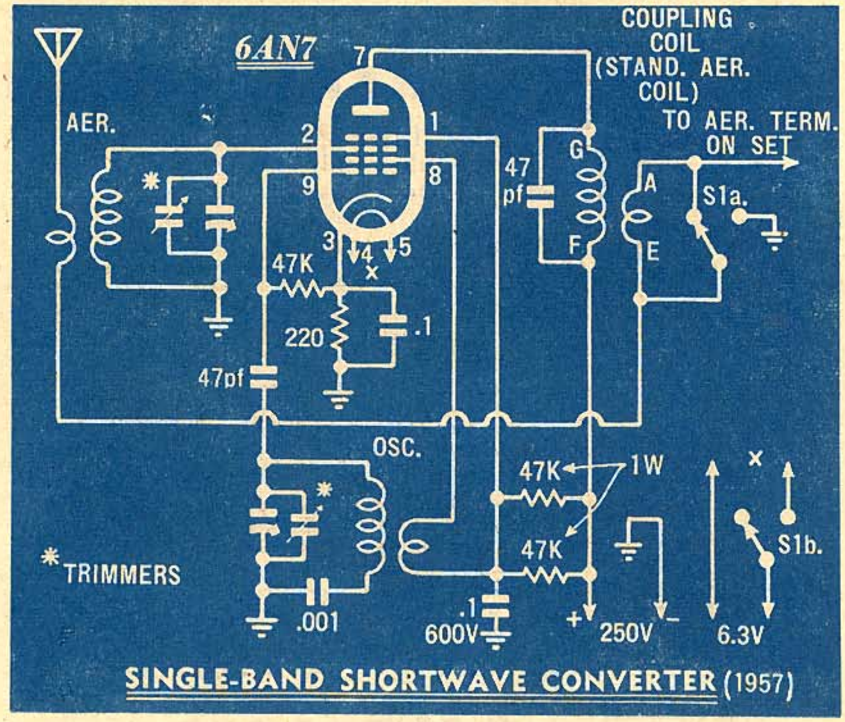
In addition, the converter valve in the converter will contribute some amplification, so that the overall gain of the system is also likely to be better than that of a conventional receiver, all things being equal. The improvement may not be staggering, but it is still worthwhile.

SIMPLE AND CHEAP

When we add to these points the fact that the converter is quite simple and relatively cheap to build, there is no reason why anyone who is interested should not enjoy satisfactory reception on the short-wave band. Even if you have only made a few simple sets before, there is no reason why you should not make a success of this simple unit.

The components used are all quite standard and readily available from most radio dealers. The valve is the miniature 6AN7, though others having similar characteristics would probably work as well. Filament and HT supplies for this are obtained from the main receiver, the amount required being small and normally within the limits of most sets.

CIRCUIT DIAGRAM OF CONVERTER



The circuit is extremely simple, being essentially the "front end" of a short-wave set. Note the simple switching system which allows the aerial to be left permanently connected to the converter and fed to the B/C set when required.

The tuning capacitor is a standard two-gang type, though there is no reason why one of the older, larger types may not be used if the additional physical size is not a disadvantage. Since it is proposed that the dial shall be hand calibrated, the gang does not even have to match this component in other than the purely physical sense. A trimmer capacitor is mounted on top of each section.

The dial itself is one of the smaller types originally designed for our KarSet and similar small sets. Although no short-wave glass is available for it, it is relatively simple to make up a suitable scale in place of this, as we shall detail a little later on.

The coils are hand wound on plastic pre-grooved formers, fitted with adjustable iron cores. In order to make things as simple as possible we have selected winding wires which should be quite simple to buy. In any case, the fact that the spacing of the turns is determined by the grooving of the formers makes the exact gauge of wire not particularly critical.

They are designed to cover the now virtually standard 16 to 50 metre (19 to 6 Mc) band. A major reason for the popularity of this band is the location of several A.B.C. short-wave outlets near the 6 Mc position and which are unavailable on the older 13 to 42 metre (23 to 7 Mc) band.

The coupling coil, or 1st IF transformer, is a standard aerial coil working "backwards". What is normally the secondary is connected in the plate circuit of the 6AN7, while the normal primary connects to the primary wind-

PARTS LIST

- 1 Chassis 6in x 4½in x 1½in
- 1 Panel 7in x 5in
- 1 two-gang tuning capacitor 415 pf approx.
- 1 Dial MSL/48 or similar
- 1 2-pole, 2-pos. switch. Series 20, type 22 or similar
- 1 Standard B/C aerial coil
- 2 Coil formers ¾in, grooved, with mounting bases and iron cores. Type GF/1 or similar
- 1 6AN7 valve
- 1 Miniature 9 pin socket

RESISTORS

- 2 47K 1W
- 1 47K ½W
- 1 220 ohm

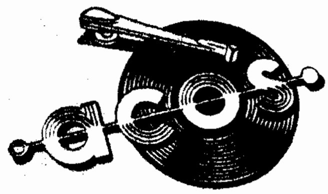
CAPACITORS

- 1 .1 mfd 600V paper
- 1 .1 mfd 200V paper
- 1 .001 mfd mica
- 2 47 pf mica
- 2 trimmers

MISCELLANEOUS

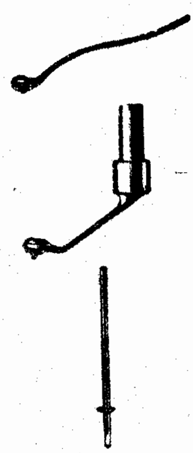
- 1 terminal
- 2 knobs
- 1 8 tag terminal strip
- 22g tinned copper wire (for coils)
- 5/.0076 hook-up wire (for coils)
- nuts and bolts, solder lugs, hook-up wire, grommets &c.

YOUR RECORDS DESERVE NOTHING BUT PERFECTION



REPLACEMENT STYLI

There is a correct stylus for each type of Acos pickup. Ensure that these only are used as replacements. All Acos styli are manufactured to rigid specifications.



SB-1 for standard 78 r.p.m. records.
SB-2 for microgroove 33⅓/45 r.p.m. records. Use with Acos G.P.19, G.P.27, H.G.P.35, H.G.P.39, H.G.P.41 and H.G.P.45 cartridges.

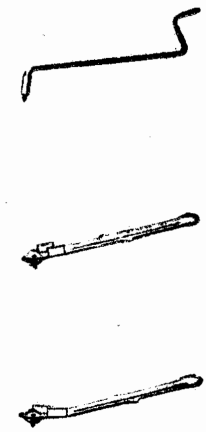
SC-1 for standard 78 r.p.m. records.
SC-2 for microgroove 33⅓/45 records. Use with Acos G.P.25 and G.P.29 series turnover cartridges.

SD-1 for standard 78 r.p.m. records.
SD-2 for microgroove 33⅓/45 r.p.m. records. Use with Acos H.G.P.33 series turnover cartridges and with Acos H.G.P. 33⅓/Garrard and Acos H.G.P. 33⅓/Collaro replacement pick-up heads.

SE-1 for standard 78 r.p.m. records.
SE-2 for microgroove 33⅓/45 r.p.m. records. Use with Acos H.G.P.37 series turnover cartridges and with Acos H.G.P.37/Garrard and H.G.P. 37/Collaro replacement pick-up heads.

SK-1 for standard 78 r.p.m. records.
SK-2 for microgroove 33⅓/45 r.p.m. records. Use with Acos G.P.59 cartridges.

SL-1 for standard 78 r.p.m. records.
SL-2 for microgroove 33⅓/45 r.p.m. records. Use with Acos G.P.61 cartridges.



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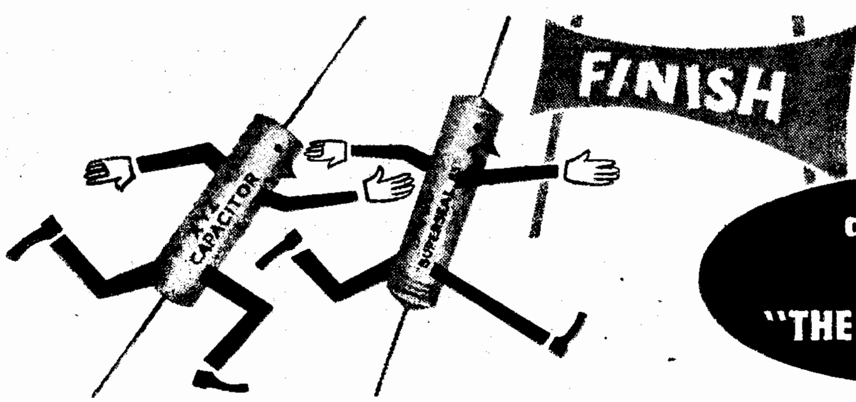

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ing of the broadcast receiver aerial coil. In this way quite a good match between the two units is obtained.

The new primary (G & F) of this coil is made to resonate at 1,600 Kc by connecting about 50 pf across it and adjusting the iron slug. Some makes of coil may be able to resonate with less additional capacitance, others may require slightly more.

Examination of the circuit will show a rather ingenious switching circuit which we have employed to allow a simple changeover from broadcast to short wave. The switch has two sections, one controlling the filament circuit, the other the aerial connections.

The aerial is left permanently connected to the converter and, when required for the broadcast set, is fed from the bottom of the short-wave aerial coil, via the switch contacts which short circuit the coupling coil, and thence to the broadcast receiver terminal. The small amount of inductance added by the short-wave coil is negligible at broadcast frequencies.

S/W POSITION

In the other position, as well as energising the valve filament, the switch removes the short from the coupling coil and earths the appropriate end of both the short-wave aerial coil and the coupling coil. This automatically connects the coupling coil to the receiver and allows the short-wave aerial coil to function in a normal manner.

The chassis and panel are quite simply constructed from a small piece of aluminium. We used 16g for maximum rigidity, but we feel that this was hardly necessary and that 18g would have been adequate, even allowing that the chassis is made without ends in the interest of simplicity. All the essential dimensions are given in the accompanying drawing.

The dial is mounted in what may be regarded as a normally "upside down" position, the turned over portion of the back plate resting on top of the chassis and being bolted to it through two holes already provided. This places the tuning knob on the left of the panel and the change over switch in the vacant hole on the right hand side.

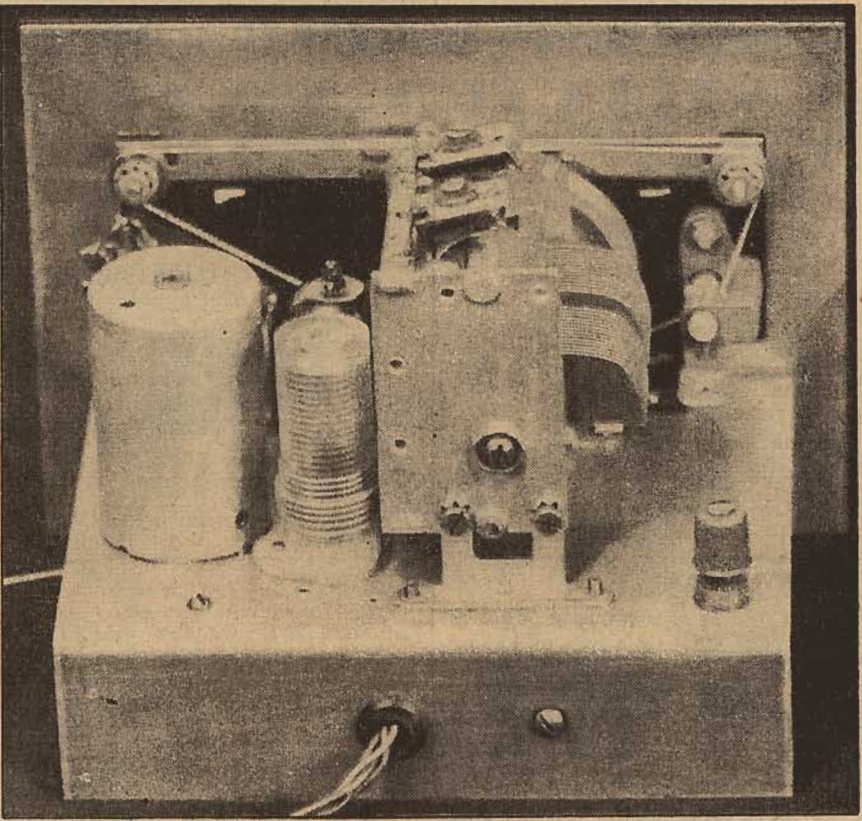
Take particular note that the retaining screw through the centre of the drum is only a temporary fitting intended to retain the stringing of the dial until such time as the drum is fitted to the gang shaft.

CHECK DIAL

It is also a good idea at this stage to check the stringing of the dial and make sure that there is no backlash or other mechanical defects, however minor, which might make for difficult tuning on short waves.

We made a dial scale from a piece of white card mounted in front of the regular dial glass. A slot in the centre enables the pointer to be seen against the black back plate, and calibration markings may be made both above and below it. It will be necessary to remove the existing markings from the dial glass, at least, behind the slot, and if you don't feel inclined to spoil the glass, it may be replaced with a piece of plain glass cut to the same size.

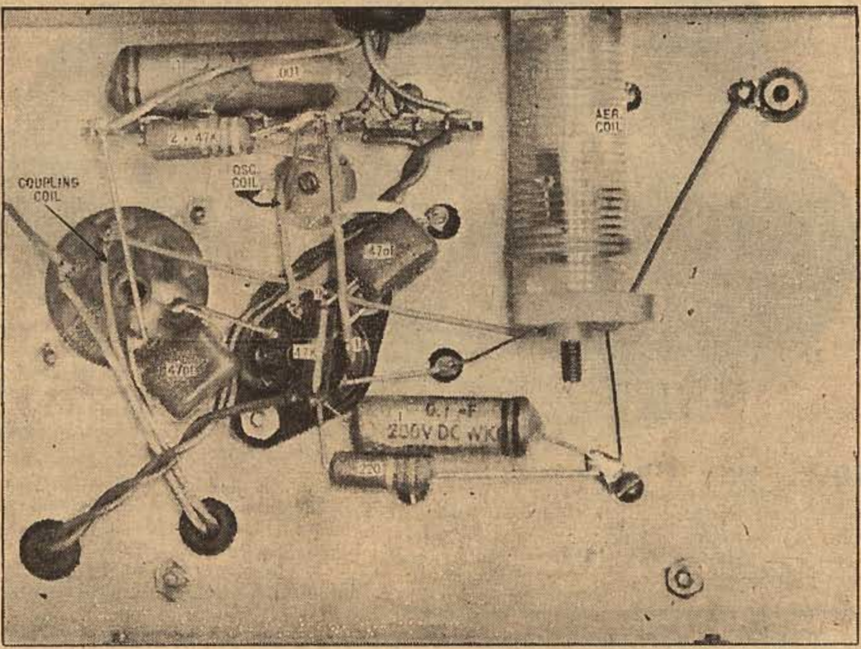
The two grooved coil formers used for the short-wave coil are both fitted with mounting bases and adjustable iron



The placement of the major components above the chassis is clearly shown in this picture. The oscillator coil is alongside the tuning capacitor, the converter valve behind it, and the coupling coil on the extreme left. Note the trimmers on top of the gang.

cores. The aerial coil is mounted underneath the chassis (see photograph) by the end opposite the base, the latter being retained merely to help terminate the leads and support the adjustable core.

The oscillator coil is mounted above the chassis alongside the rear (oscillator) section of the gang. In both cases the coil bases have four small holes drilled in them, approximately equally



This coded photograph shows the wiring and placement of the minor components underneath the chassis. The rear of the chassis is at the top of the picture. Note the mounting of the S/W aerial coil, and the underside of the oscillator coil near the tag strip.

spaced, and through which the coil leads are brought out. Each lead should be made long enough to reach directly to its appropriate connection in the circuit.

Bare tinned copper wire of approximately 22 S.W.G., was used for the secondaries, and very light plastic hook-up wire for the primaries. The use of this latter makes it easy to interwind the two sections, and the spacing is virtually automatic. The hook-up wire is classified as 5/.0076.

However, there is no reason why other types of wire should not be used, either enamelled or bare, provided that at least one winding is insulated. The same bare tinned copper wire could probably be used for both windings by encasing the primary wire in thin plastic tubing. The exact coil details are given in the accompanying panel.

TRACKING

The design of the coils and the value of padder are such that very good tracking is obtained when using 1,600 Kc, as the first I.F. Even if this exact figure is not used, the tracking will still be good, particularly when it is considered that the selectivity of the aerial tuned circuit is, by the very nature of things, not very high.

This situation is similar to that encountered in commercial dual-wave receivers where the aerial coil is normally designed to be fairly broad, and so simplify tracking problems.

The valve socket is mounted with the pin gap facing in the general direction of the gang, the exact orientation being indicated by the mounting holes. The coupling coil has the new primary mounted nearest the valve socket.

Near the rear of the chassis there is mounted an eight tag terminal strip. This serves to terminate the incoming filament and H.T. leads as well as support the .1 mfd. by-pass, the two 47K dropping resistors, and the .001 mfd. padder. The remaining few components are mounted directly between the appropriate circuit points.

Power may be picked up from the main receiver by any convenient means. If there is room a miniature four-pin socket may be mounted on the chassis and a matching plug fitted to the cable from the converter.

TERMINALS

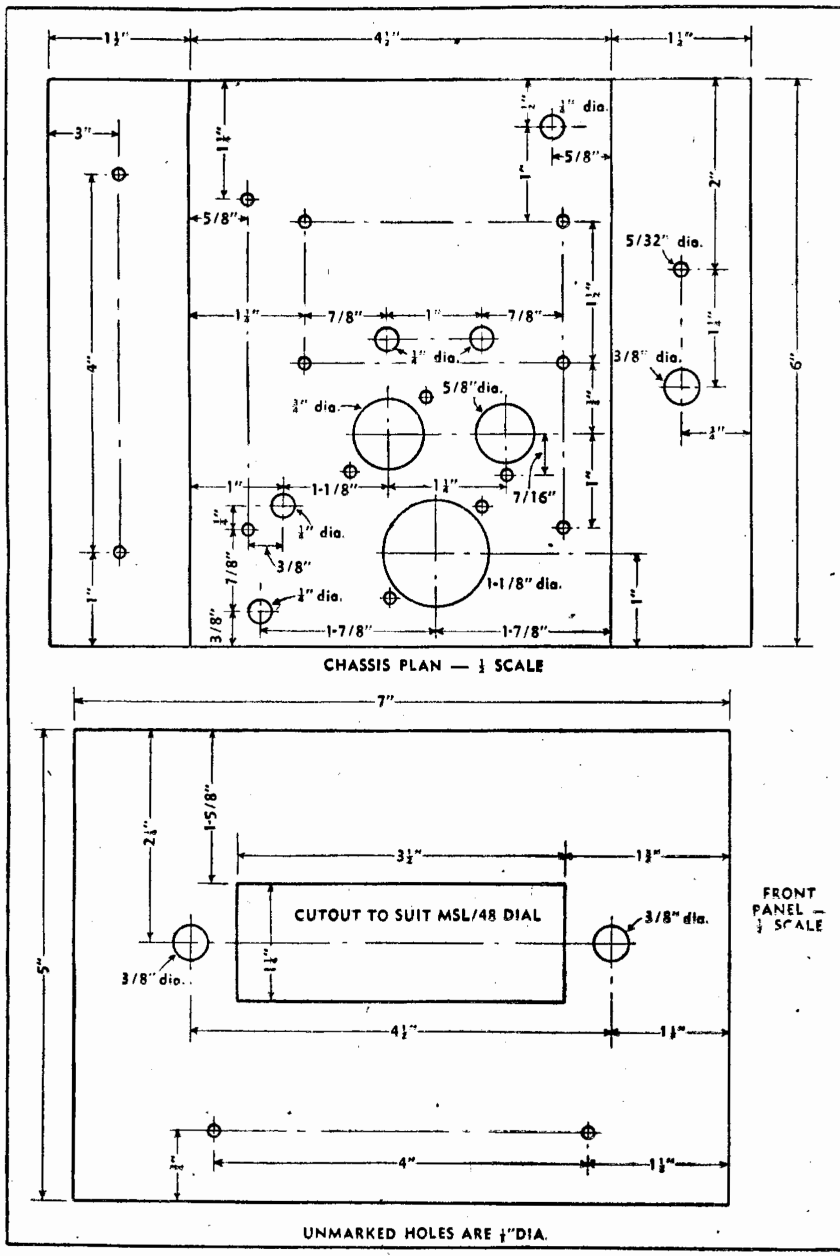
Alternatively, a set of terminals may be fitted, but remember that the H.T. on an exposed terminal can deliver a nasty shock to the unwary. While not so convenient, many readers will probably be quite content to solder the cable directly into the set, bringing it out through any convenient hole in the chassis.

When the unit is complete it may be connected up to the main receiver and given a trial run. It will help if a service oscillator is available to establish the correct tuning range, though it is by no means essential. In any case, it is a good idea to start with both the iron cores and the trimmers set in about mid-position.

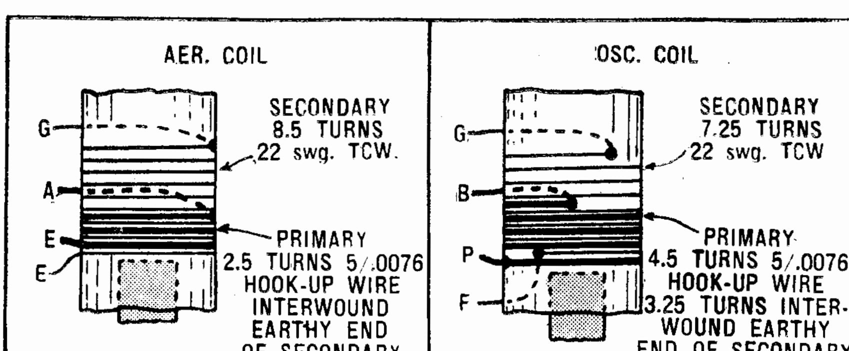
Tune the broadcast receiver to approximately 1,600 Kc, choosing a spot where there are no strong signals apparent, otherwise there is a risk of these getting into the system and mixing with the wanted signals. Also note that the converter should not be placed directly

(Continued on page 121)

DIAGRAM FOR CHASSIS AND PANEL



The chassis and panel are quite easily made using ordinary metal working tools as found in the average workshop. Material is either 16 or 18 gauge aluminium, and the chassis is made without ends in the interest of simplicity. Use the escutcheon as a template for the dial cut-out.



These diagrams give all the essential data for both coils. The gauge of wire is not particularly critical, due to the use of grooved formers and adjustable iron cores.

TV SERVICE AND AERIAL PROBLEMS

In a recent lecture before the Sydney Division of the Institution of Radio Engineers (Aust.), Mr. P. Kirkham, Chief Engineer of Dickson Primer Television Services Pty. Ltd., made some very interesting points in relation to the installation and servicing of television receivers and aerial systems.

MR. KIRKHAM said that there was much in favour of the scheme, now being widely adopted locally and overseas, of specialist companies handling installation of both receiver and aerial, as well as maintenance of the receiver during its life.

The set owner was saved the embarrassment of having an aerial installation company blame the receiver and a dealer-serviceman blame the aerial system for faulty reception — neither being willing to take corrective measures.

When a single company did the whole installation under contract to the dealer, it assumed responsibility for the whole job and did not—or should not—consider it complete until the best possible reception had been obtained.

In response to a question after the lecture, Mr. Kirkham said that a difficulty still arose in cases where a new receiver had picture aberrations, which might charitably be referred to as mere "peculiarities" of a particular model. Most frequent of these were non-linear scanning effects at the top or left-hand edge of the picture.

DESIGN LIMITATION

In such cases, there may be obvious difficulty in correcting a condition which the manufacturers themselves had been forced to tolerate.

In general, installation companies preferred not to remove the back from a new or nearly new receiver, in case it should weaken their claims on the manufacturer, if the trouble should become a point of issue or if others should develop within the warranty period.

They therefore preferred not to tamper with the receiver, confining attention only to adjustments which the manufacturer had seen fit to make accessible either at the front or the rear of the cabinet.

Failure after the warranty period and during normal service was a completely different matter, constituting a normal service call and requiring normal service procedure.

Mr. Kirkham said that Sydney was a very difficult city to cover with television signals, because of its rough topography, its deep harbour foreshores and its residential areas along the sea coast.

Much of the population, of course, was spread over flatter areas but a sufficient proportion was concentrated along foreshoes, etc., to provide a real problem for TV installation companies. In such cases, the provision of even reasonable pictures involved much experience, a survey of the particular site, the use of just the right aerial and the hard work necessary to get it permanently into position.

The greatest worry came from inland bays, where houses are sheltered on one side from the transmitting masts but look directly to the opposite cliffs, which face the masts. In such a case, the direct signal is very weak but reflections from the opposite foreshore are very strong.

If the reflected signals were unambiguous, as from a single structure, they could be used in preference to the direct signal. However, the signals from an opposite foreshore are always confused and give rise to strong multiple images which are quite intolerable.

The lecturer said that, in all his experience, he did not know of a single installation where such complex reflections were preferred to the direct signal, even though the latter was much weaker.

In all such cases, the installation company had to recognise the presence of a highly distorted wavefront and be prepared to make a survey of signal strength over the entire building and allotment and at all practical heights.

Nothing could be taken for granted under such abnormal conditions, even for sites which physically looked much the same.

Best results may be obtained in one case by putting the aerial atop a 40ft mast in the grounds. In another, best results may be obtained by keeping the aerial below roof height, using the direct signal available there and the bulk of the dwelling to shield the aerial system from reflected signals arriving from the opposite direction.

In such sites, it was not so much a question of obtaining perfect pictures but, rather, pictures which were acceptable as distinct from intolerable.

In view of such reception problems, it was most lamentable that the transmitting aerials, particularly for the two high frequency stations, were not on the one site. The distance between them, relative to nearby shadowed locations, was sufficient to cause further embarrassment.

It was also unfortunate that all three channels were not active for the whole day, since aerials could not be properly sited by guesswork on a missing channel and repeat calls were often entailed.

COMPLEX AERIALS

The one thing that could be assumed in difficult locations was that the aerial must have a high front-to-back ratio with minimum side lobes and the most successful types were therefore very complicated, even to the use of "stacked" elements on the higher frequency channels.

Simpler aerials, like conical fans, double-Vs, etc., while excellent for general use and well suited to Melbourne and its environs, were a poor choice for really difficult locations. Because of their compromise design and essential simplicity, such aerials had poor front-to-back ratio and side lobes which often admitted the spurious signals which it was desired to attenuate.

During question time, the lecturer was asked whether the use of high-gain aerials for directivity had led to overload problems in receivers due to excessive signal input; furthermore, whether such overload problems, if they did occur, had been related to specific types of AGC system.

In reply, he pointed out that this question was very topical at the moment, with Channel 2 having just gone on full power. It was undoubtedly true that overload was occurring in certain cases, particularly where gain on the lower frequency channel had been made too high in the first place.

Fitting an attenuation pad was not always an acceptable measure in such a case, because it often meant reducing Channel 7 and 9 signals towards the noise level before Channel 2 signals could be controlled properly. Failing the use of a frequency-conscious absorption pad, the correct approach would be to alter the balance of gain in the aerial to favour the higher frequency channels in a ratio of about 3:1.

As for any correlation between overload phenomena and types of AGC system, no conclusion had yet been drawn, though individual makes and models did show varying degrees of tolerances to very high signal input.

During the course of discussion, the lecturer said that the very aerials which gave best results in shadowed locations were also proving a good choice for fringe areas, where high forward gain and good front-to-back ratio were once again desired.

SIGNAL/NOISE RATIO

In this case, however, the performance of the aerial was judged primarily on its ability to give as much signal with as little noise as possible. Because of the long transmission path and the attenuation which any reflections are likely to suffer, multiple images are seldom a problem in such circumstances, the degraded nature of the signals in any case tending to obliterate second-order aberrations.

Commenting on feeder problems, the lecturer said that a certain amount of mismatch was inevitable but that a standing-wave-ratio of 2:1, for example, made negligible difference to the strength of the received signal. In his opinion, it was more important to achieve a reasonable match between the feeder and the receiver's input circuit, whose job it was to absorb the incoming energy without reflection.

In any case, one reflection cycle through a 50ft length of feeder would produce a delay equal in dimension to one picture element and it was doubtful whether this would be apparent under any conditions which obliged the use of a complex aerial and feeder system.

Mr. Kirkham said that much work re-

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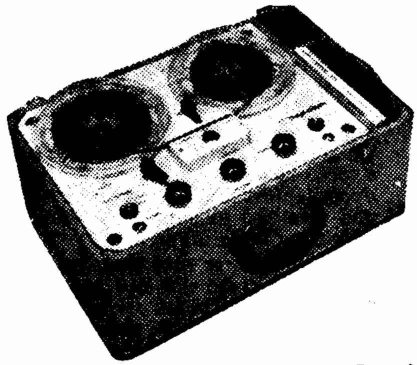

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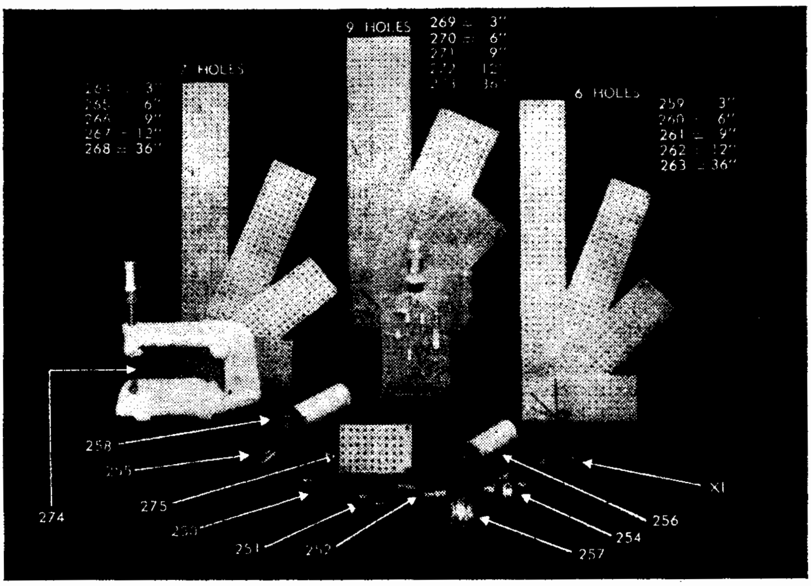

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mained to be done locally before the possibilities of long-distance TV reception could be assessed and amateurs might well contribute a good deal to any conclusions which might be reached.

It was clear that long-distance reception as, for example, Sydney-Newcastle, was affected by weather conditions and viewers were already predicting how TV reception would most likely be the following evening, by watching the barometer.

It also appeared that signals tended to be present along ducts, which varied in depth and height and which were seldom the same for Channels 7 and 9.

The best position for an aerial had therefore to be determined by averaging out results on different channels in different weather conditions.

STACKED ARRAYS

In some cases horizontally stacked arrays were the best choice, in others vertically stacked. Again, in odd cases, tilting the array upward by a few degrees helped, while there was also a suggestion that a position to give other than horizontal polarisation might help. All these observations were very tentative, however.

As distinct from Newcastle, the Sydney-Wollongong path over the coastal mountain ridge produced a most complex field strength pattern.

In some sites in Wollongong the field strength from one or more of the stations is comparable with that in a Sydney suburb. In other sites, apparently no less favourable, little signal is available. This promotes a good deal of argument and misgiving about the relative merits of typical commercial aerials and receivers.

On the subject of receiver servicing, the lecturer said that the average television receiver to date had required service calls at the rate of five per year. Analysis had shown that the service calls could be subdivided as follows:

Valve failures	0.80
Component failures	0.49
Accessible adjustments	0.21
Pre-set adjustments	0.94
Miscellaneous	0.73
No fault found	0.69
Antenna faults	0.61
Repeat calls	0.45
	4.92

Discussing these faults, Mr. Kirkham said that, considering the number of valves in a TV set and the onerous conditions under which they operate, their failure rate was gratifyingly low. Considering that most "accidental" valve failures occur early in service, it could be expected that the percentage of valve troubles would henceforth show a decline.

FAULTS MORE OBVIOUS

At the same time, everybody had to be prepared for more frequent valve replacements in television receivers than in AM broadcast sets. Whereas a loss of 3db gain is barely perceptible in a sound channel, the loss of 30 per cent in either picture dimension would be intolerable.

As contrasted with valves, the likelihood of failure in other components increases with age. The present rate of component failure is therefore inconclusive and their ultimate quality and influence on service calls will only become apparent as the receivers age and possibly with repeated humidity-heat cycles during the forthcoming summer period.

The figure for pre-set adjustments appears to be too high and calls for more careful control at the factory inspection and, perhaps, the use of circuits which are less susceptible to differences in mains voltage. Most of these adjustments relate to picture dimension and linearity.

At the same time, relevant calls, together with those listed under "no fault found" are aggravated by the current practice of TV stations radiating lengthy periods of test pattern. Minor peculiarities are made very obvious and calls have even originated from clients measuring the test circle patterns with calipers!

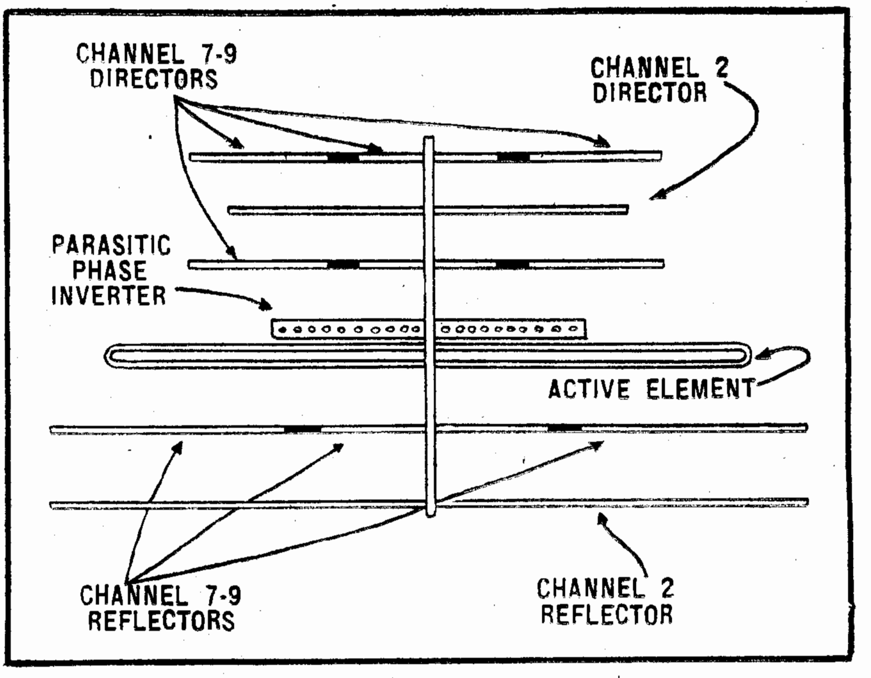
Other calls have been traced to the radiation by stations of patterns or programs containing known aberrations. It would help minimise unnecessary service calls if announcements or other indication could be given regularly that the transmission and not the individual receiver was at fault.

"Miscellaneous faults" include broken or loose knobs, dry joints and sundry mechanical troubles, all of which need to be eliminated at the factory.

Aerial troubles are also too high. Some involve troubles in the aerial itself but a great many are traceable to salt-spray fouling the 300-ohm feedline. Where repeated troubles of this nature threaten, the best approach appears to be to use 300-ohm twin shielded feeder.

According to the lecturer, the figures quoted above bear a close relationship to those issued for receivers in the United States during 1950. The figures there have gradually improved so that the current rate of service is about 1.5 per receiver per year.

If lessons and experience are applied locally to the same degree, it should be possible to achieve a comparable figure.



Illustrated above is a type of aerial to which Mr. Kirkham particularly referred in his lecture. On the low frequency band it operates as a 3-element Yagi with folded driven element. On the high frequency band, the driven element operates as three half-waves in phase, the centre element having its phase reversed by a special vane in close proximity to it. Six directors and three reflectors provide a stacked array on the high frequency channels.

SAWS AND PLYWOOD

When sawing plywood it is important to avoid unnecessary splintering on the working face, otherwise one may be faced with the tedious and time wasting job of filling and puttying before the job can be polished—to say nothing of the disfigurement to the finished job.

Plywood tends to splinter on the underside when the cutting stroke is in a downward direction—as when using a handsaw — and this should be allowed for when marking out the job. By keeping the working face on top the damage to it will be kept to a minimum.

The same remarks apply to most circular saws, bandsaws, and jigsaws which also cut in a downwards direction. However, most portable power saws cut in an upward direction, so that the material should be reversed when using one of these.

When working with the material inverted for the latter, check and double check your layout. It is all too easy to cut on the material side of the line rather than the waste side, thereby ruining a valuable piece of timber.

FROM THE SERVICEMAN WHO TELLS

There's no doubt about the serviceman's life—one never knows what type set will turn up next. One I had this month must be just about ready to qualify for membership in the Vintage Radio Club, while almost immediately afterwards I was puzzling over the problems of a TV set. It certainly keeps you on your toes.

First, however, I would refer you to the portion of a letter reproduced elsewhere, from Mr. B.M.B., of Indooroopilly, Queensland. Apparently Mr. B.M.B. has also encountered examples of the self-generating capacitors I mentioned a few months ago and gives his own theory as to why they behave as they do.

The theory is interesting to say the least, though I'm afraid my basic knowledge of the materials involved is too sketchy to enable me to comment on whether it is a reasonable one or not. Perhaps some other readers may have some comment on the theory, or some theories of their own.

FOLLOW UP

In the meantime I have been trying to follow up the original sample I described and which I passed over to one of our large capacitor manufacturers. Unfortunately it seems that the insatiable appetite of the TV industry is gobbling up capacitors at such a rate these days that no one can afford to take time off to investigate the matter on a proper basis. So we may have to wait until things quieten down a little before the answer is forthcoming.

And so to my case histories.

The Vintage Set was one of the old autodyne, 57-58-57, etc., combinations so popular in the early thirties and which, incidentally, are generally regarded as the first really satisfactory set for everyday home use. Prior to this the T.R.F. and the regenerative detectors had provided fine material for the fiddlers and out-and-out enthusiasts, but were far too critical and had too many limitations to suit the average man (or woman) without any technical background.

The superhet, on the other hand, had long been regarded as the answer to the problem, and the autodyne was the first practical version to do the job with a reasonable number of valves. When we consider that it offered a degree of selectivity and an order of gain previously only dreamed about, it is little wonder that both the manufacturers and the public went for them in a big way.

DEBIT

Of course there were some "catches" and, looking back, we are all too conscious of their limitations. Yet, by and large, they did a remarkably good job and the disadvantages were mostly minor.

(I trust my readers will bear with me in this mood of reminiscence, for I feel it has a twofold appeal. I have no doubt that plenty of old timers will experience a feeling of nostalgia at the mere mention of the period, while the younger generation will probably find more than a little interest in designs which were popular before they were able to appreciate such things.)

The particular set in this story turned out to be in a remarkably good state of preservation and the owner explained that it made a very handy second set for use in his workshop. While by no means high fidelity, it was still good enough to enable him to follow his favourite sporting broadcast etc., and he felt justified in trying to keep it going as long as possible. In the circumstances this seemed reasonable enough

OVERLOAD

His present complaint was very serious distortion on a couple of the local stations, which were relatively close by. He went on to explain that this seemed to be connected with the action of the volume control in some way, the signals being reasonably clear (though too loud) when the control was advanced, but distorting as soon as any attempt was made to reduce the volume to a reasonable level.

Further questioning revealed that the original control had failed recently and that there had been no easy means of establishing its value. Either there had never been any markings on it or they had long since been obliterated, there was no circuit available, and the control was so badly damaged internally that no one considered there was any chance of measuring it. As a result, it had been tossed out.

Dear Serviceman,

Your voltage producing capacitors in "R. TV and H." (August), while not totally unique, are interesting. I have noticed a colossal "dielectric remnance" on some odd capacitors, to the extent that a measurable voltage appears after the leads have been left shorted for several minutes, then opened.

It would seem quite feasible for some dielectric materials or impregnants to retain electrical "directivity" for long periods, partially, but not completely, analogous to permanent magnetism.

The value of 0.5 volt would be exceedingly difficult to produce even artificially, using the components found in a capacitor, on an electrolytic basis. Possibly you have ferreted out the answer by now, but I am inclined to favour the dielectric as the nigger in the woodpile.

(Signed) B.M.B.
Indooroopilly.
Queensland.

(In fact, it is generally possible to find the value by measuring what is left of the element and noting how much of the total it represents. This applies, particularly, to wire-wound types—as in this case—since they invariably have a linear law.)

Then, in the absence of any specific data, someone had suggested 10,000 ohms as being a good round figure which would probably work well enough in such a simple application, even if it wasn't exactly as in the original. So a 10,000 pot. had been purchased and fitted, the owner being sufficiently handy with tools to do the job himself.

Unfortunately things didn't work out quite as expected, the aforementioned distortion being distressingly evident. The owner immediately assumed that he had mixed up the connections, but was scared to try them any other way for fear of making things worse. The more he thought about it the more confused he became, finally seeking my aid in an effort to get the problem straightened out

CONTROL PROBLEM

At this stage, it might be worthwhile to consider some of the problems of controlling volume in these old-style sets. AVC had yet to be applied, but the prime requirement was still to protect the "front end" valves — particularly the IF valve — from overload. The usual arrangement was some form of bias variation on as many valves as possible.

In a TRF, both RF valves could be controlled and the degree of control was quite good and was further helped by the fact that the gain of the stages was not particularly high any way. With the advent of the autodyne it was no longer possible to control both stages, the "first detector" demanding that its operating conditions be left unaltered — so that it would not stop oscillating.

It was soon discovered that controlling a single stage was not enough, strong local signals being able to blast through, even when the valve was biased to virtual cut-off. What was worse, the signals were invariably distorted by this mode of operation.

A BETTER SCHEME

Then someone had a bright idea. By connecting a previously unused terminal on the volume control to the aerial terminal, it could be arranged that the aerial would be progressively "shorted out" as the bias on the IF valve was increased. Thus the volume was controlled at two points and was many times more effective.

However, the system was not without its snags. It was necessary to ensure that these two separate control functions were correctly balanced and each stage controlled proportionately, if maximum benefit was to be realised.

I imagined that something like this had happened in this case: the selection of a pot. valve "on spec." probably resulting

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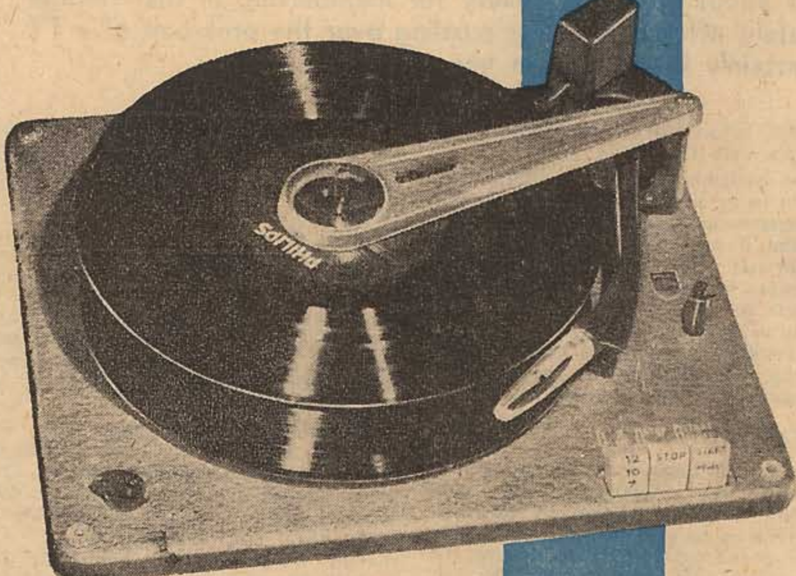

The new AG 1003 multi-function record changer combines a simple push button record changer with an automatic record player of completely new design. It incorporates the latest technical refinements for simplicity of operation and trouble free service. The unit is attractively finished in Gold Hammerloid with burgundy tone arm. The turntable is flock sprayed and effectively cushions the records and so avoids damage. Completely automatic, just load up to 10 records (all sizes of a similar speed intermixed) press the start button and forget. The unit cuts off after the last record and, of course, mutes the pick-up during the change cycle. The loading arm lifts off for automatic single play operation and the record can be placed directly on the turntable. Select the record size, push the start button and the arm is lowered safely and gently on the record with a precision not possible by hand. Push the stop button and the pick-up arm returns to its rest at the finish of the record and switches off.

- *Automatic Record Changer, Automatic Player and Manual Player in one unit.*
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- *Featherweight pick-up arm with detachable dual stylus pick-up head — Muting Switch.*
- *All record speeds: 78, 45 and 33⅓ r.p.m.*
- *No interfering rumble or wow.*
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240 VOLTS 50 CYCLES A.C.

