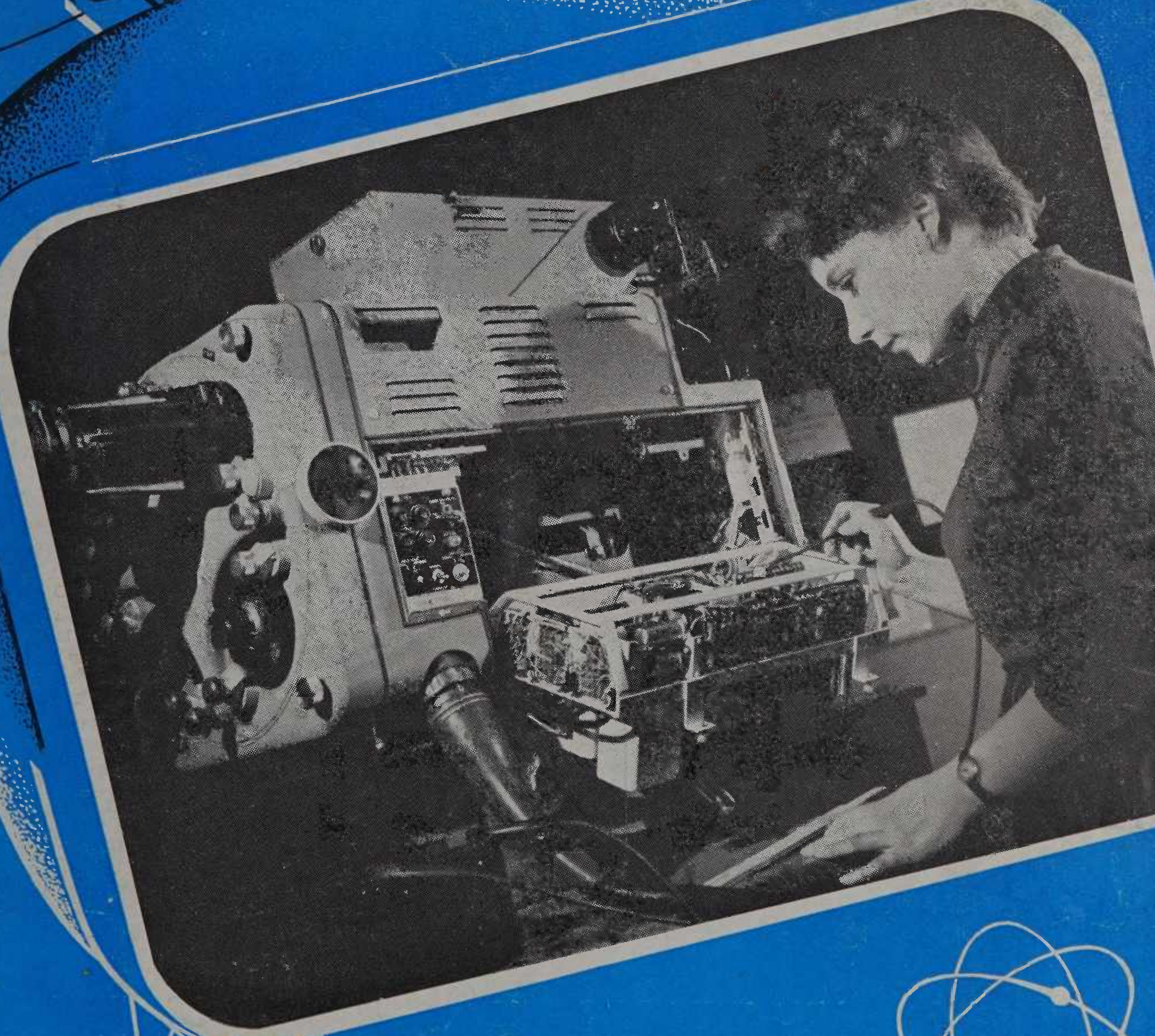
RADIO and ELECTRICAL Review

TELEVISION - COMMUNICATIONS - SERVICE - SOUND

Incorporating "RADIO and ELECTRONICS"

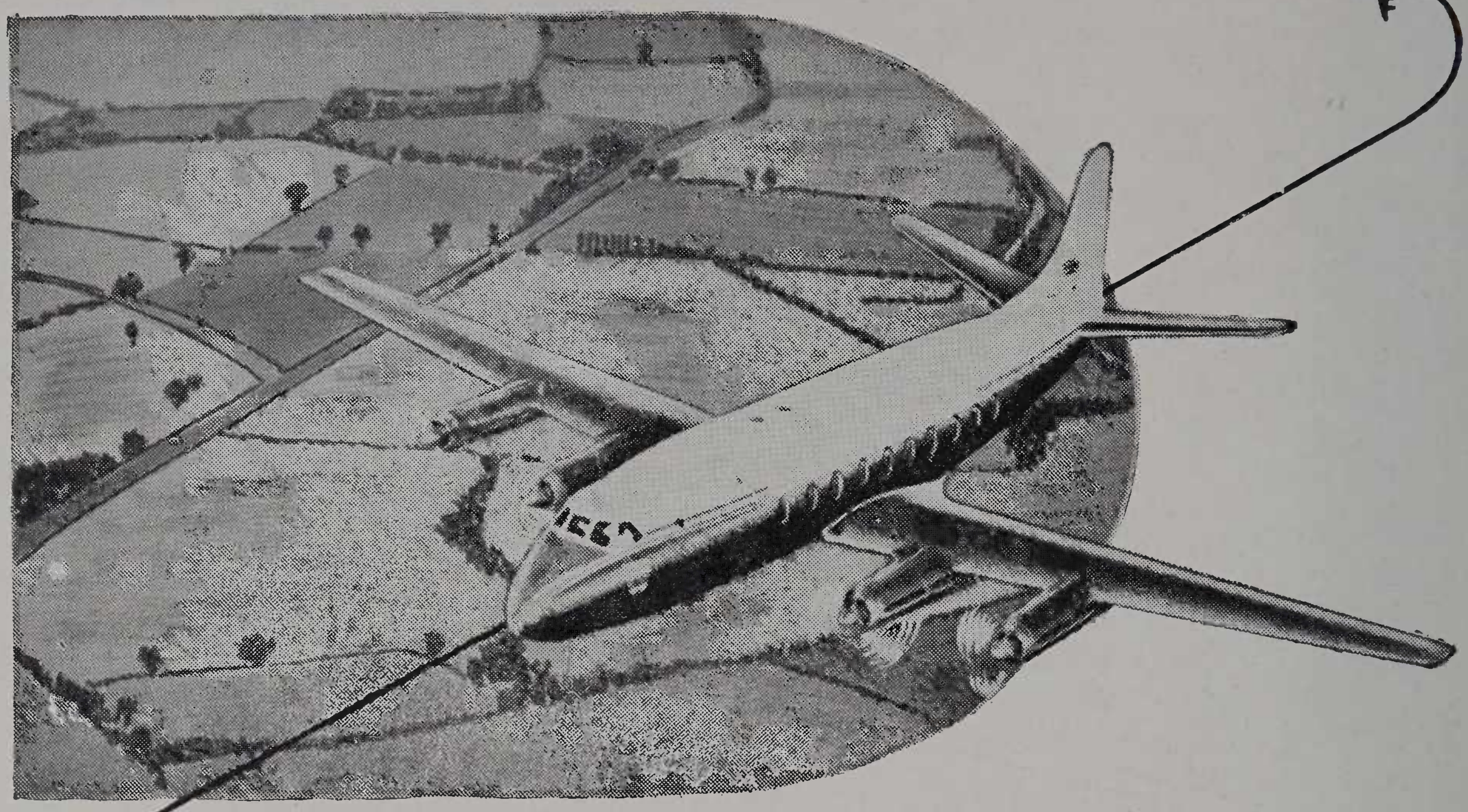


MAY 1st, 1956

VOL. 11, NO. 3

PRICE 1/10

TOP PERFORMANCE IN THE AIR



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Radio and Electrical Review

OUR COVER PICTURE this month shows a technician checking a Marconi Mark II camera. Facilities exist at Marconi's Chelmsford Works and Marconi College for the training of engineers and technicians of either sex who possess suitable qualifications.

Official Journal of

The New Zealand Electronics Institute (Inc.).

The New Zealand Radio and Television Manufacturers' Federation.

The New Zealand Radio and Electrical Traders' Federation.