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- *Featherweight pick-up. Twin sapphire Styli.*
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- *Position trouble free auto-stop with pick-up muting switch.*
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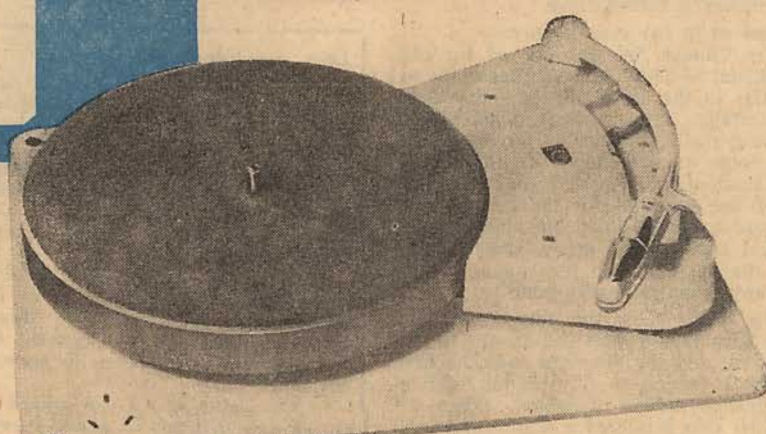

TYPE AG 2002 RECORD PLAYER

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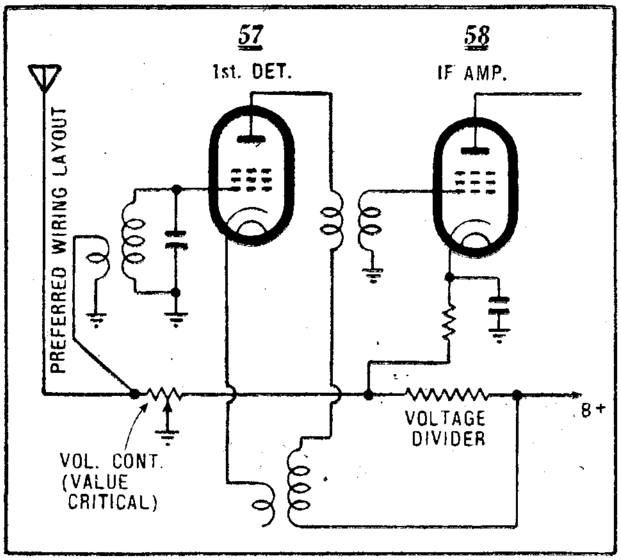
in one which was sufficiently off the mark to upset things.

I checked the set on the bench, confirmed that it was performing as described, and then set about tracing the relevant portion of the circuit, which is reproduced herewith. As can be seen, the volume control is really an extension of the voltage divider, the cathode returning to the junction of the pot. and the divider proper.

Since the moving arm is earthed, this junction becomes increasingly positive as the moving arm moves away from it, thus increasing the bias on the valve.

The other end of the pot. is connected to the aerial terminal and, as the arm moves away from the voltage divider, it moves closer to the aerial terminal, progressively reducing the resistance between this point and chassis. Thus the double-barrelled action is provided.



The relevant portion of the old autodyne receiver, showing the volume control circuit which operated in both the IF amplifier cathode and the aerial. If the potentiometer value is not correct the two control actions will not coincide.

NOT WORKING

Or, rather, it should have been. Since it was fairly obvious that it wasn't, I set about making some voltage checks to find out why. Using one meter to check the voltage at the end of the pot., I used another to measure the voltage across the valve's cathode limiting resistor. (Intended to protect the valve from zero bias operation.)

Since this voltage was dependent on the cathode current, it was a convenient indication of how this latter varied with the volume control setting. Varying the control was found to vary the current quite effectively, but it did not take me long to establish that the valve was virtually cut off when only about half the element was in circuit, leaving something like 5,000 ohms still between the aerial and chassis.

In the circumstances it wasn't surprising that the set distorted. With 5,000 ohms across the aerial primary winding (invariably at low impedance type in these old sets), the amount of attenuation at this point would be negligible, leaving the IF valve to do the whole job.

What was more important, however, was the fact that I now had a pretty good idea of the correct value of pot. to use. Since enough bias to produce cut-off could be developed across approximately half the 10,000 ohms resistor, it seemed logical to try a 5,000 ohm type.

I was fortunate in having one on hand and it did not take many minutes to fit it. The improvement was quite spectacular, it now being quite possible to receive the strongest local station without overload or distortion of any kind.

THEORY

It is not hard to understand why the lower value made such a difference. With it in circuit, there was only a very few ohms across the aerial primary coil by the time the IF valve was approaching cut-off, thus severely restricting the amount of signal reaching the first detector grid.

In turn, this limited the signal applied to the IF stage, and kept it within the limits imposed by the controlling bias. Thus it was not nearly so likely to drive the valve into non-linear operation, with the resultant distortion, cross-modulation, and other complications.

On the other hand, it would be entirely possible to select a value of pot. which was too low. If this happened, the major controlling factor would be the short-circuiting effect on the aerial and which would become effective before the gain of the valve was sufficiently restricted by the bias network. The result would be a very jumpy and erratic control of little real value in controlling strong signals.

As far as the set itself was concerned, there remained only one more thing to do, and this was more a matter of policy than strict requirement. This was to re-arrange the connections around the aerial terminal, volume control, and aerial coil. Long years of experience had taught me that there was some merit in taking the aerial lead directly to the pot. terminal, thence to the aerial coil.

This allows the aerial to be shorted more effectively than if, for instance, it is taken to the coil terminal and then to the pot. Admittedly, the difference may not appear to be important, but it must be remembered that the primary winding was invariably a low impedance type, and there were circumstances where this change could mean the difference between bad and passable results.

TOUCH AND GO

To be sure, the need to take such precautions would indicate that one was "battling against the wind," but this was frequently the case with these old sets, and many such tricks were considered justified simply because they worked in a particular case.

As it was, by making the change, I felt confident that the set would stand the best possible chance of working in a difficult location. Unfortunately, that was not the same as saying that it would work in any location, but at least I had done my best.

Let me just stress in passing that a 5,000 ohm pot. was optimum for this set. Others of similar vintage may require a different value by reason of a different voltage divider or circuit arrangement. In many sets, for example, the pot. was tapped across portion of the divider, a larger value then generally being required.

Jumping from the past right up to the present, I have another TV story. It is a little out of the ordinary, inasmuch as it is not the type of service job I go looking for as a rule, but it makes interesting reading and gives me an excuse to discuss the relevant portion of the set.

The set was the R.T.V. and H. 17in job. It had been built by an acquaintance (and very well built, too), and he was anxious to give it a final check-over and adjustment, as well as clear up one or two points about which he was rather doubtful.

As I say, this is not the type of job I go looking for, since it is seldom that one can recoup the time spent in terms of £.s.d. On the other hand, it was an opportunity to see what kind of a job the average home builder can make of a TV set, familiarise myself with some of the problems he is likely to encounter, and—most important—probably yield some copy.

Another factor which influenced me was the fact that the set was already working reasonably satisfactorily, producing pictures and sound of at least average quality. In the circumstances, I reasoned, there was not much chance of being caught with a really sticky problem. At the worst we would be no better off, while there was a possibility that some small improvements would result.

As we were setting the gear up on the bench, the owner explained that the thing which worried him most was the question of adequate drive to the line output stage. According to the original article (July, 1957), as well as various text-books, this was most easily judged by the appearance of a vertical white line in the centre of the picture when the stage was overdriven. Reducing the drive to the point where this just vanished would then be the optimum setting.

If the drive is inadequate, there are several undesirable side effects which can result. The most likely is a reduction in EHT voltage and reduced voltage applied to the EHT rectifier filament, which is reasonably critical.

In addition, there may be a reduction of B-plus boost, and this, if severe, could prejudice the deflection circuits and linearity.

COMPLEX ACTION

Finally, it will have a direct effect on the horizontal scan, though the exact effect is not a simple function. While the lower drive will reduce the scan, the resultant reduction in EHT voltage will tend to offset this by making the beam easier to deflect. Without more experience in the matter, I wouldn't like to say which effect would be predominant, though it seems inevitable that underscanning must occur eventually.

When I raised these points with the owner, he replied that he had no means of measuring the EHT except to note the length of the spark. As far as he could tell from this, and the set's general behaviour, it was at least reasonable. The B-plus boost was "spot on" at 500 and a few odd volts, but there was some

suggestion of overscanning, a problem which also had him rather worried.

The first thing I did was to set up the EHT probe in the VTVM and measure the EHT voltage. It measured a fraction over 15kV, but I had no means of knowing whether this was the exact value one should expect from this particular set or not. It was certainly close enough not to worry about, assuming everything else checked correctly, but as a precise value it didn't mean very much.

In this respect, it is perhaps worth commenting that such readings are, by their very nature, useful only in the light of the set's overall performance. For one thing, a tolerance of plus or minus 10 p.c. may mean a shift of 1,500 volts above or below the manufacturer's design-centre figure; which seems a pretty big variation, though it is perfectly acceptable.

To this must be added the inaccuracies of the probe, and high value resistors of this type are not easy to make in a form that will hold their accuracy over long periods. As a result, we must usually assume something less than the normal 2 p.c.

USES AND LIMITATIONS

All of which means that such devices are useful for showing when the EHT is nearer, say, 10 kV than 15 kV, but are not much use in picking a fault which may, as a secondary effect, shift the EHT by a mere 1,000 volts or so.

In this case, it seemed reasonable to assume that the drive was fairly close to optimum, even if it couldn't be taken beyond this point for some obscure reason. As far as the set's performance was concerned, we could probably have left it at that, but, like the owner, I was curious to find out just why the original performance could not be duplicated.

So we brought the C.R.O. into operation and commenced checking the waveforms around the line oscillator and output stage. All these, including the one at the grid of the line output stage, checked very closely with the published data in both shape and amplitude. In the light of this, I felt more certain than ever that the stage was receiving adequate drive, though only just, and with nothing to spare.

The question was: Why?

We went over the drive and output stages step by step and component by component, measuring or substituting any which were likely to affect the drive. We drew a complete blank, everything appearing to be well within normal tolerances and not even the complete removal of the drive control capacitor would induce the white line to appear.

WIRING CHANGE

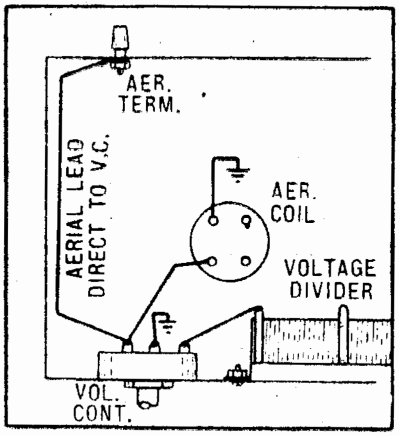
Then the owner made a suggestion: "When I was wiring the EHT cage, I followed the written instructions in the article as far as possible, mainly to help place the parts correctly. Maybe I misread it, but I took it to mean that the 6B6Q screen by-pass should return to earth, and I wired it that way.

"Later, when I checked the circuit, I found that it returned to cathode, but I didn't bother to change it. It seemed like too much trouble, and I was anxious to get some pictures on the screen. Anyway, I didn't think it would make much difference."

Taking another look at the circuit, I had to agree that I couldn't see any immediately obvious reason why **this** change should matter. At the same time, I suggested that it might be best to conform to the published circuit, if only for the sake of uniformity, while there just might be good reason for the circuit being as shown.

The earth connection of the by-pass wasn't easy to reach, but we eventually unhooked it and made a temporary connection across to the cathode. Then we switched on and waited for the picture to come up. When it did, my immediate impression was that there was still no white line, but a closer inspection showed something vaguely like it.

Switching to a blank channel and advancing the contrast slightly put the matter beyond doubt. The white line was there, all right, faint, but quite unmistakable. Further proof, if needed, was provided when the owner adjusted the drive control and the line came and went exactly as predicted.



This layout shows how the aerial side of the potentiometer would be wired for most effective control. Other arrangements allow less effective "shorting" of the aerial and may cause overload in very strong signal areas.

Finally, to prove that this change was, in fact, responsible, and that we had not overlooked the line previously, we tried the capacitor back on the chassis connection again, whereupon the line vanished and no setting of the control would produce it. However, it reappeared immediately the cathode connection was restored.

THE REASON?

After one or two other minor adjustments had been checked the set seemed to be working particularly well and the owner took himself off in a very happy frame of mind.

After he had left, I took another look at the circuit and began trying to fathom out why the return of the screen by-pass had produced the marginal difference in drive. At first glance the tendency is to suppose that the cathode is adequately by-passed, is therefore at chassis potential at the relevant frequencies, and that there would be no difference in either connection.

The probable fallacy in this assumption seems to be that the cathode is really at chassis potential. It is more likely that there will be a small amount of degeneration present (a .25 mfd has an impedance of approximately 40 ohms at 15,000 cps), and with the screen returned to chassis, this will appear in the screen circuit. Of course, there are lower frequency components present in the sawtooth sweep and the impedance at these lower frequencies will be greater.

Which brings us to one of those fundamental truths which are so often overlooked in practice: The fact that the screen of a valve should, by rights, always be returned to the cathode, rather than to chassis, since the cathode is the reference point for all the signal voltages.

In ordinary radio practice it seldom matters, partly because it is generally not hard to provide adequate cathode by-passes and partly because any slight degeneration is not particularly important, anyway.

Horizontal output stages are in a somewhat different category, the amount of power required being such as to justify designing the stage for maximum economy, consistent with performance. In these circumstances, it is not hard to appreciate that it may be necessary to watch small points like this.

CRITICAL VALUES

It might be argued that the correct thing to do is to provide an adequate cathode by-pass in the first place, but this is not necessarily a valid assumption. While I have no specific information on the subject, it might well be that the value of cathode by-pass was deliberately chosen to help maintain a particular characteristic, linearity being one that immediately springs to mind. The point seems to be that the circuit, as published, works.

All in all, I felt that the time spent had not been entirely wasted. Apart from being able to help a fellow enthusiast, I had scored some copy and, above all, become far more closely acquainted with some of the finer points of line output systems than I was before.

And, believe me, these "finer points" are going to come in mighty handy from now on.

TV QUESTIONS AND ANSWERS

During the past few weeks, we have collected together a variety of questions which have been put to us, relative to home TV construction. Since this is a subject of prime interest at the moment there is a good chance that these questions plus the answers will be of assistance to other readers.

by Neville Williams

MANY of the questions relate directly to the "R. TV and H." 17-inch receiver, described in the May-August issues, but many others are of a general nature.

The first three or four, in fact, are from a reader who is apparently trying to build up a set which is a composite of many circuits and ideas. Apart from their immediate interest, the questions are indicative of the troubles which can be encountered by someone who elects, at this early stage, to leave the "beaten track."

Q: With the video detector in the "R. TV and H." receiver connected in the prescribed manner (cathode IF, plate to diode load) the rectified signal is negative in sign, resulting in a negative image on the picture tube. The only way I can obtain a satisfactory picture will therefore be to reverse the diode connections. Is this corerct? (G.C.).

A: You will have to revise your thinking on this point. There is no basic error in the circuit and we can assure you that the "R. TV and H." 17-inch receiver gives a first-quality, positive picture. Here's why:—

Current flows through the diode only when the cathode swings negative. The flow of current carries the plate toward the cathode potential, which means that the plate builds up a negative voltage across its load resistor and bypass. This negative potential can be filtered and used directly for AGC purposes.

Because of the negative modulation characteristic used in Australian transmitters, greatest carrier power is developed for black and infra-black signals. With the diode connected as specified, the detector therefore delivers high negative output when black and infra-black signals are being received.

The peak-negative signal voltage is inverted by the video amplifier to become peak-positive on black and infra-black. Applied to the cathode of the picture tube, a positive signal diminishes the beam intensity as required, to produce a dark area in the picture. This is what is required to produce a positive image.

* * *

Q: Because of the above, it would be necessary to wire a second diode to obtain AGC and I am loath to do this (G.C.)

A: This assumption is wrong, as is your analysis of the original circuit.

Our tip is that, in changing things around, you have removed AGC from the tuner and IF amplifier. The positive image you now see is probably an inversion, due to overload of an already inverted image, due to your own circuit modifications.

In other words, you have things properly tangled up.

If you revert to the original circuit, most of your difficulties should clear up.

The simple AGC circuit in the original receiver will handle strong, but not excessive, input signals. We have tested the prototype in an area similar to yours without trouble. However, if there is evidence of overload and you are sure that the AGC is working as intended, check the receiver on a more modest aerial, say a simple dipole.

We gather that you have built your IF channel around 6AC7 valves instead of those specified. A 4-stage channel using 6AC7s would have excessive gain and may be difficult to control with any system of AGC, let alone a simple one. Even a 3-stage channel, as used in our 5-inch receiver, has plenty of gain using these valves.

* * *

Q.: I am unable to avoid a spot appearing on the screen after switching off the receiver. As a temporary expedient, I can control it by running the cathode intensity control back to the B-plus boost voltage. I am using an MW43-69 tube with low impedance deflection yoke, matching line output transformer, EHT transformer and frame output transformer. The circuitry, picture tube connections, synch. separator and line and frame oscillators are practically the same as the "R. TV and H." circuit. The tubes are 6CK6, 12AU7, 6SN7GTA and 6BM8. (G.C.)

A.: In the original receiver, no provision was made for blacking out the trace on switch-off, because no provision was necessary. The trace disappears within one second of the switching operation, provided the receiver is simply switched off without touching the brightness control.

We have not as yet done any work with the group of components you mention, and therefore cannot comment from experience on the likely ramifications of their use. It may even be that the persistent spot has to do with some time constant in your amended circuit.

It was to avoid the possibility of such complications that we advised readers in very positive terms to follow strictly the original design.

All considered, with a commercial tuner, a modified IF channel, a different video amplifier, different selection circuits and a different picture tube, there isn't much of the original design left. You're simply in the throes of developing a new receiver altogether. The result may be very good, but the difficulties can become rather discouraging.

Incidentally, your reference to a 6BM8 is intriguing. This is a triode-pentode, and any attempt to use both sections, without allowing for the additional 180-degrees phase shift, would produce a negative picture. Could this be where some of the trouble lies?

* * *

Q.: I have noticed a peculiarity with the contrast control. Fully shorted out, there is less contrast than in some intermediate positions. Again, with the full 500 ohms in circuit, the contrast is well down. (G.C.)

A.: This, too, is likely to be a by-product of the difficulties just discussed. The operation of the control should be continuous and smooth.

In strong signals areas, or with large high-gain aerials, the contrast control will normally operate with nearly all resistance in circuit, giving minimum video gain. We have yet to find conditions where the maximum-gain setting was required or even useable in the original "R. TV and H." receiver.

The video circuit is so simple that there is little chance of making an error. The most likely complication is instability at full gain, which is generally the result of long leads unwisely placed. If the lead from the sound trap to the contrast control is suspect, it can be run in a short length of LOW CAPACITANCE shielded cable.

In any case it is wise to earth the contrast control at a point near the video amplifier rather than near the potentiometer itself

* * *

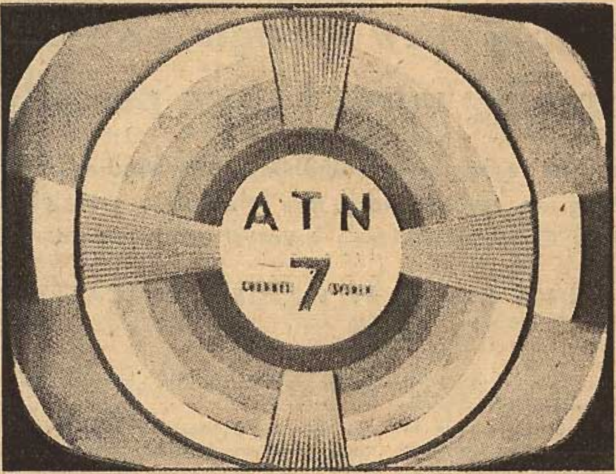
Q: Can the "R. TV and H." 17-in receiver be modified to take a 21-inch picture tube? If so, can you supply a circuit for same?—(C.O.).

A.: To answer this question we have to "beat the gun" somewhat. The original 17-inch receiver was designed with a view to use a 21-inch tube and, in fact, the same layout, the same chassis and the same general circuitry would serve. Thus, it should be possible to follow the original design in respect to tuner, I.F. system, video amplifier, audio and power supply.

(Continued on Page 53)

Here is a typical test pattern as it would appear on a perfect television receiver. The circles would be regular and graded from black through three shades of grey to white. The black-to-white and white-to-black areas on each side would be sharply divided, without smear or ringing. The vertical and horizontal wedge would be completely resolved.

In practical receivers, some irregularity of the circles normally has to be tolerated, the effect being much less noticeable on ordinary program material. The main fault with this picture is that it lacks brightness, as evidenced by the fact that there are large areas of black and the whites are resolved as light grey Advance brightness control.



This image shows just the reverse fault to the preceding one. The white areas are very white, the light greys are almost "washed out" and the black areas are mid grey. Excessive brightness reduces the effective contrast, fatigues the eyes and may also give the impression that the picture is flickering. Reduce brightness till white areas cease to dazzle.

Here is a true case of insufficient picture contrast, evidenced by the fact that there is insufficient relative difference between black and white. There is neither black nor white in the picture. Advance the contrast control, readjusting the brightness, if necessary. If insufficient contrast cannot be obtained, a better aerial system may be required.

In this image dark grey has merged into black and light grey has become white, leaving only a single mid-grey tone. The contrast is excessive and the contrast control should therefore be turned back to restore the full range of tones. If contrast cannot be reduced further, the signal input from the aerial may be excessive, requiring modification.

A pattern like this indicates loss of horizontal hold and is normally corrected by adjusting the horizontal hold control. Try to find a setting which is satisfactory for all Channels. If horizontal tearing persists, it may indicate a fault in the relevant circuits. In some cases, horizontal tearing will occur if excessively strong signals are fed to the receiver.

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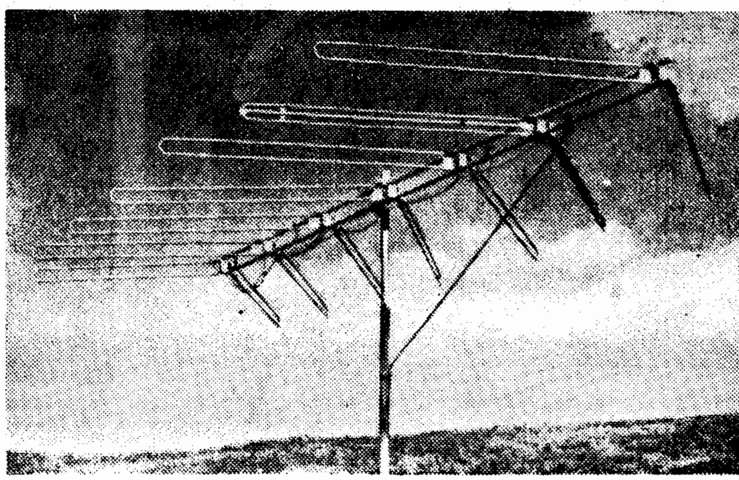

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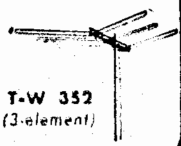
T-W 351 *(5-element)*



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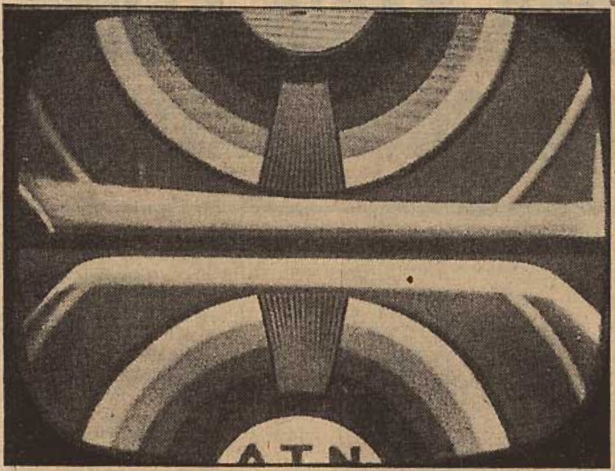
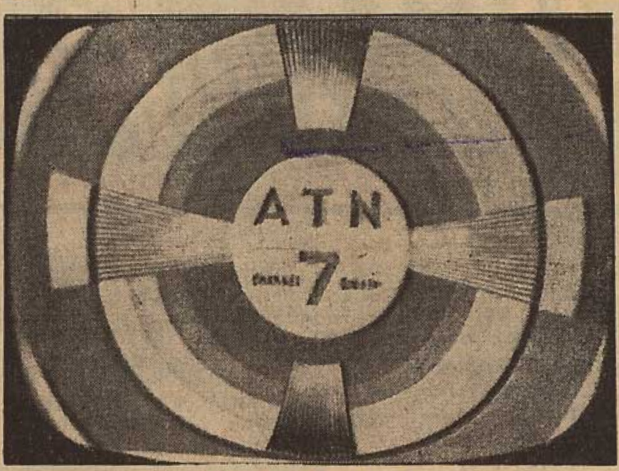
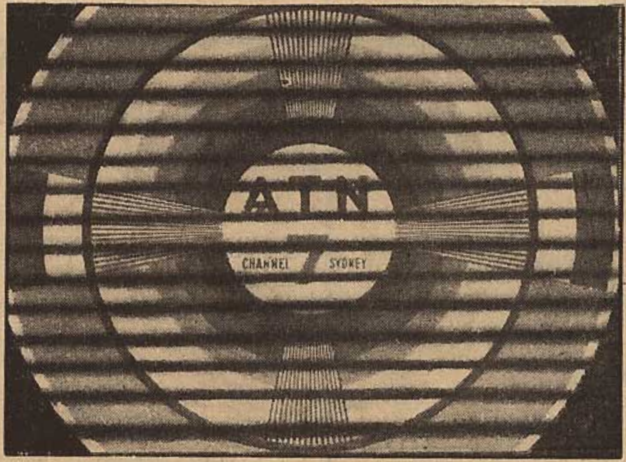


A picture which is divided as shown, or which rolls or flicks in a vertical direction indicates loss of vertical hold. Readjust the vertical hold control until it locks into position. If the picture rolls on changes of scene, &c., the hold control may be a little off its optimum adjustment. Try a new setting a fraction of a turn from the original.

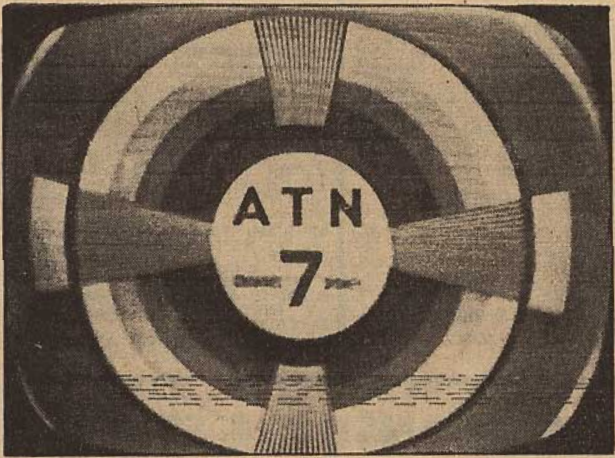


If the fining tuning is set too close to where sound breaks up the picture, the line structure may break up into tiny serrations, due to modulation by the 5.5Mc intercarrier beat. Fine detail in the wedge patterns may also be modulated in sympathy with the sound being radiated. Readjust the fine tuning control till these effects disappear.

A picture which lacks contrast and which is marred by erratic white, dots indicates lack of signal input to the receiver. The white dots are due to internal receiver "noise" and the effect is often described as "snow". It is a normal condition in fringe areas but elsewhere may indicate a fault in the aerial system or an inadequate aerial system. Seek technical advice.



Light and dark streaks which seem to flash over the picture in time with the sound are due to sound interference with the picture. The effect can often be avoided by setting the fine tuning a little further away from where sound actually breaks up the picture. Sound streaks which persist despite tuning adjustment probably indicate a fault in the receiver, requiring attention.



Erratic black dots or streaks across the picture are generally caused by external electrical interference, notably from auto ignition systems. In poor signal areas adjacent to highways, some auto interference may be inevitable but it can often be minimised by installing an aerial giving vertical directivity, preferably on the side of the house remote from the highway.

One of the most persistent troubles in TV reception is "ghosting", due to the reception of signals reflected from prominences adjacent to the receiving location or the signal path. Indoor aeriels are very prone to ghost image effects and the trouble can usually be minimised by installing an outdoor aerial, directed towards the station and away from the intereference source

(Pictures on this and the preceding page are reproduced by arrangement with Ferris Bros. Pty. Ltd.)

Present indications are that the same vertical deflection components could be used but employing a 6CM7 valve in preference to the 12BH7. The same line oscillator would serve, but the contents of the E.H.T cage would be different —a new line output valve and transformer and modified circuitry surrounding them. Needless to say, a 21-inch picture tube would have to be bought, plus a 90-degree yoke to go with it.

We plan to build a 21-inch version as soon as possible and to work along the lines indicated. However, until we can do the practical work and try out various circuit arrangements, we cannot be more specific.

In the meantime, it would be a good thing to make sure that you want a 21-inch set, because it is not automatically a better proposition just because the screen happens to be larger.

Viewed too close by a person with normal keen eyesight, the line structure and general graininess of poor program material can be rather annoying on a too-large screen.

* * *

Q.: In your observations and corrections listed on pp. 64 and 65 of the June issue, you mention two capacitors in the "12AU7 grid circuit" as being badly printed and suggest the value as .01mfd. There are two blurred values in my issue in the frame integrator circuit. Are these the capacitors to which you refer?—(K.G.)

A.: You're quite right, K.G. The capacitors are in the frame integrator circuit. In the rush to get the article through we inadvertently typed "12AU7 grid" instead of "12AU7 plate" circuit, which would have been correct. The figures appear in the new circuit drawing published in the August issue.

* * *

Q.: I live in what is virtually a fringe area. Could you give me advice about the use of keyed A.G.C., as it will probably be necessary.—(K.G.)

A.: Anything we have to say about the use of keyed (or gated) A.G.C. will have to come as a major article — when it can be tackled. However, your inference that a special A.G.C. system will assist in fringe areas must be questioned. The type of A.G.C. will not affect the initial sensitivity or signal-to-noise ratio and therefore the ability of the receiver to perform on weak signals. The value of keyed A.G.C. could only be to level out variations in signal strength more effectively if there are any fading phenomena to cope with.

Commercially, the real value of keyed A.G.C. lies in its ability to cope with a wide variety of signal conditions, allowing a given model receiver to be used in weak signal areas, where not much A.G.C. action is required, or in very strong signal areas where a simple A.G.C. system may be hard put to prevent overload.

It may well be that some form of augmented or amplified A.G.C. will ultimately be preferred because keyed A.G.C. has its own problems.

* * *

Q.: I have a compact commercial television receiver capable of being carried around in a car. I also have an inverter unit capable of operating it from the car electrical system so that I could easily enough take the receiver with me to local picnic spots, etc. The problem is the aerial. For weak signal areas could I use a small convenient aerial and rearrange your TV tuner to act as a preamplifier? (E.J.)

A: Without commenting on the wisdom or practicability of your scheme, we can only admire your enthusiasm for television.

Technically, we are not at all enamoured with the idea of adapting the tuner as a preamplifier.

The problem in a case like yours is not merely one of gain, but also of signal-to-noise ratio. Extra gain may be useless if it means introducing or amplifying noise in the same ratio as the wanted signal.

Most commercial tuners use a cascode RF amplifier and have the best signal-to-noise ratio that their designers have been able to achieve, aided by special switches, turrets and the like.

In the original "R.TV and H" tuner, a pentode RF amplifier was used, together with a conventional switch and an essentially simple circuit arrangement.

While it performed very well—and is still doing so—one could not suggest that the merit of its RF stage would be equal to that in a fully engineered commercial tuner. Therefore, to use such a stage or two stages in the similar arrangement could not but deteriorate the signal-to-noise ratio.

The use of "Signal Boosters" has received a certain amount of publicity overseas, but many of them could easily suffer the same condemnation.

In other words, it is scarcely worth considering the construction of a signal booster unless you know beforehand that you can build one with useful pass-band and gain and a signal-to-noise ratio that will equal or surpass that in your present tuner.

One highly efficient RF stage would be of more value than two poor stages. In fact, two poor stages could be a liability, quite apart from problems of bandpass and stability.

It may be a lot easier to look again at your aerial problem, as it is much more likely to be productive of results.

* * *

Q.: I live in what might be called a remote fringe area, but am sufficiently keen on television to go to any reasonable trouble to get pictures. What set do you recommend? Would a preamplifier help? Can I build some special kind of high gain aerial? (C.W.)

A.: Our answer to the previous question should answer yours re the preamplifier. Unless you are prepared to tackle the design and construction of a preamplifier in the same painstaking way as a "Ham" on the VHF bands, no great benefit will be realised.

As regard the best type of receiver, we are not in a position to make any recommendation. If we were in your position, we would make as many enquiries as we could about the performance of receivers in service in fringe areas, in an effort to establish types that seem to be good, and those that appear to be the reverse.

Your local dealer may be able to get you a few pointers on this, provided he isn't prejudiced by being tied up to one or two particular brands.

In regard to the aerial, it is possible to buy or to build types having higher gain than usual, although we can't supply specifications at the moment.

Quite frankly, however, if it is a "touch and go" whether you can get signals at all, we would seriously consider putting up two or even three separate aerials, specifically cut for individual channels and each with separate feeders.

It may sound clumsy at first recital, but three separate Yagi aerials, folded dipole, reflector and director would not represent excessive bulk, and would be free of the compromises necessary in a multi-channel design.

They could be placed one above the other, a couple of feet or more apart, with the highest frequency channel on top. You may even be able to obtain useful directive qualities in a vertical direction by experimenting with the vertical spacing.

At the receiver end, a simple plug with three sockets would allow easy change from one aerial to the other.

Some would-be viewers in fringe areas use multiple aerial arrays, stacked either horizontally or vertically, according to which seems to give best results in their district. Stacked yagis for three separate channels get rather bulky, however, and the preference is to stack two commercial high-gain, all-band arrays in the fashion and at the height which gives best all-round results.

* * *

Q: I have successfully completed the 17-inch receiver which appears to be going well. The picture locks properly and remains very steady. One thing that has me puzzled is that it seems to flicker at times, an effect that I have often noticed in commercial sets. How can one overcome this? (L.S.)

A. Simply turn the brightness down a trifle, L.S., till the flicker effect disappears.

The flicker you see is the fundamental picture repetition rate of 50 per second, which is the same for all transmitters and receivers in Australia, in England and in many other countries. It is just a trifle above the picture repetition rate of 48 per second, used in movie theatres.

This picture repetition rate is sufficient to give the illusion of movement without perceptible flicker to the average eye at average picture brightness.

However, not everybody is blessed with "average" eyes and some are much more sensitive to flicker than others. The sensitivity to flicker also varies with the angle at which light strikes the eye.

Some people can notice the 100-cycle flicker from fluorescent tubes, which happen to be to one side of the field of vision. Some are disturbed by the 48-cycle flicker from black-and-white films in theatres using high intensity arcs and highly reflective screens. The 50-cycle picture repetition rate for television pictures is just another potential source of annoyance.

Irrespective of one's sensitivity, however, the flicker sensation is dependent on brightness and for any given repetition rate there is a brightness threshold above which it will be noticed.

In other words, the problem of flicker is one of physiology, transmission stand-

(Continued on page 55)

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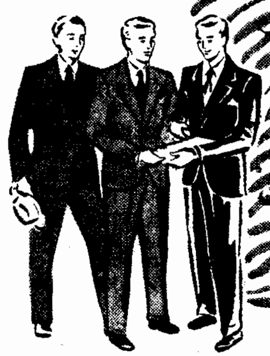

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ards and, to a lesser extent, viewing conditions. It has nothing to do with receiver design. If it is a worry, when viewing television, avoid using excessive brightness and experiment with ambient light and degrees of picture contrast which give the most comfortable overall viewing.

It is interesting to note, in passing, that flicker is much less of a problem in the U.S., where the picture repetition rate is 60 per second instead of 50 per second. This divergence of practice has its own problems in other directions, but that is another story.

★ ★ ★

Q: Would you recommend the "R. TV and H." Fan Aerial as being suitable for use in a fringe area?

A: The fan aerial was not expressly intended for DX use but rather as a good general-purpose aerial for use around the outer suburbs. We have had many enthusiastic reports on it in this role and we have heard of one reader who is making them up as a spare-time venture and installing them underneath tiled and slate roofs, allegedly with good results.

Quite recently, we did have a report from the reader at Kiama, which is 100-odd miles from Sydney on the N.S.W. south coast. He reported that the "R. TV and H." aerial did as well as if not slightly better than a typical commercial aerial sold in the district, but best results were obtained from the two operating together as a stacked array.

As we have stated elsewhere, the results from any given "compromise" design will not equal those from separate aerials of the same style but cut for specific channels. Thus, we would expect stacked multiple Yagis to be better again than the two types just mentioned. But the matter of practicability has to be considered, and most people are happy to settle for the smallest—and cheapest—aerial system which will give them acceptable pictures.

★ ★ ★

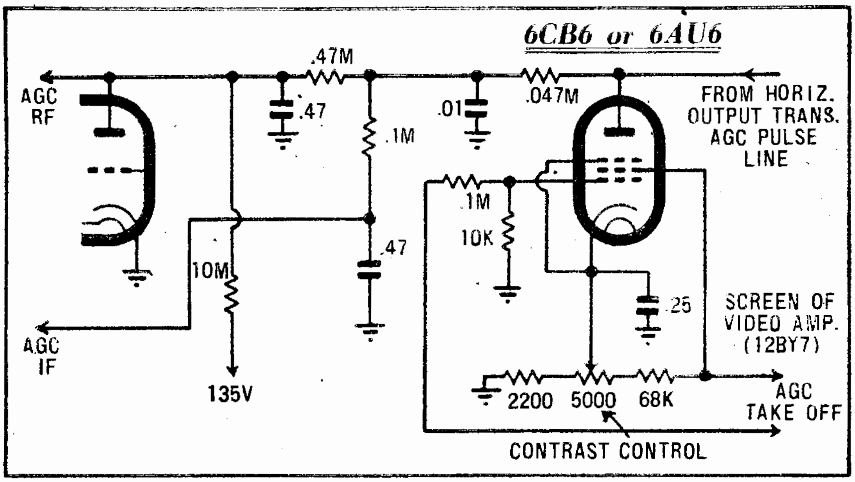
Q: I plan to make up my own video strip, winding my coils on standard 455 Kc. transformers and using the existing 455 Kc. slugs. I am making the cans myself and am omitting the normal inductive elements. Will all this work out properly at the higher frequencies involved? (J.R.)

A: Much as we would like to do so, we can't answer this question with a simple yes or no. If they are standard small IF transformers, there is no obvious reason for you having to make your own cans. If they are the larger type, then the chances are that the former size will not be as specified and this will affect the whole design of the coil.

The original specifications were for a specific size of former, screw-cut internally to take a slug. Any variations from this would involve a variation in the number of turns, etc.

IF coil cans are normally pressed from aluminium, which would not be possible for a home constructor. You might get away with cans from zinc or brass or copper, but beware of the effect of iron or steel cans in any guise.

We cannot follow what you mean by the normal "inductive" elements. You may have in mind rings of iron-dust



A circuit was given on page 99 of the May issue which could serve as a guide for anyone wishing to add keyed AGC to the "R. TV. and H." 17-inch receiver. Experience has shown that rather better operation is obtained with the constants as above. (See text).

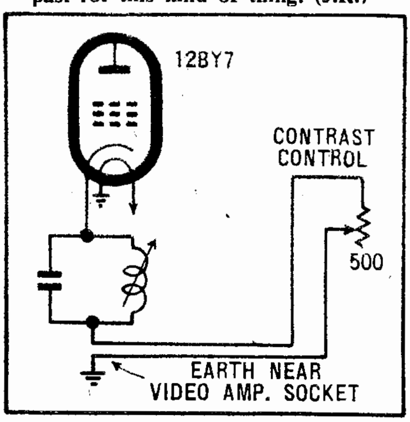
which sometimes enclose the windings. These would certainly not be required, as they are foreign to the specifications.

Whether the existing slugs would be suitable for 30 Mc would be a pure guess, though, if the transformers concerned are old, we would be inclined to doubt their suitability. Core materials have undergone a lot of development in recent years and only good quality, modern core materials are of any use at 30 Mc.

Unless you are prepared to take a deliberate risk on things working out, we would suggest that you make some effort to get modern formers and cans, intended for the job.

★ ★ ★

Q: In building the abovementioned transformers is it permissible to use Tarzan's Grip to secure the turns? I have found it very suitable in the past for this kind of thing. (J.R.)



The contrast control pot. should be earthed back to a point near the video amplifier socket, as in the original receiver. Earthing near the pot. itself can produce regenerative effects apparently due to coupling via the chassis into the IF strip.

A: Tarzan's Grip is one of several quick-drying cements of the cellulose type and, as far as we know, is quite okay for the purpose. Another popular choice is clear nail lacquer, which comes complete with an in-built brush. As far as we know, clear adhesives and lacquers of this general type do not contain any filler which is likely to introduce RF loss.

At the same time, if recognised coil lacquer can be obtained, without much extra cost and effort, it may be a safer choice.

★ ★ ★

Q: I have built the "T. TV and H." 17in receiver to stage I, using a set of prealigned IF transformers. The sound is reasonable sometimes, but seems to distort badly on peaks. I have thoroughly checked the audio amplifier for wrong bias, &c., but can find nothing wrong. The dealer says that the IF transformers would not cause distortion, so where could the trouble be? (B.D.)

A: It looks very much as if your dealer has misled you on this point. Barring an actual error or faulty component, the most likely source of distortion is misalignment of the ratio detector transformer. Depending on the degree of misalignment, the distortion may range from something quite hopeless to something that does, in fact, sound very much like overload on peaks.

Since the frequency of the sound carrier is fixed at 5.5Mc (the differences between the two station carriers) no amount of tuning will correct distortion from this source.

We take it that your IF strip uses transformers which are nominally prealigned, but only a supreme optimist could expect them to be "spot-on" after being removed from the factory test set, then rewired into a completely different assembly.

Our tip is that a half-turn of the ratio detector transformer secondary slug will clear up the distortion completely.

★ ★ ★

Q: I have tried the keyed AGC system as shown in your May issue but am not satisfied with the results obtained. The control is very sharp and acts more like a switch. I'm reasonably certain that no mistakes were made as I actually tried it on two separate occasions with the same result. (W.C.)

A: The circuit you refer to was not part of the original article on the receiver but was included for purpose of

illustration in the "Course In Television." By coincidence, it happened to be in the same issue as the 17-inch circuit and we suggested that it could possibly be substituted for the simple AGC system specified.

Because of pressure of other work, we have not had time to experiment along these lines ourselves but understand that the circuit in its original form is not above criticism. In discussion with the A.W. Valve Co., they suggest that rather better operation can be obtained by amending the circuit as shown above.

H.T. DIVIDER

A still further improvement may be to supply the screen of the keyed valve, not from the video amplifier screen but from a divider network across the HT supply and set to give a reasonably stable 150 volts. As it is, the screen of the 12BY7 video amplifier is liable to rather wide variation.

They stress, however, that the circuit is still only tentative, even in its amended form and may be capable of further improvement, as far as ease of control is concerned.

In view of all this, your experience with the circuit is not surprising. You may care to try the amended version or else wait until we are able to make firm recommendations ourselves.

★ ★ ★

Q. I have a rough idea of what is meant by interlace, but I haven't enough practical experience to be able to recognise whether a set is interlacing correctly or not. As far as that goes I'm not absolutely sure what degree of "correctness" is normally accepted in commercial sets, or does a set simply interlace completely or not at all, with no intermediate condition? (C.W.)

A. As you say, your ideas are a little rough, so perhaps we had better run over the story of interlace first, just to straighten out any doubtful points.

The purpose of interlaced scanning is to give an effective picture repetition rate of 50 per second, but without the increase in bandwidth which would be necessary if we tried to present 50 complete pictures per second. By dividing the picture up into two fields, one containing all the odd scanning lines and the other the even scanning lines, we are able to present 50 "half pictures" (fields) per second.

FLICKER PROBLEM

As far as flicker perception is concerned, this is nearly as effective as if we presented 50 full pictures per second, yet requiries no more bandwidth than that for 25 full pictures per second — which, in terms of picture detail, is all we actually transmit.

In theory, interlace is provided automatically by simply selecting standards that provide an odd number of lines to make a complete picture. Then, if the picture is broken up into two fields (by doubling the frame oscillator frequency from 25 to 50 per second), each field must have an odd half line. (312.5 in the case of a 625 line system.)

Thus successive frames commence the downward trace from either the extreme left-hand side of the picture of the centre of the picture, the half line difference being the amount necessary exactly to interlace the odd and even frames.

Provided our receiver line and frame time bases — in particular the latter — always trigger at exactly the same amplitude of the synch pulses, and behave absolutely consistently in terms of flyback time etc., interlace will take place automatically.

Unfortunately, in practice, these desirable conditions do not happen automatically. On the contrary, it generally happens that there are plenty of circumstances conspiring to prevent them happening and interlace is thereby prejudiced.

As far as the receiver is concerned, the trouble is almost always due to stray energy from the line deflection system being coupled into the frame deflection oscillator. The main variations from one set to another are mainly the manner in which the coupling occurs. It can be due to stray capacitance coupling between leads, from leads to the frame oscillator valve, through a common power supply, or even due to earth loops caused by random chassis return circuits.

The amount of energy present at line frequency is quite high and, at 15 Kc, is easily coupled into the frame circuit if the interstage shielding is not adequate. In the case of our own 17in receiver it was necessary to fit a metal shield between the two stages on the underside of the chassis.

FRAME TRIGGERING

On alternate frames, the frame oscillator should be triggered exactly midway between two line pulses if correct interlace is to be maintained. However, a frame pulse "grows" (in the integration network) over a period of two and a half lines, ideally triggering the line oscillator at exactly the same stage of its growth for both odd and even frames.

If there are line pulses present across the integrating network they will either "capture" the frame oscillator completely by causing it to trigger on a line pulse or, if the amplitude of the line pulses is insufficient for this, they will add energy to the integrating network so as to cause triggering to occur earlier than would otherwise be the case.

Since there is a half line difference between the frame pulses, the spurious line pulses will occur at different times during the growth of the odd and even frame pulses respectively.

In the worst case, where the line pulse causes actual triggering, the whole of the vital half line difference between frame pulses is lost, meaning complete loss of interlace. In lesser cases the frame oscillator is triggered early by some fraction of a half line, causing partial loss of interlace.

Thus, to answer part of your question, C.W., it is perfectly feasible for a set to have varying degrees of interlace, ranging from perfection, through varying degrees of pairing, to complete pairing or loss of interlace. A few commercial sets appear to interlace almost perfectly, most pair to some extent, which still gives an acceptable picture, while a few interlace erratically or not at all.

CHECKING INTERLACE

Now for the second part of the question: how to recognise any of these conditions. A certain amount of skill is required here, C.W., but most people can acquire this with a little experience, if they know what to look for.

First, take the case of complete loss of interlace. In this case the lines appear perfectly stationary on the screen, giving the impression of having been drawn there with a ruler and pen. In addition there will be a space between each line, at least equal to the width of a line. Finally, run the tip of your finger slowly up or down the screen and allow your eye to follow it. If the lines still appear absolutely rigid, there is no interlace.

Recognising correct interlace is not so easy, since our eyes play tricks when close to the screen and tend to "buck" the interlace. (An effect known as "stroboscopic twinning.") Thus a correctly interlaced picture, viewed too close, may at first appear not to be interlacing.

However, if we now draw our finger tip up or down the screen, the lines will appear to follow it and, if this effect is noted, it may be assumed that at least partial interlace is occurring.

Next, we must train our eyes to concentrate on one spot on the screen and avoid following the line shift between odd and even frames. Only then will we be able to see the true state of the line structure. With a little practice this is quite easy, and one can even assess the degree of interlace.

(Continued on page 127)

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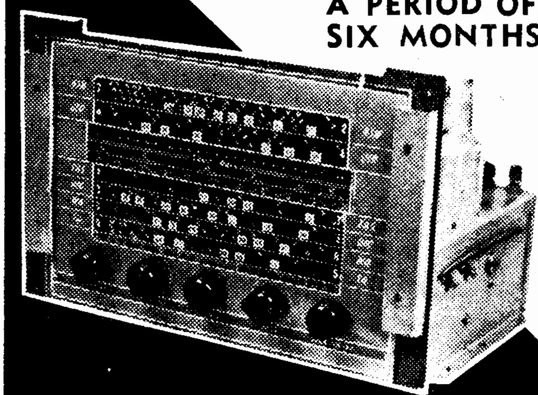

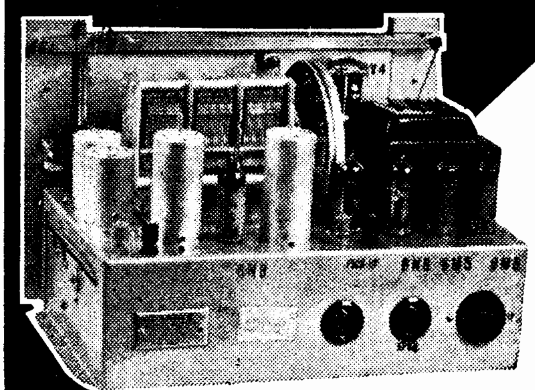

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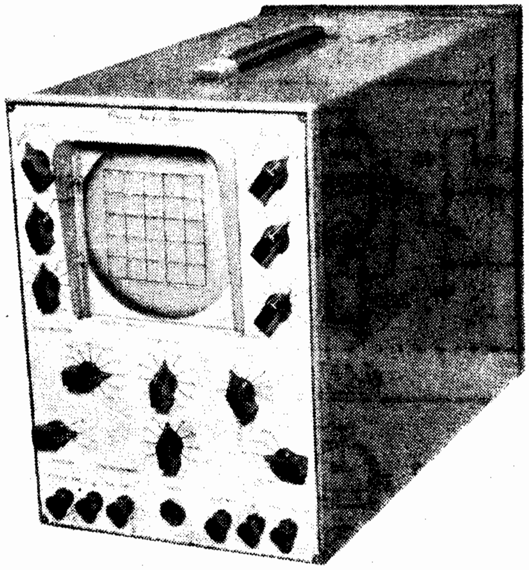

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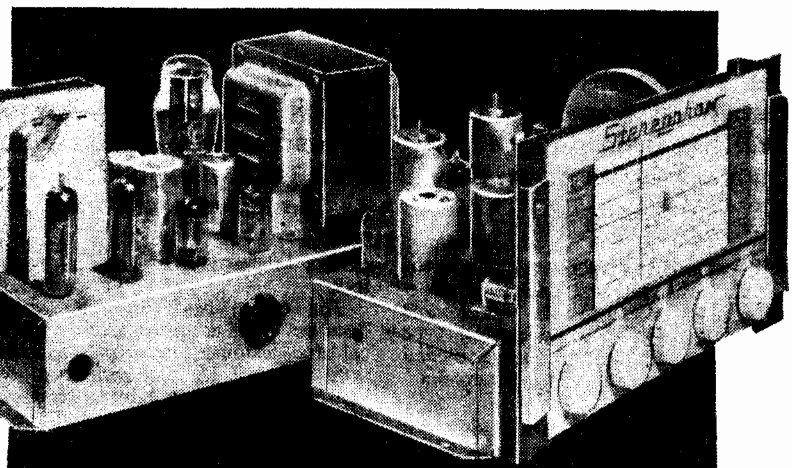

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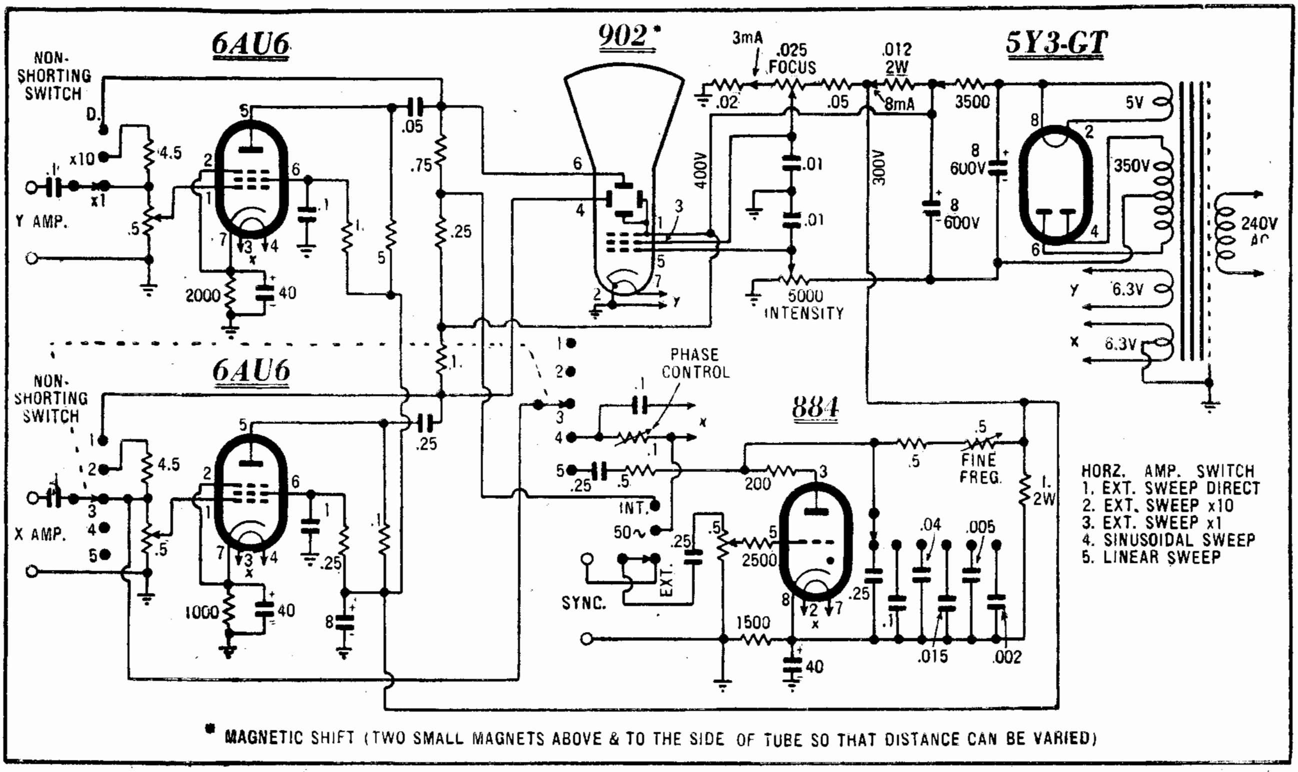
CIRCUIT FOR SMALL OSCILLOSCOPE



We haven't actually built this instrument but readers should find it a good starting point for experiment.

For those who have a stock of disposals parts including a small cathode ray tube, here is the circuit for a small oscilloscope which would be suitable for testing audio amplifiers. The circuit has been designed on paper and may require some minor modifications in order to ensure satisfactory operation. This will not be beyond constructors who have some experience with receivers and amplifiers.

THE cathode ray tube suggested is the 902 which has one each of the deflector plates tied to the accelerator anode internally. The disposals type VCR139A could also be used provided the deflector plates are similarly connected externally.

Two potentiometers and a number of resistors are eliminated by using magnetic shift rather than the usual system. In fact, provided the tube is reasonably well lined up the shift controls may not even be needed.

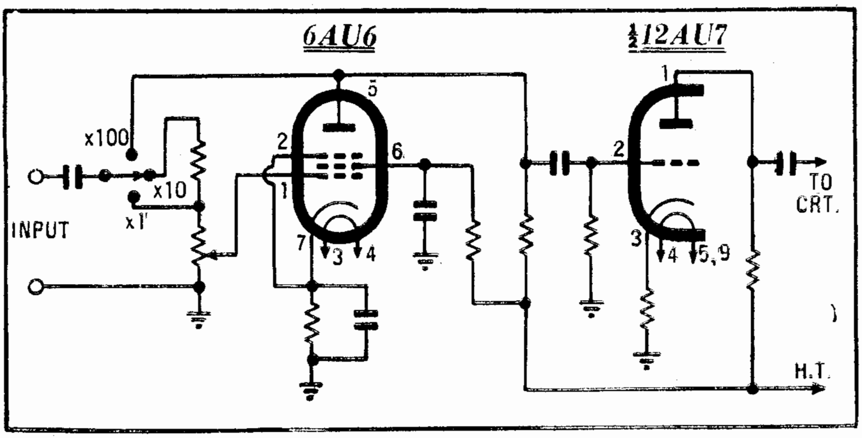
The vertical amplifier using a 6AU6 has a high value plate load. According to calculation the beam will be deflected 1in with only 100 mV rms applied to the input terminal. However, the response will be level only up to about 10 Kc/s because of the stray capacities between the live side of the circuit and ground. This is good enough for many service jobs. High level signals can be handled by a X10 switch while very high level signals can be fed directly into the deflector plates. This direct terminal would also be useful for modulation checks in the case of amateur transmitters.

The 6AU6 horizontal (X) amplifier does not have as much gain as the vertical and requires, according to calculation, 500 mV for full deflection. Again the X10 and direct connection facilities are available. Type 6SH7 could be used in place of either of the 6AU6's.

Any one of several gas triodes could be used for the time base oscillator which produces a linear sweep over the frequency range from 25 c/s to 5 Kc/s.

A sinusoidal sweep is also available and this is very useful for comparing the frequency of incoming signals with that of the power mains. The included phase control helps to make this easy.

For those who would like a better quality instrument an alternative amplifier circuit is suggested using a 6AU6 and one half of a 12AU7 or alternatively a 6SN7-GT. By suitably choosing component values either the frequency response of the amplifier can be extended or the undistorted deflection increased



This alternative amplifier will give improved performance at the expense of an extra valve.

Here's your answer, Tom!

Tom's initial query and those following may seem to be a little naive. However, they are evergreen puzzles for those starting out in radio and the answers we have given should assist them to a better understanding of this fascinating hobby. After all that is the idea of this page.

Recently I built the Three-Band-Three receiver described in the May 1957 issue and now wish to attach a magic eye to it. Can you tell me how to do this.

You seem to have overlooked the purpose of a magic eye, Tom. In a multi-stage set, where the stages are under the influence of A.V.C. action, it is difficult to assess the proper tuning position relative to the loudness of the signal. As the signal strength increases the A.V.C. voltage increases and reduces the gain of the stages which it controls, thus tending to keep the output constant.

A magic eye is connected so that the A.V.C. voltage adds to or subtracts from the existing bias on its grid, the pattern on its fluorescent screen tending to close or open accordingly, thus giving an indication of maximum signal strength.

ACCURATE TUNING

By watching the magic eye, the person using the set can tune it quite accurately. In a simple set, such as the one to which you refer, even if you were successful in connecting one up, a magic eye would be superfluous since it would indicate the obvious. With no A.V.C. present, the variation in sound output would be just as obvious as the variations in shadow angle in the magic eye.

* * *

Is it possible to build a TV set using transistors?

As a laboratory project, a TV set using transistors has been built. However, as a constructional project for the man-in-the-street or a production run for a factory, the proposition is out of the question at the present. Transistors which will operate at around 200 M/c are very rare and, assuming that this problem could be overcome, the overall cost would still be prohibitive.

Portable transistorised TV transmitters have been built, and it is only a question of time before receivers using similar principles become a proposition.

* * *

I have noticed that I.F. and audio transformers have the same markings. Can I use one in place of the other?

The answer is definitely not, despite the similar markings. There is a substantial difference in their construction and one will not work in place of the other.

The windings of an audio transformer are wound with many turns of fine wire over an iron core and giving an inductance of many henries. At audio frequencies this constitutes an adequate load for the preceding amplifier valve.

An I.F. transformer, on the other hand, has very much smaller windings which are deliberately tuned by means of small capacitors to resonate at a certain frequency, the most common one in use at present being 455 Kc.

A properly adjusted IF transformer will work at this frequency and no other. If used in an audio amplifier the load presented by this transformer would only be a few ohms and the valve could not amplify.

The markings are identical only because both are interstage transformers and involve connection to similar valve electrodes.

* * *

Some time ago you discussed a muting circuit on these pages. Is a noise limiter a similar type of circuit?

Nothing could be further from the truth, Tom, for, while the muting circuit is used to silence the receiver except when tuned to an incoming signal, the noise limiter is used to attenuate bursts of noise without interfering any more than necessary with the signal.

A circuit we have often used in the past is reproduced and, refering to this the action is as follows: One half of the 6H6 is used for detection in the normal manner, the diode load being made up of two .25 meg resistors in series, the audio being taken from their junction.

The second half of the diode is connected in opposition to the first with regards to polarity. On switching this second half into circuit, the signal reached the audio stages through its electron stream.

CATHODE NEGATIVE

When thus connected the second diode will only pass signals as long as its cathode is maintained at a potential more negative than its plate. Assuming the full voltage that is developed across the diode load to be 20 volts, then the DC voltage from the split load will be 10 and the standing bias applied to the diode cathode will be 10.

The purpose of the two 1 meg resistors and the .01 capacitor is merely to act as an audio filter to ensure that no signals reach the limiter cathode while allowing the DC to be used as required.

From the foregoing it is obvious that any signal or noise peaks in excess of 10 volts will not pass through the limiter diode. Since noise peaks may quite easily reach value in excess of this, they are not passed on to the audio system.

Modulation of approximately 100 per cent may be handled and slight distortion of modulation peaks may be experienced, but not sufficient to spoil intelligibility.

The obvious advantage of the system is that since the limiter standing bias is obtained from the detector diode load, the limiting action will be approximately the same irrespective of the signal strength.

* * *

What is neutrodyne, autodyne and a heterodyne?

The word "neutrodyne" describes a general type of circuit and belongs to a very early era. It refers to the neutralisation adopted to overcome the feedback caused by the internal capacitance of triode valves in RF amplifier circuits. An external capacitor is connected to feed some out-of-phase energy from the plate to the grid so as to neutralise the energy fed back through the valve capacitance.

NEUTRODYNES

Receivers using neutralisation in the RF stages were referred to as neutrodynes. Nowadays, pentodes overcome the trouble because they have very little plate-to-grid capacitance and neutralisation is unnecessary.

Autodyne is the name given to a special type of frequency changer used in superhet receivers. It was popular in the early thirties but was later replaced by pentagrid and other converters, with circuitry specially designed for them.

The autodyne frequency converter used an ordinary RF pentode as the frequency changer. This valve combined the functions of oscillator and mixer and did the job quite well on the broadcast band. Its disadvantages were the difficulty of applying gain control and its limitations on the short waves.

A heterodyne, on the other hand, is not a set or a circuit but something which occurs when two frequencies beat together and produce other frequencies. The other frequencies are often referred to as heterodyne frequencies.

As you are more familiar with small sets, we will cite an example which you should have no difficulty in appreciating. In a one-valve regenerative set, such as the one you may have, you may tune in a station on 1,000 Kc while the detector is left oscillating.

As you tune over the station, the frequency produced by the oscillating detector passes over that of the station and produces an audible beat note or heterodyne whistle, which you hear in the phones.

Let us assume that at a particular instant the detector is oscillating at 1,001 Kc, and it beats with the 1,000 Kc signal of the station. The result will be beat note or heterodyne of 1 Kc.

Heterodynes need not necessarily be in the audible range but are always produced when two or more frequencies are fed simultaneously into a non-linear device such as the detector in a receiver.

In a superhet receiver for example, an oscillator generates a local signal which beats or mixes with the incoming signal in the mixer or converter to produce the heterodyne effect which is necessary for the operation of a superhet.

* * *

What is flux density and what are Maxwells?

A Maxwell is a unit of magnetic force in just the same way as the volt is a unit of electrical pressure, the amp is the unit of current flow and so on. Maxwells are not as familiar, because they are much less encountered in an intimate way.

Volts and amps can be measured by the use of a meter and we may directly observe their effect in a circuit. But Maxwells have no tangible form for they remain essentially the concern of those interested in the design of magnets and magnetic circuits.

To give the Maxwell its full definition however, it is the unit of magnetic flux and is equal to one line of force.

The explanation of flux density may now be easily understood. When lines of magnetic force pass through the pole pieces of a magnet the number of lines or the strength of the magnetic field is referred to as the flux density. The measure of flux density is the gauss and is equal to one line of force between pole faces one centimetre square in area.

Speaker specifications often include the flux density and, generally speaking, the greater the flux and the greater the total number of lines of force, the better will be the magnet and the speaker performance.

* * *

I have seen reference made to overloading when discussing audio amplifier. What is overload and what are its effects?

The overload you mention, Tom, refers to any amplifier valve and particularly to the output valve. Taking the case of the output valve, a certain set of operating conditions is chosen to give a certain output to drive the speaker. In the case of a 6V6 this might be 4.5 watts, or it may be a lot less with other types of valves.

GRID SIGNAL

To make the output valve deliver the chosen power it has to be excited by a certain value of grid driving voltage which may be anything from 1 to 50 volts depending on the type of output valve and operating conditions chosen.

Whether the unit containing the output valve is an audio amplifier or the audio section of a receiver, it will probably have several stages of amplification, and will be capable of driving the output valve from a certain input signal. This may be a few millionths of a volt in the case of a signal collected by the aerial to a few hundredths of a volt in the case of a gramophone pickup or microphone.

But local stations are capable of feeding a very healthy signal to the aerial which, when amplified, will many times exceed that necessary to drive the output valve to full output. Likewise the signal output of pickups and microphones varies and the result and drive voltage may be far in excess of the requirements.

If you turn the gain up under these conditions, the full available signal voltage will be fed to the output valve and the result will be overload of the last stage. Regular waveforms in the signal are flattened off because the valve's plate current can't vary over wide enough limits to follow them.

At first, the sound becomes rough and raspy but, as the overload is increased, it becomes downright unpleasant. In extreme cases of overload the output may become so distorted as to be completely unintelligible.

OVERLOAD DISTORTION

Boiling this down, Tom, it follows that if an output valve can deliver a watt of power under certain conditions, no amount of overdrive will produce more useful power. It will only cause distortion. If you require more power, you must simply choose a new set of operating conditions or a different type of valve.

Overloading is by no means confined to the output valve although this is the point for overload to show up first. Given sufficient input signal you can overload one of the earlier stages as well, or, if the speaker is too small for the job, you can overload that, too.

The result in all cases is the same, namely distortion.

The degree of overload in an electrical circuit which one might tolerate is not likely to cause trouble. Overloading the speaker, however, will ultimately ruin it, because of the mechanical stresses of the cone, the suspension and the voice coil.

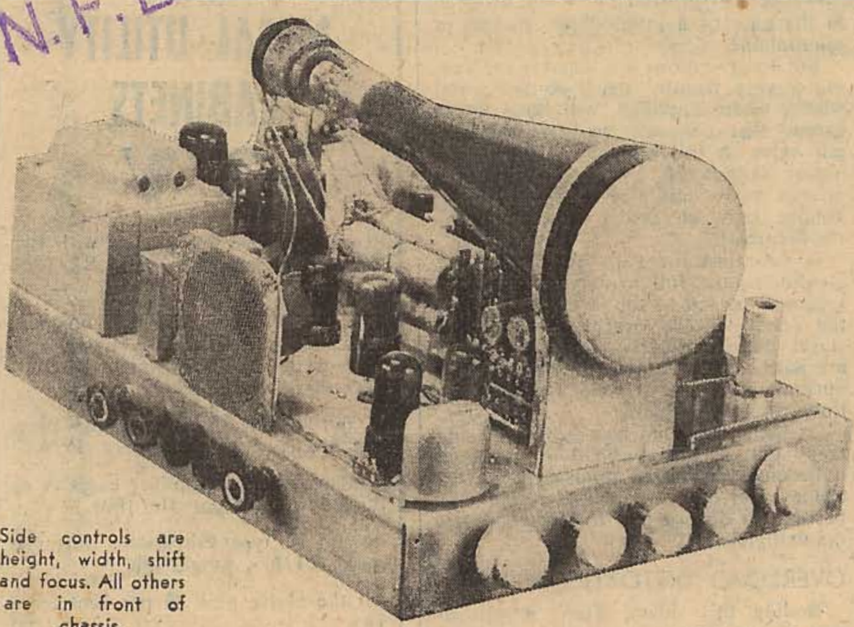
* * *

I have been advised that I can connect a pair of headphones across the voice coil of a loudspeaker and get satisfactory sound in the phones. This seems a horrible mismatch, even for low impedance types. Will it work and, if so, why.

A. Yes Tom, it works, and works well. It is true that the phones do not match the output impedance but, assuming the speaker is also in circuit, the output valve will be correctly loaded, so there is no worry on that score. If the speaker is not required a resistor of the same value as the voice coil impedance may be substituted.

As far as the phones themselves are concerned the mismatch will merely mean that the power delivered to them is reduced — in this case by a considerable amount. However, far from being a drawback it proves an advantage, the level being almost exactly right for comfortable listening.

If the power delivered to the phones was appreciably greater we would be worried by hum and other set noises which cannot be controlled by the volume control, resulting in very uncomfortable listening.



Side controls are height, width, shift and focus. All others are in front of chassis.

A picture of our 5-inch TV set which has already excited great interest among our readers. Normally the 5BPI is shielded.

More About The 5-inch TV Receiver

This month we spend a good deal of space discussing the IF strip of our 5-inch TV receiver. This strip has proved momst successful, providing a comparatively simple solution to what initially appeared to be an extremely difficult job. Comprehensive alignment instructions are also given in this article.

by John Moyle

A COMPLETE general description of the set appeared in last month's issue, together with more detailed treatment of the various sections, with the exception of the IF strip.

This is virtually the heart of the receiver, and we are therefore devoting most of this month's instalment to it.

Further experience with the strip has demonstrated its possibilities for use with any type of TV set. We have now worked over three versions made by various people, and, although each showed small differences which can only be expected, they all produced good results without the need to modify any of the coils once they were wound.

A PRACTICAL DESIGN

All ended up with response curves which would not have disgraced a first-class commercial set.

It seems from this, therefore, that the task of producing such a strip is not beyond the capabilities of any reader well enough informed about the radio to tackle the set in the first place.

For, in fact, it requires little more effort than careful winding of wire on prepared formers, according to the information given here, and intelligent wiring into its chassis.

It wouldn't be too much to say that a nimble-fingered lad of 12 years could produce a perfectly usable set of coils.

Although originally designed for this 5-inch set, it is equally suitable for larger jobs, such as the 17-inch receiver we have been describing during the past few months.

Because we deliberately built it on the same sized chassis, it will fit without any difficulty, and the connections to it are much the same as those for the commercially wired strip we used in the first place.

There is very little difference, either in gain or response, between the two.

The fact that the home-built strip has one stage less in the video section is made up for by the use of the 6AC7 valves, which have a higher gain than the miniature types generally used today.

The fact that there are fewer circuits to tune might on paper indicate greater difficulty in getting a copybook response curve, but, in practice, there is very little to choose between the results obtained from either. Both are well within the optimum required for a good picture.

But because there are fewer circuits to twiddle, alignment should actually be easier and less liable to ambiguities with the home-made version.

Unity coupling between the coils, too, makes them easier to wind, as there are fewer critical spacings to be considered between the windings.

Although the exact placing of the traps might be subject to some modification if you are very particular, we have not found it necessary to change their positions in any of the strips made to date, although in one or two cases a fractionally better curve would have been achieved.

EXTRA SOUND STAGE

The sound section of the strip has one extra stage as compared with the Mk. 1 commercial version. The Mk. 2 was modified to include a similar stage.

There is little objection to using the new strip in any TV set, on the grounds that the valves are old types.

The 6AC7s were originally designed for video amplifier work, and have an extremely high Gm. At frequencies down to 30 Mc they are probably just as good as the miniature types from a physical point of view, despite their larger sockets.

And there are still many thousands of valves on the disposals shelves, so many that the supply position isn't likely to worry anybody. Nor is the price, which is less than 4/ per valve at most disposal stores.

In the sound channel, you will notice that our photograph shows 6S17s in the sockets in place of 6AV7s.

In fact, there are several types of valves which will work here equally well, including the 6SH7, perhaps the best of all. To be strictly accurate, some minor changes to circuit values should be made, but for all intents and purposes, it is satisfactory to use any of these types without change to the circuit, the only noticeable difference being in overall gain.

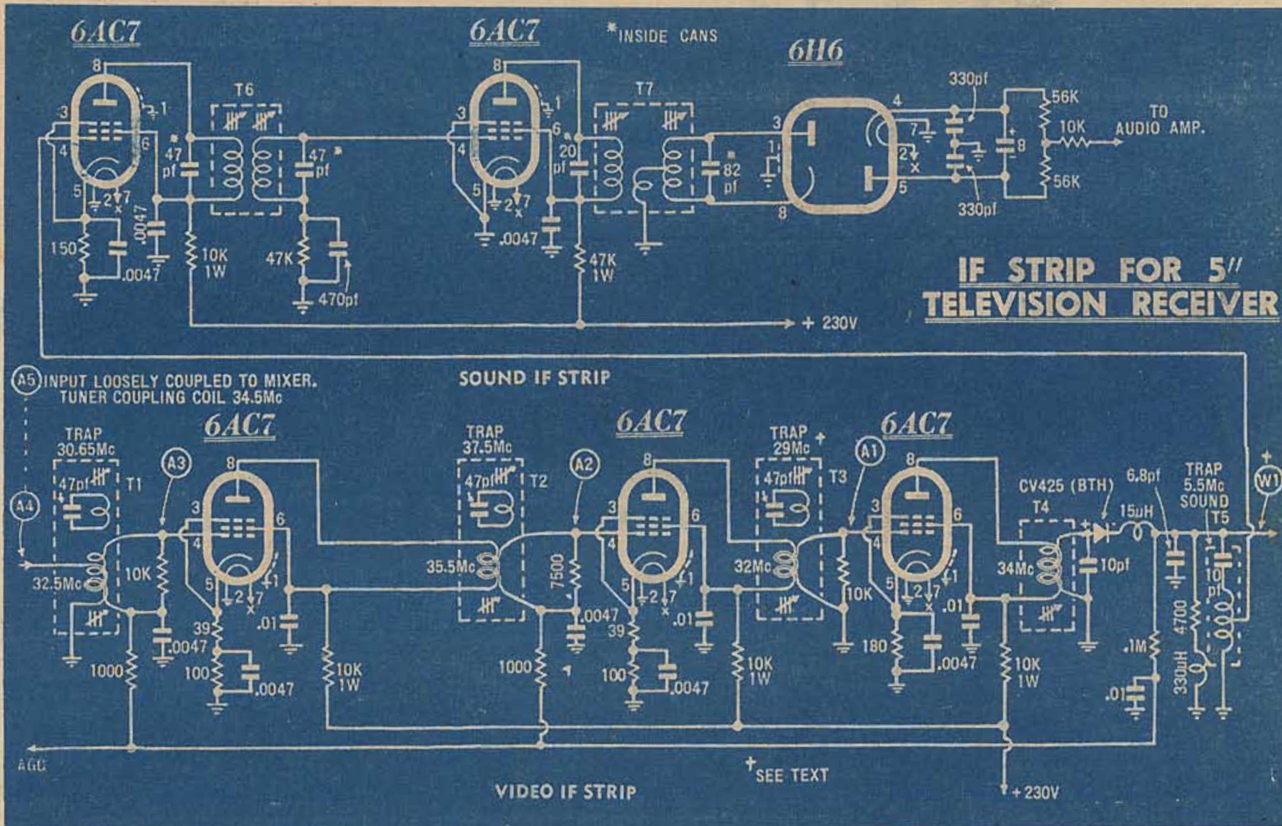
No socket changes are necessary for valves such as the 6AC7, 6SH7 and 6SJ7.

Although we have not used EF50s in place of the 6AV7s, there seems no reason why they should not work well, with slightly lower gain.

MODIFICATIONS

The coil data as published here for the coils is not quite the same as that originally given in our issue of December, 1956.

CIRCUIT DIAGRAM OF IF STRIP FOR 5-INCH SET



The circuit of the IF strip is really a section taken from the complete circuit published last month. It carries suggested spot frequencies for alignment, and indicates the points at which we fed the wobbulator to obtain the curves shown on page 69.

The differences concern the gauges of wire, small changes in the number of turns, and an odd capacitor value.

It is surprising how much trouble some readers have had in obtaining small quantities of winding wire. Because of this, we thought it a good plan to use as few gauges as possible, and to specify those which are most likely to be available. We have used enamelled wire throughout because it is probably the easiest to get.

The exact gauge of wire is not particularly critical, so that one size larger or smaller than those specified could be used at a pinch. But changing the gauge will alter the inductance of the windings, and it is therefore, best to keep to our specification, although the adjusting slugs will probably take up any tuning discrepancy. This, however, is not the entire story.

FORMER SIZES

Similarly, the coil data is given for 7mm formers, whereas you might have formers 8mm in diameter. As this is a change of about 10 per cent, we suggest that with the larger formers you decrease the number of turns by about this amount, arriving at a figure accurate to the nearest turn.

If you have already built up a set of coils using the original winding data, do not bother to change them over. They are so alike in results that it wouldn't be worthwhile.

The coil formers normally available to home builders will be plastic types, all of which are subject to malformation in some degree if subjected to enough pressure and heat.

When winding your coils, therefore, do not use any more force than necessary, and do not wind the wire under more tension than is needed to ensure that the windings lie neatly in place.

This is best accomplished by rotating the former between the thumb and forefinger, feeding the wire into place as this is done.

If the wire is too tight there is a distinct possibility that the former will be distorted when it gets warm, as undoubtedly it will.

If this happens, the cores may jam, making adjustment impossible, and the alignment of the circuits can easily be upset.

This is particularly the case with the discriminator transformer, which, if not precisely balanced, will cause distortion in the sound. In fact, some manufac-

PARTS LIST IF STRIP

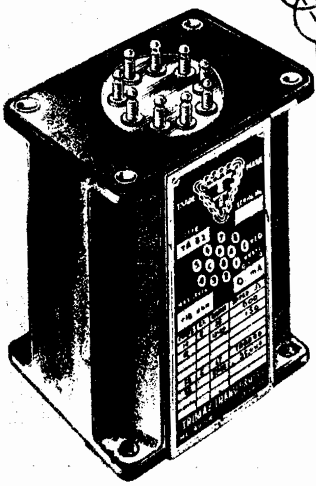
1 Chassis 10 3/8in. x 4in. x ½in.
7 miniature coil formers with cores and cans. Winding wire to suit coils. See coil data.
5 6AC7 valves.
1 6H6 valve.
6 Octal sockets.
1 germanium diode. GEX35, OA72, CV245 &c.

CAPACITORS

1 8 or 10 mfd electrolytic. 25V.
1 .01 metallised paper.
3 .01 ceramic.
8 .0047 ceramic.
1 470 pf ceramic.
2 330 pf ceramic or mica.
1 82 pf ceramic.
5 47 pf ceramic.
1 22 pf ceramic.
2 10 pf ceramic.
1 6.8 pf ceramic.

RESISTORS

1 .1M ½W.
2 56K ½W.
1 47K 1W.
1 47K ½W.
4 10K 1W.
3 10K ½W.
1 7500 ohm ½W.
1 4700 ohm ½W.
2 1000 ohm ½W.
1 180 ohm ½W.
1 150 ohm ½W.
2 100 ohm ½W.
2 39 ohm ½W.
1 15 uH choke.
1 330 uH choke.
2 2 tag terminal strips.
3 3 tag terminal strip.
1 4 tag terminal strip.
1 8 tag terminal strip.
Nuts and bolts, solder lugs, hook-up wire.



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Part No. 63 Frame Output Trans. 6BM 8.	Price 33/4

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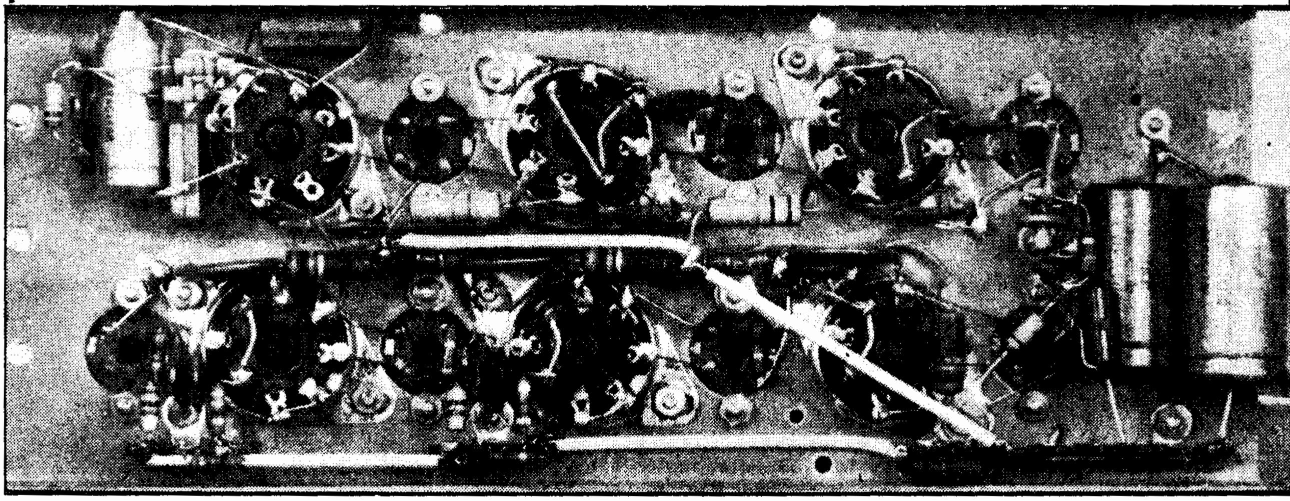
UNDERCHASSIS VIEW OF IF STRIP FOR 5-INCH SET



This picture shows the actual strip as we built it. The electrolytic capacitors at the left belong to power supply filtering and not to the strip as such. The white lead along the top edge is for connection—the other white lead connects to high tension. Video output is at upper left—audio output from lower right: Compare this picture with the diagram below

turers even prefer to use good quality cardboard formers here in preference to plastic, to guard against discriminator drift.

When fitting the formers into their cans, once again care should be used. The tops of the formers generally fit into recesses pressed into the can, after which small tabs are bent up from the bottom edge of the can on opposite sides to press against the bottom of the base and keep the former from dropping down.

FIT GENTLY

Be very sure that there is no undue pressure on the former when finally in place, otherwise it may well bend slightly in the centre and be subject to other distortion. We had a bad case of this with a former the top of which had been forced out of its recess due to some careless handling of an alignment tool.

For the first period of alignment it is permissible not to lock the formers in the can with the tags in case you need to remove the cans and adjust the trap spacing. But for the finished job, take time to do it properly.

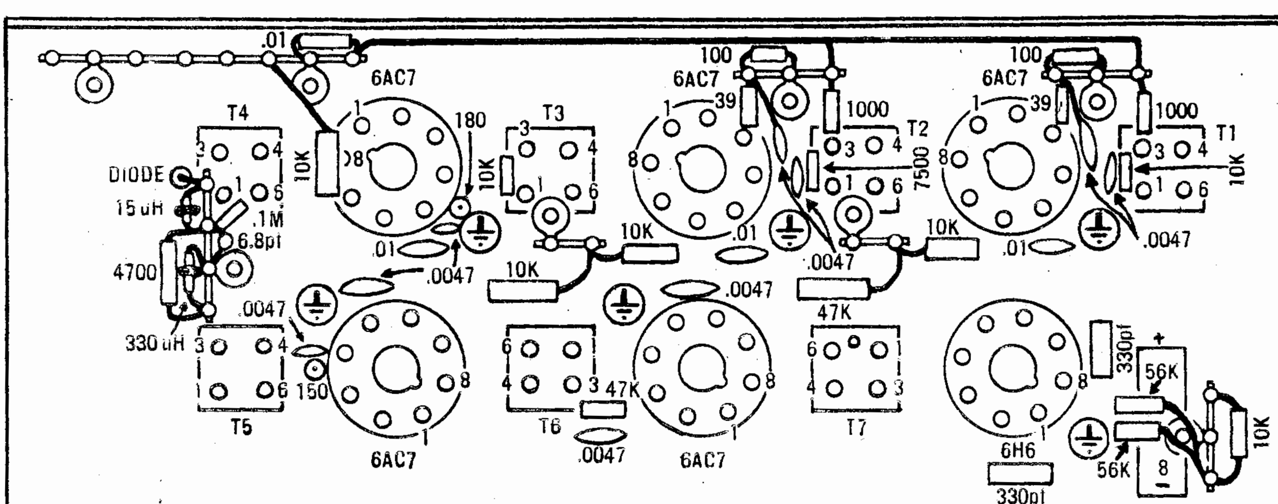
The windings are kept in place with coil dope. When commencing each winding it is often a good idea to dope the wire after a couple of turns and wait for it to dry, so that you can exert reasonable tension on the wire without unravelling the coil. The same technique can be used at the end to prevent the winding springing apart.

The ends should be cleaned and threaded through the solder lugs moulded in the base and soldered in place with the least possible amount of heat. Allow the solder lugs to cool before moving, for they will almost certainly have melted the plastic material. Keep the coil leads well apart and where capacitors are enclosed in the can, keep them spaced away from the windings as much as possible. Mica or disc ceramics are best to use.

That's about all we can say about making the coils. The diagrams will give you clear instructions about the exact positioning of the windings and their connections.

It is quite important to mount the valve sockets and coil cans on the strip so that the shortest possible leads are used to connect them together. To illustrate this point we have shown a diagram and photograph of the underside of the strip, and from these you should be able to follow out the best arrangement of components. The diagram will also show you how we mounted resistors and bypass capacitors in a convenient manner for wiring and the grouping of earth points.

See that the earth points associated with each stage are grouped together to the same solder point, or at least separated by only a small length of chassis. In no circumstances should the bypass for one circuit be earthed to a sol-



This diagram shows placement of important parts and orientation of valve sockets and coils. Some components are indicated but connecting wires are not shown. Chassis measures 10 3/8in. x 4in. Coil and valve socket centres are 1¼in. apart, grouped in two parallel rows each 1¼in in from outer edge. The centre of input coil T1 is 1 1/8in. from the end of the chassis. The shield plate dividing the video and audio sections originally used was not found essential. All resistors are carbon.

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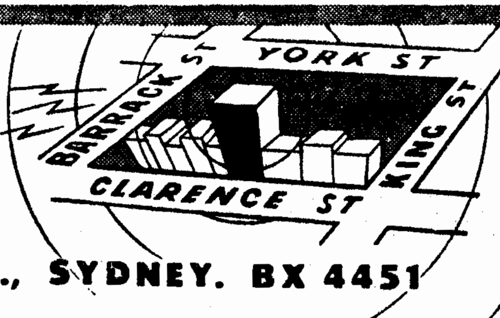

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HOMECRAFT'S FAST DESPATCH SERVICE

der point used for another. Otherwise you may run into problems of instability.

The earth points in question are those of the bypass capacitors for grid, screen, plate and cathode circuits.

It is not strictly necessary to earth the cathode resistors at this same point, for they should, if effectively bypassed, be carrying D.C. only, and quite dead as far as R.F. is concerned.

The type of capacitors used for bypassing the strip should be carefully watched.

Our first strip used ordinary miniature paper capacitors, and although it worked, there was evidence of regeneration in the video section.

Some of the circuits, which are specially damped with resistors to flatten their response, showed peaks which prevented an acceptably flat top on the band-pass curve.

CERAMICS BEST

Replacing the tubulars, particularly in the cathode circuits, or paralleling them with disc ceramics, made a great improvement, and we ended up by using these disc ceramics throughout.

Although they would be the preferred types, the very tiny, self-sealing tubular types could be used, and often are commercially. But as the difference in price isn't great, it might be best to play safe from the start.

Paper tubulars would be more acceptable in the sound strip, if you must use them.

Although in theory two identical strips should perform exactly alike, in fact they rarely do. Differences in component tolerances, and particularly in valves, will affect the shape of final video curve, and once you have lined things up it is a good idea not to exchange or remove the valves if you can avoid it.

Similarly, the exact value of the resistors across the IF transformer windings may vary from one strip to another.

The nominal value is given as 10K, but we have found it a good thing to use even lower values than this at times.

The two centre circuits are those most likely to need the lower values, and we have specified 7.5K for one of them.

In one strip we found one of these circuits providing rather more of a peak at about 32Mc than we cared for, and found that we could flatten it out by reducing the associated resistor to 5K. This, however, is likely to be the lowest value you should need. The point is that you should not be worried if some experiment is necessary. The lower resistor values will lower the gain of the strip, but in most cases this won't matter, as the set is not primarily intended for fringe areas.

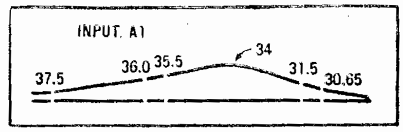
ALIGNMENT PROBLEM

The amount of coupling for the traps will also affect the gain of the associated stage.

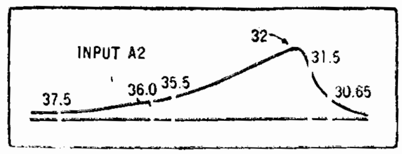
If you are lucky enough to have a full set of test equipment available, there is nothing more fascinating than to experiment with all these points of adjustment, for they are all inter-related, and even in their simplest form they present quite a complex problem to the design engineer.

Ever since we faced up to the problem of designing TV sets for home construction, alignment of the strip has been a bit of a worry to us.

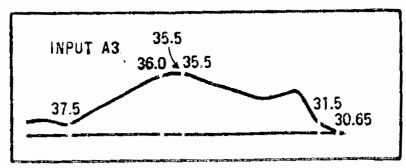
ALIGNMENT CURVES



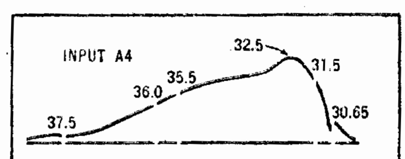
Input to A1. Tune T4 to 34 Mc. No trap circuit.



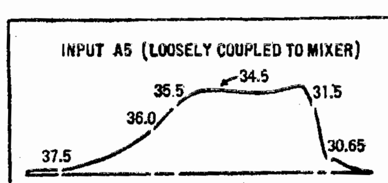
Input to A2. Tune T3 to 32 Mc. Set trap to 29 Mc or 30.3 Mc approx. See text.



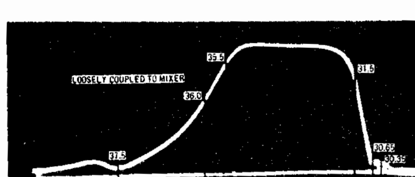
Input to A3. Tune to 35.5 Mc approx. Set trap to 37.5 Mc



Input to A4. Tune T1 to 32.5 Mc approx. Set trap to 30.65 Mc.