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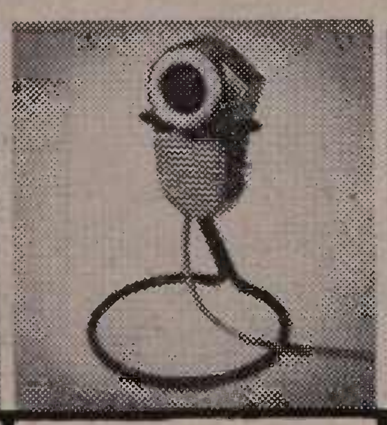

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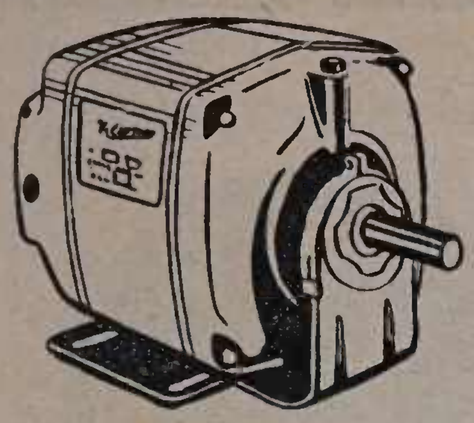

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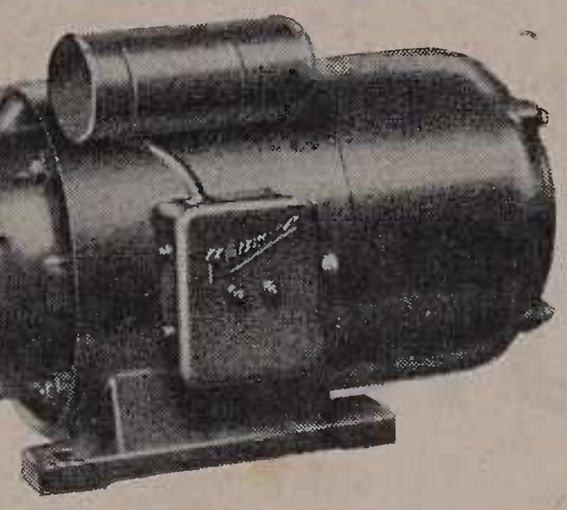

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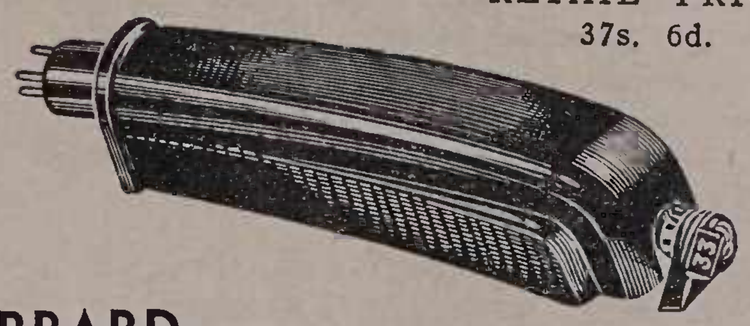

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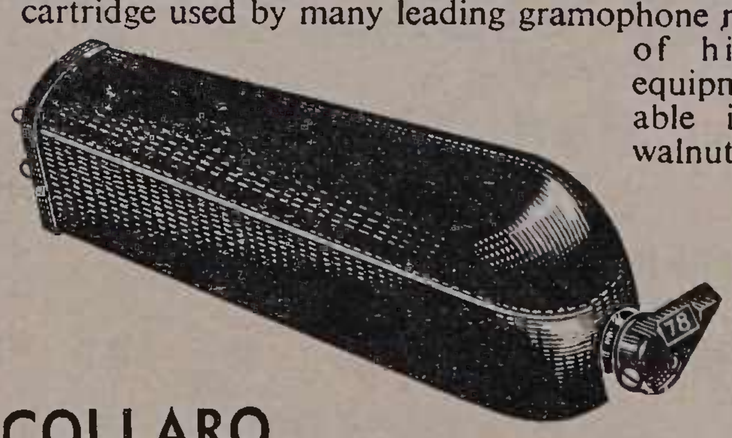

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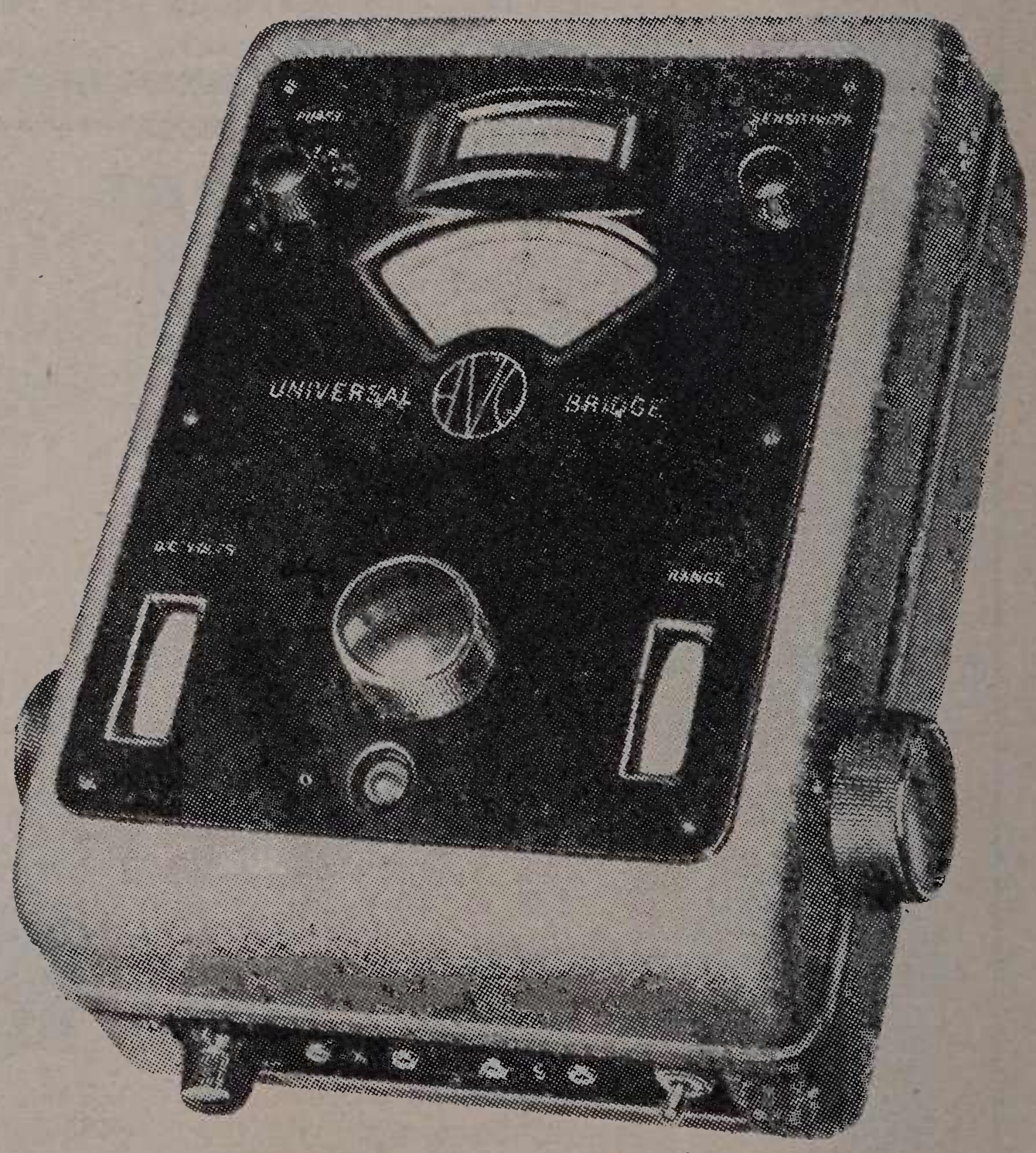

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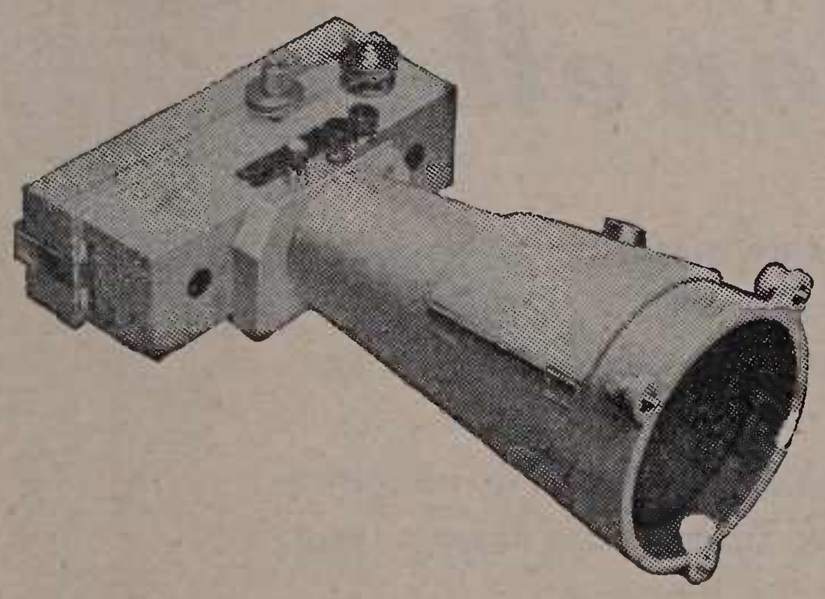