Input A5. (Loosely coupled to mixer). Tune coupling coil to 34.5 Mc approx.



This is an actual photograph of the final curve obtained on this strip. It is as near optimum as one could wish.

We looked forward to the time when we could find out how successful the home constructor is likely to be, using simple equipment.

By assuming the role of the beginner, and facing up to strip alignment from scratch, just as he would have to do, we endeavoured to reproduce our wobbulator-produced curves from the strip illustrated here.

For this purpose, we handed the strip over to Phil Watson, well experienced in the art of core-twiddling, as his excellent article on alignment has shown. The point is, he did not build the strip, but was given the task of installing it in the set and aligning it from the ground up.

We thought it best to let him tell his own story about his experiences.

His results, and the frequencies he found best for spot alignment, checked very closely with those already observed for the original strip, and we can therefore assume that, although there will probably be some variations from one case to another, the procedure he has worked out will prove to be a most useful guide.

Mr. Watson now takes over

The alignment of the IF strip may be undertaken in two ways; by means of a sweep generator and a CRO, or with the aid of a signal generator or grid-dip oscillator and output meter.

There is no doubt that the sweep generator method is to be preferred as being both more accurate and a good deal quicker and easier. On the other hand there are plenty of readers who will not have this facility available—at least not immediately—and it is for them that we have evolved a "spot frequency" technique to suit this strip.

OUR EXPERIENCES

How good is it? Well, we won't pretend that it will produce as good a curve as will a sweep generator, and it is fairly obvious that it will take longer anyway. But we have demonstrated to ourselves that it can be used to produce a perfectly acceptable curve; one that will deliver good pictures and sound without serious interaction between the two.

This means that the absence of sweep generator facilities should no longer deter readers who would like to try their hand at this set. If, when the set is working, you can arrange to give it a proper check, so much the better.

But even here, the fact that some preliminary work has been done will be very valuable, since it will probably not be necessary to do more than "touch up" a couple of cores in order to produce an optimum curve. The sweep alignment is further simplified if it is known to what frequency each coil has been set. If you happen to be paying for someone else's time to do this job, the saving can be well worthwhile.

STRIP No. 1

We are basing these statements on the work we have been doing on a couple of these strips in our own workshop. We started with the prototype strip as used in the set described last month. Using the sweep generator, we first aligned this to what we considered the best curve possible. (See photograph.)

Then, still using the sweep generator we checked the response of each stage and endeavoured to analyse the frequency to which each coil was adjusted. Having tabulated this we then deliberately unscrewed all the cores and started over again, this time armed only with a signal generator and output meter.

The resultant curve, when displayed on the CRO, was not perfect, but it did approximate the required shape. What was more important was the fact that it worked—producing good pictures and good sound.

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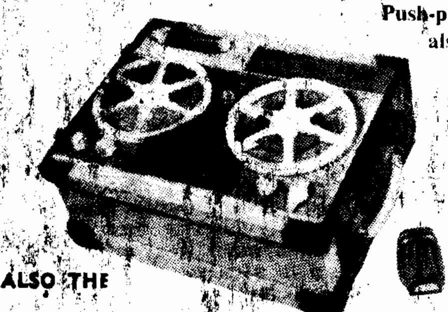

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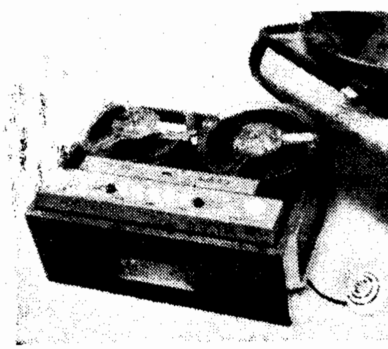

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In the light of the obvious errors, we modified some of the frequencies slightly, then tried again. This time we used a second strip which had just been completed by another member of the staff.

Resisting the temptation to put it on the sweep generator first, we wired it into the chassis and tackled it just as our readers would have to do. The only trouble we encountered was a trap which would not reach its required frequency, but we tracked down the trouble (a faulty resonating capacitor) and corrected it, using only the output meter and generator.

GOOD CURVE

When we finally submitted the strip to the sweep generator check, the curve it produced was extremely good, even if there were still some obvious minor discrepancies. Particularly significant was the fact that we needed to move only two cores less than a quarter turn to produce the correct curve, and we correctly nominated each core before trying it.

So much then for the general picture. We propose now to describe three methods of tackling the job; using a sweep generator and CRO, using a signal generator, and using the unmodulated signal from a grid-dip oscillator.

First, however, we suggest that the reader refer to the article on alignment in the August issue. Many of the remarks there are equally applicable to all strips and will provide a useful background against which the detailed instructions for this strip can be studied.

As with this previous strip we have marked the circuit with "A" (alignment) and "W" (waveform) numbers to show where the signal is to be fed in and taken out respectively. We also show the approximate waveforms to be expected when feeding into these points. Note, however, that these must be regarded mainly as a guide rather than a rigid requirement. Individual strips will vary slightly and the final overall curve is the important thing.

NEW TECHNIQUE

A slight modification on our previous technique is to isolate completely the grid circuit of each valve from the previous tuned circuit when signal is being fed into it. This is to avoid modifying the response at the frequency of the grid tuned circuit, and really arose from our early efforts to pin down the frequency of each tuned circuit. It would seem to be desirable, at least for the initial adjustments.

It is done by disconnecting the coil lead directly at the valve socket grid pin and connecting a 10K (approx.) resistor between the grid pin and chassis. RF energy is then fed to the grid of the valve.

The output for the CRO is taken either from the detector (W1) or from the plate of the 6AC7 video amplifier. This latter position is handy if the detector gives an inverted image, and which may be disconcerting to some. In either case, an isolating resistor of about 0.1M is essential to avoid instability. As far as accuracy of alignment is concerned, it does not matter which position you decide to use.

External bias in the form of a 4.5 volt battery should be fed to the AGC line, the latter being disconnected from the .1M decoupling resistor and connected to the battery negative terminal. The positive terminal goes to chassis.

Before commencing alignment (by any method) screw the cores well out of the windings and make it a practice to provide the required peaks with the cores in the outermost position. This is to avoid unwanted coupling between bifilar and trap cores which will take place if they are close together.

Feeding into point A1, T4 should be adjusted for a peak at 34 Mc. (see picture). There should be no difficulty about this, as there are no other tuned circuits to mask the response. As can be seen, the response is quite broad. There is no trap assoeiated with this transformer.

Feeding into point A2, T3 should be adjusted to peak at 32 Mc., once again a quite definite response. At the same time the trap may be adjusted to 29 Mc., the adjacent channel vision frequency. An alternative use for this trap is to help form the sound plateau, in which case it will be set to 30.35 approximately.

This is most likely to be needed if the 30.65 Mc. trap is not coupled closely enough to the bifilar winding and the plateau tends to rise too high. Since there is little chance of adjacent channel interference at the present time, it is quite permissible to use the T3 trap in this way.

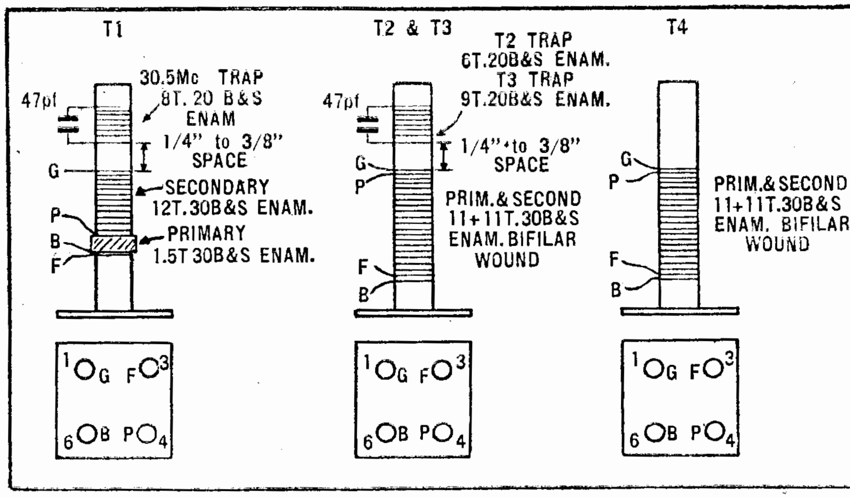
From point A3 we adjust T2 to approximately 35.5 Mc., again quite a distinct response. The trap is set to 37.5 Mc., the adjacent channel sound frequency. This also helps a little in the shaping of the slope from 35 Mc.

INPUT TO TI

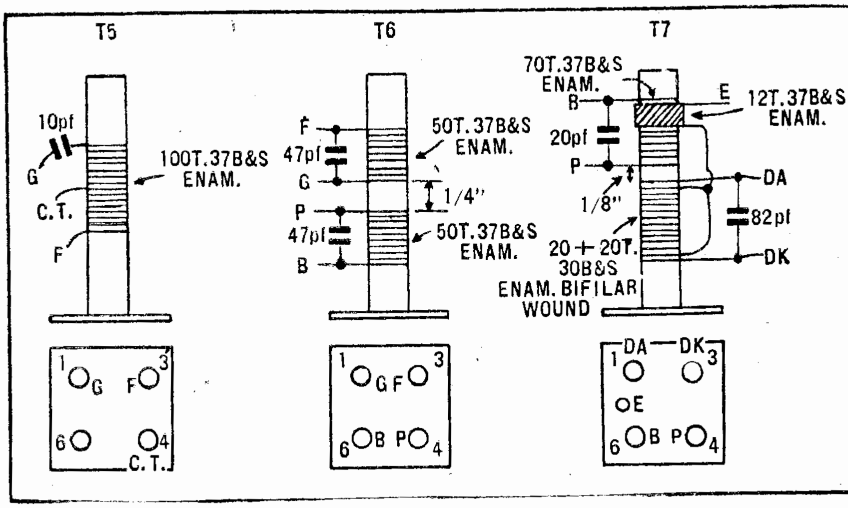
A4 input is to the link winding of the T1 bi-filar and it should be disconnected from the tuning unit coupling coil link during this adjustment. No resistor is necessary to complete the circuit. Although the coupling is more intimate by this method of injection, the low impedance of the link winding prevents any serious distortion of the response.

T1 is adjusted to approximately 32.5 Mc., which is close to that of T3 and is therefore not quite so pronounced. However, reference to the waveform picture will give a good idea of the response to expect. The trap is set to 30.65 Mc. to complete the sound plateau. This should be between 5 and 10 per cent of the total height.

Finally the sweep generator is capacitively coupled to the mixer valve (see August article) and the coupling coil adjusted to approximately 34.5 Mc. This should lift the high frequency end of the response and produce the shape shown in the final diagram.



The above diagram shows how the coils are wound for the video strip. TI primary is insulated from the secondary by thin paper layer.



At the right—details of coils for the sound strip. 7mm formers for video and sound.

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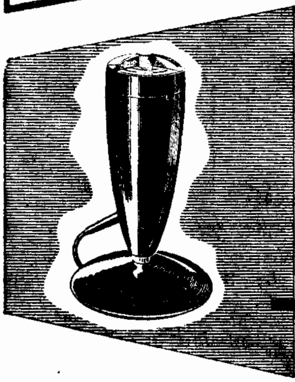

DESK or HAND MICROPHONE, MIC36

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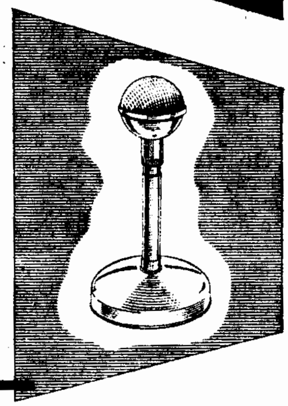

TABLE or STAND MICROPHONE, MIC22

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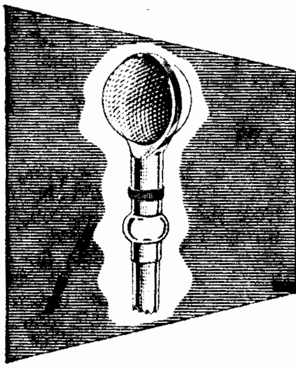

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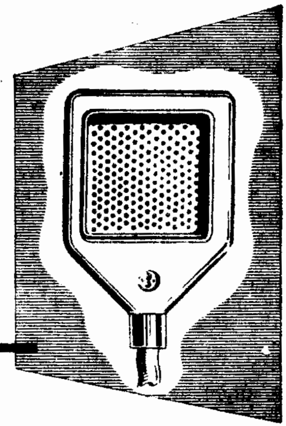

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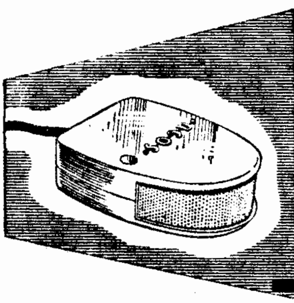

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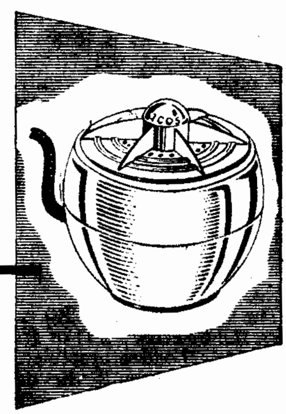

HAND or DESK MICROPHONE, MIC33

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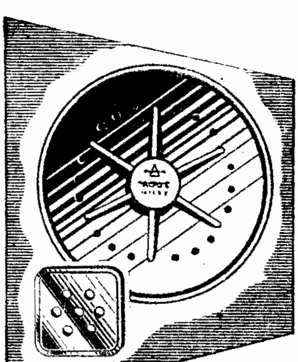

(MIC32 illustrated)
(MIC23 illustrated)

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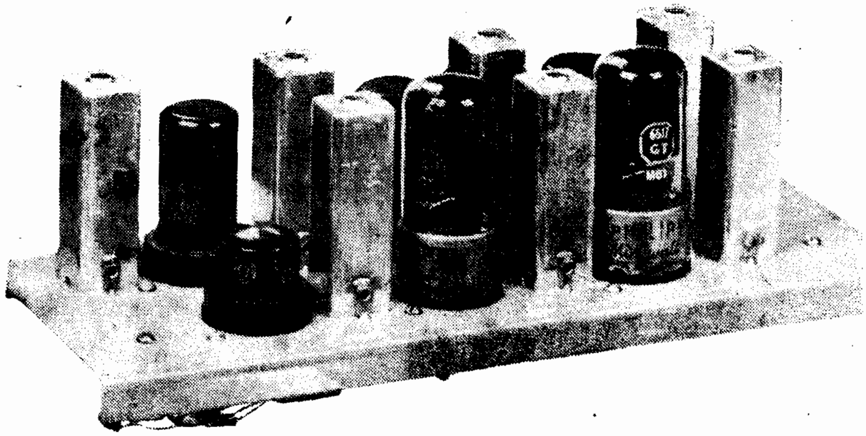


Photograph of the finished strip ready for installation.

If there is any departure from an ideal response it is quite in order to indulge in a little intelligent "fiddling" to tidy it up. Keeping in mind the frequencies of the various windings, it is not hard to pick the one most useful to correct a particular fault. T4 is often most useful for "tilting" the entire pattern if it should have a marked lean one way or the other.

VARY DAMPING

Also, in stubborn cases, it may be profitable to modify the value of one or more damping resistors to increase or decrease the influence of a particular winding if this should appear to be desirable. But if any great variation of resistance seems called for, check back on your coils.

The second method of alignment assumes the use of a signal generator and output meter. Unfortunately most service oscillators do not extend beyond 30 Mc. and, although it is possible to use harmonics, there is always the risk of ambiguity. We must, therefore, assume that the reader at least has access to an instrument covering the range from about 25 to 40 Mc.

Ideally this range should be available in the one band and output should be essentially constant over the range required. Alternatively a grid-current meter or similar indicator should be available to permit some allowance to be made.

The output meter may be the usual multimeter type connected in the plate circuit of the 6V6 video amplifier. However, it is important to take precautions against instability and connection should be made through 10K isolating resistor, by-passed with a .01 mfd capacitor.

In order to provide a reasonable margin against overload, we found it desirable to set the output meter on the 10-volt range and to limit the voltage indicated on the scale to 2 volts, the generator being adjusted to limit each peak to this value as the coil is adjusted. The contrast control was advanced approximately half-way.

The generator is coupled into the various "A" points in exactly same manner as described for the sweep generator, though the substitution of the resistor for the preceding coil is more important in this case.

The generator is set to the frequency nominated for either the bifilar winding or trap, and the appropriate core adjusted for either a peak or dip respectively. Since some slight interaction between bifilar and trap windings is inevitable, each adjustment should be checked a couple of times.

CORE LOCKING

It is also desirable, as each core is adjusted, to apply or fit whatever form of core locking device you intend to use. It is rather frustrating to complete a complex alignment procedure, only to realise that each core has to be removed in order to cover it with locking compound.

An important point to watch is the possibility of obtaining false peaks, particularly towards the front end of the strip. For example, if the core in T1 should be accidently set to 35.5 Mc instead of 32.5 it will create such a large peak at 35.5 that there will also be a measurable rise at 32.5 and to which the generator is set. On the output meter it will look exactly like a peak at 32.5.

If the final "curve," as checked in a manner to be described, shows gross distortion, or there is a tendency to oscillation, check this point very carefully. In general, the strongest peak will be the correct one.

When the spot adjustment is complete it should be possible to make a useful assessment of the response shape by sweeping the generator over the band and noting the readings on the output meter at various points. Correction should be made for varying generator output if necessary.

RESPONSE CHARACTERISTICS

An ideal response would have the following characteristics: A level response from 32 to 35 Mc or, at most, a slight dip in the centre. At 35.5 Mc the response should be not more than 3 db down (a fall to .707 of the reference voltage) and at 36 Mc, 6 db down a fall to .5 of reference). It should be virtually zero at 37.5 Mc.

At the other end it should be not more than 3 db down at 31.5 and fall rapidly to something between 1/10 to 1/20 of reference at 30.65. At 30.5 there may be either a slight rise or a level response, but which is relatively narrow and takes careful observation to assess fully. From about 30.3 the response drops fairly rapidly to zero.

With a little practice it is surprising how adept one becomes at visualising the curve and working out the most likely corrective measure. However, when you do decide to modify one particular setting, don't be too heavy handed. A quarter-turn can make a marked difference to a response curve. Also, note carefully the setting of the core before moving it, so that it can be restored easily if it appears that the correction is not effective.

Just how good the final curve will be depends to a large extent on the amount of time one is prepared to spend on the job, and a couple of hours at this stage may well mean the difference between a curve which is just good enough and one which is much closer to optimum.

The final method assumes the use of a grid dip oscillator. We feel that this method is going to be very popular for the simple reason that far more of us have these available than have signal generators extending above 30 Mc.

Constant output is equally important in this case, but not so easy to ensure. The best idea seems to be to locate the required range near the centre of the band and to work out a form of correction curve using the grid current as indicated on the meter as a guide. It may well be worthwhile winding a special coil to cover this band.

In any case, whether using an existing band or a new one, every effort should be made to achieve the highest possible accuracy, and a check against some better standard is a good preliminary step. At least you should be sure of your calibrations at the frequencies shown on our illustrated response curves, which should be used as checkpoints.

In general the technique is the same as that already described for the generator, the two main differences being the type of output meter and the method of coupling to the various circuits.

Since a GDO is normally not modulated, it is not possible to use the conventional output meter. Instead, we used a 1 mA meter connected between the earthy end of the video detector load resistor (4700 ohms) and chassis. In our case a reading of 160 microamps (1.6 volts on the 10 volt scale) was equal to 2 volts on the output meter set-up already described.

WORKS WELL

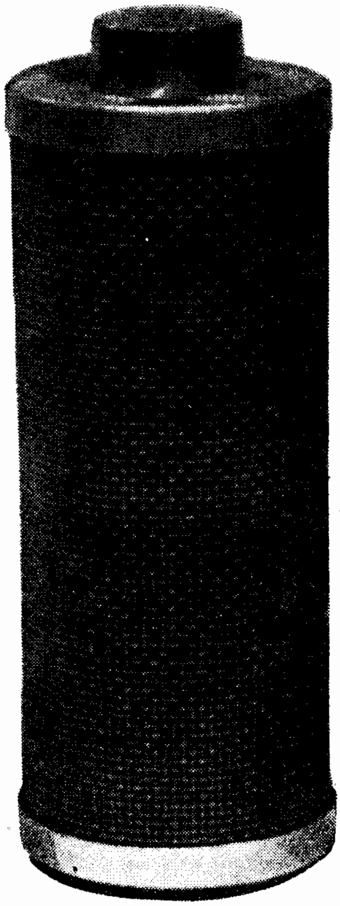
This form of output meter is very satisfactory and even easier to fit than the previous arrangement. Since it does not involve extending leads carrying high levels of video signal, the risk of instability is considerably less. There is no reason why it cannot be used with the signal generator method already described, and many may prefer this arrangement.

Since the radiation from a GDO is normally high, and there is no attenuator, the level can be controlled only by varying the distance between it and the appropriate circuit. In our case we coupled into the first two circuits by placing the GDO coil against the temporary grid resistor.

As we moved towards the front end and the gain increased it became necessary to increase the distance, something like six inches being necessary between the coil and the mixer valve for the final adjustment.

After the coils have been set, the same assessment of the overall shape should be made as described for the signal generator, and obvious errors corrected. Once again, the more time you

(Continued on page 91)



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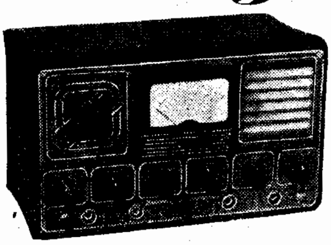

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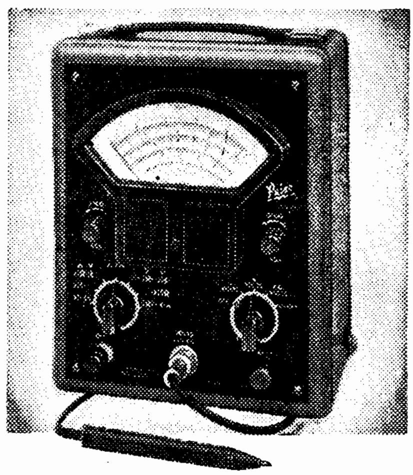

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HISS IN HIGH-GAIN AMPLIFIERS

Hum, instability and noise are problems which are always "just around the corner" with any high-gain amplifier. The first two have been discussed at considerable length from time to time and provided against by filtering and layout. But what of background noise or background hiss, as it is often described?

BACKGROUND noise—or hiss—in amplifiers can be due to a variety of causes but usually stems from one only—high overall gain, capable of amplifying noise in an early valve to an audible level.

The less frequent causes of noise include supersonic oscillation, "noisy" resistors and valves which are actually faulty.

Supersonic oscillation in an amplifier does not necessarily produce noise but it can be a contributing factor. It is most easily checked by means of an oscilloscope but will also show up, as a rule, if a multimeter set to 10 volts A.C. is connected across the voice coil terminals.

Any deflection of the pointer in the absence of input or with the volume control fully off is an indication of output at some supersonic frequency.

Quite apart from any contribution to noise level, supersonic oscillation is likely to have a most damaging effect on distortion and power output and must be eliminated at all costs. It may involve rearrangement of wiring, the use of grid, plate or screen stoppers, or amendment to the feedback circuit.

HF OSCILLATION

If there is any suspicion of supersonic oscillation in an amplifier, it should be eliminated before attempting to reduce noise level by other means. It may be a contributing factor or it may be the major cause.

Grid and plate resistors associated with the preliminary stage (or stages) can produce noise if the resistance of the element tends to vary erratically with temperature or the passage of current. Since resistors are relatively cheap, the simplest check is to replace them with new ones, possibly of another make.

High stability, low-noise resistors are available in limited quantities but their use is seldom warranted in domestic amplifiers. Provided they are not actually faulty, standard type resistors do not appear to be a frequent source of embarrassment in such equipment.

Valves which are actually faulty can also cause background noise due to leakage between electrodes or pins, while similar trouble can come from sockets which have been contaminated by soldering paste.

In general, faulty resistors, valves and sockets are fairly rare as a source of noise. When it does occur, the resulting noise usually has an erratic "frying" or "scratching" quality, easily associated with an intermittent circuit.

It is quite distinct from the smooth, high-pitched hiss, which is the more usual source of complaint. This can be caused by supersonic oscillation but, as we said earlier, is more usually the product of high overall gain and electron movement within the first or possibly the second valve.

If the movement of electrons between cathode and plate was completely smooth, there would be no resultant noise. In actual fact, the electron flow in a valve is anything but smooth.

The number of electrons passing to the plate at any one instant is affected by the rather erratic way in which they are emitted from the cathode surface. The flow, furthermore, is subject to some disturbance by the intervening electrodes.

VALVE NOISE

This somewhat erratic electron flow produces a "noise" signal, which has frequency components extending from the audio spectrum right through to very high radio frequencies.

It is a problem in high-gain audio systems, in short-wave communication receivers, and in television sets, where it produces "snow" on the screen.

Valve noise can be combatted to an extent by careful design and by quality control but it cannot be eliminated. If the gain of an equipment has to be made very high in an effort to amplify weak input signals, then the noise problem must inevitably arise.

Anyone who has used microphones, particularly low output types, will need no convincing on this point.

And this brings us to a very practical observation about current Hi-Fi audio practice.

In an effort to secure lower groove loading, lower distortion and flatter overall reponse, the designers of many gramophone pickups have been prepared to sacrifice a great deal of signal output voltage, getting down towards "microphone" level.

MORE AMPLIFICATION

This has been accepted readily enough by high fidelity enthusiasts, who have provided the additional amplification necessary in their playback equipment, along with frequency correction. The current popularity of "Control Unit" is evidence enough of this trend.

Pickups with a nominal output of 100 or even 50 millivolts present no great worry, because the degree of amplification necessary to bring this to full listening level does not—or need not—reach the figure where valve noise is an urgent problem.

Some pickups, however, have a nominal output nearer to 10 millivolts and, while more than this may be available on peaks, it does call for a very high order of overall gain. Valve noise, along with hum, microphony and stability all become immediate problems, as a result.

While many Control Units, commercial and otherwise, are equal to the task, they are virtually "limit" designs. Whether a pickup requiring such gain can be regarded as completely practical and satisfactory is open to considerable debate.

It may well be argued that a pickup intended for domestic use should not call for "studio" amplifier techniques.

In some cases, where the natural output from the pickup is very low, the manufacturers make available a suitable high-quality step-up transformer to bring the output to a more convenient level. Such a transformer is an asset but will also be costly, if it is not to prejudice performance or pick up mains hum.

The "Playmaster No. 6" is a typical Control Unit having very high overall gain, and capable of working with very low output pickups.

It uses two type EF86 low-noise pentodes in cascade. The first provides pre-amplification with facilities in the plate circuit for compensating various recording characteristics. The second affords additional gain, with provision in its plate output circuit for variable bass and treble control.

VERY HIGH GAIN

The volume control is between the two stages and the overall gain with this fully advanced is very high. Under these conditions, some background hiss is only to be expected but it would normally not be apparent with the amplifier actually reproducing a program.

Retarding the control would reduce both program and hiss level alike, thereby maintaining an acceptable signal-to-noise ratio.

What does cause misgiving is a hiss level which persists even with the gain control turned right off.

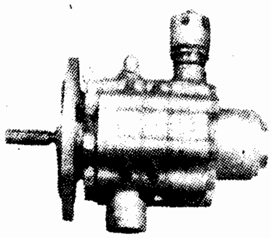
In a control unit patterned along the lines of the No. 6, turning the gain control off isolates the first stage completely, so that any hiss which remained would be attributable to excessive gain AFTER the volume control. This would include the second EF86, the whole of the main amplifier and the loudspeaker.

To include the loudspeaker may, at first, seem rather surprising but it does have a definite bearing on gain and noise level of an amplifier system.

Over the past few years, the sensitivity of speakers in all price groups has progressively increased, particularly in the treble register. If, in addition, the speaker happens to have a prominence or peak in this region, the difference may amount to many decibels, as compared with earlier types.

As far as hiss level is concerned, an increase of two or three times in overall or treble sensitivity is equivalent to a similar increase in amplifier gain.

Thus an amplifier which may be judged as acceptable when feeding a



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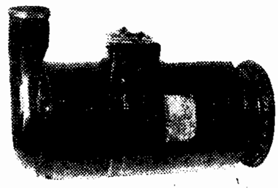

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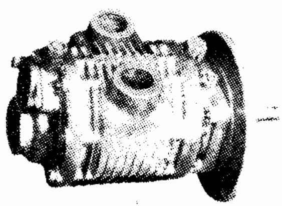

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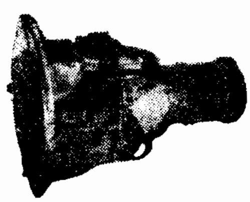

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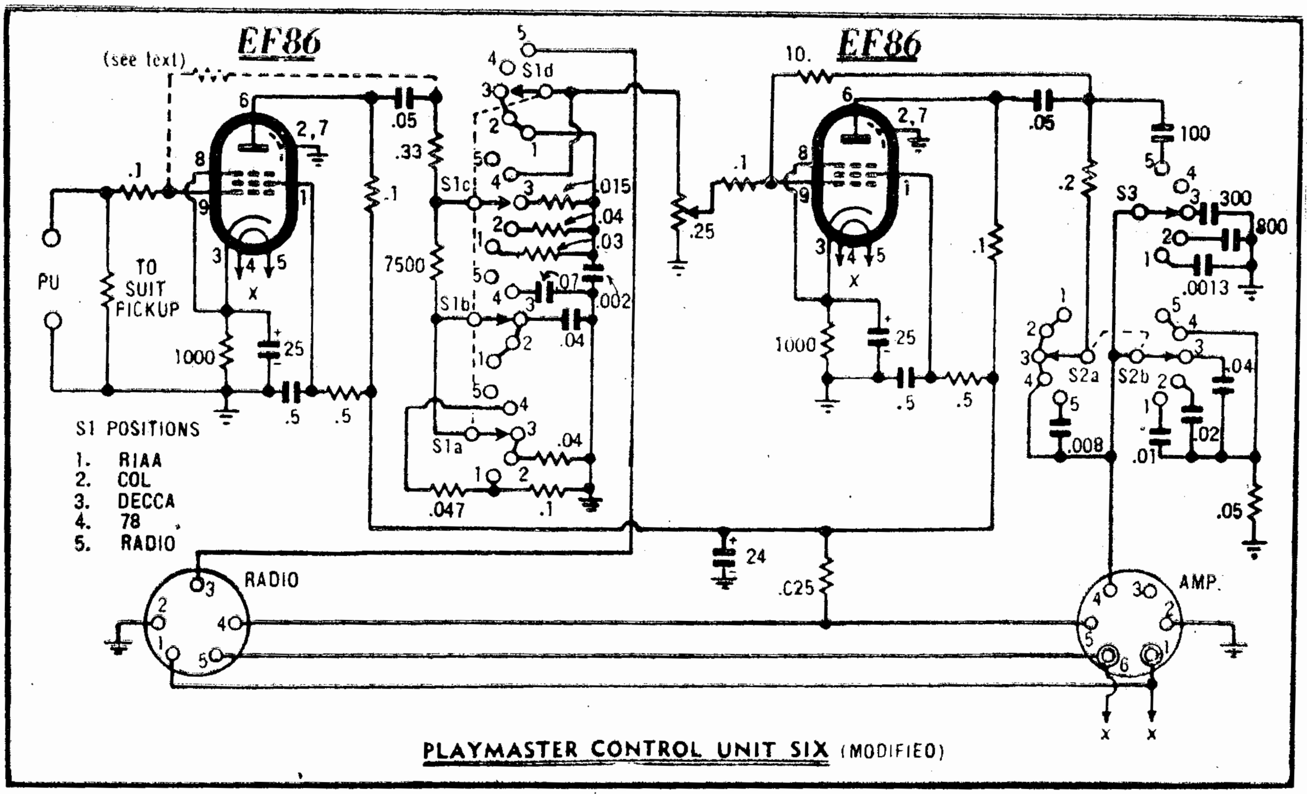


The Playmaster Number Six Control Unit has high overall gain and is suitable for use with very low output pickups. The gain of individual stages can be varied by means of the feedback resistors shown dotted. Heavy feedback around the second stage will combat hiss with the gain control fully off.

modest or a "flat" speaker, may not be so, if connected to a more sensitive speaker or one with a peak in the middle or upper register.

The size of the room also plays a part and may deteriorate the signal-to-noise ratio, because a small room obliges the listener to sit closer to the speaker and operate it at a lower signal level.

AMPLIFIER GAIN

The gain of the basic amplifier is itself subject to a good deal of variation. As a general rule, basic amplifiers are designed to give full output with a RMS input of something like 0.3 volt but the figure is only an approximate one. By reason of variation in design and component values, it can easily lie between half and double this figure.

But this is not the end of the story. Even assuming the same input sensitivity, "full output" may be 4 watts for a small amplifier or 30 watts for a large one, representing a ratio of 7/1 in power or 2.6/1 in voltage gain.

For a given small input signal therefore, whether it be program or noise, the large amplifier will produce more output by the above ratio —because it has more gain!

Remembering that the preamplifier itself will be subject to some variation, it is obvious that the overall gain of an amplifier system may vary by a factor of several times, depending on the components and units from which it is put together.

If the system has been designed to have only moderate gain in the first place, the variations may pass unnoticed. On the contrary, if the gain is very high in the first place and circumstances conspire to increase it still further, it may easily reach a level where valve noise is evident.

While all this is interesting enough by way of general discussion, the listener is naturally much less concerned by what causes the hiss as how to reduce it.

If there is any suggestion of supersonic oscillation or faulty components, the necessary corrective measures should be taken but, after that, it is largely a question of gain.

By and large, the overall gain of an amplifier system need not be any higher than is necessary to ensure the maximum required sound output from the smallest anticipated input signal. Any gain over and above this is quite useless and may only aggravate the noise problem.

REDUCE AFTER CONTROL

As a further general rule, it is better to reduce excess gain AFTER the volume control rather than before it. This will minimise the risk of the control itself becoming noisy in operation but, more important, will help ensure that the equipment is completely silent with the control in the fully "off" position.

In the case of the No. 6 Control Unit, the distribution of gain can be varied very easily. Provision is made to connect a feedback resistor around each stage and the gain can be reduced drastically by simply reducing the value of the resistor.

With very low output pickups, the best idea is often to remove all feedback from the first stage, allowing it to run at full gain. With such low input, the distortion level with or without feedback will be very low.

However, by operating the first stage at full gain, it may then be possible to reduce gain elsewhere in the system and the obvious place to start is with the second EF86. It is simply a matter of reducing the value of the feedback resistor until the gain is not more than necessary to drive the amplifier to the required output with the minimum available signal.

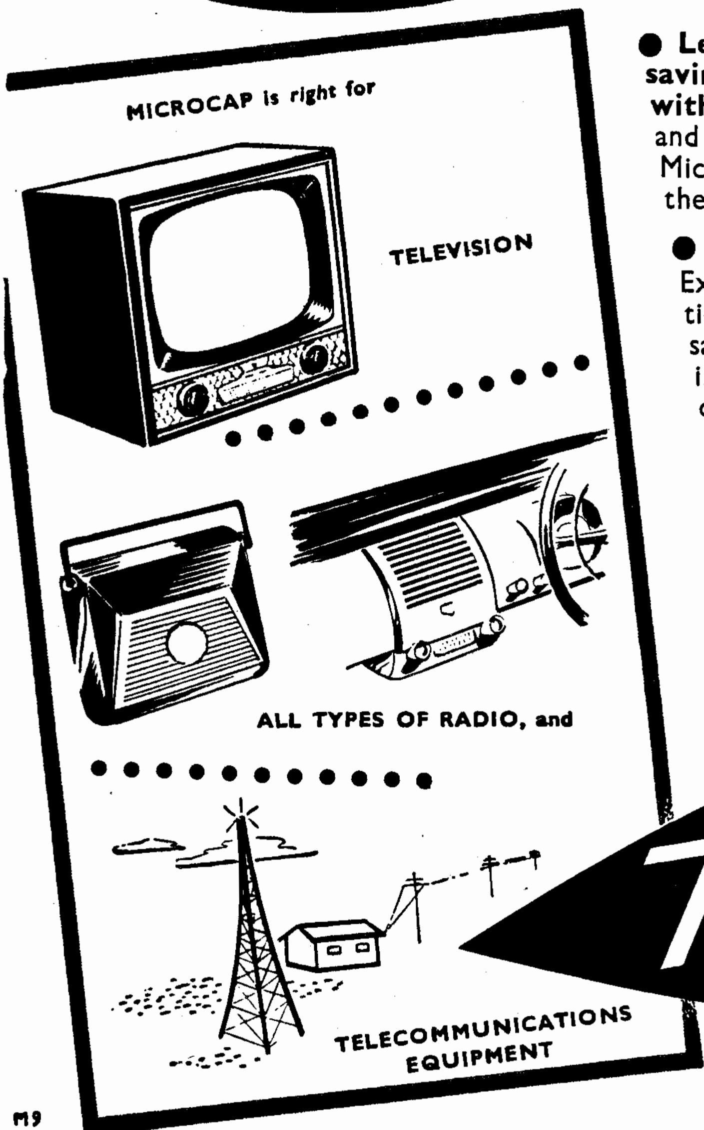
As often as not, a simple redistribution of gains as suggested will ensure that the amplifier is quiet with the gain control turned off. Any hiss which may be present with the control advanced is generally masked by the program itself. In any case the noise margin under these conditions is largely a function of the signal level — whether it is high enough to ensure a reasonable signal-to-noise ratio.

The chance of noise being encountered with other two-stage control units is less than with the Number 6 because, being designed for higher output pickups, their gain is naturally lower. However, trouble can occasionally occur.

NO. 4 IN PRACTICE

By way of example, the original Number 4 Control Unit is currently being used by a member of the R. TV and H. staff, in association with the 17-watt Playmaster and a 3-speaker system. The background hiss is audible only in complete quiet a few inches from the speaker. Connected, instead, to single speaker having higher sensitivity or a more peaky treble response, the hiss becomes evident to varying degrees, indicating the importance of the speaker, as mentioned earlier.

As before, a reduction in gain of the second stage will effect a proportionate reduction in hiss level and one means of accomplishing this would be to insert



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an isolating resistor in series with the grid lead, applying feedback in the same way as for the No. 6 Unit.

Two other means of reducing the gain of the system suggest themselves and are worthy of mention, both to establish the possibility and to warn of complications.

The first is to instal a 1.0 meg. potentiometer adjacent to the input plug of the main amplifier. One side is earthed, the other goes to the signal lead from the Control Unit, while the centre lug joins to the input grid of the main amplifier.

Turning the control full on allows the system to operate at normal full gain, while retarding the control reduces the proportion of signal fed to the main amplifier. It also reduces in the same proportion any valve noise introduced by the second stage in the Control Unit.

SUITABLE SETTING

By experiment, it may be possible to find a setting for the control which will still leave adequate overall gain but reduce the hiss level to an acceptable figure. Once set, the auxiliary potentiometer need not be touched further.

The weakness of the scheme is that it can lead to overload distortion, if used unwisely or to correct gross inequalities of input and gain.

Obviously enough, as the pre-set potentiometer is retarded, the Control Unit has to supply an increasing output voltage to drive the main amplifier to full output. A condition could ultimately arise where the Control Unit reaches overload on peaks with the main amplifier still not fully driven.

With a sensitive main amplifier, requiring say 0.1 volt input, the pre-set control could give a 5:1 attenuation and still only call for half a volt from the Control Unit. But a 5:1 loss ahead of an insensitive amplifier may require 2 or 3 volts of signal, with a consequent rise in distortion.

For all that, the idea is a useful one and well worth a trial in a difficult case.

To check the functioning of the new control, the best approach is to put on a heavily modulated record and operate the amplifier with the new control full on and the normal volume control in its usual position.

SETTING THE CONTROL

Taking note of the general quality, the extra control should then be gradually retarded and the normal volume control advanced to maintain full listening volume. The chances are that relative settings will be reached where distortion will become evident on signal peaks, indicating that the Control Unit is being overloaded.

Note, for reference, the position of the pre-set control where overload occurs. It should then be advanced again, as far as possible from the position, consistent with an adequate reduction in noise level.

A further obvious method of reducing gain is to increase the feedback in the main amplifier, generally by reducing the value of the feedback resistor.

If the feedback initially is not more than about three times (10db) then a further 2:1 reduction of gain by this means is safe enough. This will halve the gain and sensitivity of the system and possibly effect the necessary reduction in hiss level.

Where the feedback is already in the 16-20db region, additional feedback should be added only with caution, because of the risk of HF instability or, at least, ringing tendencies on transients. Ideally, heavy feedback should be used only where facilities exist to check on these things.

If circumstances indicate that a large reduction is necessary in the main amplifier gain and it cannot be reduced in other ways, it may be best to reduce the gain of the first pentode by reducing the value of its plate load resistor. The feedback can be adjusted at the same time to maintain the usual 15-16db.

FEEDBACK VALUES

In an extreme case it may even be worthwhile to rewire the first pentode as a triode, again readjusting the feedback.

The order of feedback present can be checked easily enough with the aid of a multimeter and any source of constant tone input.

Disconnect the feedback, connect the multimeter as an output meter to the voice coil or output plate circuit, setting the signal level and range to give something approaching full-scale deflection of the pointer.

Note the reading, connect the feedback and take a new reading. The factor by which the output voltage is reduced indicates the order of feedback. A 3:1 reduction is about 10db, 4:1 is 12db, 5:1 is 14db, 6:1 is 16db and 7:1 is 17db.

As distinct from the very high-gain Control Units, like the number 6, hiss is sometimes encountered with "crystal type" Control Units like the Number 7, as illustrated above.

This general circuit arrangement, which has become popular both locally and overseas, is intended for use with crystal pickups. It is distinguished by the fact that all tone compensation is accomplished immediately after the pickup.

This arrangement reduces drastically the signal level available to the amplifier, necessitating the use of a high-gain preamplifier valve, in this case an EF86.

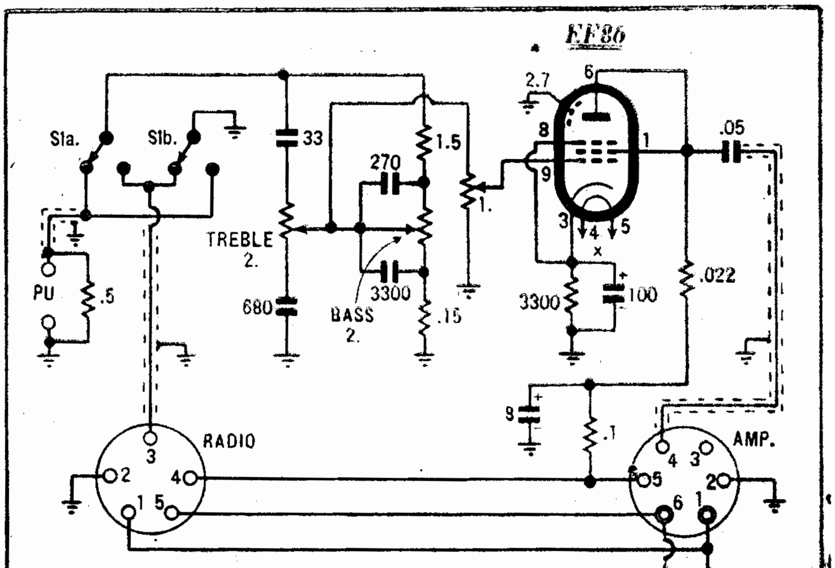
Since the volume control is ahead of this valve, any hiss introduced by the preamplifier is apparent, irrespective of volume control setting.

Provided the gain of the whole system does not exceed a certain critical maximum, the hiss level will not be troublesome but any increase in gain, due to the factors listed earlier, may render it objectionable.

The trouble is particularly likely to occur with Control Units in which the EF86 is wired as a pentode—a connection which was deliberately avoided in the "R, TV and H." design.

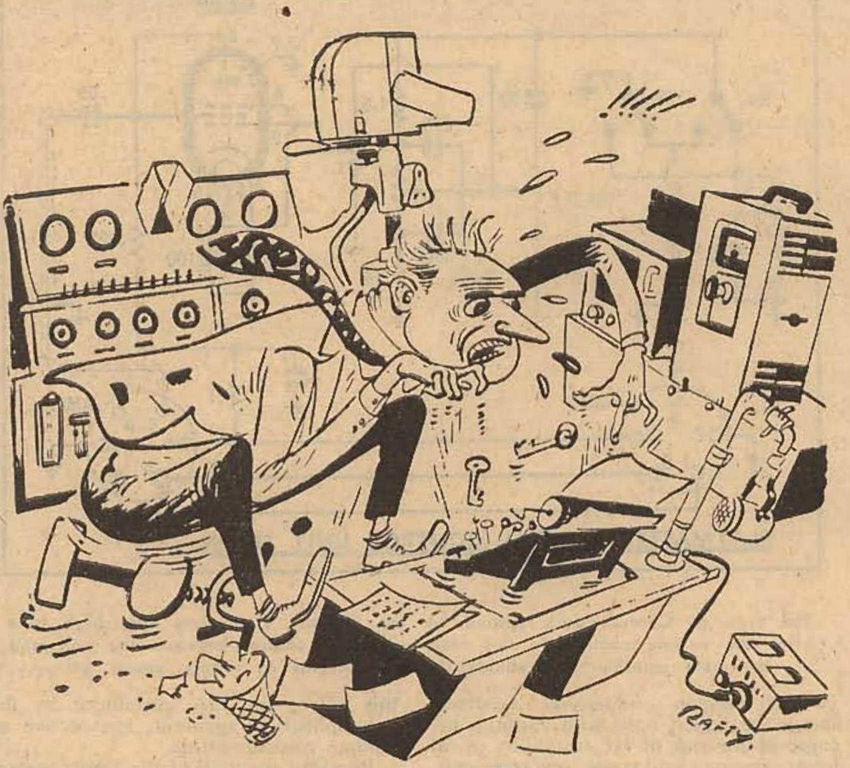
The obvious course with a Number 7 or similar control unit is to use a pre-set potentiometer between the unit and the main amplifier. Since the full output from the plate of the EF86 is available, a large reduction factor is possible in a potentiometer before there is any danger of the EF86 overloading.

In this respect the unit differs from the Number 6, where the plate output of the second valve is already divided down by the tone compensating circuit.



PLAYMASTER CRYSTAL CONTROL UNIT SEVEN

The type of Control Unit typified by the Number 7 involves very high gain after the volume control. In this case, a pre-set control between the unit and the main amplifier is probably the best scheme to reduce excess gain.



Let's Buy An Argument

One of the questions most frequently asked these days in radio circles is this . . . "Television programs, are they any good?" The answer is: "No, they're terrible," supplied in most cases by people who DON'T own a television receiver. Peculiar, isn't it?

by Neville Williams

IN making this statement, I haven't the slightest intention of backing and filling, because I know it to be perfectly true. Times out of number I've had to listen in on conversations about television programs and heard them condemned in the most forthright manner.

Times out of number I've waited the chance and popped the question, "How long have you had your set."

The answer, as I said, has come back. "I don't own one and I don't want to own one.

"I've seen all the television I want to see at the club" . . . (or the pub).

HAVEN'T SEEN ANYTHING

To those readers who may think this way, may I suggest kindly but firmly that anyone who has watched television only in a club or a pub, hasn't yet seen and used television as it's intended to be seen and used. They're not in a position either to appraise or to condemn.

In fact, I'll go so far as to say the same thing about anyone who has only watched television in the house next door. You still can't judge its appeal.

Why not?

Well, think what happens when a television set is operating at the club or pub. It's over there against one wall, producing pictures on the screen and issuing noises relevant thereto. According to the whims of those present, it either stays on the same channel for hours on end or is flicked from one program to the next in a search for something that might catch the fancy.

Half the people in the place are completely pre-occupied with their own activities, offering spirited competition to the TV set in both spectacle and noise. What chance has any program of building atmosphere in such surroundings? And how can one judge any program without atmosphere and even continuity of attention.

Divorced from their context, the emotings and posturings of any actor — or actress — are apt to look rather ridiculous.

But what of viewing in a friend's home? Well, think again what happens.

Even if they only live next door, your visit has to be the subject of mutual arrangement. You've "gone out" to see television and your arrival, behaviour and departure are all subject (we hope) to social conventions.

A night which is mutually suitable may not be the best one, as far as programs are concerned. If the program is only mediocre, you certainly don't suggest to the owner that he try something else. Nor will he do so, unless it's obviously unsuitable, in case you should happen to be interested in it. So both parties politely tolerate the mediocre.

You therefore decide that you don't like the programs, quite oblivious of the fact that something really interesting has been happening on another channel, or will happen on a night when you can't invite yourself in next door.

With a set in your own home, these problems just don't exist. You may look at the papers, decide on a particular program, then not like it very much. There isn't any question of politeness . . . you just change the channel or switch off and do some odd job around the house which needs attention.

An hour later, with your shoes resoled and your pants presed, you might try another program but here's the point: You don't go to bed with that guilty feeling that you've wasted the whole evening. You've soled your shoes, haven't you, and pressed your pants and fitted in some entertainment as well?

POLITENESS TRIUMPHS

But that kind of adaptability isn't possible when it involves the neighbour's set next door. Politely, you tolerate the unacceptable.

And there'll be other times, after a few hours behind the lawnmower, that you wouldn't be dragged "out" with a team of horses. You want to sit and relax. That's just the time when you can get the maximum of pleasure from the minimum of subject matter—when it's just in front of you, at the flick of a switch.

Who cares whether it's a quiz or a whodunit or a sporting roundup? You can probably take your pick, anyway.

Until you use television that way, well—you just don't know television. You're not in a position to say whether the programs are adequate or not.

And what about the programs?

So often they're dismissed, again by "the unitiated" as a compilation of quizes documentaries, old films and American whodunits. That's a smart and very damning definition, but it isn't necessarily a just one, because it happens to be reasonably accurate.

It's reasonably accurate to describe a glamorous lass as a compilation of so much water, so much carbon, etc., but, oh brother, what compilations seem to get around these days!

The fact of the matter is that some of the quiz and audience participation shows are quite entertaining.

Some of the whodunits are interesting and well produced.

And plenty of the old films are just as good as the fare currently being served in local cinemas. Does it really matter if the characters look ten years younger than we know they are? In some cases, it's a jolly good thing!

Last evening, for example, I sat through two such films, both features in their day and occupying, with a 10-minute break, the entire evening. I thoroughly enjoyed them.

There are two or three more films scheduled for the rest of the week, but they're not my meat. Nor am I worried in the least; in fact I'm rather glad. I just don't have the time nor the inclination to spend every evening in front of a television set watching films, even if they were current hits.

Nor, for that matter, would I want to spend every evening watching a symphony concert, as televised recently by Channel 2. After all, symphony concerts are just as time-consuming as films.

NATURAL SELECTION

All of which, of course, is simply a roundabout way of admitting that the programs are patchy, just like those in the local cinema or anywhere else, variously suiting one person or another according to taste.

But, by the time one exercises natural selection and fits the wanted programs in between everyday commitments, there are plenty of interesting things to watch. Too many, in fact!

Perhaps that's why the people who own a television set have least to say in criticising the programs.

From R.J., in Charleville, Qld., comes a letter which looks quite alarming at first glance. Apparently we have been guilty of ignoring definitions which have appeared in valve books for years and we likewise ignore criticisms, giving publicity only to those who say nice things about it.

The last charge might be rather hard to sustain, I feel, because we've published and answered a lot of critical letters in these very columns over the past few years. As for the "Correspondents" page, however, we haven't tried to keep any statistics of readers "for" or "against."

All we know as a staff is that, no matter how hard we seem to work at it, there's always a full basket of letters waiting to be answered. Somehow they have to be fitted in between the more urgent problems of building, testing, writing and drawing. Frankly there isn't much time either to preen, or to get hot under the collar.

DIDN'T LIKE OUR ANSWERS TO "TOM"

Dear Sir,

I note with interest your "Answer Tom" feature in last month's issue of R. TV & H., especially that portion dealing with class, A, AB1, AB2, B, and class C amplification. I would refer you to the "Radiotron Designers Handbook," fourth edition, pages 545 and 572; the "Radiotron" valve data book series RV2, pages 5 and 6.

It will be seen that the class of amplification refers to the particular plate current and grid voltage only. Grid current does not enter except as a subscript 1 or 2.

Your definitions are misleading, and in the case of class AB1, wrong. A class B amplifier stage does not necessarily draw grid current, although it usually does, and should be referred to then as B2 stage.

I note also your habit of acknowledging praise from readers in your "Answers to Correspondents" but failing to acknowledge any criticism offered.

Yours faithfully,
R. J.
Charleville, Qld.

In actual fact, where remarks are made at all, the vast majority of them are complementary to what we are trying to do. Readers tell us about successful constructional ventures, knowledge gained after so many years' reading, pleasure obtained from using equipment, etc — generally as a preamble or a postscript to some immediate request.

Perhaps they are trying to be politely encouraging. Perhaps they prefer to be modest about their failures. They may even mean what they say but, whatever the explanation, you can hardly blame us for making some formal acknowledgment of their remarks.

WHAT ABOUT TV?

Of course, we do have critics. About 12 months ago, some readers were quite impatient about our apparent inertia over constructional television. We seem to remember telling them in the columns, more than once, that we would encourage readers to spend their money only when we thought that the whole project could be properly organised — circuit, supply and price structure.

Well, we stuck to that policy and are very happy that we did so. So are the trade houses, who have to attend to all the tedious detail of getting parts to readers over the counter.

We've been criticised, also, for our failure to publish design data for an all-transistor portable. Interest in this subject at the moment is terrific.

On his way back through America last year, our Editor picked up a number of transistors, as used in current overseas portables. We could spend the time necessary to design a set around those but where could readers get the transistors necessary to duplicate our efforts?

They couldn't.

Only a couple of issues back, encouraged by promise of continuing supply, we put out a couple of regenerative transistor sets. Through unforeseen circumstances, the supply dried up and, right now, the said articles are scarcely worth the paper they're printed on.

That's the kind of thing that makes you weep or drives you to drink, according to your inhibitions or prohibitions.

And then, of course, there are the holders of Restricted Ham Licences, who would dearly like to see some up-to-date locally designed 50 and 144 Mc gear.

So would we, O.M.s. But Ham gear isn't stuff that you just build up and rush into print. You build it up and then use it on the air long enough to find out why it isn't really optimum. Then you rebuild it and try again, describing it only after you're satisfied.

TRYING THINGS OUT

The big trouble is that you can't be "rag-chewing" on the air while you're fiddling with a television set or watching programs or living with a new amplifier or an FM tuner. Perhaps we should add . . . or using a photoflash or a Geiger counter or one of the many other devices we've built up in past years.

Such equipment can only be conceived and assessed against a background of actual use under typical conditions and that means time, time and more time.

But wait a minute. We're a long way off the track, all because R.J. prompted us to recall grounds for past criticism. It's time we got back to the present.

And what about these definitions which are the main bone of contention in R.J.'s letter? Is he wrong or are we wrong or is there more to it than meets the eye?

We shall see.

First of all, the definitions which R.J. quotes are well known, of long standing, and logical in their meaning. Our correspondent is certainly not wrong in quoting them.

He has every right to ask why, to "Answer Tom," we didn't simply quote these definitions and leave it at that. He may well wonder why we adopted the historical approach and explained the terms more or less as they grew up.

The answer is simple enough. For all their apparent logic, the definitions have not supplanted earlier and less precise terminology, even in valve manufacturers' own literature. Whether this is carelessness or Continental bias against American practice or what . . . I don't know. The fact of the matter is that they are honoured as much in the breach as otherwise.

DEFINITIONS?

Perhaps the trouble is simply that the definitions were not sufficiently authoratitive in the first place, reading more like statements of usage than otherwise. One book I have defines classes A, AB, B and C then adds, by way of a note, that suffixes 1 and 2 "may be added" to denote the bias and drive condition.

It then proceeds to list valve data in which the subscripts are variously included or omitted. That's scarcely a good example.

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should cover either class A1 or class A2. However, class A2 operation is so rare that the majority of technical authors and the majority of those who compile valve manuals apparently consider it unnecessary to add a subscript.

As a result, the general term "class A" is used to describe what are patently and specifically class A1 conditions. Our "Answer to Tom" merely acknowledged this common practice, attributing to class A the meaning it has in the majority of textbooks and valve manuals — a linear plate current relationship and no grid current.

But in case you think this is a "wriggle," have a look at what the "Radiotron Designers' Handbook" has to say about class B. Having made the point about subscripts, it adds "With Class-B operation, the 2 is usually omitted, since operation with grid current is the usual condition."

RARELY USED

And this observation is certainly warranted. Only in specific cases, where there is a special point in so doing, will one find any distinctive reference to class B1 and B2. In the vast majority of textbooks and valve literature, the term class B is used to describe what is obviously class B2 operation.

And, as if that's not enough, who has ever seen discussion of class C1 and class C2 amplifiers? In nearly all existing literature the unqualified term "Class C" refers to an extra-cutoff bias condition with drive into the grid current region.

On the basis of usage, therefore, our explanations are probably a good deal more realistic than the "definitions" quoted if, in fact, they are definitions. If our article is to be criticised, it should be for not having gone into this rather lengthy story.

And what about our "class AB1" definition, which R.J. quotes as being definitely wrong. Presumably he takes objection to our statement that "the grids are never driven substantially positive;" it should read "the grids are never driven positive."

WHAT REALLY HAPPENS

On a strict definition basis, R.J. is right and we are wrong. But pause a moment.

In rating an amplifier, it is common practice to quote such things as maximum output, maximum undistorted output, or maximum output for so-much distortion. All these figures are based on the end result, as measured across the output terminals.

I don't recall any published figures of output at grid-current point, as measured on a microammeter, which incidentally may or may not occur at zero grid volts.

In a practical "class AB1" amplifier, its measured and published characteristics may easily involve a small excursion into the grid current region, particularly where the penultimate stage has a low output impedance and a reserve of output voltage.

It was to encompass this rather practical possibility that we quite deliberately included the word "substantial."

WHAT HAPPENS TO AN OPEN GRID?

Dear Sir:

I wish to clear up an argument I have been having with a friend.

If a triode valve has voltage applied to the plate by means of a battery and the grid is connected to the cathode a certain current flows depending on the characteristics and voltage applied.

Now if the grid is disconnected from the cathode and left unconnected, I contend that some of the electrons leaving the cathode reach the grid which, since there is no way for them to leak away, acquires a negative charge. This would reduce the current flowing in the valve. Also, if still more electrons are added to the grid, as by trucking with a highly negative, electrostatically charged body, I maintain that due to the grid going still more negative the current decreases further.

My friend says that in order for any charge in potential of the grid to affect the plate current there must be some connection between grid and cathode. Who is right?

Yours sincerely,
F. H.
Maidstone, Victoria.

So much for that.

From the above letter, it appears that two other people are currently engaged in an argument about valve operating conditions. They want me to settle it.

In point of fact, I'm likely to settle them both because, strictly speaking, they're arguing about a situation that doesn't exist. But let's start at the beginning.

In a practical valve, there are several factors which would influence the potential of an "open" grid.

First and foremost, the grid is situated within the cathode-to-plate electron stream, where it intercepts electrons which would tend to build up a negative charge. The degree to which this charge can build up is limited by the simple fact that electrons are repelled as the charge increases.

GRID EMISSION

A second effect, which may be evident, is traceable to the tendency of a grid to emit electrons. This should not happen, admittedly, but it often does because the grid is heated by radiation from other electrodes and is itself spattered with emissive material from the cathode.

Because grid emission loses electrons from the grid, it tends to produce a positive potential.

A still further complicating factor is the impossible presence of gas in the valve, which is ionised by the cathode-to-plate electrons flow. The positive ions are readily attracted to the grid and also tend to carry it positive.

The relative degree to which these factors are significant depends a good deal on the type and structure of the valve. There have been valves like the old 45 and 47 which were quite famous for the tendency of their grid to "run away" in a positive direction.

The first point, therefore, is that the factors governing the potential of an "open" grid are rather more complex than the contenders have apparently realised.

But why did I put quotes around the word "open"?

Simply because valve engineers assure me that there is no such thing as an open grid circuit. They say that it is rare to find one having an effective resistance higher than 10,000 megohms, by reason of leakage.

Admittedly, this is a lot of resistance but it is still low enough to allow any surplus charge which may have been introduced artificially on a grid to leak away. Therefore, the idea of inflicting a permanent high negative potential on an open grid is not realistic.

WILL EQUALISE

The charge will always tend to equalise at the potential determined by the abovementioned factors for the particular valve.

In actual fact, valve engineers can predict quite closely the resting potential of an "open" grid by drawing a loadline equivalent to the leakage path across the grid current characteristic curves. I've never done it personally but I am assured that it is a perfectly practical procedure.

One point remains to be emphasised.

At any instant, the influence of a grid on plate current is largely a matter of electrostatic fields. Therefore, it is of no great consequence whether the the grid potential is self-generated or applied as a temporary charge while "open" or applied from a low impedance source.

For a certain instantaneous grid voltage, the plate current will be so much and that's that!

FINAL WORD

If there's anything left to argue about, I'd say this:

(1) If the self-generated grid potential of the triode in question is less negative than the normal applied bias, then opening the grid circuit will allow the plate current to rise.

(2) A permanent charge cannot be applied to the grid because there will always be a path by which such a charge will leak away, however slowly.

(3) A potential at the grid will always affect plate current, no matter how derived. A tangible grid-cathode circuit is not necessary for the control effect to be evident.

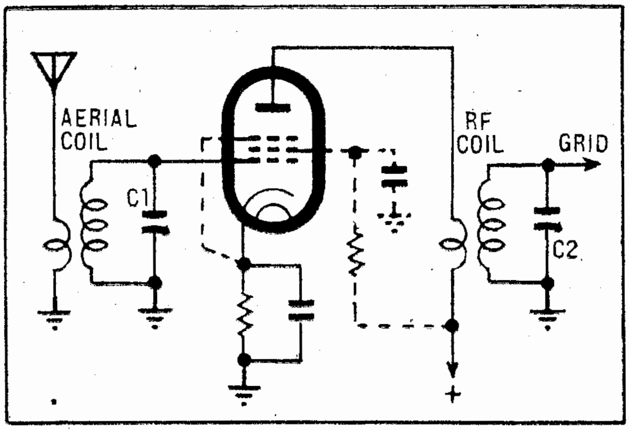

Figure 1: Here is the basic circuit for an RF amplifier stage. Input and output circuit are both normally tuned to the signal frequency, thereby improving selectivity. Early RF stages used triodes but tetrodes or pentodes are much to be preferred.

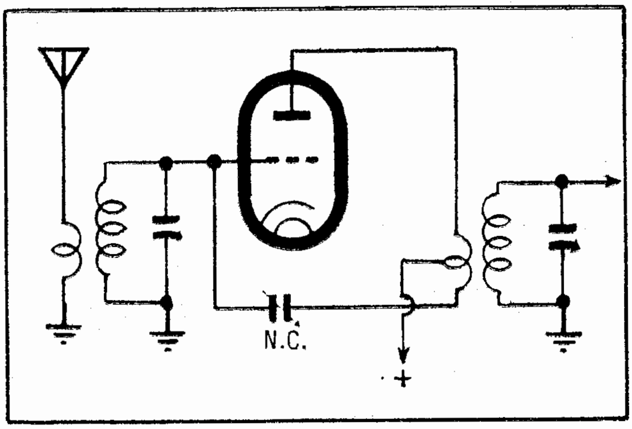

Figure 2: In an RF amplifier stage, triodes tend to be unstable because of their inherently high grid-plate capacitance. This was countered in the early "Neutrodyne" receivers by feeding energy back to the grid, out of phase with that from the plate, through a special circuit.

TRF Receivers and the Superheterodyne

While a beginner may concentrate initially on building small regenerative receivers of the type discussed last month, he must inevitably wonder about the design of larger receivers. In this article, we explain the basic idea behind two well known types of receiver, the "TRF" and the "superheterodyne."

A SIMPLE COURSE IN RADIO—10

IN an article of feasible length, it is not possible to discuss individual circuits in detail — the how and why of every resistor and capacitor. The reader will have achieved something, however, if he can understand the general idea behind these circuits, particularly the superheterodyne.

Having grasped the basic idea, it should be possible to enlarge upon it later by studying the circuit and design information on actual receivers which are described from time to time in these pages.

The TRF and, later, the modern superheterodyne receiver, came as a natural development from the desire to produce receivers which were more sensitive, more selective and more suitable for use by non-technical members of an ordinary household.

Their story is really a continuation of the story told last month about small receivers and it must inevitably read like a piece of radio history.

As we pointed out in the last chapter, a receiver having a regenerative detector followed by two audio stages is capable of receiving a great many stations, both on the broadcast and short-wave bands.

By using a power valve in the final stage, such a set can operate a loudspeaker at good volume on the stronger stations and, in the early days of radio broadcasting, many domestic receivers were of this general type.

For domestic use, however, such receivers have certain basic limitations.

In the first place, performance depends very largely on proper use of the reaction control. If it is too far advanced, the set oscillates, producing whistles in its own loudspeaker and in neighbouring receivers tuned to the same station.

If the reaction control is not sufficiently advanced, perhaps to limit volume, selectivity is likely to suffer to the point where two or more signals are heard together.

While this is no problem to anyone who understands what the controls are for and how they are supposed to be set, it did prove an embarrassment in the early days for non-technical members of the household. Some less critical arrangement was obviously desirable for general use.

Another difficulty with simple regenerative sets lies in the fact that there is a practical limit to the amount of amplification one can provide after a detector. Thus, while one or two audio stages can usefully increase gain and even selectivity (the latter by roundabout means), anything more than this can lead to difficulty.

Slight vibration in the detector valve, causing slight changes in plate current, can be amplified by subsequent stages to produce what are known as MICROPHONIC effects. Tapping the valve, or even normal vibration, may produce thumps and ringing noises from the loudspeaker.

Then again, noise due to electron flow in the detector itself can be amplified to the point where it produces a continuous background hiss. And in mains-operated receivers, very slight 50-cycle or 100-cycle voltages, coupled into the detector circuit from heater and power supply, can produce audible hum from the loudspeaker.

Last, but not least, slight variations in high-tension supply voltage, caused by plate current variations in the output valve, can be fed back as a spurious signal to the plate of the detector. If regenerative, this feedback can cause an effect called MOTOR-BOATING, evident as a regular pop-pop-pop noise from the speaker.

While all these problems can be minimised by careful design, they do set a limit beyond which the detector-plus-audio idea becomes rather impractical.

OTHER MEANS

This limit was reached very early in the history of broadcasting, and designers had to find other means of improving the performance of their receivers. Since additional stages could not be added after the detector, the only alternative was to add stages ahead of the detector and to amplify the incoming signal at its own frequency.

Such stages were known as RADIO-FREQUENCY AMPLIFIER stages or simply RF stages.

Now an ordinary valve will not amplify radio frequency signals very effectively if merely coupled to the following stage by a resistance-capacitance network or by some kind of a transformer.

It will give a great deal more amplification if coupled to the following stage by means of a circuit tuned to the incoming signal frequency.

Figure 1 shows the essential details of a TUNED RF AMPLIFIER.

The incoming signal is fed through a tuned circuit to the grid of the RF amplifier valve. This first coil, connected to the aerial, is normally referred to as an AERIAL COIL. It is connected directly to the grid of the valve, without any capacitor or resistor, because the valve is intended to operate as an amplifier, not as a detector.

For the same reason, it is provided with the cathode (or grid) bias necessary to ensure operation as a class A amplifier.

Signal output current from the plate circuit flows through the primary winding of a second coil assembly, and is coupled into a tuned secondary winding, the two windings forming what is commonly referred to as an RF COIL.

MUST TUNE BAND

The two secondary windings, with their associated capacitors, must be capable of tuning over the entire broadcast band. To receive any given station, both tuned circuits should be set to the frequency of that station.

Under these conditions, the signal from the desired station is selected and passed to the RF amplifier grid, in preference to other signals which may be present. It is amplified by the RF amplifier valve and passed through the second tuned circuit, which also favours the desired signal and tends to reject signals on other frequencies.

In other words, the use of a tuned RF stage not only provides amplification, but it also increases selectivity. This was—and is—a most important point.

Since an RF amplifier stage feeds into a circuit tuned to the signal frequency, this is the only frequency which it can amplify properly. Because there is no load resistor in the plate circuit and no audio transformer, it cannot amplify or pass on signals within the audio range. Therefore, it is not nearly as susceptible as an audio stage to hum, hiss, microphony or motor-boating. This, too, is important.

Many early receivers used one triode RF amplifier stage, a regenerative detector and two audio stages. These were the first "TRF" receivers, the letters indicating the use of a tuned radio frequency amplifier stage.

Such receivers were generally better than earlier types without the RF stage. They had better gain and selectivity and therefore relied to a lesser extent on critical setting of the reaction control. And because there was an amplifier stage between the detector and the aerial, the reaction setting was not affected so much by the type of aerial in use.

CONTROL REMAINED

For all that, the basic problem remained that there was still a reaction control to set, and attempts were made to produce receivers with two RF amplifier stages ahead of the detector, but with no reaction.

Here designers came up against the basic problem which was mentioned in Chapter 6 of this series. They found that, because plate and grid in a triode were side by side, there was considerable capacitance between them and energy was being fed back from plate to grid as a result.

In detector or audio service it did not matter a great deal, but in RF stages, with both grid and plate circuits tuned to the one frequency, the feedback tended to cause oscillation. One low-gain triode RF stage was practicable, but two such stages were almost unmanageable.

A temporary answer to the problem was found in the so-called "Neutrodyne" principle, which enjoyed some popularity in the late twenties. The basic idea is shown in Figure 2.

The primary winding of the RF coil was centre-tapped so that a signal voltage appeared at the lower end similar to but out-of-phase with the signal voltage at the plate end. A small variable capacitor was connected from the lower end of the primary to grid and adjusted to have the same value as the grid-plate capacitance of the valve.

Being connected in this fashion, this so-called NEUTRALISING capacitor fed back to the grid a signal equal to and out-of-phase with that fed back from the plate, so that the two cancelled out. As a result, the tendency to oscillation was overcome and two triode RF amplifier stages became practicable.

The early "Neutrodyne" receivers were, therefore, a special type of TRF receiver, employing the principle of neutralisation.

In point of fact, neutralised TRF receivers did not enjoy a lengthy period of popularity because valve designers came to light with the screen-grid principle. Applied in RF tetrodes and pentode valves, it almost eliminated grid-plate capacitance, and, therefore, eliminated the major source of instability in RF stages.

WORKED WELL

As a result, it became possible to achieve high figures of stage gain, and, furthermore, to use two high-gain stages in sequence. Nor was there any great trouble with instability. By shielding the valves and coils and adopting a layout which kept input and output leads reasonably apart, such a set could remain completely stable, even under full gain conditions.

With such gain available and the selectivity afforded by three tuned circuits, reaction became unnecessary and the familiar reaction control therefore largely disappeared from sets of the day.

By carefully matching tuning coils and adding TRIMMER capacitors across each tuned circuit, designers were able to gang together the three tuning capacitors and operate them from a single tuning dial. This done, domestic receivers became really simple to operate for the first time—one dial to select the station and one knob to control the volume.

TRF receivers reached their heyday about 1930 and their general design followed the pattern shown in the block schematic diagram of Figure 3.

The incoming signal was fed by the aerial to the first RF amplifier stage, then passed to the second RF amplifier stage and thence to the detector. This was followed by a single audio stage,

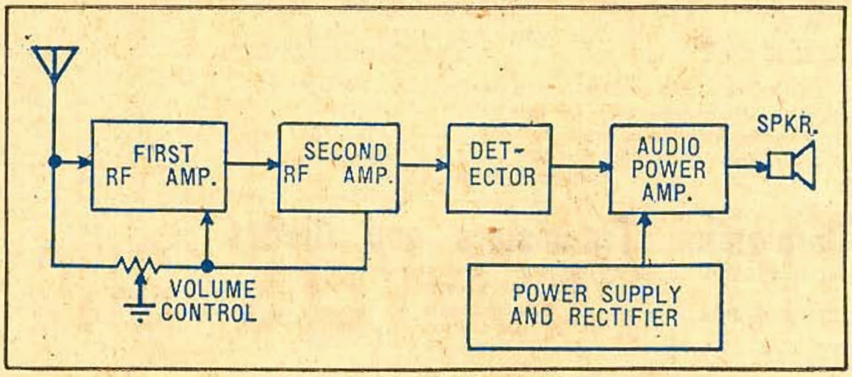

Figure 3: This block schematic shows the sequence of stages in a typical TRF receiver, popular for domestic listening around 1930. In such receivers, the volume control was usually a manual gain control operating in the cathode circuit of the RF amplifier stages.

but, using a sensitive pentode valve, which gave high amplification as well as ample power output to operate a loudspeaker.

Power to operate all these stages came, in mains receivers, anyway, from a power supply built on to the same chassis. This included a power transformer, a rectifier, a filter choke of some description and two or more filter capacitors.

The volume control in such receivers usually took the form of a potentiometer connected at one end to the two RF amplifier cathodes, and at the other to the aerial terminal. The adjustable tapping went to earth.

SHUNTED AERIAL

With the moving arm towards the cathode end, the RF amplifier valves operated with minimum bias and maximum gain, while the amount of resistance between aerial and earth was too high to make any real difference to its efficiency. Adjusting the control the other way applied high bias to the RF amplifier cathode and reduced the stage gain; at the same time it shunted the aerial to ground and therefore reduced the signal input.

It might be thought that the evolution of this standard kind of TRF receiver would have largely halted receiver development in that it provided good gain and selectivity with plenty of acoustic output and simplicity of operation.

But it didn't.

About the same time, many new stations were coming on the air, crowding the broadcast band and ever increasing the demand for selectivity. The limitations of the simple TRF soon became apparent, particularly for the more difficult reception areas.

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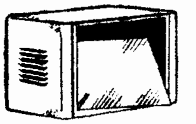

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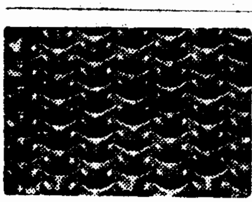

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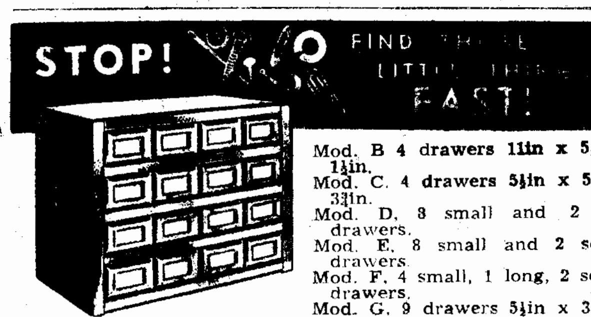

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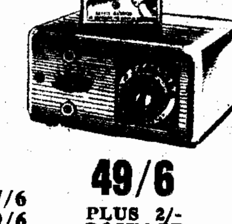

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tuning circuit gave only limited improvement at the cost of much greater complexity — with the attendant risk of instability. There didn't seem to be any obvious way of making tuned circuits much more efficient. To resort again to reaction as an aid to selectivity was unthinkable to a commercial designer.

As a result, they began to look for other basic methods of receiver design, and the one which seemed to hold the greatest promise was the superheterodyne principle. This was not new, having been employed, in a limited way, for many years. But with new valves and new methods it might be capable of transformation. This, indeed, proved to be the case.

VERY POPULAR

Designed around the better valves available, and using a more modern circuit technique, the superhet receiver quickly established itself in popular favour, and has remained in undisputed leadership ever since.

But how does the superhet work? At this point, we can drop the semi-historical sort of discussion and settle down to some straight theory. This is appropriate, because the superhet principle does not yet belong to history. Practically every modern broadcast, communication and television receiver uses the principle.

As the name suggests, the superheterodyne receiver utilises a method of heterodyning or beating two signals together.

It has been found that, when two signals are fed into a non-linear circuit, they combine to produce signal voltages at frequencies additional to and distinct from either of the original input frequencies. Further, that these new frequencies are equal to the sum and the difference of the original frequencies.

Consider, for example, two frequencies which we shall designate as f1 and f2. If fed into a non-linear amplifying stage, it would be possible to detect output voltages, as expected, having the original frequencies f1 and f2. But, in addition, we would find that output voltages were present at frequencies equal to f1 plus f2, and f1 minus f2 (assuming f1 to be the higher numerical value).

Taking an actual case, we may feed signal voltages at, say, 2,000 and 1,500 kilocycles into a non-linear stage. Both original signal frequencies would be present in the output, plus additional frequencies of 3,500 kc/s (2,000 plus 1,500) and 500 kc/s (2,000 minus 1,500).

OTHER COMPONENTS

In actual fact, there may be other frequency components in the output, due to the presence or generation of harmonics, but we can afford to neglect these as being incidental to the main effect.

As we already know, stations on the broadcast band transmit on allotted frequencies between the limits of 550 and 1,600 kc/s. To tune and amplify them on a TRF receiver involves the use of a ganged capacitor tuning two or three matched coils.

There are difficulties in the way of tuning more than about three coils in this way, so that the performance of a TRF receiver is largely limited by the selectivity and gain which can be achieved with three variable tuned circuits.

But, in the superheterodyne, the designers utilise the heterodyne principle to change the frequency of each desired incoming signal to a new prearranged frequency. This is passed to and amplified in a section of the receiver, which can employ any desired number of fixed tuned circuits.

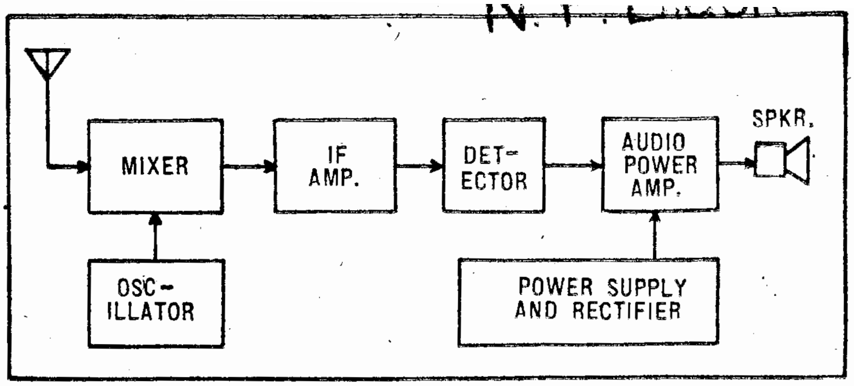

Figure 4: This diagram illustrates the sequence of stages in a typical superhet receiver. Modern practice is to combine the oscillator in the one valve envelope with the mixer. Detector and IF amplifier are also commonly combined for the sake of economy.

The new frequency is usually lower than the signal frequency but still well above the audio spectrum, which is perhaps the reason why it is commonly referred to as the "Intermediate" frequency.

The particular intermediate frequency is selected by the designer to suit his requirements. If high gain and extreme selectivity is the object, he may choose an intermediate frequency of about 200 kc/s. But, with such a low frequency, great care has to be exercised to avoid receiving the same signal at two points on the dial — called "two-spotting" — owing to unwanted heterodyne effects.

An intermediate frequency of more like 2,000 kc/s minimises double-spotting, but requires greater attention to the design of the tuned circuits, if gain and selectivity are not to be sacrificed.

STANDARD PRACTICE

A compromise figure, which is widely employed in this country, is an intermediate frequency (abbreviated to IF) of 455 kc/s or thereabouts.

Assume that a desired signal is on 1,000 kc/s. The first obvious requirement then, is for the tuned aerial input circuit to be resonated to this figure. This is accomplished by tuning the aerial input coil with a variable capacitor, exactly as in an ordinary TRF receiver.

The desired 1,000 kc/s signal is then fed into the "mixer" or "frequency changer" valve. In the output, remember, one desires a frequency equal to the selected intermediate frequency, which one may assume to be 455 kc/s.

Essential for the frequency change is an oscillator valve, which delivers a locally generated signal voltage to the mixer stage. To obtain the desired result, the oscillator would be tuned to 1,455 kc/s — a frequency higher than the incoming signal frequency by just 455 kc/s.

At the output of the mixer stage, one would expect frequency components of 1,000, 1,455, 2,455 and 455 kc/s. But the mixer valve plate invariably feeds directly into a tuned circuit, which would be resonated permanently at 455 kc/s. This one frequency is, therefore, selected and passed on, while the first three mentioned above, together with all other incidental harmonic frequencies, are suppressed.

If the desired signal were on 1,020 kc/s, then it would be necessary to increase the local oscillator frequency by another 20 kc/s to ensure the output at 455 kc/s.

Thus, in a simple superhet, there are two variable tuned circuits. One gives initial selection at the signal frequency, and the other adjusts the local oscillator frequency to a figure which differs from the signal frequency by the selected intermediate frequency.

In the earliest "supers," the aerial and oscillator circuits were controlled by separate capacitors and tuning dials. But, in all modern sets, the coils are accurately adjusted, and the oscillator tuned circuit provided with a "padder" capacitance, so that they maintain the required frequency difference automatically.

Turning the one dial selects the desired input signal and maintains the required frequency difference between the signal and oscillator tuning circuits.

The new intermediate frequency generated at 455 kc/s from the broadcast carrier retains the original modulation, so that it can be amplified and passed on to the detector in the usual way.

PERMANENTLY TUNED

It is here that the advantage of the superheterodyne principle becomes evident. Since each selected signal is automatically transformed to a constant frequency (which we have assumed to be 455 kc/s), the IF amplifier channel may be provided with any desired number of circuits, permanently tuned to the selected intermediate frequency.

Coupling coils between valves may have both primary and secondary tuned, instead of the secondaries only, as in ordinary TRF practice. No variable tuning gang is necessary for this purpose, and the coils may be designed for compactness and efficiency, and thoroughly shielded for stability.

IF tuning circuits are frequently resonated by means of small compression type mica trimmers, adjusted with a screwdriver. Alternative and common practice nowadays is to have a fixed mica tuning condenser and to vary the inductance of the coil by a small adjustable iron core.

Most ordinary superhets employ one stage of IF amplification, involving two double-tuned IF transformers — and, therefore, four tuned circuits. Larger sets may use two IF amplifier valves with three IF transformers, and, therefore, six tuned circuits.

These tuned circuits in the IF channel

Goodmans

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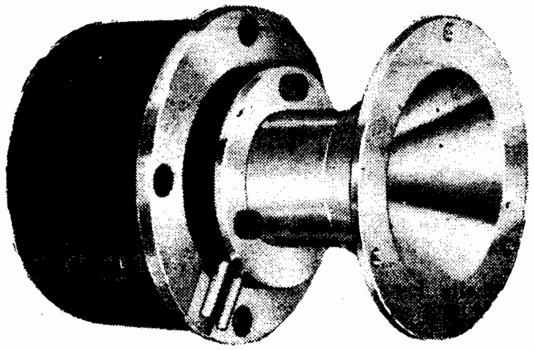
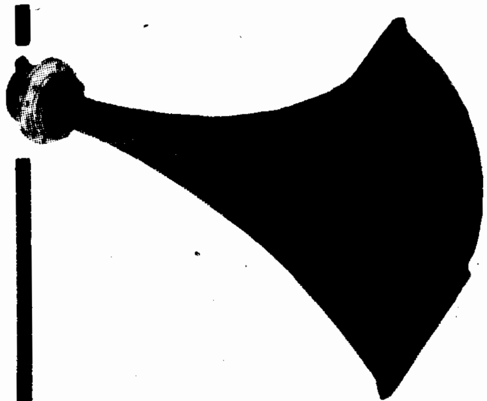


TREBAX HIGH FREQUENCY PRESSURE UNIT

Trebax is a new high efficiency pressure-driven reproducer covering the treble register in multi-channel High Fidelity systems. The frequency coverage is achieved with complete freedom from irregularities in response. The efficiency of Trebax is such that it may be used with the most efficient bass and mid-range units.

SPECIFICATION

FREQUENCY RANGE	2,500 cps to 16,000 cps
IMPEDANCE	15 ohms at 10 Kc/s
SYSTEM POWER HANDLING CAPACITY	25 watts
CROSSOVER FREQUENCY	5 Kc/s.

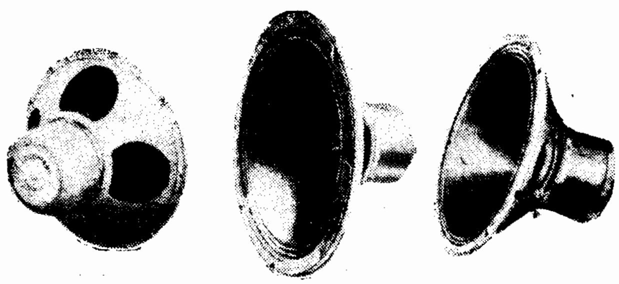


MIDAX MID-RANGE PRESSURE-DRIVEN HORN UNIT

This entirely new reproducer is designed for high efficiency, low distortion coverage of the middle register in multi-channel high fidelity systems. It consists of a pressure driver and horn unit designed to cover a total frequency range of 400 cps to 8 Kc/s. The efficiency of Midax is such that it can be employed with any direct radiator up to 18 inches in diameter.

SPECIFICATION

FREQUENCY RANGE	400 cps to 8 Kc/s
IMPEDANCE	15 ohms at 400 cps
SYSTEM POWER HANDLING CAPACITY	25 watts
CROSSOVER FREQUENCY	750 cps and 5,000 cps



AUDIOM BASS LOUDSPEAKERS

The AUDIOM series of loudspeakers are robust single cone units and feature the refinements necessary for very low distortion reproduction of the bass register and the high reliability under full load conditions. The crossover points may be placed at any frequency below 800 cps depending on the requirements of the other units.

SPECIFICATION

	AUDIOM 60	AUDIOM 70	AUDIOM 80
FLUX DENSITY	14,000 Gauss	17,000 Gauss	14,500 Gauss
BASS RESONANCE	35 c.p.s.	35 c.p.s.	35 c.p.s.
POWER HANDLING CAPACITY	15 watts	20 watts	25 watts
IMPEDANCE AT 400 C.P.S.	15 ohms	15 ohms	15 ohms

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are fully effective in discriminating against unwanted signals.

For example, the desired signal may be on 1,000 kc/s, with an adjacent and interfering signal on 1,010 kc/s. The single tuned circuit ahead of the mixer valve could not discriminate effectively against a signal only 10 kc/s removed from the desired one, so that a substantial 1,010 kc/s signal may reach the input of the mixer valve.

REJECTS INTERFERENCE

In the output of the latter, there would, therefore, be the desired heterodyne frequency of 455 kc/s, plus another heterodyne produced by the unwanted carrier at 445 kc/s. But, with four or more circuits to negotiate, all tuned to 455 kc/s, the signal on 445 kc/s would have little chance of reaching the detector at troublesome level.

Thus, even though the average domestic superhet uses only a two-gang tuning capacitor, there are actually five tuned circuits to discriminate against unwanted signals — as against two tuned circuits provided by a two-gang capacitor in the TRF arrangement.

The double-tuned IF transformers provide higher gain and efficiency into the bargain, and their isolation from one another adds greatly to the flexibility of the individual circuits.

The output from the IF amplifier stage ultimately feeds into a detector, which may be any one of several varieties. The output and power supply arrangements are exactly as for a TRF receiver.

Figure 5 shows the sequence of stages in a typical superhet in block schematic form. The aerial input signal is fed to the mixer or frequency changing stage, where it is mixed with a signal generated by the in-built oscillator.

The resultant or intermediate frequency is then amplified in the IF stage and passed on to the detector, where the audio component is extracted. This is amplified in the audio stage and applied to the loudspeaker, power for the receiver coming, as before, from a power supply.

SEPARATE VALVES

At first, the functions of mixer and oscillator were entirely separate, as indicated in Figure 4.

The oscillator, generally a triode, occupied an appropriate position on the chassis, together with its associated components.

In the absence of other specialised types, the mixer valve was a triode and later a tetrode or pentode, when these became available.

The mixer was normally operated under very high bias conditions, as employed for a detector. Hence, the mixer valve in these early superhets was commonly referred to as the "first detector." The normal detector for demodulation naturally gained the title of "second detector."

In the inevitable trend to simplification, it was found possible to obviate the separate oscillator valve, and the first detector was made simultaneously to fulfil the function of oscillator by connecting it to the oscillator tuned circuit.

This arrangement, employing generally 57 or 6C6 pentode, was widely used around 1932. Known as the "autodyne" circuit, it proved quite efficient and adequate until the demand for dual-wave sets emphasised its non-suitability for such receivers.

Ultimately, the trend to superhet circuits, the popularity of dual-wave receivers and adoption of automatic volume control, led to the evolution of special valves for use as frequency changers.

These vary a good deal in structure from one type to the next, but normally have a triode oscillator and a screen-grid mixer section within the one envelope. For all intents and purposes, they are treated as a single valve.

It is also commonplace to have one or two diode elements, serving as detector, in the same envelope as the IF amplifier or audio power valve.

Because of such economies and other circuit developments, it is now possible to make perfectly serviceable domestic superhet receivers incorporating only four valves in all: Frequency changer, IF amplifier and detector, output valve, rectifier.

Such sets are no dearer to produce than a simple TRF, but are capable of much better overall performance. Hence their universal adoption.

Receivers intended for specialised communication work invariably use the superhet principle, because of the high gain and high selectivity which it offers.

In such cases, economy is of only secondary importance and it is commonplace to use two or even three intermediate frequency stages. These can be arranged to give high overall gain and the high selectivity necessary to separate weak individual signals coming from distant transmitters.

Many such receivers, in fact, use what is known as a "crystal filter" in the IF amplifier to achieve extreme degrees of selectivity. Heart of the circuit is a quartz crystal ground to resonate mechanically at the intermediate frequency.

The provision of this and other facilities at the fixed intermediate frequency is something which could not reasonably be duplicated in any TRF design.

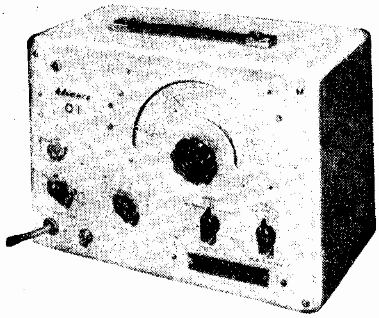
At the same time, most high performance superhet receivers do use at least one RF amplifier stage ahead of the frequency changer.