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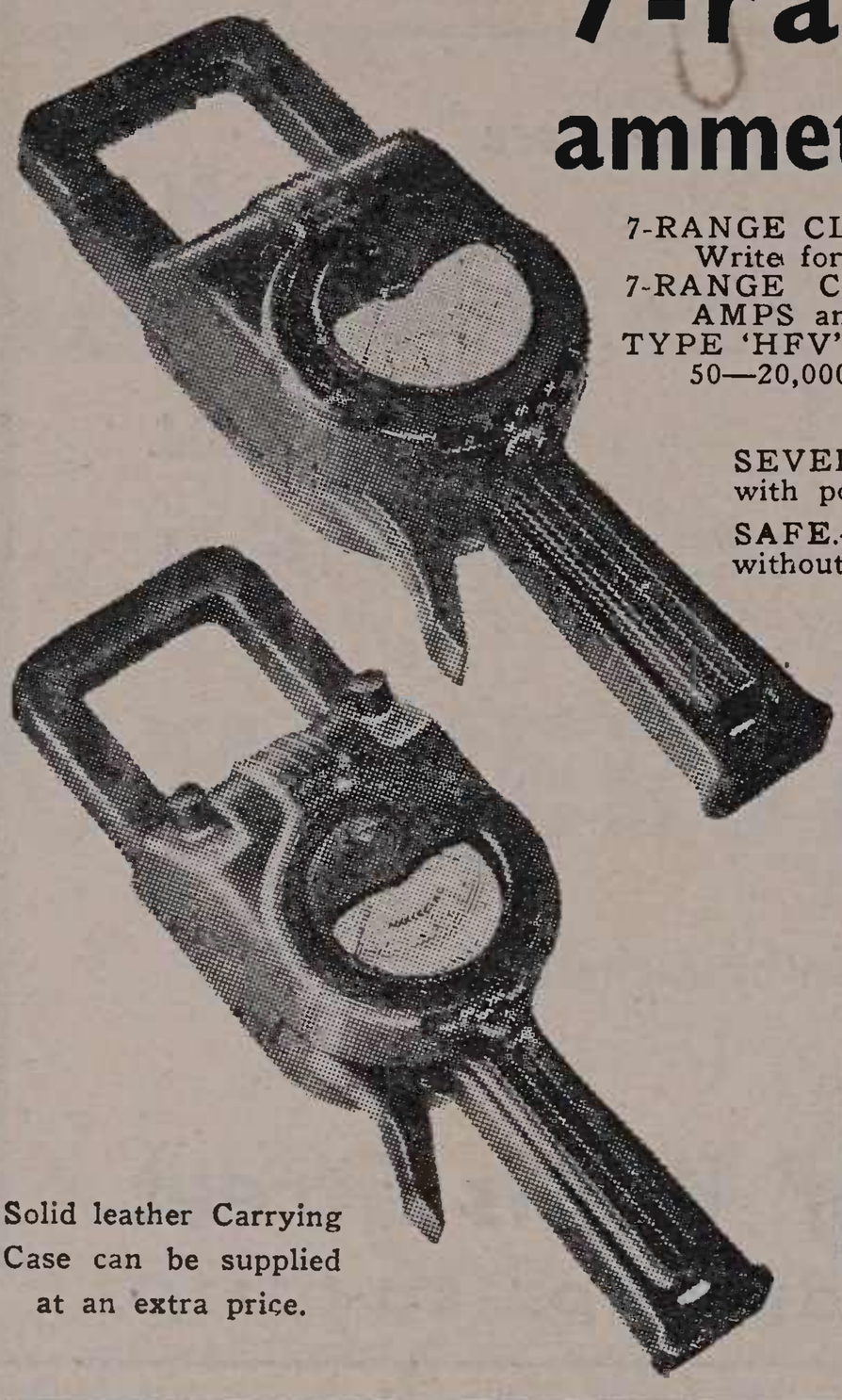

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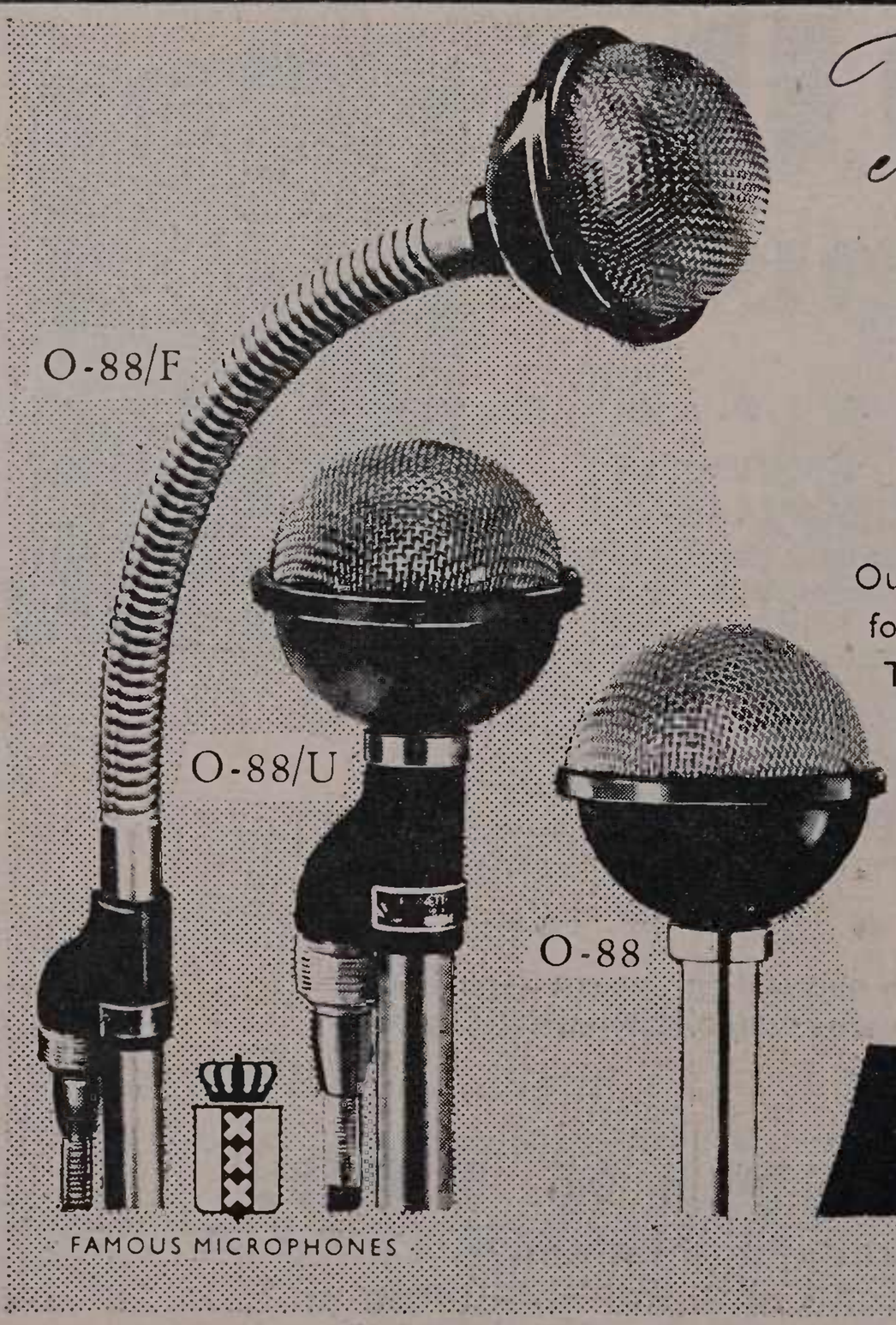

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Three popular microphones by **Ronette**

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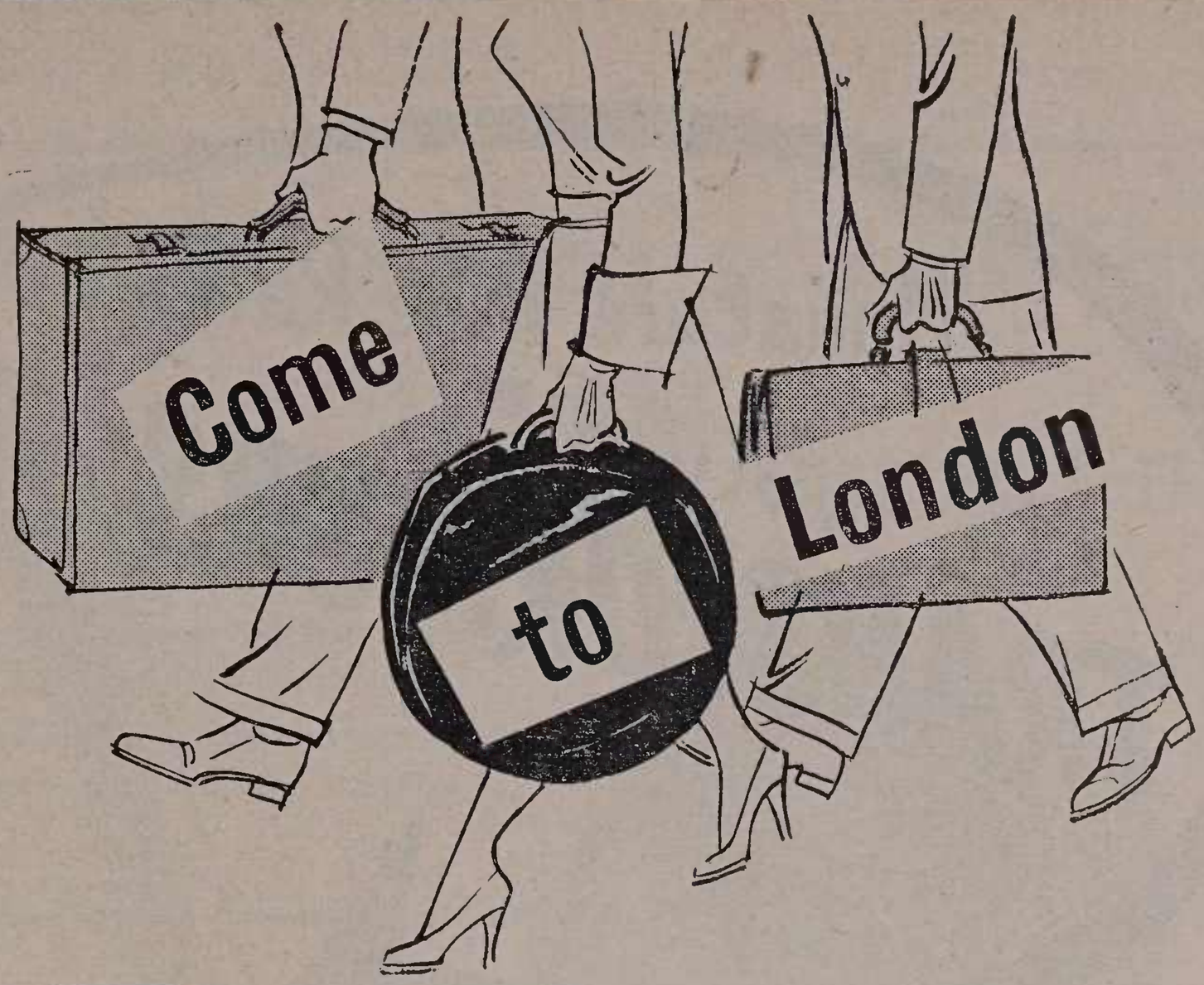

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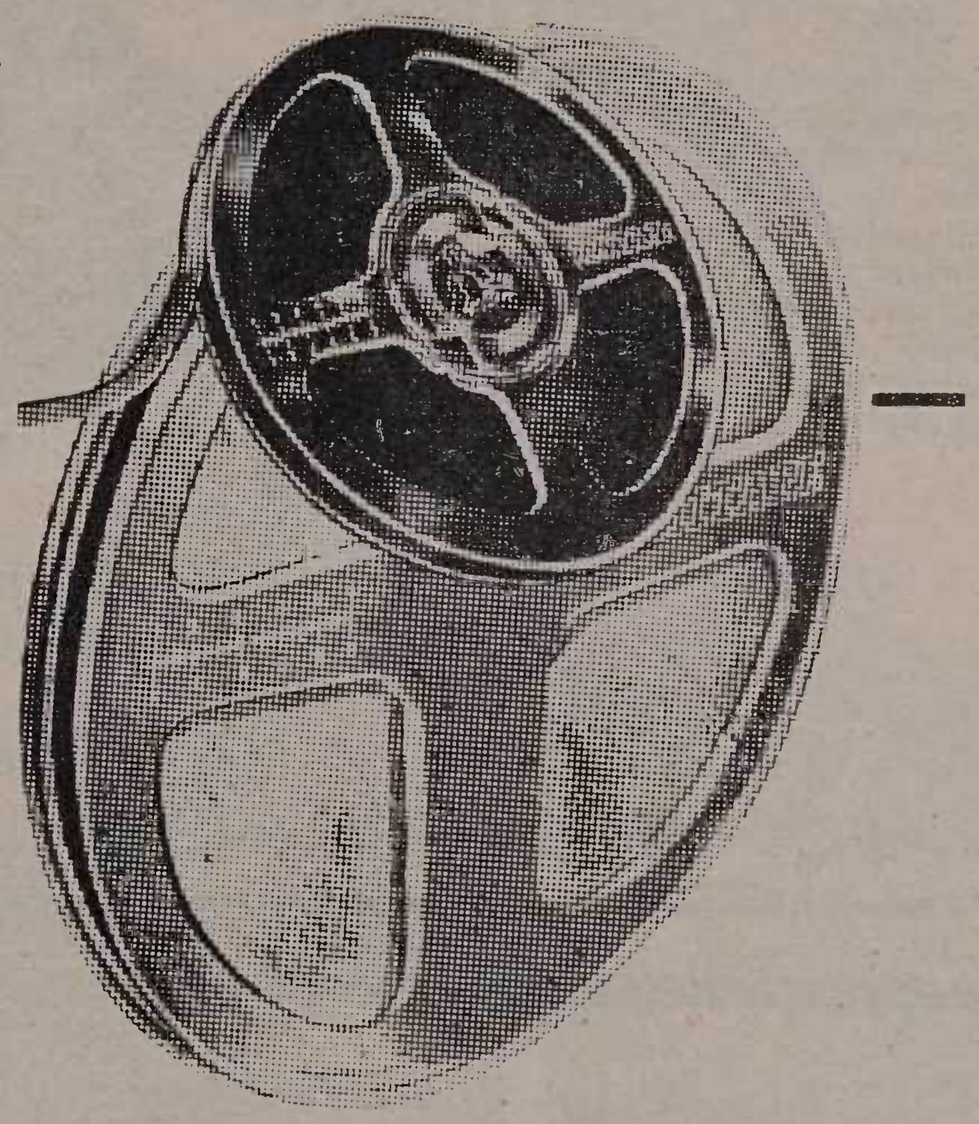
Emitape "99" is a specially-developed thin-base tape giving an increase of 50 per cent. recording time for long-play purposes.



NEW $5\frac{3}{4}$ in. Continental Spool

The addition of the $5\frac{3}{4}$ in. Continental spool to the Emitape range fills a long-felt want.
Emitape spool sizes are now:

3 in. Message (175 ft.)
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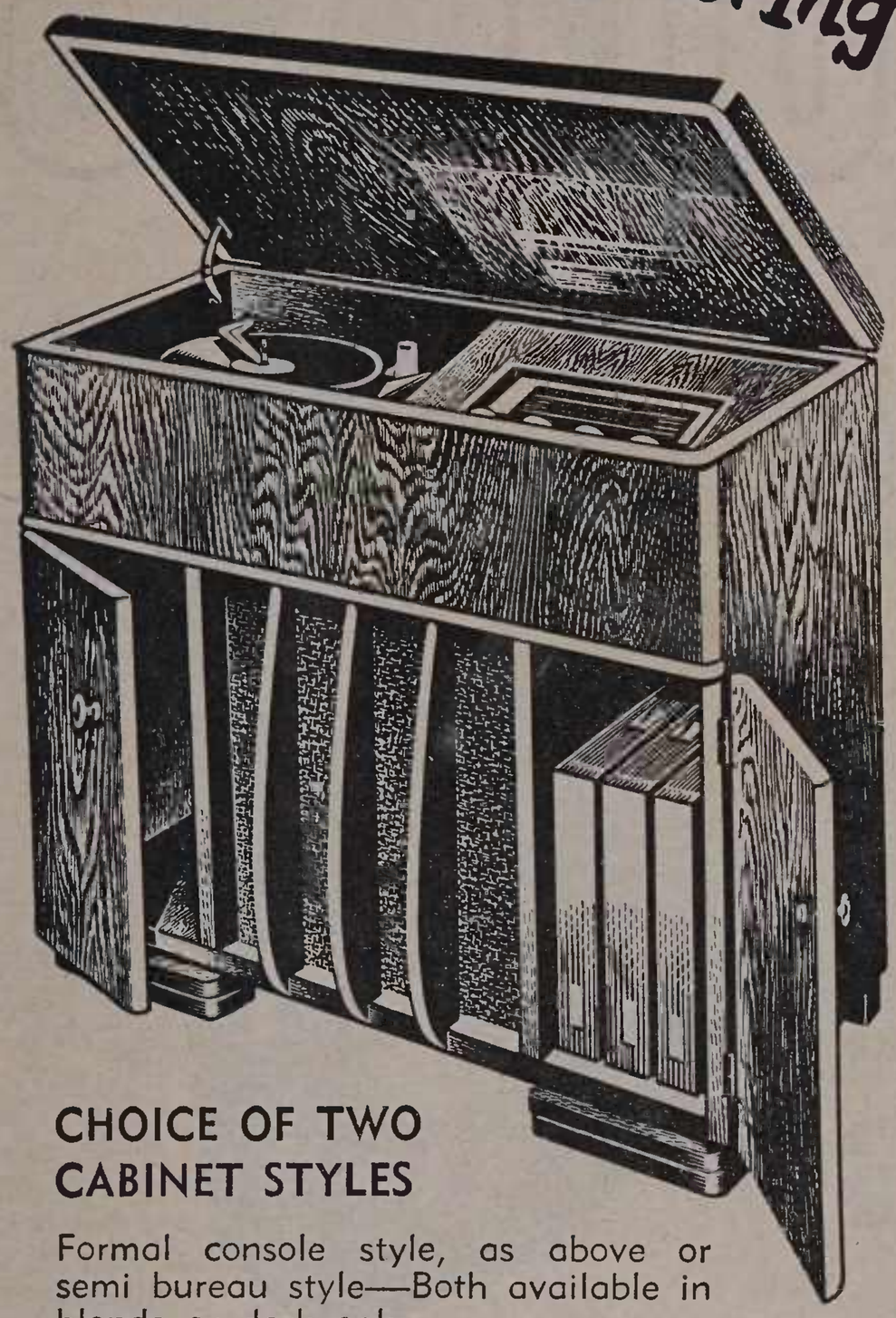

Now, Bell incorporates THREE speakers, bringing you vastly increased tonal reproduction! And still at an unbeatable price. Installed with the Monarch 3-speed automatic mixer changer.