AN RF STAGE

An RF stage ahead of a superhet circuit makes a minor contribution to gain and selectivity and also helps exclude from the frequency changer strong signals at frequencies remote from the desired station. In special circumstances, such signals may cause spurious beats with harmonics of the local oscillator and penetrate the IF channel.

The main advantage of an RF stage, however, is that it has a lower inherent noise level than a frequency changer. By amplifying the incoming signal somewhat before its frequency is changed, a more favourable signal-to-noise ration can be obtained.

Modern television receivers also use the superhet principle. The problem in this case is not to get extreme selectivity but a specific amount of selectivity—no more and no less. To meet this requirement in the variable tuned cricuits of a TRF would be very difficult but, in the IF channel of a superhet, it can be provided without any special difficulty.



More about the 5 inch TV Receiver

(Continued from page 73)

can devote to the job the better but, in any case, we feel that by one of these methods it should be possible to get your set working—and working well.

For the record, our first attempt at alignment with the GDO produced once again a curve quite good enough to give satisfactory pictures and sound.

That's the end of Phil Watson's story, and we hope it will help you to get your receiver lined up.

It is true that quite a number of fellows have received pictures and sound by more or less aimless adjustments, and it's true that some kind of results are possible with the most hair-raising response curves.

But in all cases, better results will be obtained by achieving something that looks the way it should.

And, as we have said, with everything just right, and a good tube, it is quite amazing how good the pictures can be.

THE SOUND CHANNEL

Lining up the sound channel is quite simple by comparison with the video circuits. In most cases when tuning to a station some kind of sound will be heard, even with the coils well misaligned.

Once again the wobbulator is the best way to line up the sound channel, and to obtain a nice S curve in the classical manner.

But it's so easy to get quite good sound simply by lining up on the station itself, that we rarely bother to go through the whole process.

There are two steps in lining up the sound channel. First you must adjust the various tuned circuits for best signal strength, and then you must balance the discriminator.

The simplest indicator for peak alignment is an ordinary multimeter connected from one side of the 6H6 output circuit to ground. The meter should be set to read about 10 volts, and isolated from the diode with a resistor of about 47K. It may not even be essential to use the resistor.

When tuned to a TV station, the circuits other than the secondary of the discriminator transformer are adjusted until the highest reading is obtained on the meter. For preference the signal should not be too strong while this is being done, otherwise the limiter will flatten the response and make it hard to find a definite peak on the coils.

The coils are, of course, adjusted by means of their iron cores.

METER CONNECTIONS

To balance the discriminator connect the negative side of the meter to the junction of the two 56K resistors and the 10K resistor. The positive side goes to the chassis. Adjust the core of the discriminator transformer until you strike a zero reading which coincides with the clearest sound.

Just before reaching this zero, the meter needle will move in one direction according to whether the core was initially too far in or out, then it will pass through the zero position to read approximately an equal amount in the opposite direction, or should we say it would read if it did not hit against the pin.

The required zero is quite sharp, and you should adjust the core quite carefully in case you run through it. But there will be no mistaking the correct setting once you find it.

The coils concerned in the complete adjustment are T5, T6 and T7.

There are a number of minor points we would still like to cover about this receiver, but most of them will have to wait until next month, when we hope to conclude our remarks on it for the time being.

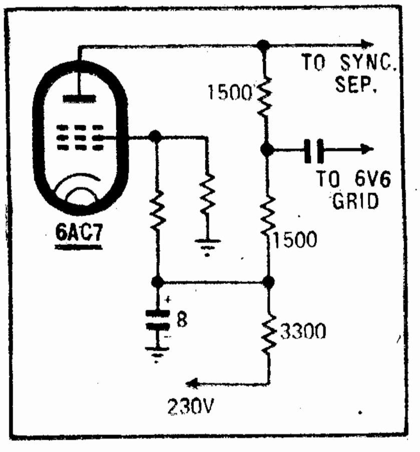
SYNCH. SEP. CHANGES

One improvement which might be useful in some cases concerns the connection in the synch separator input circuits.

As we have already mentioned, it is quite important that the pulses as fed to the oscillators shall be quite free from any video information.

This is particularly so in the case of the line oscillator, which, being a simple multi-vibrator, is very easily triggered. If enough video should get through to this oscillator, some lines might trigger on picture information instead of on the synch. pulses, causing line tearing or slight displacement of some lines in the picture.

Our task here is made more difficult



Amended circuit of first video amp to increase amplitude to seperator.

because the frame oscillator needs a very large pulse to cause it to lock reliably, so that we are forced to extract the largest possible pulses we can get free from video.

The first requirement to obtain efficient clipping at the grid of the synch separator is to feed it with a very strong signal.

By adding a second 1.5K resistor to the load of the first video amplifier, feeding the synch separator directly from the plate of the valve, and the 6V6 from the junction of the two resistors, we can get just about double the available voltage for the separator while retaining approximately the same drive voltage for the 6V6.

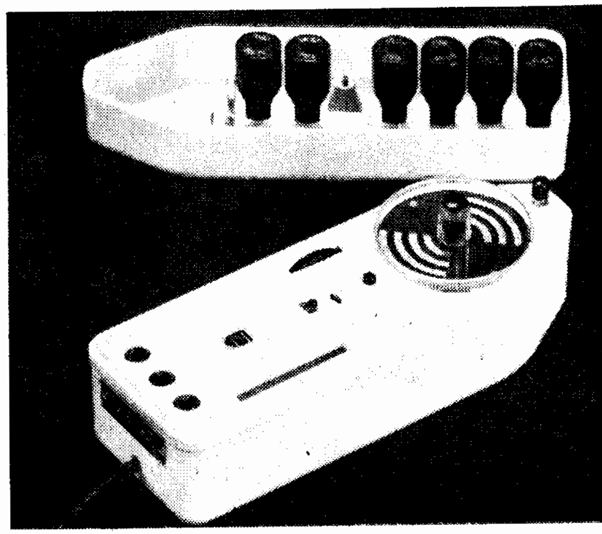
The higher load in the 6AC7 plate circuit will probably reduce the video band-

(Continued on page 127)

TRADE REVIEWS AND RELEASES

NEW WAVEMETER FROM PHILIPS HAS MANY USES

Philips Wavemeter type GM3121 (grid-dip oscillator) was recently made available for test by Philips Electrical Industries Pty. Ltd., of 69 Clarence St., Sydney, and proved a very useful instrument for the adjustment of peaking chokes and trap circuits in a television receiver we happened to be working on at the time.



☆

Philips GM3121 wavemeter is 9½in long by 3¼in. wide by 3½in. high complete with lid. It covers from 2.5 Mc/s to 260 Mc/s.

☆

THE wavemeter has many uses. Finding the resonant frequency of a tuned circuit, finding the approximate frequency of incoming radio frequency energy, finding capacitor and inductor values by resonance methods are a few of the more common ones.

The essential part of the instrument is a tuned circuit made up of an internal split-stator capacitor and a series of external plug-in inductors enabling the instrument to cover a frequency range from 2.5 Mc/s to 260 Mc/s. The maximum frequency error is 2 p.c.

One half of an ECC85 valve is connected across the tuned circuit and can be switched to operate as a Colpitts oscillator for exciting external tuned circuits or, alternatively with the high tension switched off, it behaves as detector of incoming energy.

In either case the rectified grid current is indicated through an amplifier by means of a type 4662 neon tube which performs the same function as a meter in a conventional grid-dip oscillator. The length of a light column varies according to the grid current of the first section of the ECC85 but the initial position of the column can be varied. Thus high sensitivity is retained while large variations in incoming signals or oscillator activity can be compensated.

In a typical job of determining the resonant frequency of a tuned circuit, the instrument would be switched to the "Osc." position and with a coil covering the estimated range in position the light column is adjusted to occupy about half of the length of the tube. When the instrument is held near the tuned circuit, the length of the column will be reduced as the dial is tuned through resonance. Having found the approximate point, the exact setting can be found by reducing the coupling until the dip is barely perceptible.

The instrument is extremely well finished and housed in a moulded plastic case. The latter is a safety precaution in case of work on transmitters, etc. Coils are neatly housed in the plastic lid. The price is £46/12/ plus sales tax where applicable.

FERGUSON TRANSFORMER KIT FOR WIDE-BAND CRO

FERGUSON TRANSFORMERS PTY. LTD., Ferguson Lane, Chatswood, N.S.W., have produced a special kit consisting of two power transformers and a choke for the "Radio, Television and Hobbies" Wide Band CRO.

The main high tension transformer, under the type number PF1229, is designed for either 230V or 240V 50 c/s mains and the secondary winding delivers 340-0-340V with the filtered DC output 150 mA. An electrostatic shield is fitted inside the transformer between the primary and secondary windings and an external copper band for stray field reduction in accordance with the original specification. The transformer mounts on the horizontal chassis of the instrument with the cover above the chassis and the bulk of the transformer below.

Type PF1230 is generally similar except that it has windings to supply the filaments and the EHT circuits of the instrument. The filament windings are: 6.3V at 3A, 6.3V at 1.1A tapped at 4V, 5V at 2A, 4V at 1A tapped at 2.5V. The EHT secondary normally used in series with half of the main HT transformer secondary delivers 860V with a nominal current rating of 2mA.

The matching choke has an inductance of 4 henries measured at 200 mA DC with 10V AC 50 c/s superimposed. However, it may be used with 300 mA when the inductance is 3 henries. The DC resistance is 50 ohms. Type number CF396.

All three components are well finished with grey hammertone covers and with laminations in black. They are supplied in boxes with data on ratings and connections.

QUALITY PORTABLE TAPE RECORDER FROM NORWAY

We recently had the opportunity of examining and using the "Tanberg" tape recorder made by the Tanbergs Radiofabrikk A/S, Oslo, Norway. Local agents for the machine are Simon Gray Pty. Ltd., 28 Elizabeth St., Melbourne. General finish and performance of the instrument are excellent and we would expect it to give trouble-free performance even in the hands of unskilled personnel.

The "Tanberg" tape recorder complete with its portable carrying case. Overall dimensions including case are 15½in x 12½in x 8in high. Recorder proper is easily removed from carrying-case when needed for use in conjunction with other pieces of equipment.

THE recorder is made in several models to suit particular applications. The simplest has two speeds of 1 7/8 and 3 ¾ in/sec, giving 2 x 128 minutes and 2 x 64 minutes of twin track recording with a 1,200 foot reel of tape, respectively. If thinner tape is available the length of a spool may be up to 2,400 feet with a corresponding increase in recording time. Frequency response of the recorder is within 2 db from 30 to 4,000 c/s at the lower tape speed and from 30 c/s to 8,000 c/s at the higher speed.

A second model has the same characteristics as the above but with the addition of relays to allow remote control of start, stop and rewind.

The third model has an additional tape speed of 7½ in/sec which, at the expense of recording time, permits a frequency response curve, level within 2 db between 30 and 16,000 c/s.

Every effort has been made to ensure ease of operation and avoid the possibility of accidentally wiping off recorded material. A three-position lever controls the motion of the tape and the positions of the recording heads. Fast forward and rewind are available by moving the lever from side to side and we were impressed by the speed and positive action of the braking system.

MECHANICAL

The tape is brought into intimate contact with the magnetic heads when this same lever is pulled forward, and, therefore, this is the position used for either record or playback.

The electrical circuits which operate the changeover from playback to record are interlocked with the lever so that it is necessary to hold the switch in a spring loaded position to lock the lever for recording. It is, therefore, almost impossible to record on the tape by accidental switching.

Immediately the lever is pushed to "Rewind" or "Fast Forward," the electrical function switch automatically returns to playback position.

No special threading of tape is required in setting up the machine. The tape is simply placed in a slot with the lever in the neutral position. The tape is automatically brought into contact with the heads when required when the machine is operated.

LEVEL CONTROL

Recording level is set by a panel control and monitored by an electron ray tube. A novel circuit gives a fast attack but a slow decay time to the indicator, making it easy to ensure that the peak recording level is not such as to cause distortion but at the same time high enough to be well above the noise level of the system.

Additional facilities add to the usefulness of the recorder. For example, the internal amplifier can feed directly between microphone and speaker where a public address system is required. Provision is made for recording from a radio receiver or from a gramophone pickup. Many other combinations are possible by using the internal amplifier separately.

R. W. Steane & Co. Pty. Ltd., open Sydney office

THE manufacturers of the well-known line of "Q-Plus" electronic components will now be able to offer a better service to customers in Sydney via their new Sydney office.

Mr. F. John Randell is the manager and the temporary address is 8 Cadow Street, Pymble. Telephone JX3556.

VERSATILE ACOS PICK-UP CARTRIDGE

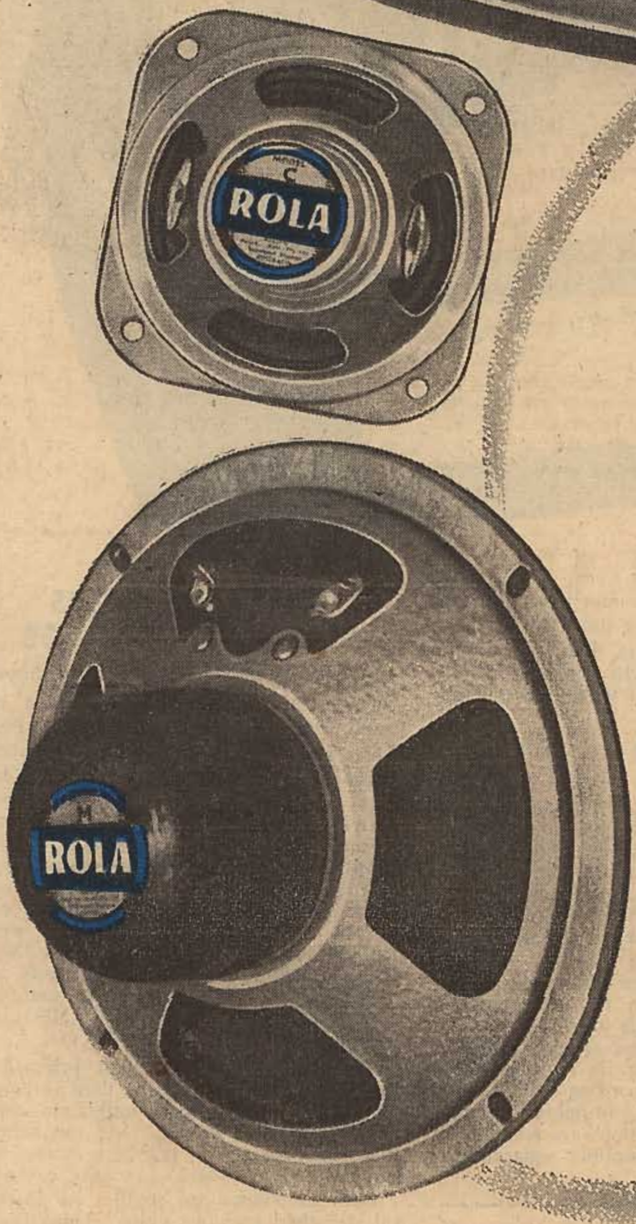
SAMPLES of two types of turnover crystal pickup cartridges are to hand from Amplion (Australia) Pty. Ltd. One carries the type number GP65-1G and the other GP65-3G. The first has normal output for a crystal cartridge and an excellent overall frequency response characteristic. Data supplied by the manufacturers for the cartridge on microgroove recordings shows that the response is 3 db down at about 40 c/s at the low end, very smooth over the middle register and rising to about 3 db above reference at about 5,000 c/s. The curve returns to reference again at about 8,500 c/s and is 3 db down at 10,500 c/s.

The GP65-3G is designed primarily for high output and can be used in conjunction with low gain amplifiers and portable record players. At the same time the frequency response curve is smooth and acceptable in many cases.

Both cartridges are smaller in physical size than previous units. They have the standard slotted mounting holes with ½in between centre lines but in addition a tapped mounting hole between the two to suit certain types of commercial pickup heads. This change is noted in the type numbers by the letter "G." The "C" bracket has ½in mounting holes and "D" bracket is a side mounting type.

Retail price for both the GP65-1G and the GP65-3G is £2/18/6.

The TV Pair



These two new Rola loudspeakers, Models 6M and 3C, are particularly suited for use in table model TV sets where space is at a premium, yet adequate facilities must be provided for the extended range reproduction available from TV's frequency-modulated sound channel.

Both new speakers incorporate the famous Rola "Fluxmaster" principle which eliminates the stray magnetic fields which can distort the TV picture.

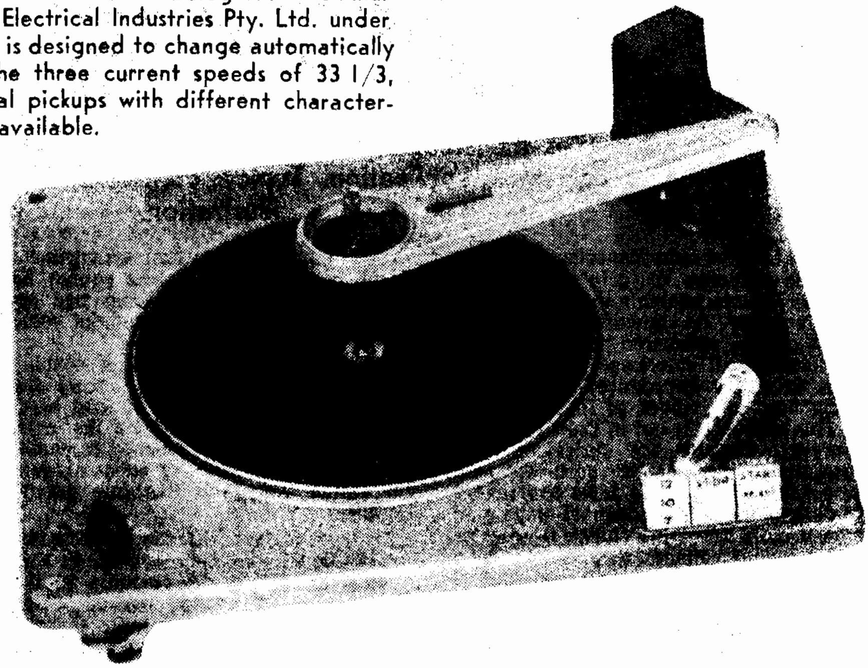
The response of the high efficiency 6M takes care of the low and mid frequencies while the conveniently sized 3C can be front-mounted to provide top response and forward-projected sound which gives "presence" and perspective to the TV set's audio.

ROLA COMPANY (AUST.) PTY. LTD.

THE BOULEVARD, RICHMOND, VIC. JB 3921. 116 CLARENCE STREET, SYDNEY, N.S.W. BX 3996.

A THREE-SPEED RECORD CHANGER

A record changer of good quality, suitable for a radiogram or similar installation, is available from Philips Electrical Industries Pty. Ltd. under the type number AG1003T. This unit is designed to change automatically up to 10 records and will handle the three current speeds of 33 1/3, 45 and 78 r.p.m. A range of crystal pickups with different characteristics is available.



Philips AG1003T Automatic Changer. Base dimensions are 13in x 12in. Full instructions for mounting and operation are supplied with each unit.

WHEN used as an automatic changer, the 10 records of each load may be 7, 10 or 12 inch, mixed in any order, but must have the same groove type and the same speed. A special automatic mechanism for sensing record diameter is included. Any record can be rejected while playing and the next one in the series automatically takes its place. Also the performance can be stopped at any time required without damage to the mechanism.

Single records at all three speeds can be played as desired, except that a special spindle is required for 7 inch records with the large centre hole.

The entire changer assembly is secured to the cabinet by means of a spring mounting so that the speaker can be placed in the same cabinet without the need to prejudice the low-frequency response excessively, although, obviously, wherever it is possible to mount the speaker separately, it is desirable to do this.

A feature of the AG1003T changer is the series of pickup heads with different characteristics. Where convenience is more important than the best possible quality, the AG3010 dual sapphire stylus head is recommended, while the AG3012 and AG3013 are recommended for high-quality reproduction from standard and microgroove recordings respectively.

A special quality head with a diamond stylus for microgroove records, type number AG3025, is available and has an expected life considerably longer than the sapphire styli. The diamond stylus should also result in reduced record wear due to the fact that it maintains optimum shape over a long period.

Q Plus Core Locking Compound

ADJUSTING cores for IF transformers etc. which stick or which are loose have always been a problem in high frequency radio equipment.

In television receivers where there is a large number of adjustments which must be accurately maintained loose or sticking cores can be a very serious matter.

R. W. Steane and Co. have produced a core locking compound for locking and lubricating threaded iron dust cores in coil formers. The manufacturers claim that it will not harden or soften with age, heat or cold and that the core remains in position even under severe vibration.

BASIC TV IF KIT

A BASIC kit for the IF strip of the "R. TV and H." 17in receiver is now available from the Aegis Manufacturing Co. Pty. Ltd., 208 Little Lonsdale Street, Melbourne.

The kit consists a ready punched plated chassis with all the tag strips required attached by means of eyelets. Valve sockets and IF transformers cans complete with moulded formers and slugs are included in the parts supplied. Full information on winding the coils is supplied by Aegis.

Details of the circuit and alignment methods will be found in the August 1957 issue of Radio, Television and Hobbies.

A COURSE IN TELEVISION

F. Black

PART 25 — VIDEO AMPLIFIER STAGES (Concluded)

This article concludes the treatment of video amplifier stages with a discussion of video peaking chokes and their application. Typical complete video circuits are shown by way of illustration.

BECAUSE of stray capacitance effects, the response or gain of a video amplifier tends to diminish with increasing frequency. As shown last month, the effect can be countered to some extent by keeping all interstage coupling circuits to a low impedance, normally by using very low values of load resistor.

This approach is not in itself sufficient, however, because the order of load resistance necessary to ensure a flat response to 3 or 4 Mc is so low that it is difficult to realise adequate stage gain with it or to develop a sufficient order of signal output voltage.

If load values have to be kept higher than optimum to overcome these latter difficulties, some compensation for the resulting high frequency loss may be possible by partial by-passing of amplifier cathode circuits. Unfortunately, however, cathode compensation is not always convenient and is seldom adequate.

As a result, all current model television receivers use some form of inductive compensation, involving so-called "peaking" chokes in series or parallel with the load and signal circuits.

On a broad basis, the function of such chokes can be explained by pointing out that the reactance of a choke rises with increasing frequency, which is just the reverse of capacitive reactance. One would expect, therefore, that the inclusion of a discreet amount of inductance in a circuit could counteract the effect of capacitance.

RESONANCE EFFECTS

In general this is true but a good deal more than just this is involved. The presence of capacitance and inductance in a circuit must inevitably lead to resonance effects and to possible sharp discontinuities in the response curve. Phase distortion will also occur.

To take due account of such resonance effects, it is necessary to choose just the right amount of inductance to suit the capacitance present in the circuit and to make sure that the "Q" factor of the resulting resonant circuit is likewise of the right order.

If the values are improperly chosen, the compensation may be inadequate or, conversely, it may produce a serious peak in the response curve, leading to "ringing" or other picture faults.

In some cases, the design procedure and the association of the chokes with existing load circuits is sufficient to give a suitable "Q" figure. In other cases, the "Q" of particular chokes may have to be reduced artificially by connecting resistors in parallel with them.

While all receivers use video peaking, therefore, the number of inductance of the chokes involved and their position in the circuit varies widely with the circuit itself and the physical arrangement of the components. Values cannot be transferred automatically from one receiver design to the other without some risk of incorrect operation.

For all this, the inclusion of peaking chokes in a video system allows the use of much higher values of load resistor than would otherwise be the case, for a given order of frequency response. The problem of obtaining adequate gain and output voltage is therefore greatly simplified.

In point of fact, the use of inductive peaking confers another benefit, in that it tends to sustain the response to the selected high frequency, beyond which the response may roll off quite sharply. This tends to minimise interference with the picture of the 5.5 Mc intercarrier beat or other spurious components which do not belong to the picture information.

POSSIBLE COMPLICATION

Without such peaking, the response would tend to diminish much more gradually with rising frequency, making it desirable in any case to include resonant absorption circuits for frequencies above the video pass band.

Video peaking may be subdivided into two basic methods, namely "shunt" peaking and "series" peaking, which may be used separately or in combination.

Figure 138 illustrates shunt peaking in its usual form—a peaking choke connected in series with the plate load resistor of a video amplifier.

It might be suggested that it would be more appropriate to refer to this method as "series" peaking but such is not the case. The word "shunt" is derived from the fact that the choke is part of a circuit in shunt between the signal path and chassis potential. (B-plus is at chassis potential as far as video signals are concerned.)

With series peaking, on the other hand, the choke is assumed to be in series with the actual signal path.

In the shunt circuit of figure 138, resistor RL and peaking choke L together constitute the plate load. At low frequencies, the choke is not a significant factor, because its reactance is designedly quite low. However, at high frequencies, where shunt capacitance is beginning to affect stage gain the rising reactance of the choke adds to the value of the load resistor and maintains the gain more nearly constant.

MORE EXACT APPROACH

This is the function of a shunt peaking choke in very broad terms but a much closer examination is necessary if the effect of resonance is to be reckoned with and something like an optimum curve obtained.

When actually designing a simple shunt peaking circuit, it is first necessary to nominate the highest frequency to which full stage gain is to be retained. It is also necessary to know the amount of capacitance to ground in the circuit to be compensated.

This latter can be measured directly with a suitable direct-reading capacitance-to-ground meter.

Alternatively, a response curve can be plotted using a tentative value of load resistor and arranged to exclude losses from other portions of the total circuitry. It can be shown that capacitive reactance will equal the resistive component at the point where the response is 3db down.

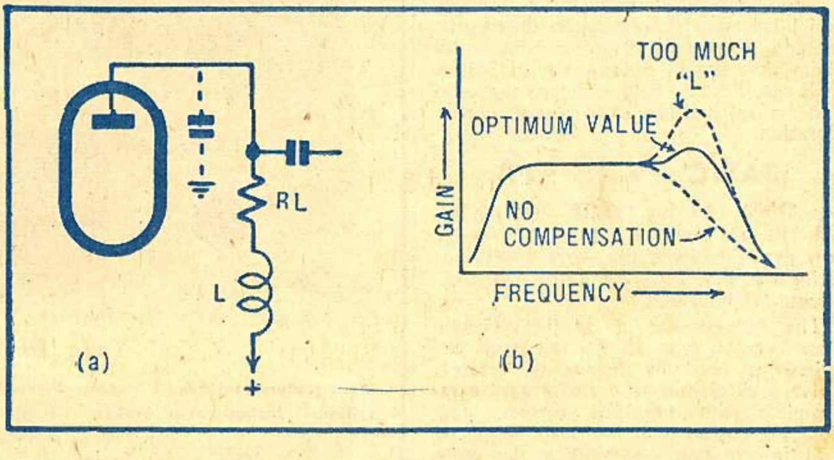


Figure 138: In its usual form, shunt peaking involves connecting a selected inductor or choke in series with the load resistor. Correct compensation extends the natural curve as shown; too much inductance produces an undesirable peak in the response curve.

Having ascertained the capacitive reactance and the frequency involved, it is a simple matter to deduce the figure of capacitance which must be present, from tables, charts or direct calculation.

The relevant formula is:

Ct equals 1 / (2 pi RL f)

where:

Ct is a total shunt capacitance in farads,

RL is the total effective load resistance in ohms and

f is the frequency in cps where the response is 3db down.

By way of example, one might assume the use of a 3000 ohm load resistor and further assume that its effective value would not be much reduced by the presence in shunt with it of the following grid resistor and the valve's own plate resistance. If, using such a load, the response was shown to be 3db down at 2.7 Mc, applying the above formula would show that the total shunt capacitance across the circuit must be about 20pf.

VARIOUS METHODS

At this point there is some division of opinion as to the best method of calculating the circuit constants and the amount by which the response curve should rise above or fall below reference. The following approach is relatively simple, however, and widely accepted.

Having decided the frequency to which full response is to be sustained, and knowing the shunt capacitance, the first step is to provide a load or total resistive component, equal to the shunt reactance at the frequency nominated.

For example, if the top frequency is to be 4 Mc, the reactance of 20pf will be near enough to 2,000 ohms. Assuming the use of an ordinary pentode with high plate resistance and a high following grid resistor, the plate load would therefore, be made 2,000 ohms.

Under these simple conditions, the response at 4 Mc would actually be 3db down. The addition of a shunt compensating choke makes up the difference.

By mathematical analysis, it can be shown that the response at the "3db down" point is just brought to reference when the reactance of the choke is one half the value of the load or of the capacitive reactance.

INDUCTANCE VALUE

In the particular example selected, the choke would therefore need to have a reactance of 1000 ohms at 4 Mc. The relevant formula is:

L equals XL/2 pi f.

Where:

L is inductance in henries,

XL is the inductive reactance required in ohms and

f is the reference frequency in cps.

In the particular instance, the inductance value would work out to 40 microhenries. Connected in series with the 2000 ohm plate load resistor, the combination would produce the curve indicated in figure 138 as "optimum," rising slightly above reference, then passing back through reference at the designed upper frequency limit.

The rise above reference occurs because the load circuit passes through a region of maximum impedance due, in part to the onset of resonance between L and C. In fact, however, the true resonance does not occur at the point of maximum impedance but at a nominal frequency considerably above the designed cut-off frequency.

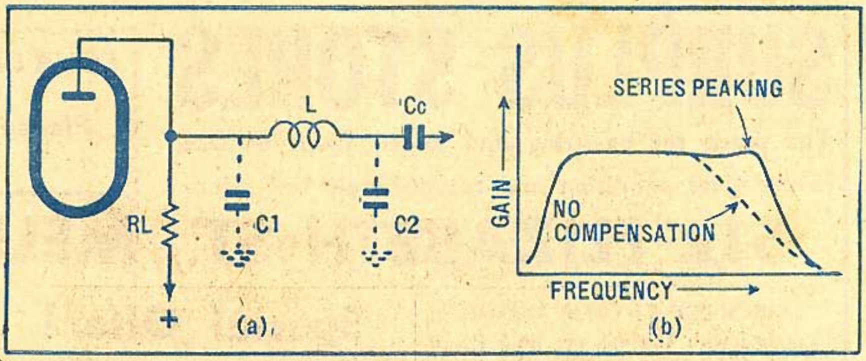


Figure 139: Diagram (a) illustrates series peaking in its usual form, with the associated stray capacitances divided by the series choke L. Diagram (b) shows how the natural curve is extended by the resonant peak but with a very sharp roll-off beyond the designed highest frequency.

For the design procedure just outlined, the maximum response peak is about 3 per cent above reference and occurs at 0.6 of the upper design limit. The nominal resonance of L and C occurs as 1.4 times the upper design limit.

Obviously enough, this latter figure offers an alternative method of calculating L for optimum compensation. A still further approach would be to select R by trial and error to give a response 3db down at the desired upper limit, then select a choke, again by trial and error, to yield an overall curve of the shape suggested.

WRONG INDUCTANCE

If insufficient inductance is used, the response will fall below this optimum curve. If too much inductance is added, a prominent peak will occur; well above reference and shifted somewhat towards the low frequency end of the spectrum.

In practice, over-compensation, which may result in picture "ringing" is highly undesirable and it is always safer to err the other way if, indeed, error has to be tolerated.

The figures used in the foregoing by way of illustration are typical enough of what might be required in a receiver for Australian standards.

The immediate problem is that a load resistor of 2000 ohms is inconveniently small for either a video detector or a video amplifier —in fact it may be impossibly so.

The designer is therefore usually faced with the alternatives of reducing shunt capacitance still further, settling for a narrower pass band or resorting to other methods of compensation.

In practice, it is virtually impossible to reduce shunt capacitance below a certain minimum figure and, as a result, one or both of these suggested alternatives have to be accepted.

SERIES PEAKING

Figure 139 illustrates the principle of series peaking, where the choke is placed in series with the signal path.

By way of general explanation, it can be suggested that the inductor L separates the capacitances associated with the respective stages, so that only those to do with the plate circuit are in shunt with the plate load. Thus the diminution of output with rising frequency across the load is less than would otherwise be the case.

It might be expected that any benefit which might thus be derived would be more than offset by the voltage-divider effect between the series choke and the capacitances to earth associated with the following stage. This is not so, however, because the choke is deliberately chosen to form a resonant circuit with the associated capacitances adjacent to the designed upper frequency limit.

In actual fact, C1 and C2 may be considered as being connected in series across L, with their junction point earthed. In the vicinity of resonance the voltage across C2 will tend to rise, be-

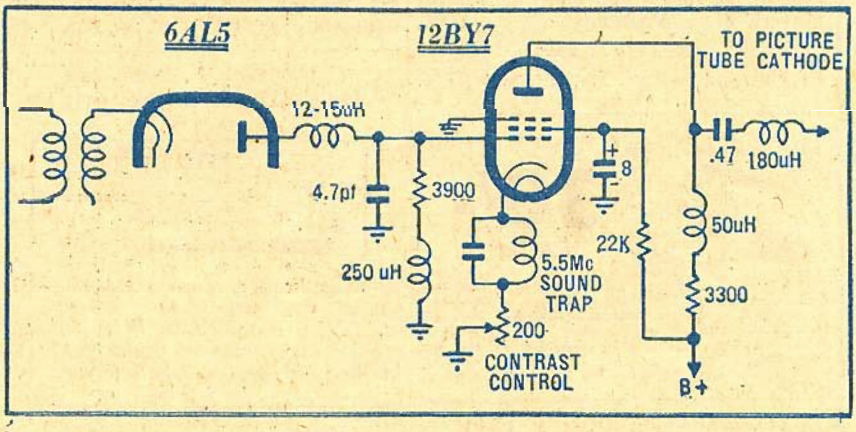


Figure 140: Commercial receivers commonly use a combination of shunt and series peaking, as illustrated at left. The method of design suggests proportioning the stray capacitances so that C2 is twice C1, with the load resistor on the low capacitance side. Gain can be higher than with either method alone but the cut-off characteristic is very sharp.

...ing portion of the tuned circuit, this voltage also being the signal to the following stage.

As with shunt peaking, various approaches can be adopted to determine a suitable value for L. Without going into lengthy detail, an accepted method is as follows:

Nominate the frequency to which full response is to be maintained and determine the order of capacitance present, exactly as outlined for shunt compensation.

Try to arrange the wiring and placement of parts so that C2 is about twice C1. Placing the blocking capacitor and/or grid return resistor on one side or the other of the peaking choke, for example, will alter their ratio by shifting the associated "strays" from one side of the circuit to the other.

PLATE LOAD

Optimum value for the plate load resistor, again assuming an ordinary pentode amplifier, is given by the formula

RL equals 1.5 Xct

where

RL is the plate load resistor in ohms and

Xct is the total capacitive reactance at the frequency to which full response is to be sustained.

The inductance L is then equal to

L equals 0.67 Ct (RL squared)

where

L is the peaking inductance in henries,

Ct is the total shunt capacitance in farads,

RL is the calculated load resistor in ohms.

The point which is immediately obvious from the above is that the plate load resistor can be 50 per cent higher for series peaking than for shunt peaking, which would suggest 3,000 ohms as a likely value instead of the 2,000-ohm figure previously mentioned.

This promises a significant increase in both gain and output from video stages but still with no greater margin in either. As a result, it is common practice to employ both methods of compensation simultaneously to allow a still further increase in load resistance, with consequent increase in gain and output voltage.

DESIGN METHODS

As with the simple shunt and series circuits, so the constants for a combination peaking system can be derived in a variety of ways, to give an equal variety of results. In general, procedures which suggest a high value for the load resistor and rely heavily on inductance to sustain the response, give an overall curve which is unduly lumpy and aggravate phase distortion in the stage. The reverse is also true.

Phase distortion is undesirable in any video system, tending to produce "fringe" effects in the picture in the way of exaggerated outlines.

Accepted formulas for calculating the constants for combination peaking are:

RL equals 1.8 xCt.

Series L equals 0.52 Ct. (RL squared),

Shunt L equals 0.12 Ct. (RL squared),

where

RL is the plate load resistor in ohms,

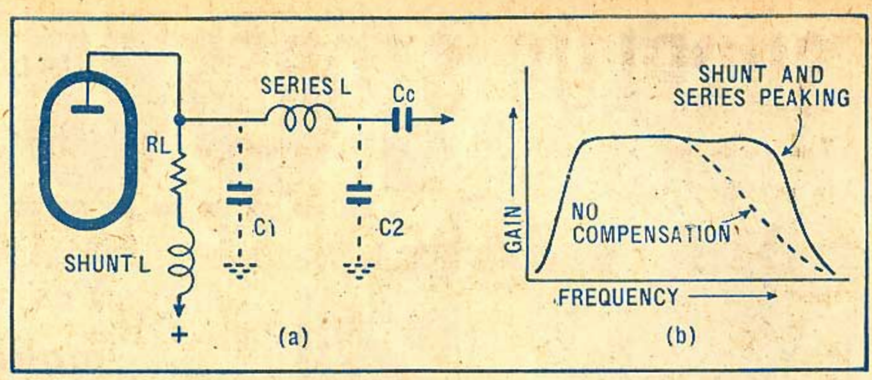


Figure 141: Here is a typical video amplifier stage, using a pentode valve with both shunt and series peaking in its plate output circuit. Note also the shunt peaking coil in the diode load circuit.

Ct. is the total shunt capacitance in farads and

L is the relevant inductance in henries.

Application of the above formulas is relatively straightforward and may suggest that the whole matter of video peaking is similarly so. In practice, however, there are quite a few complicating factors.

By way of example, the video detector circuit requires compensation for the same reasons as the video amplifier. Its load has to be kept as high as possible to give good detector efficiency, yet it is subject to its own stray shunt capacitance, as well as that associated with the video amplifier grid circuit.

In addition, there is the inevitable capacitance and inductance associated with the R.F. filter, intended to eliminate the I.F. component, also that to do with the sound take-off.

While shunt and series peaking can be applied to correct the resulting high frequency loss, there is considerable difficulty in assessing the amount of capacitive reactance which needs to be compensated and the effective resistance in the circuit. The load resistor itself presents no problem, but the internal resistance of the diode as a generator is a highly complex quantity, varying with signal level and over the input cycle.

Since the resultant is not easy to assess or even similate, a precise analytical approach becomes rather difficult. As a result, designers are likely to be guided by previous experience with similar circuits and to select constants by observation of results.

In the video amplifier plate circuit it is often necessary to use a wire-wound resistor to obtain adequate current-carrying capacity. Such resistors will have some inevitable inductance, varying with brand and type, which is effectively in series with the plate load resistor.

VALUE SUBTRACTED

This extra inductance, whatever it is, should be subtracted from the value calculated for the shunt peaking choke.

A further and very practical difficulty is that the capacitance effects may vary from one chassis to another, due to placement of leads and components. It does not follow, therefore, that precise values ascertained in a prototype chassis will be optimum for production versions of the same thing. The inductance values ultimately used are therefore, likely to

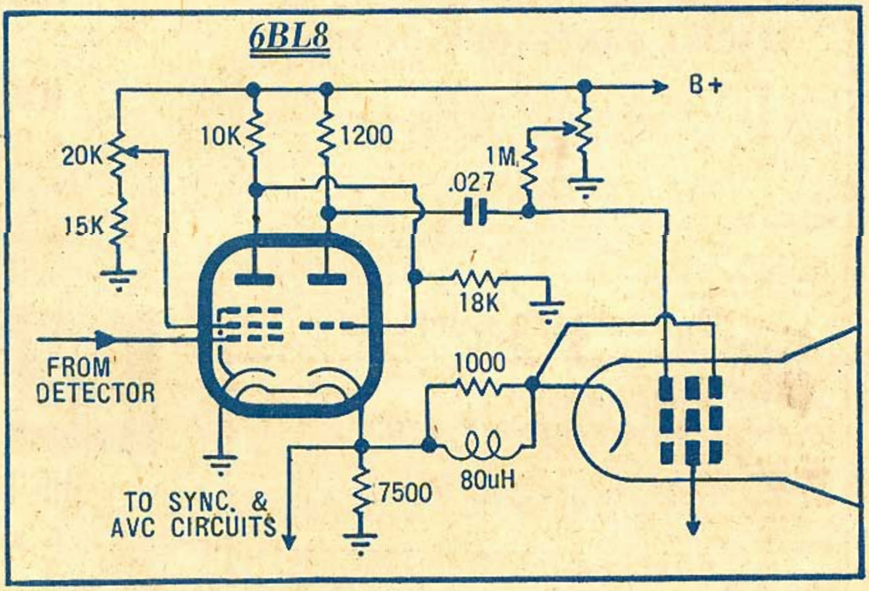
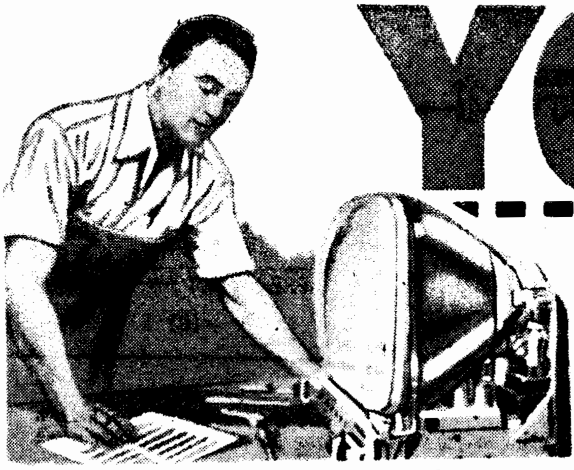


Figure 142: Another video amplifier circuit, using a triode-pentode valve. The triode, as a cathode follower, provides a low impedance feed to the picture tube and relies less heavily on peaking than the circuit above.



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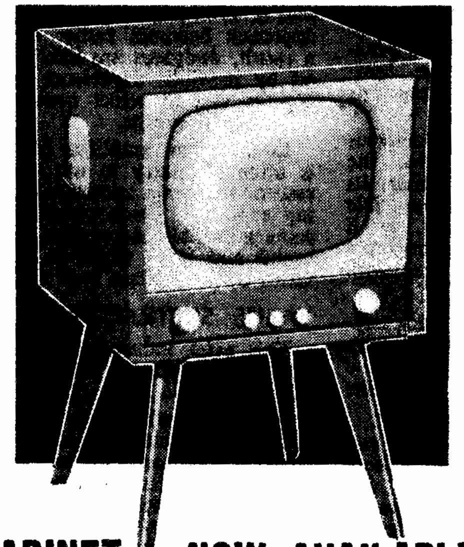

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OFF THE RECORD — NEWS & REVIEWS

This month, for a change I am commencing my remarks with comment on two books which I recently received. There is much in both which invites comment, but I have only space to deal with a few of the matters that come to mind while looking through them.

ONE of the most curious things about judging the quality of a sound system is the manner in which many people go about it. There is probably a very natural reason for the fact that most of them will sit you down in a chair and play a disc of what Percy Wilson calls "queer noises."

He makes this point in "The Gramophone Handbook," a copy of which was sent to me by the Technical Book and Magazine Co., 295 Swanston Street, Melbourne.

Now I am just as fascinated by records of unusual sounds as the next man. There are few more interesting and entertaining pastimes than to listen to brilliant and ingenious sounds which some recording engineers are particularly adept at producing.

USE OF QUEER SOUNDS

To a trained ear, there is undoubtedly some meaning in hearing the internal workings of a gas engine as presented by Mr. Cook, even if we are not very familiar with how a gas engine should sound.

The unmistakable cries of a baby in distress, and the equally obvious movements of its mother in preparing the called-for sustenance will provoke mixed feelings, but the sudden noise of a jet plane passing overhead or a steam engine stopping a few feet from your nose can supply plenty of information to an expert, if his nerves will stand it.

But for the average person to evaluate an equipment or collection of equipment this way when he is primarily interested in music doesn't altogether make sense.

This comment I think could extend to such things as jazz bands which specialise in queer sounds particularly as made by trumpets and reed instruments.

TIMBRE AND DISTORTION

The waveform of many such sounds is so ragged that it is doubtful whether distortion as such can be easily detected. In fact we could make a good case that the very timbre of these instruments depends on what we normally consider as distortion, except that in this case it involves the kind of sound the player wants us to hear.

The greater the harmonic content of the sound being reproduced, the less significant is the amount of distortion with which it is reproduced. And if our acceptance of reproduction will depend on mental reference to some standard of past experience, what is the standard for a queer noise? The queerer the better, I should say.

When an engineer wants to test by listening whether there is distortion to be heard in a sound, he doesn't use square waves. By employing pure tones of sine wave character, and adding or subtracting small amounts of distortion, one is amazed just how easy it is to hear amounts which, on more complex tones, would simply be lost in the rush.

It's reasonable, therefore, if you want to assess the pleasantness or otherwise of a sound system, to avoid noises which will mask many of the effects for which you are listening.

Incidentally Wilson makes the point that listening to records of gliding tones as an attempt to judge an amplifier, is misleading. This I think is not a complete statement, as such a test can be very informative if its limitations are realised.

DEMONSTRATION DISCS

In fact this is my only real quarrel with Mr. Wilson; he is apt to make statements rather dogmatically which, under some circumstances, might not be true.

But then for a technical writer, this is one of the most difficult things to avoid. Try it yourself if you don't believe me!

I am extremely glad to see in Australia special demonstration records such as those recently issued by Capitol.

They answer in a most practical way the question "What record can I use to test my amplifier which will represent accredited good recording?"

It is safe to say that if the record company was not prepared to be judged by the excellence or otherwise of its product, the record would not have been passed.