CHOICE OF TWO CABINET STYLES

Formal console style, as above or semi bureau style—Both available in blonde or dark oak.

they're great radios — these **BELL** *Radios*

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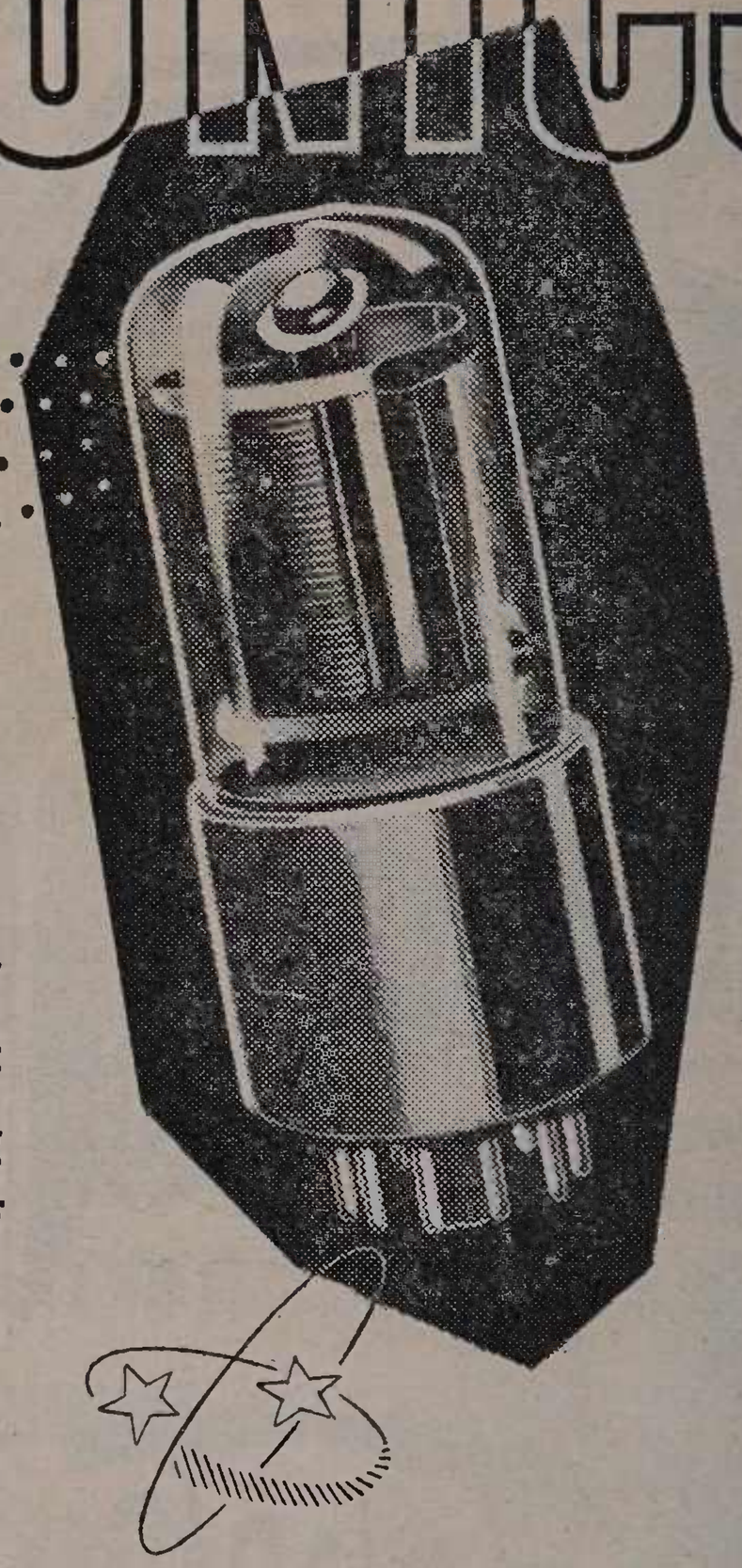

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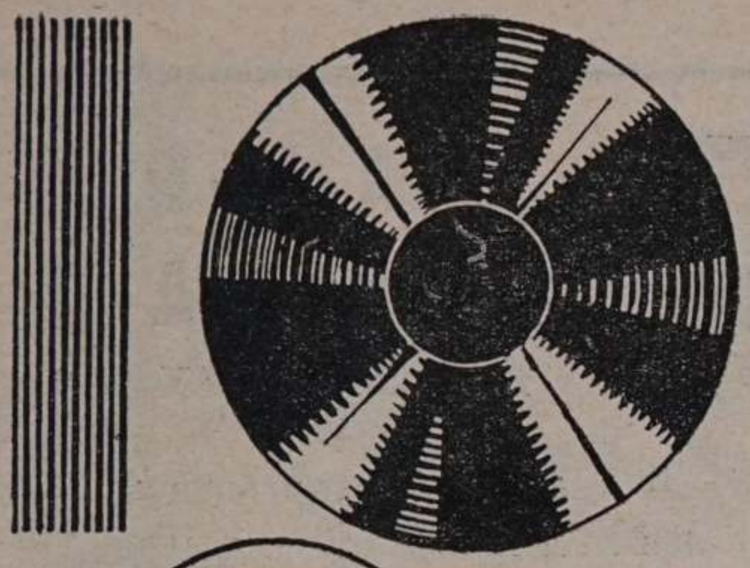
RECORD FEATURES



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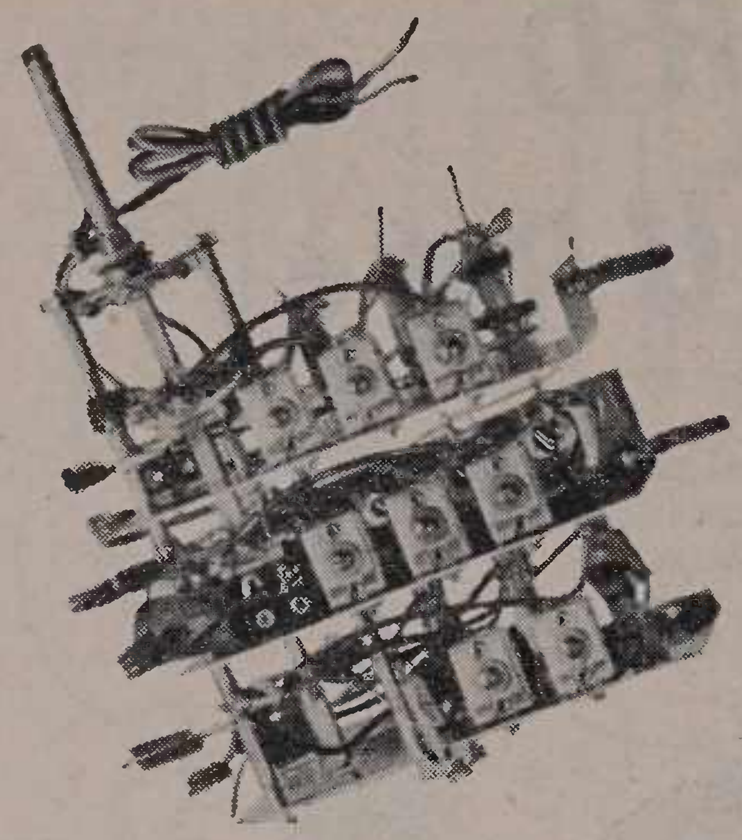

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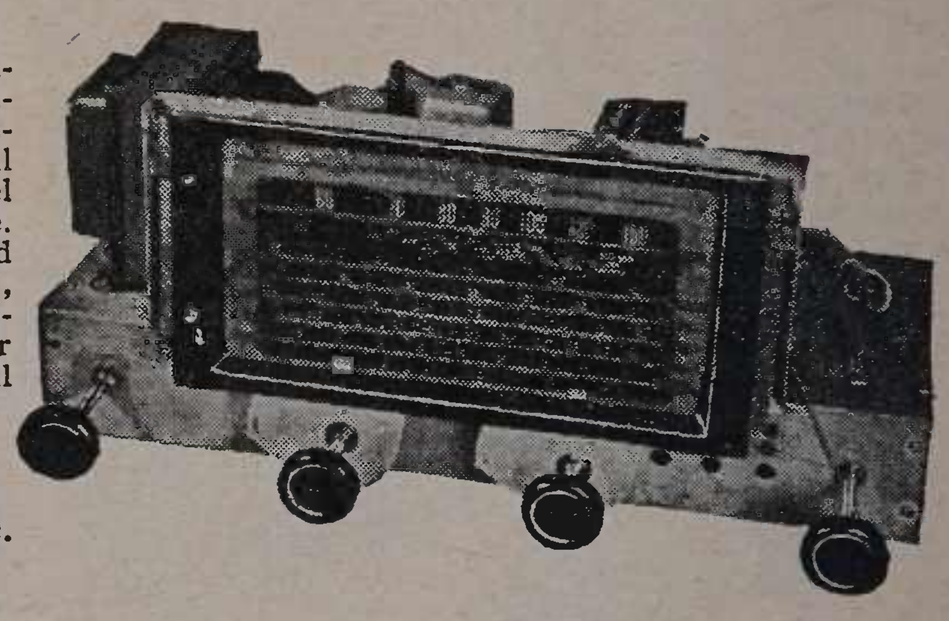

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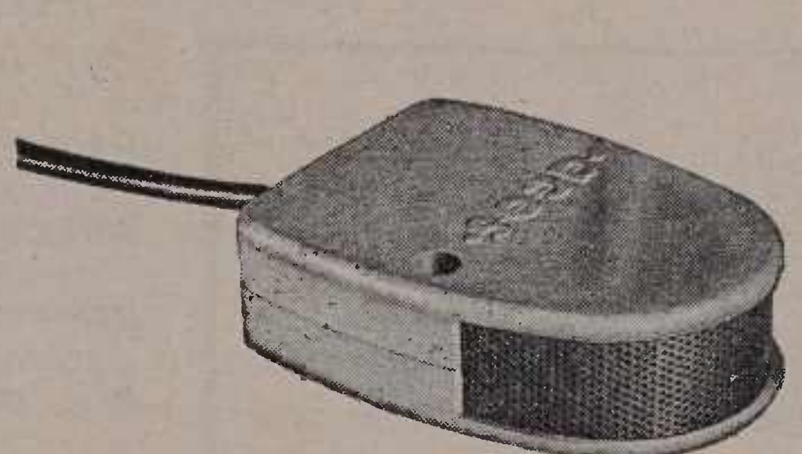

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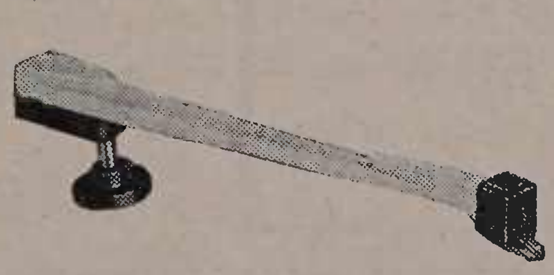

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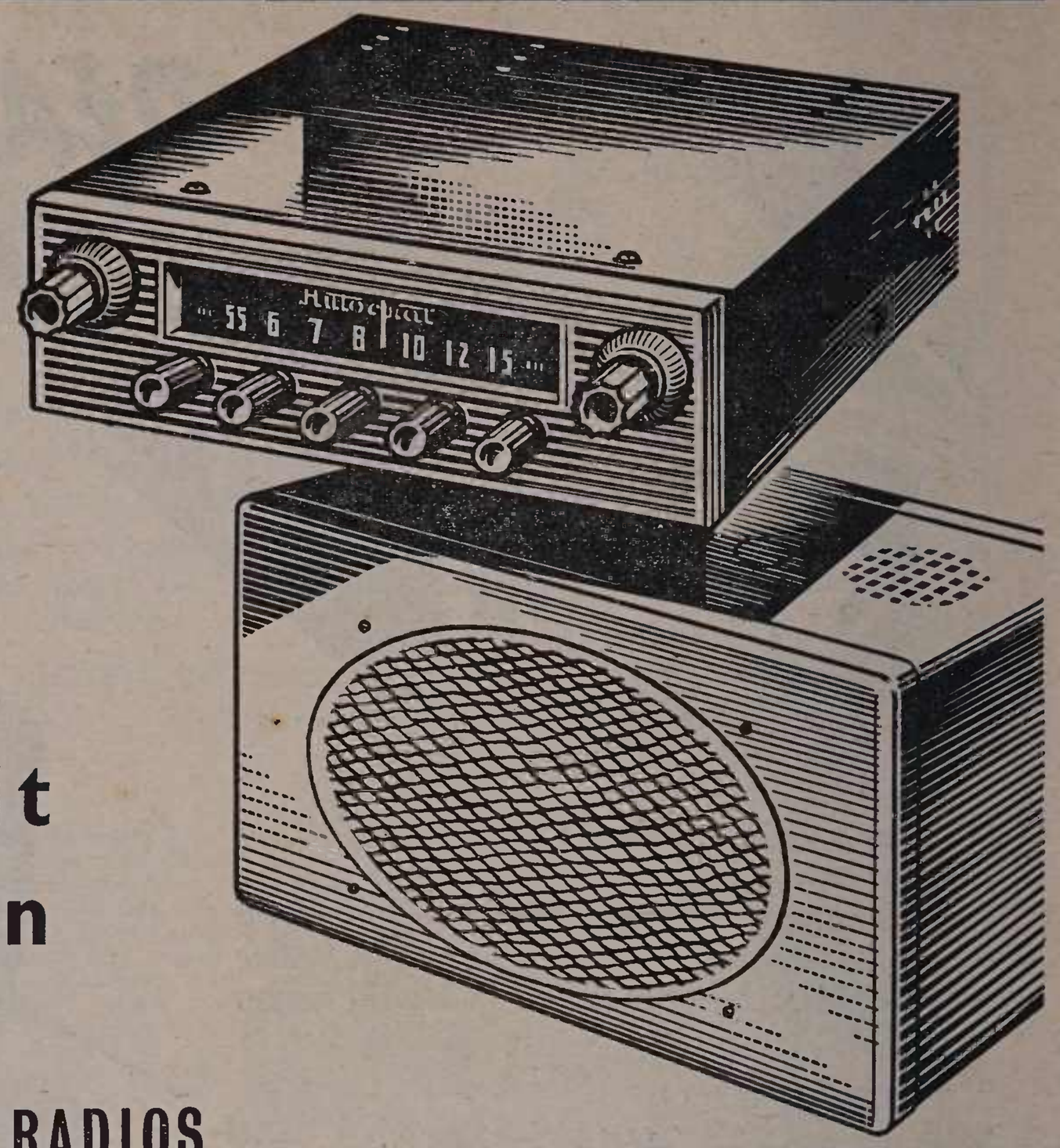

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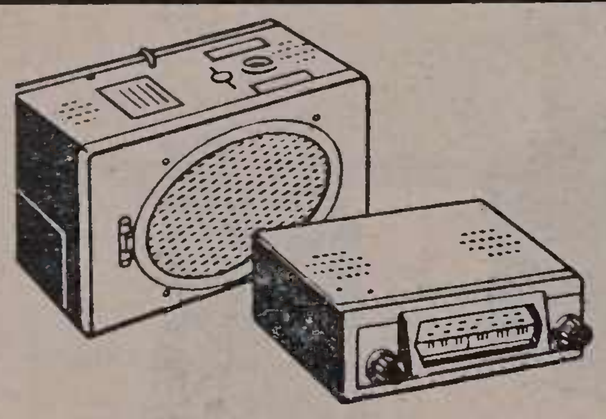

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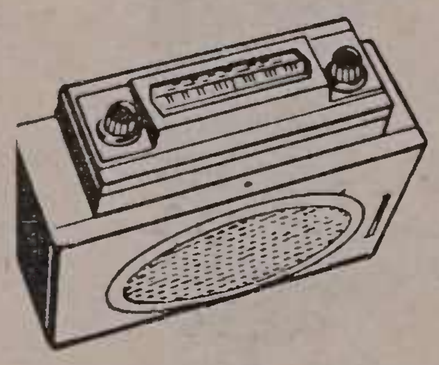

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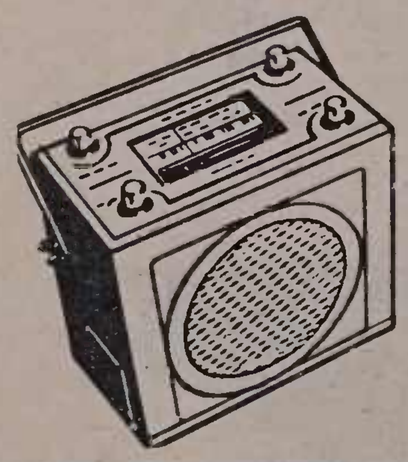

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Television In Australia

The year 1956 will be remembered as the date of the first television broadcasts to take place in Australia. It will no doubt figure as well in the history of television in New Zealand, but only as an indication of the number of years that will have elapsed before we have a service in this country. But as it appears that we must continue to exercise our already well-tried patience in this respect, all we can do at this stage is to look on from afar, and hope that the inauguration of TV in Australia may do something, however small, towards the institution of our own service.

We know that a great many of the readers of this journal feel with us that some activity on the television front is long overdue, and like us, are extremely interested in its devolpment in our nearest Commonwealth neighbour. Accordingly, we propose to devote this month's editorial space to a short account of the present status of TV in Australia.

From the inception, there will be two kinds of television broadcasting in Australia—Government-owned, non-commercial, and privately-owned commercial. In this respect, the set-up will be very similar to that of sound broadcasting in that country. Initial planning by the Australian Broadcasting Commission is for two stations, one in Sydney, and one in Melbourne. The transmitters for these two stations are due to arrive in Australia in September, and it is expected that they will be ready to go on the air by November of this year. It is believed that both ABC stations will commence their service using filmed programme material, and that live broadcasts will not be undertaken for some time. Both Sydney, (call-sign ABN) and Melbourne (ABV) will use channel 2, 63 to 70 mc/sec.