And it is reasonably safe to assume that, on good equipment, it will play in the manner the makers say it will.

The best feature of such records is the inclusion of much material taken from their own catalogues. These give you the opportunity to judge on music of the kind you operate your equipment to hear.

by John Moyle

Because we hear the human voice more often than anything else, listening to voices is as good a test as any. The critical ear will quickly pick up colorations, particularly resonances in speaker enclosures and the like, very quickly this way, but it is most essential that the volume level should not be higher than that appropriate to your listening room.

You won't get natural voice reproduction if the sound is twice as loud as it normally should be.

I listen a good deal to chamber music when trying something new because it contains a fairly wide range of sound character, particularly if it includes a clarinet or some other wind instrument, and yet one can generally separate out any individual part for close listening.

And, of course, good examples of full orchestra and organ are necessary for testing on heavy weight.

However, this wasn't intended as a dissertation on how to test sound equipment. I am merely agreeing in principle with Mr. Wilson, in that the best test will be careful listening on good standard records rather than sound shockers, keeping the volume level appropriate to the size of your room, and working at it. By this I mean serious, attentive listening.

If you can stand four or five hours at a stretch, playing all kinds of material, and not feel unduly fatigued, there isn't much wrong.

USEFUL MATERIAL

Mr. Wilson's book contains a great deal of useful material ranging from the general to the particular. A good deal of it appears in other similar books, which, of course, is inevitable. But it is intensely practical in that it tells the average man how to do many things such as lining up a turntable and tracking a pick-up, or making a vented enclosure.

- Its price is 25/.

A very different type of book is "Understanding Hi-Fi Circuits" by Norman Crowhurst, sent to us from the Gernsback Library, and priced in U.S.A. at two dollars 90 cents in soft cover.

The author is one of the best-known writers in the audio field, and one of the best informed.

His preoccupation is primarily with circuits, how to work out amplifiers, phase-splitters, inverse feedback, loudspeaker damping and so on. But he does not consider here either pick-ups and their associated problems, or loud speakers except as far as coupling networks and their electrical problems are concerned.

PRACTICAL EXPLANATION

He has not set out to tell the reader that one method of obtaining a result is to be preferred to another. Rather does he analyse the features of each, and in doing so leaves the reader better informed and able to select the circuitry which best suits his purpose.

Crowhurst's explanations are always practical and definite; he is not an evasive writer nor one who deals in generalities. He gets down to the facts of the matter in hand because he understands it, and although occasionally he digs more deeply than the average reader, there is always a practical example to tie his theory together.

I thought this a well balanced and informative book.

STRAVINSKY—The Fairy's Kiss Ballet. Played by the Cleveland Orchestra conducted by Igor Stravinsky. Coronet KLC 558.

On first hearing, you will probably note this as one of the strangest of records.

It was composed about 1928 as a ballet, and is based on the music of Tchaikowsky, not only his manner of writing but his material as well.

The way in which Stravinsky has mixed his style with that of Tchaikowsky is absorbingly interesting. At times, one is almost inclined to believe that he is creating something very like a musical lampoon, although the extremely comprehensive cover notes claim that such an idea—even of parody—was far from his mind.

At any rate, it is a most extraordinary creation of imitation, variation and metamorphosis.

Maybe after a few hearings I could begin to think of it as a ballet, but so far its achievements as musical invention have betrayed me.

Nor has Stravinsky failed to insert some passages almost equally reminiscent of his own work. The Stravinsky of Petrouchka, for instance, is occasionally very clear.

As Stravinsky conducts, we can assume it sounds the way he wants it, and the orchestra plays and is recorded well

CHAUSSON—Symphony in B Flat, Opus 20. Played by the Detroit Symphony Orchestra conducted by Paul Paray. Mercury MG 50108.

This full-voiced and romantic symphony has rarely been recorded—this is the only LP I have in my collection Despite its limitations, it is very easy to listen to, and I have always liked it.

It is very reminiscent of Cesar Franck, who was Chausson's teacher, but then many French composers of that era showed the same influence.

But Chausson has a much warmer touch than Franck, even if he has no more to say.

The material of this symphony isn't at all profound, and is treated at length with a heavily-laden score. There are frequent touches of Wagner again a characteristic of the period.

I thought the performance an admirable one. Paray specialises in this symphony. If I remember correctly, I heard him conduct it in the Festival Hall last year; and, of course, he is a Frenchman.

The recording is a heavyweight for Mercury, particularly the bass end. This effect may be as much due to the score as the recording, for it is somewhat thickly plastered below the middle range.

Its outlines aren't quite as distinct as is usual for Mercury, but it's a most impressive-sounding thing. The top registers of strings and brass (see the opening of the third movement) may find the edge of your tweeter.

SOVIET ARMY CHORUS AND BAND—Thirteen Folk Songs; Russian, Ukrainian and English. Columbia, 330CX 7,500.

The singing style of Russian male choirs became familiar to us with the Don Cossacks, who have toured the world for more than 30 years.

The Soviet Army Ensemble, the choir and band of which are heard here, sings in much the same style, except that it is accompanied, and is, if anything, more spectacular in its strength and power.

This combination made a tremendous impression while on a recent visit to England, during which this record was made.

Most of the Russian traditional songs are to be heard, such as the "Volga Boat Song," "Kalinka" and "Bandura."

There are a couple of English songs as well, the surprise being a superlative rendering of "Tipperary."

A strange song to come from Russians, but no British combination ever sang it with greater zest.

You know what to expect, and if you want it you certainly won't be disappointed. The recording is first rate

CHOPIN—Piano Concerto No. 2 in F Minor, Opus 21. Played by Stefan Askanase and the Berlin Philharmonic Orchestra conducted by Fritz Lehman. DGG 18,040 L.P.M.

You won't hear a more graceful or musical performance than this one.

I can well imagine it being played more powerfully, more brilliantly, more tenderly. Many people imagine that it doesn't matter much how you play Chopin, they will be all right.

This, I think, is true only to a secondary degree, an idea fostered largely by people who are interested as much in displaying themselves as the music.

This man plays Chopin as though he loved the music, understood it, and believed it to be a masterwork in its own right.

His approach is in contrast to many hard-fisted performances which are not uncommon, and relieves it of the fate accorded to it by those who like pretty playing.

It's convincingly done, too. Askanase is a distinguished pianist, well able to sustain the dedicated role he has assumed, a producer of warm, full tone, if of moderate power.

I have heard few versions which gave evidence of greater thought or preparation.

The highlights are played with vigour rather than vitality, but, in general, it is a beautiful performance.

The recording has D.G.G.'s hallmark but there are nebulous spots.

Limpid, luminous Chopin which all will like, and of a class we would expect from one of today's leading exponents.

DEBUSSY — Two Nocturnes, Nuages and Fetes. Ravel—Daphnis and Chloe, Suite No. 2. Played by the Philharmonia Orchestra conducted by Guido Cantelli. H.M.V. O.B.L.P. 1089.

This is a record which makes us lament very bitterly the death of Cantelli, all of whose recordings have shown a rare quality and even rarer promise. In London last year I talked my way into a back seat in Kingsway Hall to hear him record, only to discover that something had upset him, and he didn't turn up. So I heard Kempe instead.

A few months later Cantelli was killed in an aircrash.

Missing out on that session was one of my biggest disappointments.

Both sides of this disc present superlative playing, maybe not as fine in detail as Ansermet would have done it, for instance, but sensitive and finely controlled; not as fragile as it might have been, but firm and balanced in its dynamics.

The Philharmonia shows its mettle most impressively. This is music which emphasises the strength of all sections, and this orchestra is undoubtedly as well equipped as any in Europe.

How beautifully they build the sound in Nuages; a warm, romantic glow, it is true, where a touch of austerity might have been in place, but it is a joy to hear.

Technically there isn't a better version of the music, nor a better surface. I admired particularly the balance of the basses in the Debussy. Their contribution is perfectly controlled without any loss of weight or significance.

A fine record from every point of view.

DEBUSSY—Etudes Book 1, Nos. 1-6, Book 2, Nos. 7-12; D'un Cahier d'Esquisses. Played by Walter Gieseking. Columbia 33CX 1261.

The universal praise which critics have given to the Gieseking records of Debussy has become almost traditional, but it's quite justified. He had an affinity in heart and mind which allowed him to play every note intelligently and intelligibly, apart altogether from the quality of his touch which, for the most part, fitted the music so completely.

This is probably the only record released here of the "Studies," a product of the composer's last years. They are intended as excursions into piano technique, but, as with all great studies, each has the germ of an idea or an effect of sound to exploit.

This is primarily a pianist's record. Its rewards have to be extracted by close listening, and there are many things about Debussy in it which are quite surprising. They begin at the very first bars.

Gieseking shows here two characteristics which seemed to grow in his later years—a tendency to niggle over some small-sized passages which should be delicate but firm, and a trick of covering up when the pace becomes a little too

hot. Neither worries me very much, and is small criticism to offer a performance of this quality.

I can imagine a different, but not a better one.

Piano tone is good—no jangles, no tubbiness. Columbia at its best.

In its class, a monumental disc.

BEETHOVEN—Sonata No. 14 in C sharp minor (Moonlight). Sonata No. 8 in C minor (Pathetique). Played by Rudolph Firkusny. Capitol P-8322.

This is a new pianist to me, one whom Capitol has signed up and of whom we will probably hear more.

He has a habit of hanging on to phrases he wishes to illuminate in a manner which becomes a bit monotonous because it is so obvious. It is particularly noticeable in the first movement of the Moonlight which, in my view, should be played calmly and steadily, and its tempos treated with the greatest of care and discretion.

But on the whole, it is good, traditional Beethoven, not completely in the classical mould and yet by no means modernised.

There is some variation in the tapes from which it is made. The second movement of the Moonlight, for instance, is more closely miked than is the first, and there is some background to be heard which may be the reason why the gain is advanced later on.

The piano tone is good; not nearly as cold as in some other American recordings. It hardens a little under pressure, in the final Moonlight movement, for instance, in which Firkusny snatches rather abruptly where I thought more weight and less explosion would have been better.

Not a star job, but by no means undistinguished.

BIZET—Orchestral Suite from Carmen; L'Arlesienne Suite No. 1. Played by the Vienna State Opera Orchestra conducted by Mario Rossi. Vanguard PVL-7002.

A bright, entertaining version of well-known Bizet. The orchestra plays with great zest, and a pronounced hall reverberation adds to the impression of liveliness.

Dynamic range is good and the playing has plenty of bite to it.

Some bass reinforcement I found an improvement, and although the R.I.A.A. curve is probably intended, the old E.M.I. curve sounded best to me.

FURTHER STUDIES IN HIGH FIDELITY — Full Dimensional Sound Demonstration disc by Capitol, in box with booklet. Capitol SAL-9027.

When Capitol's first Studies in High Fidelity appeared in this country a few years ago it created something of a sensation. Copies were imported and hard to get, and guarded jealously by their owners. One way and another, pretty well every kind of sound ever heard in a studio was on that record, including an amazing gong which sounded for about 15 seconds.

The successor to this disc is every bit as good if not better, for it is less self-consciously striving to pin you to the carpet.

One side is devoted to selections of popular music, and the other to classical selections.

This doesn't prevent it from including Toccata for Percussion, one of those collections of whumps, tinkles and carefully graded bams which, to me, seem to underline the miracle of recording more impressively than anything else.

Capitol's claim that every item has musical value is true—everything here is worth listening to as interesting or pleasant sound, no matter how dramatic it is judged purely as a demonstration.

You will be just as enchanted by the Pittsburgh Symphony Orchestra's strings playing Yesterdays as you will by Les Paul's wizardry in Mandolino. But its hardly worth picking items—every one is good.

An excellent leaflet goes with the record written by Charles Fowler, well-known American journalist, which takes you through the elements of the recording art and the nature of sound, and gives you some comments about what to look for in each of the items.

I included an American pressing of this disc in the collection of specialties I brought back with me from abroad last year, and can observe no discernible difference between its quality and that of the local pressing.

As a demonstration of clean, uncoloured, and beautifully balanced sound, it is in the front rank. It is typical of that clear, mirror-like quality that distinguishes the best Capitol discs.

MUSIC OF THE AUSTRIAN ALPS — featuring Pepi Wimmer, Kurt Blaas and Josef Schlegel. H.M.V., O.C.L.P 7515.

Austrian folk-songs recorded in Salzburg and Innsbruck, played and sung by a group of 36 performers.

The group, according to the jacket notes, stars in a hotel at Innsbruck, and it sounds exactly as a Tyrolean combination should sound, complete with accordion, zither, violins and yodels.

What the singing lacks in polish it makes up for in tunefulness and verve, and after all, la Scala standards would be out of place in this rustic atmosphere.

I imagine that the resounding smacks heard in some numbers are produced by the palms of the hands on leather pants in traditional style.

Some of the items are short, and their quick succession does not make for continuity, but this isn't likely to worry anyone who wants this kind of music. I should think there are many new Australians who will love it.

The recording is clear, with considerable reverberation—a happy accident or design, for it gives an appropriately spacious atmosphere of the outdoors, without which the very fine yodels, for instance, would fall very flat.

An unusual and very good disc.

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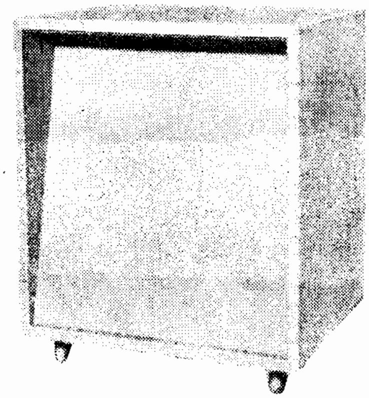

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STARLIGHT ENCORES—Dance of the Hours, Hungarian Rhapsody No. 2, Andante Cantabile, Marche Slav, Danse Macabre, Orpheus in the Underworld. Played by the Hollywood Bowl Symphony Orchestra conducted by John Barnett. Capital P-003.

The Hollywood orchestra is obviously well versed in this type of music, which represents a fairly large-sized piece of the popular repertoire.

Performances are bright and vigorous, tempos are brisk, and every opportunity is taken to make the most of the spectacular.

Marche Slav is a good example of this. There isn't much of the original atmosphere to it, but it's a fine rousing sound, with all the brass and cymbals doing their stuff.

Balance is quite good, the bass is unmistakable and often powerful without overshadowing the rest.

On the other hand, the Andante Cantabile probably takes less time here than ever before.

Best item—Dance of the Hours.

And there's no doubt, you can hear everything.

Does what it sets out to do.

BACH—The Four Orchestral Suites. Played by the Pro Arte Chamber Orchestra of Munich, conducted by Kurt Redel. London DTLA-93073/4 (Ducretet Thomson original).

One can generally provoke lively discussion among musical people on the subject of how early music should be played in this modern age.

At the one side we have those who see nothing good in presenting such music, amplified and enlarged by the resources of a modern orchestra and instruments, even if it should sound fine that way.

On the other we have those who consider playing it strictly in style is an unprofitable business, more particularly as, without the exact types of instruments used centuries ago, the result is of doubtful authenticity.

There is, I think, virtue in both points of view. These Bach Suites, for instance, were written to be played by comparatively small bands of players on instruments which were fairly common in those days, and represent music intended to be enjoyed for itself alone as part of the social life of the time.

This aspect is underlined by the very free use which he and others made of the dance forms of those days. I doubt very much whether Bach would have objected to various versions of his work being played in situations which do not allow the full range of instruments indicated in the score to be used.

He would, I'm sure, much rather have heard his music played that way than not at all.

It is rather pedantic, therefore, to insist that the only legitimate version is one which most closely imitates the original setting, particularly when we remember that Bach was often forced to limit the scope of musical colour according to the range of instruments available to him when the music was composed.

Amplification or modification of the original does not inevitably mean that his first intention or atmosphere will be lost.

But we still greet with pleasure the performance of such works in a manner which deliberately seeks to recreate the peculiar charm of the original score.

I doubt whether any recorded versions do this better than Kurt Redel and his orchestra. Some of the pieces are rather rigid in their determination to be authentic at all costs. Greater flexibility, a less rigid beat, and more variety in volume level would have been an improvement.

The recording is uneven technically. Some of the sections are not very inspiring in the quality of their sound—others seem to spring to life with extra presence and roundness of tone to give really delightful listening.

As compared with the few recordings I have of the Suites, none has better over-all definition of sound, and where Bach has intended instruments or groups of instruments to carry special interest, the conductor has not missed many tricks.

Sometimes there is an edge which you might like to modify. The famous trumpets in the Third Suite are a case in point, although they are clearly given the emphasis they deserve. With the Fourth, this Suite is perhaps the best, but then there is more meat to it, and it is probably played more than any other.

Altogether, a most interesting release, with emphasis particularly on the music.

BEETHOVEN—Symphony No. 7 in A major, Opus 92. Played by the Berlin Philharmonic Orchestra, conducted by Eugen Jochum. DGG 18069 LPM.

This is a very pleasant, untroubed version of the Seventh which I am sure will please many.

It presents quite a contrast to the recent version by Klemperer which has been hailed by most critics as the preferred version.

Jochum's touch is altogether lighter, less analytical, and much more vigorous than Klemperer's.

This is particularly so in the third movement, which jumps along at a rate rarely equalled.

I can quite imagine the admirers of Klemperer condemning it as being too brisk and superficial, just as I can imagine others accepting it as being happier and less tedious.

It certainly is bright Beethoven, but not, I think, beyond the acceptable implications of the music. If your preference is for a somewhat light-hearted approach, you will like it.

Technically it is not a glamour product. The general quality is typical of DGG a few years back, and I don't think it is one of their latest efforts.

There is a pronounced hall echo, and, particularly in the last movement, the sound becomes rather woolly and overweighted with bass.

But the mood here moves with great hurry and excitement, so that this isn't a major criticism.

In the quieter passages the sound is lively and very much "concert hall," not particularly bright in quality, but with

a roundness and body which needs no reinforcement.

Recording amplitude is not high, so that the gain control may need some advancement. Surface noise is low, and on my copy inaudible except for one small spot.

TCHAIKOVSKY — Symphony No. 2 in C minor, Opus 17 (Little Russian). Played by l'Orchestre de la Societe des Concerts du Conservatoire de Paris, conducted by Georg Solti. Decca LXTA 5245.

The greatest detractors from this symphony are those that came after it.

We hear the fourth, fifth and sixth symphonies so often that recognition of themes and general style is immediate and mistake impossible.

To hear so much of them echoed in a work such as this would lead us to imagine that someone was having a musical joke if we didn't know it was written by the same man.

Halfway through the mood changes, and we hear just as unmistakably the composer who was later to give us the three great ballets, Nutcracker, Sleeping Princess, and Swan Lake.

I doubt whether any other major symphonic composer produced an early work more obviously a run-through for its successors.

It is this feeling which has always prevented it from having any great impact upon me, which is a pity, for it is too good to be completely overshadowed.

It has little of the tension which later on lashed his scores.

The second movement, for instance, is built on a delightful march tune originally intended for an early opera.

It contrasts mightily with the following Scherzo, which immediately reminds us of a similarly placed movement in the Pathetique.

But nowhere do we find the fierce introspection of the last symphonies. This is Tchaikovsky of the ballet, and of happy imagination.

Not only is the work well played but the recording is first rate. It has great zest, excellent balance, and clear definition.

I don't remember a previous recording which is in the same class.

THE HOFFNUNG MUSIC FESTIVAL CONCERT—An extravagant evening of Symphonic Caricature devised by Gerard Hoffnung. Columbia 330CX 1406.

Gerard Hoffnung is a most unusual fellow—best known as a contributor to "Punch," where his humorous cartoons, mainly on musical subjects, have achieved international fame.

He is also a lover of the tuba. As a player he has reached orchestral standard, and he has made it part and parcel of his whimsical wit.

This concert was given on November 16 in the Festival Hall, and it consisted of items composed or arranged by his musical friends, several of whom, such as Malcolm Arnold and Gordon Jacob, are prominent in English musical life.

The items themselves are extravagantly witty parodies, arrangements, and original compositions.

There is a Grand Grand Concert Overture by Arnold which mixes some disarmingly tuneful music with riotous treatment, including a grand close made up of an almost endless procession of flourishes, extensions and final finales. It also features a consort of vacuum cleaners and three rifle-shot players.

There is an expertly played Concerto for Hose-pipe and Strings, originally written for an Alpine horn by Leopold Mozart, father of Wolfgang, in which Dennis Brain stars with a mouthpiece fitted to a piece of garden hose, and manages to make remarkable music.

There is a version of the Andante from the Surprise Symphony in which most of the surprises were not originated by Haydn, notably some outrageous key changes.

In a recitation of Scott's Lochinvar (or something like it), with orchestral effects, we hear the unmistakable voice of Yvonne Arnaud, star of the old-time early talkies with Tom Walls, Robertson Hare and company. She shows her versatility by playing the piano part in a Concerto Popolare, a deadly mixture of Tchaikovsky, Grieg, Rachmaninoff, Gershwin, and Heaven only knows what else—perhaps the best item on the program.

Judging by the laughter of the huge audience, a good deal of byplay went on which the record has missed, but there is enough there to rate this as the funniest musical recording I have heard in years.

Most such records pall after one or two hearings, but this one has so much that you will joyfully go back to sample it many times.

SCHUBERT—Quartet No. 2 in C major. MOZART—Quartet No. 17 in B flat major ("Hunt"). Played by the Hungarian String Quartet. Columbia 330CX 1367.

The Mozart is the more important of these two quartets. The Schubert, although remarkable because it was written when he was 15, isn't in the same class as his more famous later works.

It is simple and very charming in parts, with flashes of the Schubert who was to come.

I think the final movement is the best of them all, and has that unmistakable atmosphere which makes the composer welcome in any company. Its treatment, too, is more imaginative than in most of the remainder.

The Mozart I found rather disappointing, mainly because the players see fit to attack it with a particularly brusque kind of fury that deprives it of a grace and lightness it richly deserves.

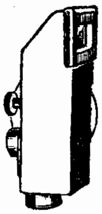
The second movement, too, is treated much too vigorously. It is true that too many performances of this quartet suffer from a sogginess which is a much greater evil, but, even so, I think the Hungarians could have less steel and a little more silk.

My mind goes back to some of the famous quartets of the past, which had no difficulty in choosing a much more rewarding middle path.

The last two movements I thought more graceful and less aggressive, or it may be that I was becoming used to the style of the players.

Recording is forward and has plenty of bite, perhaps a bit brash in the main, but always clean, precise and completely competent.

RANGE FINDERS



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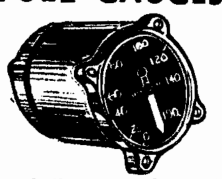

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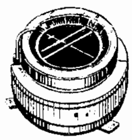

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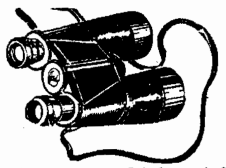

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DEITCH BROS.

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TCHAIKOWSKY. — Symphony No. 6 in B minor, Opus 74 (Pathetique). Played by the Pittsburgh Symphony Orchestra by William Steinberg. Capitol P-004.

The competition in "Pathetiques" is rather fierce at the present time, and quite frankly I wilted at the prospect of playing through about six of them in order to get some comparative ideas.

Most are good, and several very good. The Leningrad Orchestra's version is extremely hard to pass up; the more I hear it the more I feel it to be my kind of Tchaikowsky.

And as I have said on previous occasions, I think this is the best of his symphonies from almost every point of view.

Steinberg recorded this for Capitol nearly three years ago, but don't let that give you any ideas that it is therefore below par technically.

By now you will probably have begun to recognise the individual sound of Capitol's orchestral discs, and this one has all the ear marks.

It isn't as powerful as some of its competitors, nor is the dynamic range as great as elsewhere.

It has been made in a hall with appreciable reverberation and not too closely miked, but I mention this for purpose of identification and not necessarily as criticism.

CLARITY AND DEFINITION

This technique has not sacrificed anything in essential clarity or definition, both of which Capitol consider important. On the contrary it has caught a sense of lively balance and concert hall atmosphere of which I can only approve.

Steinberg's tempos are safe, and his use of them is broad and free from sudden changes.

He marches steadily through the music with scarcely a deviation to left or right, and in that I find my greatest point of criticism.

His orchestra, although a competent one, gives the impression that it is playing through — I do not get the feeling that the players are personally identified with the music.

At times they play most beautifully, but never do they stir the emotions as keenly as, for instance, do the Leningrad players.

But in the matter of clear articulation this disc is as good as any. It sounds best when played with plenty of volume, for although the cutting amplitude is moderate by present standards, it has a very low surface level.

MENDELSSOHN — Concerto in E minor for violin and orchestra, played by Yehudi Menuhin and the Berlin Philharmonic Orchestra, conducted by Wilhelm Furtwangler.

BEETHOVEN—Romances 1 and 2 for violin and orchestra, played by Yehudi Menuhin and the Philharmonia Orchestra, conducted by Wilhelm Furtwangler. H.M.V. OALP 1135.

This is obviously not a new recording. Furtwangler has been dead now for some time, and he made this disc with Menuhin three or four years ago.

The many admirers of these two musicians will no doubt welcome its release, and as such I don't think its age can count seriously against it.

There is a flavour to it, which is different from more recent recordings, and as far as Menuhin is concerned I would class it as one of his best.

His top form of recent times was his performance of the Bartok, which I think is a highlight to be compared only with his youthful success in the Elgar concerto of the old 78 days—remember?

There isn't much point in repeating that I am not an admirer of Menuhin, whose thin tone and uncertain technique so often annoy me, and blind me to the many virtues which no doubt he possesses. In this you will either agree with me or you will not.

Neither of these real or imaginary handicaps is particularly evident here, although his work does not equal in certainty or in neatness that of the finest performers of today.

Much of it, in fact, is very good, but there are occasional lapses into scratchiness, and evidence of important notes not adequately reached.

Once or twice conductor and soloist betray different ideas about who should reach the end of a bar first but, on the whole, the orchestral part is firmly handled.

The Beethoven Romances are always worth hearing, and are given here with a relaxed, smooth tone, if at times the touch is rather light.

It's good Menuhin — that's the best assessment I can make.

SCHUBERT — Symphony No. 6 in C major. GRIEG — Overture "In Autumn" Opus 11 and Old Norwegian Romance with Variations Opus 51. Played by the Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. Columbia 33OCX 1363.

Schubert's symphonies are often beautiful in spite of themselves, and are frequently held together by a charm which transcends repetition and rather simple devices of orchestration.

In the Sixth, there are many passages which the best endeavours of a conductor cannot succeed in rescuing from tuneful wilderness. Beecham here endeavours to do so by changes of speed which, although manful, are not particularly successful in building a masterpiece.

As there are few recordings of this symphony, the best I can say is that doubtless this is as good as any of them.

I didn't care much for the sound, which seems noticeably deficient in bass and not responsive to knob twisting.

The Grieg pieces sound much better, and are, in fact, quite good.

But whether you will want the record mainly for these will be a matter for you to decide.

SHORT-WAVE NOTES BY ART CUSHEN

TJF ICELAND—A RARE STATION

Our logging of the Reykjavik station and the subsequent verification of our report adds a rare country to the verification collection.

OUR verification from the Iceland station TFJ, received less than a month after the signals were heard here, is possibly the first sent to this area, from this distant station. The verification card is white with a map of the island in the centre surrounded by radio waves. The words, "The Voice of Iceland" are placed from the centre of the island. Verification details on the reverse side confirm the reception of TFJ on 12175kc.

The Iceland State Broadcasting Service was established in 1930, with offices and studios in Reykjavik, occupying the fourth and fifth floors of the Telephone and Broadcast building. The station is conducted entirely by the State as an independent establishment under the control of the Minister of Education. A longwave transmitter of 100 Kw. is operated at a location outside the capital, and has a 500ft twin mast array. A further transmitter is located at Eioer, in the eastern part of Iceland using 1 Kw. The TFJ shortwave transmitter of 7 Kw. operates for one hour each week, Monday 6-7 a.m. and uses 7 Kw. It belongs to the State Post and Telegraph administration.

The station uses directional aerials towards New York, London and Copenhagen, and operates on 12175kc.

Listeners in Iceland pay a radio licence fee to the State, which since 1932 has built the number of receivers used to well past the 30,000 mark—roughly one receiver to every five of the population. The station carries spot commercial announcements during the transmissions which help to increasé the ISBS revenue. The system also has a monopoly on radio receiver sales and the repair of radios in the country.

Cook Islands confirm

A NEW country, to most listeners is the Cook Islands, and the receipt of a confirmation of our reception of ZK1ZA was received with some information about the station. The station which is at present operating Thursday 2.30-3.15 p.m. on 4965kc uses a power of 500 watts. The transmitter is normally used for communication work.

The verification card has the calls ZK1ZA in large red letters over a white card, and the background of this is a sketch of a waterfront with palms.

Radio Raratonga, Cook Islands, is shown as the station slogan, and the verification is signed by P. F. Henderson, Officer for Further Education.

Cook Islands are scattered over 85,000 square miles of the Pacific Ocean and situated 1,600 miles north east of New Zealand. They are part of the New Zealand metropolitan territory having been included in its boundaries at the start of the century. The islands have a population of 15,000. Raratonga is the seat of the Government and the home of a third of the population.

Madrid Using 9585 Kc.

THE Spanish National Radio at Madrid has made a frequency change for its 31-metre transmission to North America and has replaced the 9363 frequency with the new 9583 channel. The broadcast in English is also carried on 6130kc. and is on the air 1.15-1.55 p.m., 2.15-2.55 p.m., and 3.15-3.55 p.m.

The other services from Madrid have also appeared on new frequencies, and the South American service is aired at 8.15-1.00 p.m. on 9363, 9795, 11815kc. Africa service, 1.45-2.20 a.m., is on 9677, English programmes to Europe are 6.30 a.m. on 9363, 7100 and 6130kc.

Cairo radio channels

A NEW frequency list for the Cairo Radio, shows the use of some new channels, including two in the 16-metre band. The new schedule now in operation is:

ARABIC MAIN PROGRAM 1.00-4.00 p.m. on 9795; 9.30-10.00 p.m. 7150, 11670; 11.45 p.m.-8.10 a.m. on 9795, 15465; VOICE OF THE ARABS and SUDAN TRANSMISSION, 1.30-3.30 p.m. on 7150; 8.30-9.30 on 11770; 12.30-2.20 a.m. and 2.30-4.00 a.m. on 7060, 11670; 4.00-5.00 a.m. 7050, 11670, 17515; 4.00-5.30 a.m. 7050, 11670; 6.30-8.15 a.m. on 7050, 11670 and 17916. NORTH AMERICAN SERVICE 9.30-11.00 a.m., on 9795 SOUTH AMERICAN SERVICE, 9.30-11.00 a.m. on 1465.

Broadcasts to EAST ASIA and IRAN, 9.00-12.30 a.m., to EAST AFRICA 12.45-2.45 a.m. and to EUROPE from 5.08 to 6.20 a.m. all on 17915kc..

Brazil on 11875 Kc.

BRAZILIAN station Radio Cultura de Bahia, has been noted on 11875kc on Sunday afternoons to sign off at 2 p.m. The station is best heard 1.15-1.30 p.m. during which time the Swiss transmitter on 11865kc is silent. The Brazilian generally operates a dance relay program and has frequent identification in Portuguese. This is a new frequency for the station, which is only assigned channels in the 90 and 31 metre bands. The signals are severely jammed at 2 p.m. when the station closes, prohibiting the clear identity of the exact closing announcement and signature tune.

NOTES for the next issue should be sent to ARTHUR CUSHEN, 212 EARN STREET, Invercargill, N.Z. ALL times are Australian Eastern.

Japan Home service

JAPAN'S Home Service relays are being reported. Australian listeners are hearing JZJ on 7285kc with a news session in English on weekdays at 7.20 p.m. Reception is good from 7 p.m. to sign off at 8 p.m. Likewise the Tokio station on 15135kc has been heard in North America from 1 p.m. to sign off at 8 p.m., at which time they make a frequency change to 11800kc.

TANGIER station WTAN, broadcasting from the International Zone, broadcasts on 7175kc, from 3.30 to 5.15 p.m., in the International services. It has been heard in Spanish and French and identifies as the Evangelistic Voice of Tangiers.

CANADA is now using the new frequency of 15225kc, with the callsign CKLX4, in the service to Europe which is broadcast 11.25 p.m.-12.05 a.m. Monday to Friday in chain with CKNC on 17820kc.

RADIO LUXEMBOURG has its English schedule on 6090kc from 4 a.m. to 9.00 a.m., but interference is severe from VL16 on the air from 6.00 a.m.

SWITZERLAND has made some frequency changes in several of its transmissions. In the transmission to the United Kingdom and Ireland which is on the air from 4.45 to 6.30 a.m. the service is now using HEU3 9656 and HE13 7210kc. To South-East Asia and Japan programs will be transmitted over HER6 15305 and HE19 21605 during the period, 10.30-12.30 a.m. Programs to India-Pakistan follow from 12.45-2.30 a.m. The service is on HER5 11865 and HE19 21605kc.

FLASHES FROM EVERYWHERE

HAITIAN stations 4VC at Port of Prince, has moved from 9485kc, reports Kevin Dunham of N.S.W. Kevin states that the new frequency for Radio Commerce is 9545kc, and the 4VB station has moved from 6091kc and is now on 5980kc. The stations are operating on 4VC 9545kc, 9 p.m.-12.30 a.m. and 9.00-10 p.m. Sunday. 4VB operates 8.00 a.m.-12.30 p.m. daily.

BRUSSELS schedule for the next two months shows some changes in the overseas service, which is now as follows: 8.00-11.00 p.m., 17845; 8.00-10.00 p.m. 21510; 10.00-11.00 p.m. 15280; 10.15-11.00 p.m. 21510; 3.00-3.15 a.m. 15280, 15335, 21510; 4.00-7.00 a.m. 15335, 17845; 7.15-9.00 a.m. 11720, 11850, 15335; 9.15-11.00 a.m. 9855, 9705, 11720, 11850. The frequencies of 15280 and 11720kc are 20 Kw. and all other frequencies are 100 Kw.

JAPAN'S Time station JJY, operates on 2500kc, 2 Kw., 4.50-8.50 a.m.; 4000 and 5000kc, 1 Kw and 2 Kw. 24 hours a day, 8000kc, 500 watts is on the air 6.50-8.50 p.m. 1 Kw. The same schedule on 10,000kc with 2 Kw.; 15,000kc, with 2 Kw. is on the air 24 hours a day. The station is silent at 29-39 minutes of the hour, and provides announcements of time in English.

RADIO NACIONAL, BRAZIL, operating from Rio De Janiero broadcasts as follows, 6147kc, 50 Kw.; 9720kc, 50 Kw. and 11720kc, 10 Kw., operate 6.30 p.m., 2.15 p.m.; 15295kc, 10 Kw., is on the air 7.00 a.m.-2.15 p.m.; 17850kc 10 Kw., 6.00 p.m.-7.00 a.m. News in Portuguese is released at 7 p.m., 9 p.m., 11 p.m., 1.55 a.m., 6.00 a.m., 9.25 a.m., 11 a.m. and noon.

A program in Spanish for South America is released at 4.40-5.00 a.m. on 9720kc.

HANOI the home of Radio Vietnam has been reported from Europe with a transmission in the mornings from 8.00 to 9.30 a.m., using the 9465kc outlet. News in English read at dictation speed takes the first 30 minutes of the program.

ANKARA has reinstated the mailbag session which was popular many years ago, and we recall a greeting to us in 1940 just after the station began to operate. The session is on a Monday morning, at a time not suitable to New Zealand listeners, but our Australian friends will find the session on 9470kc, 7.00-7.45 a.m.

IVORY COAST is now issuing a very attractive verification card reports Radio Australia, and the station is still being tuned on 4940kc with 10,000 watts and 1,000 watts on 7493kc, to 8.30 a.m., with the slogan, Radio Abadjan.

SPRINGBOK Radio at Johannesburg, which carries the English commercial service, has been heard at 6.00 a.m. at good strength at which time a musical program is being carried. The station uses the 3356kc frequency and is best on Sunday, when there is no interference from Radio Noumea which opens on 3355kc at 5 a.m.

PARIS is reported on a new frequency of 17920kc according to Stuart Morris, Victoria, who has been hearing the station from 8.30 p.m. to sign off at 9 p.m.

IRAN transmissions are reported by Radio Australia as using 17770kc which appears to replace the 15100kc outlet. The station was tuned from 4.30 a.m. to the close of the transmission at 6.30 a.m., the frequency is badly disturbed by jamming on the channel. The other Teheran station now heard at good strength is EQO using 3780kc which is now at very good strength at 5.30 a.m. when playing light orchestral numbers.

CONGO BELGIUM station on 4755kc is reported from Europe as the strongest African signal in the 60-metre band, and a contributor to Radio Australia reports the best reception is from 4.00 a.m. to 7.00 a.m. Another station in the same country OQ2AB Radio UFAC at Elizabethville on 4980kc has been noted with news in French at 4.45 a.m., with some interference from Radio Omdurman now on 4975 kc.

PARIS has been noted with an experimental broadcast to South America by Stuart Morris of Victoria, using the frequency of 9490kcs.

Each transmission appeared to be of 25 minutes duration, the first one at 9 a.m. and the second at 9.30. The next at 10 a.m. was only received poorly due to the reception conditions deteriorating. The station was heard to announce in French, Portuguese and Spanish at the commencement of the test and to play continuous light music for the remainder of the program.

ANGOLA signals from CR6RL have been noted opening at 4 p.m., when the Radio Club of Angola opens at that time on 9362kc.. The station has a three-gong note on opening, then the program follows in Portuguese.

THE HAM BANDS WITH BILL MOORE

Much amateur activity throughout the world is centred around the VHF bands. Since World War II improved techniques and the availability of suitable equipment has permitted working over distances not thought possible pre-war.

NEWS of the shattering of 144mcs DX record by a wide margin was received with enthusiasm by VHF amateurs. On July 8th W6NLZ and KH6UK made contact over a distance of 2,600 miles, 1,200 miles in excess of the previous figure. W6NLZ had listened nightly for nine months before hearing KH6UK—waiting for the completion of the latter's transmitting period of five minutes seemed an eternity to the W6. W6NLZ replied at the scheduled time, and the 7-year-old record was broken.

Both stations ran 1KW input. W6NLZ used a 24ft yagi array, KH6UK a stacked yagi array.

Four hours later, at 0130 hours local time, the KH6's signals were still riding through. Prior to this contact the Australian records of VK2AH to ZL3AR and VK5GL to VK6BO of 1951 were in world class, but to extend these mileages VK amateurs will have to look far afield.

Another world VHF DX record recently broken was for the 70cm band when G3HAZ contacted DL3YBA in Germany over a distance of approximately 500 miles. The previous record of 410 miles was set up between W1RFU and W4VVE in 1954. During the opening, DL3YBA also contacted G5YV, G5BD, G6NB, G2FNW and G2XV.

The Gs have also been working DX on their new 4-metre band. The greatest distance covered to date was during a contact between G5KW and FA3JR over 1,200 miles.

Norm Burton, well-known for his DX TV reception activity, supplies news of a series of 50mcs tests to be carried out by American amateur stations.

K6RNQ and at least five other W stations will be beaming 50mcs signals across the Pacific to Australia each Sunday. The transmission tests will commence at 2200 G.M.T., September 28, and conclude at 0200 hours, September 29. They will be continued each Sunday morning Australian time until further notice.

KH6CCZ from Hawaii will also transmit at the same period. All these stations will transmit at 15 and 45 minutes past the hour and listen for replies on both the 56 and 28mc bands. Most VHF amateurs will be able to listen out at one of the prescribed eight transmitting periods each Sunday morning.

Prearranged schedules accounted for the extension of the 144mcs world record and are practically a necessity for DX working on the VHF bands.

In the U.S. VHF amateurs will be able to co-operate in yet another IGY project. On this occasion amateurs will be requested to report on the reception of special VHF transmissions from South America.

These stations will operate on 49mcs, a frequency specially selected to allow amateur participation. The transmission will be beamed along the west coast of South America and the three transmitting sites are located in a straight line, the line if extended runs through the centre of U.S.A.

Rhombics 1,000ft aside and yagi beams will be used and two of the stations will use powers up to 20kw. It is hoped that one of the long unexplained effects of VHF propagation may be better understood after the completion of the tests—that of long distance transequatorial reception around the equinox—a method of propagation first observed by radio amateurs.

Additional receiving stations will be manned along the line in South America and the greatest distance between stations will be 1,900 miles.

It is anticipated that by means of collating reports it will be established whether the signals received along the line are due to double hop or single hop sporadic E rejections, or due to lower E layer scatter.

The reception in U.S.A. will be due to F layer scatter effects on most occasions and much valuable information on propagation sources should be recorded during the 12 months of testing.

WIA ACTIVITIES

Another annual event for N.S.W. Radio Amateurs to be held soon is the combined Hunter Branch and Sydney Division field day. The venue for 1957 is Gosford. The first of these days was arranged back in 1933 and for many years the location was Wyong with Owen Chapman, VK2OC, the local organiser.

Post war they were held at Woy Woy with Cec. Hardman, VK2KR, in charge of local arrangements.

At Gosford Major Collett, VK2RU, will arrange the programme and the N.S.W. Division of the W.I.A. will supply disposal gear for distribution.

Keep Sunday, November 17, clear for the journey to Gosford and enjoy a day's outing in traditional amateur manner.

ROSS HULL CONTEST

The Annual VHF Contest of the W.I.A., the Ross Hull Memorial VHF Contest opens at 0001 E.S.T., December 1, and concludes at 2359 east. January 31.

All Australian and overseas amateurs may enter in the contest whether their stations are fixed, portable, or mobile.

Cross band contacts are not permitted except for QSO's between the 50-54 and 56-60 mcs. bands.

Serial numbers must be exchanged in accordance with the usual practice.

An extensive scoring table for contacts with other Australian States, New Zealand and overseas stations has been arranged, varying from two points for stations readily contacted on 56mcs to 10 points for overseas QSOs.

Full rules appear in the August issue of Amateur Radio.

Don't forget the VK/ZL DX Contest to be run over the first two weekends in October. Telephony section October 5 and 6, C.W. October 12 and 13. The periods run from 1000 G.M.T. Saturday to 1000 G.M.T. Sunday, full information on the contest appears in the July issue of Amateur Radio and September issue of this journal.

Remembrance Day Contest was popular

The 10th Annual Remembrance Day Contest of the WIA conducted in August was officially opened by the Lieut.-Governor of Victoria, Sir Edmund Herring, K.C.M.G., K.B.E. D.S.O., M.C., E.D., in a ceremony presented just before the opening of the contest at 1800 hours.

His Excellency commended the amateurs on their work in peace and war and mentioned that 1,000 of the 1,800 amateurs licensed pre-war served in some capacity during the war years.

Sir Edmund pointed out that amateurs from Mawson in the south to Papua in the north would be entering in the contest to pay tribute to those of their number who gave their lives during World War II. The prestige of the amateurs had been enhanced by their work in peace, when they had been able to relieve the stresses and strains placed on normal communication systems during natural disasters, especially the N.S.W. amateurs during the extensive floods of 1956.

Continuing, His Excellency mentioned the first and last sections of the amateur code, that the amateur was gentlemanly and patriotic and that the hobby knew no creed religion and amateurs played an important part in presenting Australia to the rest of the world during international contacts. The contest was then declared open.

The Federal Secretary, Max Hull, VK3ZS, read the names and callsigns listed in the Perpetual Trophy. The callsigns of the amateurs who fell were:—

Navy — VK3IE, VK6DR. Army — VK2JV, VK3HN, VK3SF, VK5BW, VK3DC, VK3PV, VK4DR, VK6KS. Air Force—VK2BQ, VK2YK, VK3GO, VK3PL, VK3VE, VK2VJ, VK2AJB, VK3OR, VK3UW, VK4FS, VK4PR, VK5BL, VK6PP, VK5AF, VK6JG. Merchant Service — VK3NG.

The Federal Secretary then recited the Ode to the Fallen.

The opening service was particularly impressive and amateurs who listened felt proud but saddened by the solemnness of the occasion.

Arranged by the Federal Executive of the W.I.A. tapes were prepared and distributed to all divisions.

Soon after 1745 hours all State W.I.A. stations from VK2WI to VK9WI presented the opening ceremony on the 7mc, official Federal Station VK3WIA also operated. The A.B.C. gave due publicity to the contest over news sessions on the opening evening.

The 7mc band was a squealing mass of signals within a few seconds after 1800 hours. It was this band that was to provide the greatest number of points for the leading competitors.

Most competitors recorded about one third of their score on that band. The 1,000-point mark will undoubtedly be passed by a number of competitors and VK3ATN should accumulate a record score.

The holders of the trophy, Western Australia, will again be difficult to displace judging from the number of contacts recorded by their leading stations near the closing of the contest. Only other possible winners appear to be either VK7 or VK9. The latter stations were scoring well.

One thing certain was the reduction of C.W. activity in the contest. In most bands they were successfully squeezed into the low section of the band—generally only a few kcs. were left.

HUNTER BRANCH OUTING

October is alway a busy month in N.S.W. Amateur Radio affairs and four events are scheduled to be conducted during the period. Three will be run over the holiday week-end, October 5, 6, 7. They comprise the VHF and TV section's Spring Field Day, Hunter Branch WIA Blackalls Field Day, and the Canberra Radio Club's 144mcs outing in conjunction with the Spring Field Day. The fourth event is the South-western Zone's Convention to be held over the week-end October 26 and 27.