On the commercial side, two firms in Sydney and two in Melbourne have been licensed, and are planning to commence their services late this year. In Sydney there will be TCN, operated by the Television Corporation Ltd., and ATN, operated by Amalgamated Television Services Ltd. The latter will operate on Channel 7 (181–188 mc/sec.) with an effective radiated power of 100 kW., while the former will use Channel 9 (195–202 mc/sec.), also with an E.R.P. of 100 kW. These power figures refer to the video transmission, and the audio transmitters will have a power 20 kW. ATN is scheduled to commence transmission in November-December, 1956, and TCN expects to have test transmissions on the air by Easter, and hopes to commence its service on full power by August.

In Melbourne, there will be GTV, operated by the General Television Corporation Pty. Ltd., on Channel 9, with a video transmission of 100 kW. E.R.P. Its date for commencing operations is yet to be fixed. The other Melbourne commercial station will be HSV, owned by the Herald-Sun TV Pty. Ltd., and using Channel 7, also with a video E.R.P. of 100 kW. Test signals are to be radiated between May and July, 1956, and it is hoped to commence service by October, 1956.

Several companies are active in programme distribution and production, and it is plain from the information that has reached us that this side of television is going to be very big business indeed. The programme companies will not only be distributing filmed programmes from the United Kingdom and America, but will be producing them in Australia on a large scale as well. For example, one company is at present constructing a production centre on a 20-acre site outside Sydney, complete with all facilities for making 35 and 16 mm. films specially for television, not to mention commercial theatrical films, and educational or industrial ones. The sound stages will be connected by microwave links with the television stations, so that by the addition of television cameras to the equipment, programmes can be broadcast "live", as well as being filmed.

Already, scales of advertising charges have been publicised by at least one company, and it may be of interest to note that the charge for televising a one-hour programme will approximate £200, exclusive of production costs. Ten-second announcements will cost between £16 and £20.

From the above information, readers will gather that preparations for TV are well under way across the Tasman, and that all that is needed to make it a success is the co-operation of advertisers and viewers! Several organisations are active in training technicians, and the Melbourne Technical College is even offering training in TV programme production.

No doubt many readers will want to know if there is the remotest possibility of our receiving the Australian transmissions in New Zealand. There is more than a possibility that the ABC stations, on Channel 2, will come over at good strength under some conditions. The frequency of this channel is not so high that ordinary ionospheric propagation will not take place during the peaks of the sunspot cycle, when under favourable conditions, excellent communication has been established between amateurs in the two countries on the six metre band, which is only a little lower, being 50–54 mc/sec. We suggest that anyone seriously interested should concentrate on trying to pick up the sound signal for a start. A receiver built for this purpose would have to be an FM one, but should be built with as small a bandwidth as will give satisfactory reception, in order to achieve as good a signal-to-noise ratio as possible.

As for the commercial stations on Band 3, channels 7 and 9, it is very unlikely that any reception will be possible except by the method known as scatter propagation. As the powers used at the transmitting end are quite large, there is a possibility that reception by this means might be possible, and any experiments that might be carried out in this line would probably make a worth-while addition to our knowledge of this most recently discovered method of V.H.F. propagation. It is certain, however, that to have any chance of success, the receiver would need to be up to the highest standards, and would need a very high-gain aerial.

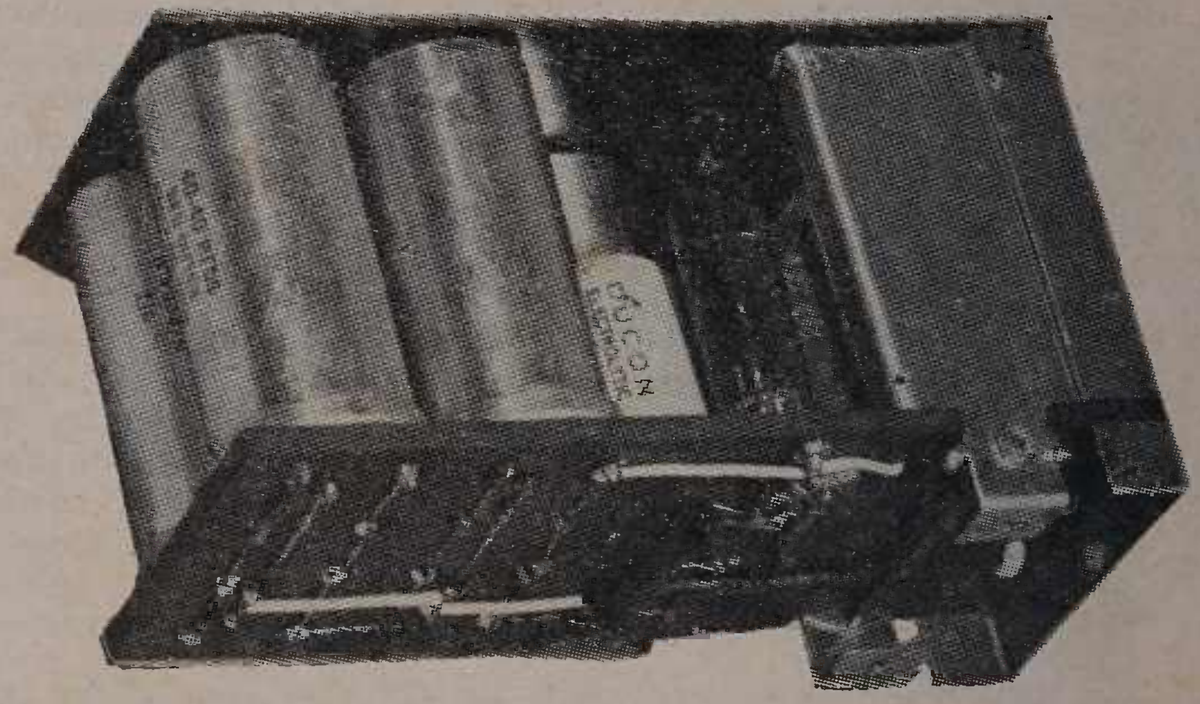
A LOW-VOLTAGE ELECTRONIC FLASH-GUN

Many builders of electronic equipment seem to be photographers as well, so that we would expect an easily-constructed flash-gun to be a popular item of equipment for home construction. This article describes the construction of such a unit, using one of the modern low-voltage flash tubes. All other components are standard radio parts, or can be easily constructed by the builder.

INTRODUCTION

For those who are interested in both electronics and photography, the electronic flash gun is a very attractive item of equipment. It is essentially simple in construction, and entails no particular difficulty. Until recently, however, the flash tubes available were solely of the high-voltage variety, and these do pose some problems and disadvantages, some of which are virtually insoluble. Such tubes as the LSD3, which were in common use on commercially built flash-guns until quite recently, suffer considerably from the fact and that their normal working voltage is approximately 2 kV. Although the use of a high tube voltage does allow relatively small values of capacity to be used in the circuit, the condensers which have to be used are large and heavy. It is not possible to use electrolytic condensers, except in cumbersome series-parallel arrangements, because of the high voltage, and the large size and weight of the special condensers that have been sold for use with high-voltage flash tubes results because they have to be of oil-filled paper construction. The development in late years of flash tubes which work at much lower voltages, and of special high-capacity electrolytic condensers for use with them, has done much to make the equipment much smaller and lighter. For instance, one German flash-gun which has been sold in quite large quantities in this country uses only 150 volts on the tube, and in spite of the enormous capacities which have to be used with such a low voltage, the construction of this gun, which can be powered either from the mains or from internal dry batteries, is exceedingly compact.

Intermediate between these very low-voltage tubes and the 2,000-volt ones are some, manufactured by the firm of Siemens, which work at maximum voltage of 500. These tubes are a little difficult to power from dry batteries, because nobody wants to carry round this voltage made up from ordinary radio B batteries, but for use where mains voltage is available. they are ideal. The unit described in this article makes use of a Siemens tube, type SF15. The working voltage is a little over 400, and a 30-joule flash is obtained. Ordinary radio type electrolytic condensers are used in the power supply, and a novel home-made triggering transformer is used, which offers no constructional difficulties at all. The tube is mounted in a flash-gun designed originally for ordinary miniature flash bulbs. These are quite inexpensive, and make the business end of the outfit a thoroughly professional-looking job. The tube is mounted in the socket intended for the flash-bulb, and the cord supplied for plugging into the camera is used for its original purpose, as is the base of the handle, which has a fitting which matches a socket placed on many miniature cameras for attaching the flash-gun, or a range-finder to them. The handle of