An extensive programme has been arranged for the Sixth Annual Blackalls outing of the Hunter Branch.

Events commence on Saturday afternoon when two 144mcs Hidden Transmitter Searches will be held. A technical lecture will be presented, and from 7.30 to 10.30 p.m. films will be shown.

Sunday morning will see another 144mcs search conducted and at 11 a.m. the VK2WI broadcast presented. Two scrambles follow, one on 7mcs, the other all band. The official prize presentation takes place at 5 p.m.

Races and competitions will be arranged for the XYLs, YLs and Junior Ops. on Sunday, plus special speedboat trips for the latter.

Disposal equipment released by the Division will be available and a prize given for the biggest fish caught.

The Hunter Branch is renowned for hospitality; if you wish to enjoy a full weekend of field events and entertainment proceed to Blackalls. Further details can be obtained from any Hunter Branch member.

NEW MASTS FOR VK2WI

The VK2WI transmitting site should soon receive a new look with the erection of masts from the old Pennant Hills Transmitting Centre. The Overseas Telecommunications Commission have kindly made the masts available at a reasonable cost. Joe Reed, VK2JR, an engineer with the commission, will be in charge of the removals and a working party will assemble early in September.

The masts aquired include eight 50ft telescopic type and one 80ft steel lattice tower.

N.S.W. State W.I.A. President, Perc. Heally, VK2APQ, will be pleased to receive calls from country members each Wednesday evening on 3.6mcs at 2000 hours east.

Q.S.L. officers Frank Hine, VK2QL, and Allen Smith, VK2AIR, report that the following cards were handled during August.

Inwards 1,266 cards, outwards to DX Bureaux 731 cards.

C.D.E.N. officer Roy Hart, VK2HO, has been busy during the month in conference with defence and State officials.

During November he will again attend the Civil Defence School at Macedon, Victoria.

S-WEST ZONE CONVENTION

Scene of this year's South-western Zone's Convention will be Coolamon. The venue of these conventions is changed annually: last year it was at Griffith.

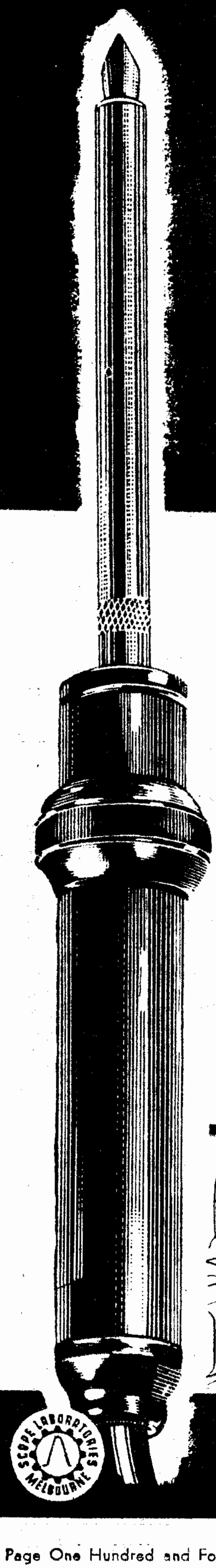
Saturday afternoon will be taken up by registration and a tour of the town for visitors.

Around 5 p.m. the first field event will be run and dinner served at the R.S.L. Hall at 6 p.m. From 8 p.m onwards emphasis will be on entertainment. An "amateur" hour will be the first item. Other novelties and films will follow.

Sunday morning will be devoted to field events: 9 to 10 a.m.—All-band Scramble; 10 to 11 a.m.—144mcs Hidden Transmitter Search; 11 a.m.—VK2WI Sunday Broadcast.

A barbecue lunch will follow, then novelty events, blindfold TX search, and disposal equipment distribution.

Any further details of the convention can be obtained from zone members or direct from the zone officer, Jim Edge, VK2AJO, Cowabbie Street, Coolamon.



SPRING FIELD DAY

The Spring Feld Day of the N.S.W. VHF and TV section will also be held over the holiday weekend. Amateurs will be in the field in many parts of N.S.W. operating on the 144mcs band.

A message originated from VK2WI will be relayed interstate if possible. A contest will also be conducted with an adjusted scoring system for the various types of stations competing—portable, country and city.

Scores recorded for portable stations will be adjusted on their distance from their home QTH and country stations on their mileage from Sydney.

At this stage most portable operators have not finally selected their locations, but it is anticipated that a number of new spots will see portable stations in action.

DX OPERATING

Big-time DX operating is unfortunately developing into more of a "cut-throat" business every day, purely a survival of those with the greatest power and the most elements. The review of DX operating tactics in August Q.S.T. provides an insight into the modus operandi of some of the leading DX exponents. It was interesting to read that the majority did not believe in "Tail Ending" (a few calls before the end of a Q.S.O. to announce your presence).

Despite the fact they did not believe in such practice they indulged because it was often profitable. All opinions pointed to the fact that bad procedure and tactics could be best controlled by the rare DX station who could ignore stations who offended.

The three main points brought forward in the review to provide better DX working were: 1. Use short calls. 2. Call off the rare DX stations frequency. 3. Observe the rare stations procedure and answer accordingly.

Nearly ten years ago the A.R.R.L. published some general rules for the guidance of DX stations. They contain a lot of good advice for operators, and were as follows:—

1. Do not answer calls on your own frequency.
2. Answer calls from W/VE stations only when their signals are of good quality.
3. Refuse to answer calls from other stations when you are already in contact with someone, and do not acknowledge or act upon calls from amateurs who indicate they wish to be next.
4. Give everyone a break when many W/VE amateurs are patiently and quietly waiting to work you. Avoid complying with requests to "listen for a friend."
5. Tell listeners where to call you by indicating how many kilocycles up (U) or down (D) from your frequency you are listening.
6. Use A.R.R.L. recommended ending signals especially KN to indicate to impatient listeners the status of the Q.S.O.
7. Let it be known that you avoid working amateurs who are constant violaters of the above principles.

If the above rules were strictly observed by the rarer DX stations it would certainly simplify DX operating. Without a doubt the biggest problem confronting operators is the calling of these stations on or near their own frequency.

C.W. is gradually being pushed out of the 7mc band with telephony stations operating right up to 7,000kcs. The edge of the band should be left for the C.W. gang. There are enough telephony stations extending their transmissions by accident to the edge of the band without anyone opening on the last few kcs. There is or rather was a "gentleman's agreement" on C.W./telephony allocations within H.F. bands and some publicity on this arrangement might help the position.

DANNY SAILS AGAIN

According to a report originating from K2OEA, Danny Weil, ex VP2VB/P, will sail again later this year and proposes to operate from the following list of rare prefixes and countries — ZD8, ZD9, Cocos, Kermadecs, Chagos, Seychelles, VR5, VR6, CEO, CR10, Laccadives, Nicobars and Tokelaus—an extremely impressive array.

Following Danny's experience during his ill-fated last expedition, he will again place his communications in the hands of amateur radio operators.

To illustrate that amateur bands are suitable spots to originate S.O.S. calls it should be noted that emergency signals from the raft "Tahiti Nui" were picked up as far away as England by G3FYT according to Stan Herbert, G3ATU "Month on the Air" feature in the R.S.G.B. Bulletin. FO8AD's final calls were recorded by many amateurs who alerted, and the Chilean authorities sent the frigate "Baquedano" to the rescue.

Pat Miller, KH6ARA, ex W2A15-ZC8PM, extends his 73 to all the VKs he personally contacted during his trip to Australia. Pat is still keen on DX on the lower frequency bands, uses 7mcs and is anxiously awaiting the opening of the 3.5mcs band for long-distance working.

The N.S.W. VHF and TV section were again alerted early in September by the search and rescue section of the Federation of Bush Walkers' Clubs when three boy scouts were lost in the valleys near Katoomba, N.S.W. Harry Lapthorne, VK2HL, and John Thornthwaite, VK2ATO, were just leaving Sydney complete with base station equipment and walkie talkie units when the news came through that the boys were found unharmed.

No. 22 & 122 TRANSCEIVERS

The 122 transceiver covers a frequency of 2 to 8 Mcs. and has been approved by the P.M.G. for use on fishing boats, small craft, bush fire brigades etc.

THESE SETS ARE SUPPLIED COMPLETE WITH VALVES. 12v. VIBRATOR POWER SUPPLY, DYNAMIC HEADPHONES AND MICROPHONE, 6in x 9in OVALTONE SPEAKER, LEADS, SPARE KIT OF VALVES AND TWO CRYSTALS TO REQUIRED FREQUENCY. RANGE TO 300 MILES. SETS AIR TESTED. **£40/-/-** F.O.R. THESE UNITS IN NEW CONDITION.

The 122 transceiver as above but less crystals, speaker and spare valves not air tested.

£18/-/- F.O.R.

The 22 transceiver as 122 but not converted for crystal control, supplied with valves, meter, power supply, dynamic headphones and microphone. **£15/-/-** F.O.R.

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 Mcs. and contain 15 6.3 volt valves including 1-807, 2-6V6, 6-6K7, 2-6K8, 6B8 etc., also 500 micro-amp. meter

UNITS SUPPLIED COMPLETE WITH VALVES, LEADS, JUNCTION BOX, GENEMOTOR POWER SUPPLY AND DYNAMIC HEADPHONES AND MICROPHONE (operate from 12v supply). AIR TESTED. **£16/15/-** F.O.R.

TRANSCEIVER ONLY SUPPLIED WITH VALVES AND METER. **£5/15/-** F.O.R.

SET OF LEADS AND JUNCTION BOX FOR No. 19 TRANSCEIVER **20/-** plus post and packing 10/-. 12 volt GENEMOTOR FOR 19.

£2/15/- F.O.R.

NEW 3" R.F. METERS. 350 MA or 1 AMP

These meters can easily be converted to 10 or 100 mA. meters, new scale supplied with meter. **7/6** Post 2/6.

BUILDING R. TV & H. 5" TV SET

ALL MAJOR PARTS IN STOCK INCLUDING R.C.S. IF STRIPS & TUNERS, VALVES, POWER TRANSFORMERS, CHASSIS, ETC.

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These 12in tubes have been recommended for TV. use in "Radio World," uses same sockets as VCR97.

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NEW DYNAMIC HAND MICROPHONES

These are a sturdy moving coil microphone made by Rola in bakelite case with switch.

25/-

Post 3/-

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20/- will purchase any one of the following valve Specials

2	EL3NG	3	6K8G
3	1P5	5	6SH7
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Post and Packing, 4/6 extra

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Individually Cartoned

20/- per doz

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829B	£3	0	0
100TH	£1	10	0
866		15	0
811	£1	0	0

NEW 2½in C.R. TUBE

Type VCR 139A

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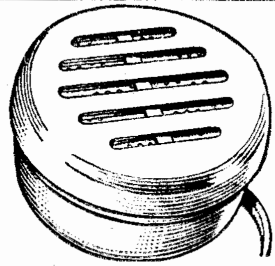

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EXTENSION UNITS

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 the voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED.

3½in Diameter by 1¾in deep **22/6**

POST FREE

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SIZE 15in square x 3ft long. Originally used for Aerials for Lifeboat Transmitters.

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1K7G	7/6	6K7G	6/-	78	7/6	EF50	3/6
1M5G	7/6	6K7GT	7/9	71A	7/6	110TH	£2/9/-
1L5G	9/6	6U7G	6/6	EL32	10/6	829B	£3/5/
6AC7	3/6	6V6GT	12/6	EL33	12/6	811	£1/-/
6B6G	9/6	6X5GT	10/-	EBC33	9/6	866/866A	15/
6B8G	9/6	6K8G	10/6	KTW62/6U7	6/6	828	£1/9/
						806	£4/9/

PLEASE ADD POSTAGE ON ALL VALVES.

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12in per-mag speaker by well-known manufacturer. 10T. CT, or 5000 Transformer **£3/5/**

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5C Standard 30/
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Supplied with 5T, or 10T, Transformer

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6in x 9in Oval Dynamic Speakers with 5T or 7T Transformer

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The switch with 1000 uses 2/6

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Containing .5 and .1 switch pots., long spindle, .5 and .1 standard and miniature pots, long spindle and other mixed sizes, short spindle

20/-

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CONDENSER SPECIAL

Boxes of 100 new mica paper and electrolytic condensers in values ranging from 50pf. mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1, Also 500 mfd/12v, 10 mfd/40v, 8 mfd/525v 16 mfd/350v, electrolytics

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½ Meg. Miniature Switch Pots, d/p Switch Long Spindle **5/6**
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NEW BOOKS

Mathematics of radio

BASIC MATHEMATICS FOR RADIO AND ELECTRONICS, by F. M. Colebrook and J. W. Head. Hard cover, 7½in by 5 in, 359 pages.

The third edition of a book first published in 1946, under the title, "Basic Mathematics for Radio Students," contains two additional chapters, written by Mr. Head, on advanced work required for dealing with some of the more difficult electrical problems. The remainder of the book is the same as the original with very minor changes and corrections.

The introduction on the jacket described the book as "Primarily written for those interested in radio or electronic engineering who find themselves handicapped by their lack of mathematical knowledge, it is suited to students — and perhaps to some teachers — of other subjects. It is so written that it can be used either for home study or to supplement a course of technical training, and the authors' lively style has vitalised and humanised what can so easily be made a dull subject." This, we feel, is a fair description of the book.

The book would be well worthwhile for those tackling the subject for the first time on their own and allow them to gain a good basic knowledge of the branches of the subject necessary for radio engineers from algebra right through to the differential and integral calculus. While we feel that you would need more practice than could be gained from the examples in the book to become proficient enough to use mathematics in your everyday work, at least the book would allow a painless introduction to the subject. As a refresher course for those who have already studied maths, the book is ideal.

INFORMAL STYLE

The authors avoid the formal language of many textbooks while observing all the customary forms in the working, so that the reader will not be at a disadvantage if he chooses to read some of the more formal books later. Touches of philosophy at the beginning and ends of chapters provide a connecting link between mathematics and everyday life.

Some of the individual chapter titles are:—Elementary Algebra, Indices and Logarithms, Equations: Complex Numbers, Continuity: Limits: Series, Geometry and Trigonometry, The Differential and Integral Calculus, the Application of Mathematical Ideas to Radio, Heaviside's Technique for More Difficult Electrical Problems.

Our copy direct from the publishers, Iliffe and Sons, Ltd., Stamford Street, London. Local booksellers are unable to give us a definite price at the moment, but it is expected to be in the vicinity of £1/10/.—(M.V.F.)

Special valve types

TUBES FOR COMPUTERS. Book XII of the Philips Technical Library series of books on electronic tubes. Hard cover, 51 pages, 6in by 9in. Illustrated by photographs, line drawings and tube characteristic curves.

Generally similar to Book XI of the series, Book XII deals with the half dozen or so tubes frequently used in electronic computers. The additional information consists of notes on computer circuits in general, with specific information on high speed and low speed computers using Philips tubes.

Our copy direct from N. V. Philips' Gloeilampenfabrieken, Eindhoven, Holland. Local distributors for the book are Philips Electrical Industries P/L, 69 Clarence Street, Sydney. The local price is 13/-.—(M.V.F.)

Salk vaccine v. polio

(Continued from Page 19.)

contracted only polio sickness among the vaccinated but 750 among the non-vaccinated.

There was not one death among those who were vaccinated but 15 among the non-vaccinated.

There was tragedy also in all this. Parents of children did not know which of their own were injected with the vaccine and which with dummy shots.

Thus eight of the 244 children who received dummy shots came down with polio when other members of the family were struck with the disease. But only one of the 233 vaccinated children contracted the disease when it appeared in other non-vaccinated members of the family.

However that is the price paid for bravery and those who were not vaccinated and suffered affliction were as great as any martyr as ever lived.

Their participation in one of the greatest human experiments of all time paved the way to the conquest of polio so that today we can look forward with confidence to the final extinction of one of man's greatest scourges.

Watches need no winding

(Continued prome Page 11.)

from it doesn't run it down. Lasting as long as its promethium 147 (estimated half life, about 2½ years), it retains one-fourth of its original power for five years, which is considered its useful life. The promethium it uses, now costly, will become plentiful and inexpensive with quantity production, as time goes on.

The applications of such batteries are not confined to the watchmaking industry. Larger models can be made, and it is hoped that eventually they will be powerful enough to operate portable radios using transistors, for instance. They are already being developed in connection with hearing aids, and no doubt designers of guided missiles and even space vehicles will look to similar units as a source of power.

Maybe perpetual motion will remain a dream, but it is not hard to visualise devices which will operate for so long a time without attention that we can almost class them as such.

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Australia's Retailers of Ex-Govt. Technical Equipment and other useful articles.

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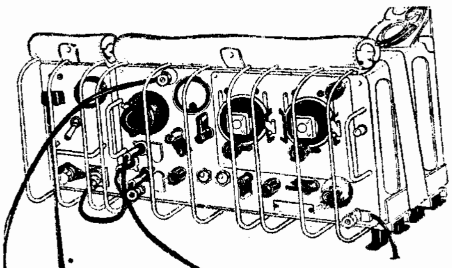
PRICE: £9/19/6 Packing and delivery to railhead, 7/6

This is No. 122 Transceiver



A Bargain at the price

No. 122 TRANSCEIVERS. In fair condition. Complete with valves and vibrator, power supplies, dynamic head and breast set.
These units can be converted easily to comply with P.M.G. requirements for Small Ships, etc. Frequency, 2 to 8 Mcs. **PRICE £17/10/-.** Packing and delivery to railhead, 7/6.

No. 19 TRANSCEIVERS. Cover a frequency of 2 to 8 Mcs. Contain 15—6.3 volt valves, including 807 (1) 2-6V6S, 6—6K7G, 2—6K8G, 6B8S, ETC., 0—1MA-Meter 4—Gang cond., HF unit, ETC. **PRICE £5/19/6.** Packing and delivery to railhead 7/6. 12-v Genemotor for this set. **£2/19/6.**

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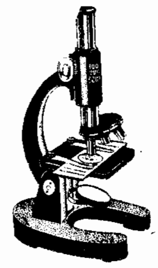
A bargain at the very low price asked.



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NOT A TOY—A REAL MICROSCOPE. SUITABLE FOR STUDENTS. Gives 100, 200, 300 times magnification. Hours of interest and enjoyment. Brand New.

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DYNAMIC HEADPHONES and microphone combined, **25/-.** LOW IMPEDANCE HEADPHONES, **17/6.** No. 3 MICROPHONES, **12/6.** Packing and postage (all States), **3/-.**

WALKIE-TALKIES

No. 108, Mk. II.
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12SJ7	12/6	6H6GT	3/11	VR78	7/6		
12SC7	12/6	6J5	12/6	VR65A	2/6		
12SL7GT	10/6	6K7	6/11	7A6	5/-		
12SF7	12/6	6K8G	10/6	7A8	5/-		
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A COURSE IN TELEVISION

(Continued from Page 99)

be based on experimental results rather than just the original calculation.

For general use, the growing tendency is to produce peaking chokes with inductance values following the "preferred" system, as used for resistors and capacitors. As far as possible, the circuit constants are then manipulated, after initial calculation, to use chokes from the preferred range.

Because of the aforementioned variations in shunt capacitance and the inevitable tolerance in circuit constants including the chokes themselves, some variation in the overall curve is inevitable. However, provided the variations do not lead to a ringing condition, they are not likely to produce any visible effect on an ordinary picture. Individual adjustment of each chassis is scarcely warranted.

In this respect, the whole approach to peaking, including methods of calculation, are somewhat less rigorous than required for measuring instruments as, for example, a wide-band C.R.O. used for the observation of angular waveforms.

Figure 141, extracted from typical valve application data shows likely constants for a circuit involving 6AL5 video diode detector and a 12BY7 video amplifier pentode.

The 12 and 15 microhenry choke and 4.7 pF bypass adjacent to the video detector is a filter intended to suppress the IF component at 30-36Mc but to pass the video components in the range 0 to 5.5Mc.

Shunt peaking only is used in the detector load circuit, where a 250 microhenry choke is shown in series with the 3.9K load resistor. Some receivers supplement the action of this choke with a series-peaking coil between the detector output and the video amplifier grid.

The coupling circuit from 12BY7 to picture-tube cathode provides a good example of the points made earlier in the article. The load resistor is 3,300 ohms, which is about the value one would expect from the formula for combination peaking. Without such peaking, however, the response would be many decibels down at 4Mc.

The two inductor values needed for compensation are, again, fairly technical, although subject to considerable variation with changes in receiver layout.

Figure 142 represents a completely different approach to the problem of video coupling, and one which relies to a lesser degree on inductive peaking.

In this case a triode-pentode valve is used, the pentode as an amplifier and the triode as a cathode follower.

The video input signal from the detector is applied to the pentode grid, duly amplified and directly coupled to the grid of the triode section. Because the shunt loading on the pentode plate is very low, a relatively large value resistor can be used, giving high gain with wide frequency response.

The triode acts predominantly as a cathode follower with a cathode load of 7,500 ohms. The real source impedance is much lower than 7,500 ohms, however, being the parallel resultant of 7,500 ohms and the cathode follower output impedance.

Across this low effective resistance, the likely stray shunt capacitance has only a minor effect and a highly damped series peaking choke is sufficient to secure a flat frequency response over the video pass band.

It is noteworthy that signal is developed also across a small resistor in the plate circuit, this letter being applied to the picture-tube grid.

SINGLE BAND S-W CONVERTER

(Continued from Page 87)

alongside the receiver, a separation of from one to two feet being desirable. Otherwise there is a risk of picking up harmonics from the receiver's local oscillator.

Now tune over the short-wave band until a strong signal is heard, or produce such a signal with the service oscillator, then adjust the slug in the coupling coil until maximum signal is obtained. When the converter is used on subsequent occasions the receiver is simply tuned to give maximum signal strength in the region of 1,600 Kc.

Next tune in a signal near (but not at) the low frequency end of the band and adjust the aerial coil slug for a peak. If a peak cannot be found it may be necessary to reset the oscillator slug slightly, re-tune for the signal, and then try the aerial slug again.

A similar procedure is adopted near the high frequency end, except that the aerial trimmer is peaked at this point. If a peak cannot be found, then the oscillator trimmer may have to be reset slightly.

With this done the unit should be very close to correct alignment and plenty of short-wave stations should be audible at various places on the band, depending on the time of the day, season, and other conditions.

Although you may find that you can receive many stations on a makeshift aerial (we received several Europeans with nothing more than a length of wire draped across the bench) results will always be better if you can get your aerial away from power cables, house wiring, etc., where there is always some electrical interference to be picked up. In extreme cases, one of the noise reducing aerials, such as we have described in the past, may be employed with considerable benefit.

Finally, the entire converter can be housed in a small wooden cabinet on top of or alongside the main receiver. With everything properly connected it is only a matter of turning the switch on the converter, waiting for the valve to warm up, and you can search the ether to your heart's content.

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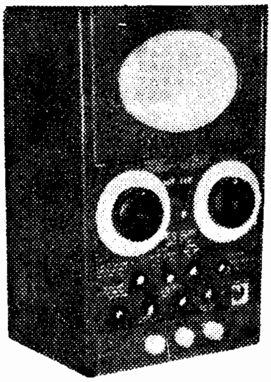

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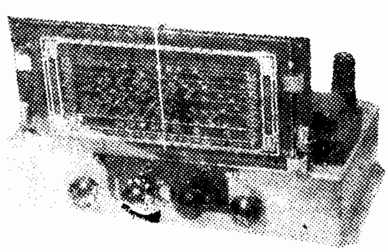

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ANSWERS TO CORRESPONDENTS

M.O.'s (Toowoomba, Qld.) has made a slight modification to the battery receiver described in the October, 1955, issue and wants to know if it is likely to affect adversely the life of the valve or batteries. He also inquires about amateur transmitters and receivers.

A. The substitution of the volume control for the grid resistor is quite in order and perfectly standard practice. It will have no adverse effect of any kind. We have described large numbers of transmitters and short-wave receivers in the past, and it would be impossible to list them all. However, if you care to give us details of what you require we will select the most suitable version from our files.

P.A. (Mackay, Qld.) says he has been able to pick up quite a deal of radio knowledge by 2½ years of reading "Radio, Television and Hobbies." He has recently completed the R. TV and H. battery charger, which is working well.

A. Thanks for your letter, P.A., and for your report on the battery charger. We are glad to know that we have been able to assist you in such a way.

C.P. (Bencubbin, W.A.) renews his subscription R. TV and H., but enters a plea for some amateur gear, particularly gear suitable for use at 60 and 144 Mc.

A. Thanks for your subscription and for your letter which we read with interest. Having once had to operate from a rotary converter, we are familiar with their vagaries in regard to frequency. Several readers have asked about Ham gear, but the best we can say at the moment is "we will, just as soon as we can."

J.C.R. (Wallsend, N.S.W.) submits a number of queries of a general interest nature.

A. We have not described any complete radiogram cabinets prior to that described in the June, 1957, issue, although we have described many radiogram chassis, and which are available from our files. The flyback erase capacitor in a C.R.O. is normally adjusted to give the best suppression of low frequency displays without prejudicing the display of high frequency phenomena. The best setting is usually a compromise, though a perfectly practical one. We have shown a number of useful voltages on various sections of our TV receiver and we may try this on other projects in the future. However, such data needs to be treated carefully, since it can be misleading to the beginner who cannot appreciate the need for normal tolerances. Thus a variation which is perfectly acceptable may lead him to believe that there is a fault in the set, or may be mistaken for the cause of poor performance, but which, in fact, may be due to completely different cause. Your question regarding the high tension lines is one we will have to consider in greater detail, and, as you suggest, we may deal with it in the Answer Tom page.

P.S. (Roma, Q.) is having trouble with a tape amplifier he has constructed from a commercial kit of parts, being unable to avoid audio feedback when the gain is well advanced.

A. Considering all the ideas you have already tried it is rather difficult for us to help without being able to examine the chassis or even being conversant with the circuit. One possibility that is suggested by your layout drawing is that the speaker transformer may be close enough to the first valve to couple to it by reason of the magnetic field. Moving the speaker away from this position would prove the point. The only other possibility is that the negative feedback network may be suffering some form of phase reversal, but, without the circuit, we cannot make any specific comment.

J.G. (Nth. Balwyn, Vic.) asks some questions about the permissible length of speaker lead for an amplifier.

A. We assume that you refer to the voice coil lead and that by "permissible," you mean a length of lead which would not have a noticeable effect on performance, as judged by ear. On this basis, it might be suggested that the connecting lead should not have a DC resistance greater than about one-third the nominal impedance of the speaker voice coil. You can work out the DC resistance of a given length of lead, knowing the total length of conductor in circuit, the gauge and number of strands and the resistance of same, as determined from wire tables. Obviously enough, the length of lead permissible with a 15-ohm circuit is greater than a 2-ohm circuit, but, in either case, no difficulty should arise from running leads across a room or from one room to the next in an ordinary home. The most suitable conductor is probably twin plastic-covered flex, with soldered connections at each end. Only open-weave materials are recommended for use in front of cones radiating middle to high frequencies. Overseas, some of the open weave plastic materials are preferred. Expanded aluminium is transparent for sound, but may rattle unless well supported. You should be able to find a source of supply by inquiring through your local radio supply houses.

K.D. (Brisbane, Q.) wants to know the nature of an FM tuner, why a regenerative set squeals, and how to re-connect a pair of headphones to a large set.

A. An FM tuner is a tuner designed to receive frequency modulated signals, which are normally transmitted on the very high frequency (VHF) band. At the present time most stations operate around the 90 Mc band. The set you have is most likely only a regenerative set—not a super-regenerative set, which uses a completely different principle. The squealling should not be so violent that it cannot be controlled by means of the regeneration control, otherwise it indicates that the feedback circuit is in need of adjustment. If possible the feedback winding on the coil should be moved away from the grid, or feedback line may be by-passed by small amounts of capacitance, say 100 pf or smaller, until the circuit becomes more controllable. A pair of headphones may be fitted to a large set most easily by connecting them across the speaker transformer secondary. If the speaker is not required at the same time it may be disconnected from the secondary, but must be replaced with a resistor of approximately the same value, usually about 3 ohms.

B.W.W. (Brisbane, Q.) is one of our younger readers and has tackled building the Basic Five of December, 1955. He writes to tell us of the excellent performance this set has given since he built it and the pleasure he has obtained from it.

A. Congratulations B.W.W., and it seems you have gone to quite a lot of trouble to build and house the set for best results and greatest convenience. Many thanks for your report on performance and it is gratifying to learn that the set is working so well. We assume the headphones are to allow listening at times when a loudspeaker might disturb other members of the family; a feature which we feel could be used more often than it is.

W.A.H. (Plympton, S.A.) writes in to tell us of some experiments with the Boffle enclosure featured recently. He is very pleased with the final results and wishes to thank us for having put the scheme in his way.

A. We note your kind remarks and are pleased at your success with Boffle. Your detailed letter has been carefully noted for possible future use in the magazine.

R. Albert (Griffith, N.S.W.) sends in a query which he would like answered in this section or the Answer Tom page.

A. Your query has been noted and found most suitable for the Answer Tom page. We have therefore filed it for use at the earliest opportunity.

D.D. (Mayfield West, N.S.W.) is puzzled by the frequent statement that high impedance headphones should be used on crystal sets in preference to low impedance types. His experience is that low impedance types give better results.

A. This statement is basically correct D.D., but assumes that both types are of similar efficiency. In practice, and particularly since the war, there are large numbers of low impedance phones available and which, due simply to improvements in manufacturing techniques, have quite a high order of efficiency. This is more than enough in many cases to offset the loss brought about by the lower detector efficiency which they incur.

V.M. (Cardross, Vic.) asks whether the Radio Course now being run in R. TV and H. would be sufficient to ensure a pass in the AOCP examination.

A. No, the Course does not have the AOCP examination in view. It is intended as a simple basic course for anyone who is just beginning in radio. What it contains might be most helpful to an AOCP examinee, but it would not be adequate. The authorities require a knowledge of communication receiver practice, transmitters and aerial systems, with some reference also to different methods of transmission, FM and television. It is not proposed, at this stage, to carry the Course as far as this.

S.H.S. (Elsternwick, Vic.) is interested in the construction of either the 10 or the 17 watt U-L amplifiers and wishes to know if we are able to supply constructional details or a back issue of the magazine in which they were featured. S.H.S. also requires the construction details of an electric guitar.

A. We regret that we are unable to supply either constructional details or back issues on any of the Playmaster equipment. Circuit reprints and under chassis views only are available through our query service. However, it should be possible to obtain back issues at reasonable cost from advertisers in the classified ads page of this magazine.

Constructional details on an electric guitar featured in the August and October issues of 1941. A further discussion on pickup units was featured in a constructional article on a guitar amplifier in the August 1948 issue. Back issues containing these are not available however but a circuit reprint of the last mentioned is available through the query service.

N.R. (Yagoona, N.S.W.) wants to use the RF power supply (January, 1957) for a 2in oscilloscope, but wants to know if it is possible to reduce the output to the 1,000 volts he requires.

A. It is generally considered that there is not much point in using this type of supply for voltages less than 2,000, it being cheaper and simpler to use a 50 cps transformer, or an extended winding on the main power transformer. If something like this is already being used, as would appear to be the case, we can see little point in installing the RF supply. It might be possible to reduce the voltage sufficiently simply by detuning the RF transformer.

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.

More about the 5-inch TV Receiver

(Continued from page 91)

width a little, but there is already more than enough, and it won't be missed.

A circuit is shown here detailing these alterations.

To make the most of this modification, the .22M resistor between the second grid of the synch separator valve and ground should be changed to .1M.

The effect of this alteration is to give more positive locking of the frame oscillator, and, by providing a greater safety margin, to allow more certain rejection of the video from the synch pulses.

A word about the power transformer for the set. We used a normal transformer as specified for the 17 inch receiver, because if you must buy one you may as well pay a little extra and have a component which will suit a larger receiver later on.

However, any transformer with a secondary voltage rating of between 285 and 310 should do, and as the drain of our set is almost exactly 150 mills, a 175 mill current rating should be suitable.

We did not specify an exact rating on the circuit, because there will be many experimenters who will use transformers on hand, with nothing to lose if they do not prove ideal.

The filament rating is rather high — you can work it out for yourself and it will come to about 9 amps. This drain can be shared between two windings if the transformer is large enough.

The transformer must have a 5 volt winding for the rectifier.

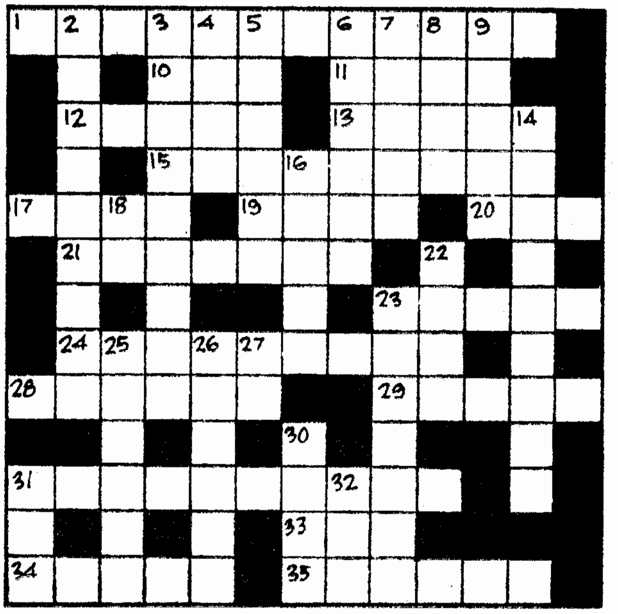
The trouble with these big old-time transformers is their external field, which is often so large that extra tube shielding may be necessary to avoid picture distortion.

Finally a word about picture tubes. We have specified the 5BP1 for obvious reasons, but we know it is now hard to buy. There are several other disposals tubes still obtainable, but we would like the opportunity to try them out before making any recommendation.

Some of them have disadvantages which are not immediately apparent, and will almost certainly need re-arrangement of the resistor values in the EHT voltage divider circuit.

We will try to have some information on these tubes for next month's issue.

THE R., T.V. & H. CROSSWORD No. 41



ACROSS

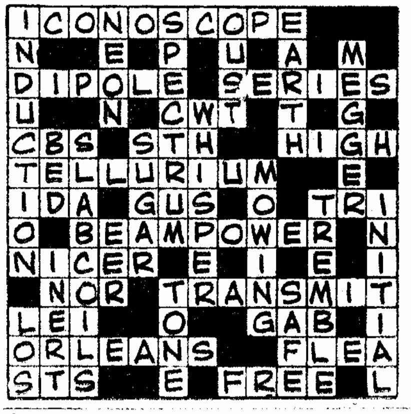
1. Type of aerial. (2 words.)
10. Extinct N.Z. bird.
11. Ireland.
12. Signal to control electrode of a valve.
13. Tower.
15. Rules of ceremony.
17. Made use of.
19. Belonging to us.
20. To give away.
21. Base-frame of a radio.
23. Small animal, below usual size (pl.).
24. Act of winking.
28. Current of water.
29. Long-winged aquatic fowls.
31. To handle.
33. To grow old.
34. Chopped in small cubes.
35. Periodic reduction in strength of signals.

DOWN

2. Still.
3. Sometimes called "apparent resistance."
4. To overthrow and scatter the enemy.
5. Proportions.
6. Nocturnal mammals.
7. Weeps.
8. Slang for "are not."
9. Blood-sucking flies.
14. Impedance due to inductance or capacitance.
16. Not agitated.
18. Expression of inquiry.
22. Melody.
23. Revolved.
25. Dissimulating ridicule.
26. A winding with a connection made to an intermediate point.
27. Type of modulation (abbrev.).
30. Man's name.
31. Prefix meaning middle.
32. Turkish commander.

Solution and further crossword next month

Last month's solution



QUESTIONS AND ANSWERS ABOUT TV

(Continued from Page 57)

With true interlace, and even assuming very sharp focus, there is very little unscanned area on the screen, so that the spaces between the lines are very much narrower than the lines themselves.

Another trick is to advance the brightness control to the point where it is possible to see the horizontal lines present due to the vertical retrace time. These are so widely spaced that there is no difficulty in observing whether they are interlaced.

The fact that they are interlaced is not an infallible indication of picture interlace, but it does indicate that the frame oscillator is being triggered correctly. Assuming that nothing happens during the retrace period to alter the retrace time between odd and even frames, then correct interlace will be maintained.

It does appear that spurious line pulses can also upset the retrace time or the actual instant of commencement of the new frame after the retrace, so that this test should only be used in conjunction with the previous observations.

However, it would seem reasonable to suppose that correct interlace during the retrace indicates the absence of such spurious pulses and that there is, therefore, less chance of the retrace time being distorted due to this same cause.

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ANSWERS TO CORRESPONDENTS

K.H.Y. (Bellevue Hill, Sydney) wishes to separate the tone control stage from the main amplifier in the Crystal Playmaster No. 13 and would appreciate our suggestions on this scheme.

A. The separation you suggest is quite feasible and may be simply effected by enclosing the tone control circuit within a metal case and connecting to the grid of the first stage by a length of coaxial cable. The length of lead should be as short as possible and should not exceed your suggested length of 2 to 3 feet. The remaining leads are not critical as to length or spacing, the radio output lead being the only one to require shielding. All earths within the shielded unit should be brought to a common point.

A.C. (South S'ton, Tas.) is anxious to obtain the base connection for the 3BP1.

A. The connections you require are as follows: Pins 1 and 14 heater. 2 cathode. 3 grid. 4 not to be used. 5 Anode No. 1. 7 Deflecting electrode DJ3. 8 Deflecting electrode DJ4. 9. Anode No. 2. 10 Deflecting electrode DJ2. 11 Deflecting electrode DJ1.

R.L. (Harden N.S.W.) wants to know whether we have never described a capacitance and inductance meter of some kind and also asks what is the advantage of amplified AVC.

A. We have described a number of resistance and capacitance brides in the past R.L., the lastest being in January, 1955. However, the measurement of inductance is not quite so easy, due to the DC resistance of the windings, as well as the inductance having to be taken into account. The purpose of amplified AVC is to overcome the fact that a simple AVC system can never compensate for changes in signal level, since the signal strength which produces the AVC is also under the influence of this voltage. In practice this is not a serious limitation and amplified AVC is seldom encountered. However, TV receivers often use some form of amplified AGC, since the signal level in some parts of a TV receiver

T.R.M. (Bullimba, Qld.) asks for coil data to suit a shortwave converter circuit he has and at the same time makes some personal remarks about his interest in radio.

A. Many thanks indeed for your letter which was read with interst. We are glad to note that you gain so much pleasure from your hobby. We have no data on coils for the converter which could be wound at home with standard size formers etc. About the only way we can suggest that you could get the converter into operation without too much trouble would be to buy a set of commercial shortwave coils and a broadcast aerial coil to use in the plate circuit of the EK2-G. Although the shortwave aerial, RF and oscillator coil combination would be designed to work into a 455 Kc/s IF channel, the tracking error with the main receiver tuned towards the low frequency end of the broadcast band would be small enough to be neglected.

J.McD. (Bowen, S.A.) writes to thank us for forwarding a back issue which he required and also to sends us a subscription on behalf of a workmate.

A. Many thanks for your letter J. McD., and for the kind remarks about the magazine. We have forwarded the subscription to the appropriate department and also your note about your own subscription. We have no doubt that this has all been cleared up by now. We trust your friend will find the magazine as interesting and helpful as you do yourself, and we will do our best to maintain its standard.

P.J.B. (South Yarra, Vic.), is interested in buying a transistor radio and asks our advice about the brand.

A. We have had the opportunity to handle so few commercial transistor radio receivers that it would not be possible for us to make any authoritative comments or comparisons. The best we can suggest is that you try to hear some of those currently advertised and form an opinion for yourself.

WANTED TO BUY, SELL OR EXCHANGE

FOR SALE: Back Nos. R. and H. for sale. April, 1939, to Oct., 1956, 2/ posted. Nov., 1956, to current copies 4/ posted, quote on large lots, also will buy spare R. and H. you have. If out of stock, I will get it for you. **A. J. Cox, 13 Glover St., Belmont, N.S.W.**

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FOR SALE: "Model Engineers" bound volumes for sale. Also unbound books. **Bolton, 70 King Street, Sydney.** Model Catalogue 5/.

FOR SALE: Morse Code automatic sending keys now available, £7/15/. Limited quantity. **Levenson's Radio, 226 Pitt Street, Sydney.**

FOR SALE: 2in C.R.O. Good order. Suitable for sweep alignment of TV sets. £10. **P. Bessell, 132 Doncaster Ave., Kensington. BA4891.**

SELL: AT300 Tx, £1; SCR522, £2; LFF set, £1; Field Phones, £3; New Metres, 10/; new Relays, 5/. **Butler, 1 Darley Street, Randwick.**

SELL: Transformer 240/110 1000W, £10. **K. Wallace, 57 Braeside St., Wahroonga, N.S.W.**

SELL: Tape Tecnicorder Model UG4, complete mike tapes. As new, £65. Also Beam prop motor. **A. O. Brand, Long Jetty, N.S.W.**

SELL: Palec mod. oscillator, as new. Portable signal tracer with 50 ma voltmeter. Sundry valves and parts. Best offer. **LL4727 Sydney.**

SELL: American professional Ampex. Full track Tape Recorder. Model 601. Heads, electronics and motors. Excellent condition. Perfect reproduction. Cash £525. **L. Nixon, Box 118, Redfern, N.S.W.** Write immediately.

SELL: Electronic Organ, Hammond type. Nearly completed. Two Manuals, pedals, new cabinet by Beale's. As it stands, £300 to first comer. **Christian Broadcasting Association, 12-14 Pine Ave., Five Dock. WF8612.**

SELL: 385V, 80ma trans., 28/. **XL1322 Melb.**

SELL: ATR7 TX and RX, complete. New, in 6ft crackle cabinet, two doors. Also remote control unit. Handbook manual connect to 26 volts D.C. and it works. Easily adapted to 240 volts. Price £50 buyer collects, weight 9 cwt. Write **300 G. W. Highway, Blackheath, N.S.W.**

SELL: Used radio parts. Details from **B. Beattie, Spencer, N.S.W.**

SELL: University MVA multimeter, OK1 oscillator, A.R.C. seperate course £22. **Oliver, 53 The Corso, Maroubra. FJ2097.**

SELL: Leak Duad 15in speaker, £42/10/. **Caldwell, William Street, Goodna, Qld.**

SELL: Two genuine American "Presto 1C" high-fidelity disc-recording cutterheads, 500 and 15 ohm matching impedance. Frequency respone 25 c/s — 17 Kc/s. Both cut microgroove or standard discs and fit Royce traversing equipment. £23 each. **J. Watson, 2 Redcourt Ave., Armadale, Vic. UY5379.**

SELL: R. TV and H. back issues 2/ ea. incl. post. All copies in good supply. **T. Weir, 56 O'Connor St., Haberfield, Sydney, N.S.W. UA2569.**

SELL: Vented enclosure, polished cedar, suit 12in speakers, £13. Excellent value. **K. Anderson, 40 Brunker Rd., Yagoona.**

WANTED: Inter-stage transf. for SCR22, tx. part No. 159 also rcv.'s and converters for 144 and 56mc. Write **M. J. O'Brien, 28 Irrawang St., Raymond Terrace.**

WANTED TO PURCHASE: Hallicrafter S27. Also QST November, 1951. Price to **Box 111, Junee.**

WANTED TO BUY: Type 2E22 valves, also type 7R7. **A. W. J. Giddings, Lancefield, Vic.**

WANTED TO BUY: Communications receiver, Commander, AR 88, H.R.O. or similar type. **A. W. J. Giddings, c/- Anzac Rifle Range, Liverpool, Sydney.** (Until October 12, 1957.)

WANTED: EL2 and 322. **McConnachie, Canada Street, Lake Cargelligo.**

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Used in conjunction with the University C3 or C5 or similar oscilloscope the actual shape of intermediate frequency and overall selectivity curves is made clearly visible.

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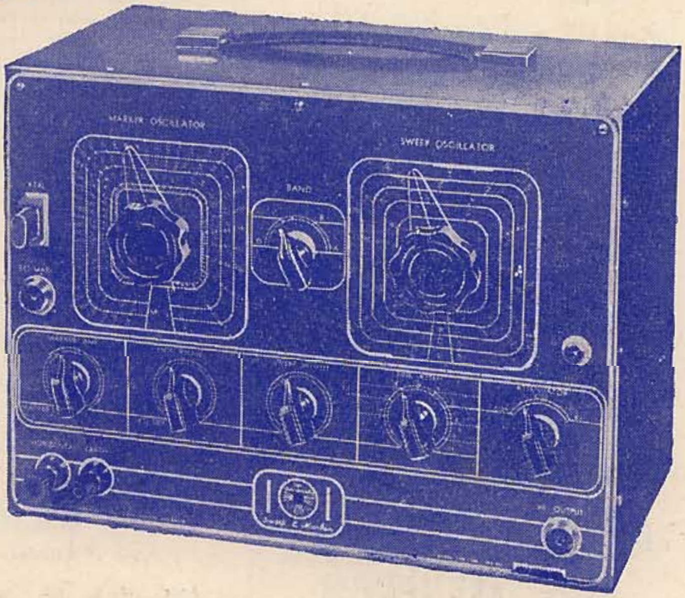

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