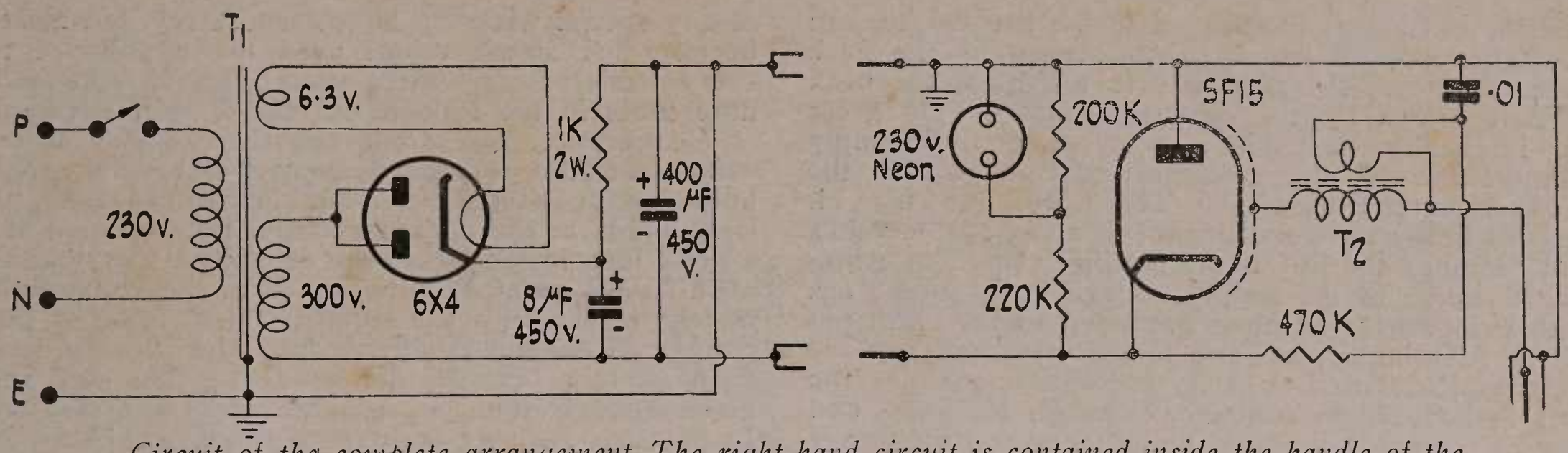
Underneath view of the power unit, showing the condenser bank, power transformer and rectifier. The power transformer is a 150v. a side, with the centre-tap on the high-voltage winding ignored.

the gun is hollow, and is intended to hold the batteries which fire the ordinary type of flash bulb. Since these are not needed for the electronic flash tube, the space is used to house the triggering transformer and the other small components, as well as the miniature neon bulb which is used to indicate when the condensers are re-charged, and ready for another flash.

OPERATION OF ELECTRONIC FLASH TUBES

Electronic flash tubes themselves are very simple devices, consisting of no more than a piece of glass tubing, bent into a convenient shape, filled with a suitable gas, and provided with a couple of wires sealed into the glass to act as electrodes. The triggering electrode is only a piece of fine wire, wrapped several times around the tube, and connected to the high-voltage terminal of the triggering transformer. The SF15 has a small Edison screw base, to the centre contact of which one of the tube electrodes is connected. The other electrode emerges from the other end of the tube as a stiff pin to which a small clip can easily be attached.

The tube is so constructed that with the correct operating voltage connected between anode and cathode, it will not conduct unless a high-voltage pulse is momentarily applied to the triggering electrode. This pulse ionizes the gas in the tube, which suddenly becomes conducting, and allows a very large current to flow. It is the passage of this current through the ionized gas that produces the light, whose brightness depends on the amount of electrical energy that is allowed to pass through the tube when it



Circuit of the complete arrangement. The right-hand circuit is contained inside the handle of the flash-gun.

conducts. This in turn is governed by the simple expedient of supplying the tube voltage, not from a power pack capable of supplying the tube current directly, but from a charged condenser. The condenser holds a quantity of electricity determined by the capacity of the condenser, and the voltage to which it is charged, so that it is a simple matter electrically to regulate the amount of electrical energy that is allowed to pass through the tube at each flash. The current drawn by the tube when it conducts is very high indeed initially, but when it has emptied the charge out of the condenser the discharge stops automatically, and the flash ends. The condenser thus has two functions: (1) to act as a reservoir of a measured quantity of electricity, and (2) to automatically extinguish the tube after the measured quantity has been discharged through it. It is obvious that the tube must not be allowed to conduct for very long, as its resistance while conducting is only a few ohms, and the peak current flowing through it is of the order of 100 amperes. If a current of this size were allowed to pass through the tube for more than a very short time, so much heat would be dissipated that the tube would in a very short space of time become red hot and melt! All this adds up very conveniently, because for photographic purposes, a very bright flash of very short duration is exceedingly useful for many different applications.

One most important thing about a flash-gun is that every time it flashes, it should do so with the same degree of brilliance. If it does not, it would not be possible to use it for photographic applications, for obvious reasons. The charging of a condenser from a given voltage source is the simplest and easiest way of measuring a quantity of electricity, and since the brightness and duration of the flash are directly dependent on the amount of electrical energy discharged through it, it can be seen that as long as neither the capacity of the condenser nor the voltage to which it is charged vary, all flashes will be identical in their photographic effect. A quantity of electricity stored in a condenser is measured in watt-seconds or joules, and can easily be calculated according to the formula:—

$$\text{Joules} = \tfrac{1}{2}C.V^2$$

where C is the capacity of the condenser in farads, and V is the voltage to which it is charged. When flash tubes were first developed, they were not made to operate at voltages low enough to allow electrolytic condensers to be used. Consequently, there was a considerable advantage to be gained by making them operate at quite high voltages. Because the energy stored in a given condenser is proportional to the square of the voltage to which it is charged, it is easier to store large quantities of energy at high voltage in a relatively small condenser than the other way about. But when very large condensers are small and very easy to make, it becomes profitable to use a low voltage, provided a tube can be made that will work with it.

Most tubes, including the SF15, are rated for a maximum discharge of 100 joules. At 2,000 volts, as used by an LSD3, this requires a condenser of about 50 μfd., but at 500 volts, the same energy storage would need a capacity of 800 μfd. If we are to use radio-type electrolytic condensers rated to stand 450 volts continuously, it would be unwise to use more than 400 to 420 volts on them, so that in this case, we have settled for a maximum of 420 volts. In practice, the actual voltage obtained from the power supply is more likely to be in the region of 400. This, with a capacity of 400 μfd., would give an energy of 32 joules, or just under a third of the maximum allowed for the tube. The question is therefore whether this is a large enough amount to give a useful flash. Fortunately, the answer is "yes". Several flash units on the market give no more than this energy, and yet have been quite successful, and, as we shall see later, the flash is intense enough for practically all purposes. At the same time, there is nothing to stop the individual builder from making the unit with a greater flash capacity if he does not mind adding more condensers, and making the unit somewhat larger in consequence. An alternative would be to use an external block of condensers, connected in parallel with the internal ones, for occasions when a brighter flash is essential.

THE CIRCUIT

The circuit has been drawn in two parts. The left-hand side is the power supply, which is built as a separate unit, and connected to the flash gun proper by a pair of leads. The right-hand portion is all housed inside the gun itself, and comprises the triggering circuit, and the neon indicator circuit.

The power supply makes use of a small instrument-type transformer nominally 150 volts-a-side. The centre-tap is not wanted, so it is cut off short, taped up, and thereafter ignored. A 6X4 rectifier is used, in half-wave connection, with an input condenser of 8 μfd. Then comes a 1000-ohm 2-watt resistor, feeding the 400 μfd. flash condenser. The purpose of the

resistor is to limit the rate at which the 400 μfd. can re-charge after it has been discharged by the flash tube. If the re-charging rate is too high, the peak current drawn by the rectifier would be too great for its health, and this is why we do not simply connect the 400 μfd. condenser straight across the rectifier output terminals. The 8 μfd. and the 1 k resistor limits the peak current to a reasonable value, and prolongs the life of the rectifier tube. The negative terminal of the supply voltage is up in the air, with the positive terminal grounded to the earth pin of the A.C. input plug, and to the metal parts of the construction. This is a safety precaution, enabling the unit to be used uninsulated, although for looks and ease of transport, it would be better to put the power supply unit in a leather carrying case. This is why the unit has been built in rectangular form, so that it can simply be dropped into a similarly shaped leather case, which one could have made for it at any saddlery shop.

The makers of the flash tubes recommend that the trigger circuit should be referred to the anode of the tube, and for this reason, the primary circuit of the trigger transformer is completed to the positive supply rail. This, too, is the reason why the positive end of the supply has been earthed, for otherwise, the triggering socket would be at a positive potential of 400 volts with respect to the camera case—a rather lethal arrangement!

Connected across the supply is a series combination of a 0.01 μfd. condenser and a 470 k. resistor. This condenser therefore charges up to the full 400 volts of the supply. One end of the primary winding of the trigger transformer is connected to the "hot" end of the condenser, and the other to the centre, insulated contact of the triggering plug. The outer, uninsulated contact of the plug is connected to the earthed positive side of the supply, and therefore to the other side of the 0.01 μfd. condenser. Thus, when the camera contacts operate, they short-circuit the connections of the triggering socket. When this happens, the 0.01 μfd. condenser is rapidly discharged through the primary winding of the transformer. Since both the resistance and the inductance of this winding are very small, a large peak current flows in the primary, and since the secondary has a large number of turns of fine wire, a momentary voltage impulse of very high amplitude is generated across it. The voltage is actually several thousands, as the transformer is able to cause a spark to jump a gap larger than an eighth of an inch with ease. It is this high-voltage impulse which ionizes some of the gas inside the flash tube, and allows the gas to become conducting, starting the flash. At this stage, we would like to emphasize that although most triggering transformers are like small auto ignition coils, and are very difficult to wind, such is not the case with this one. Its secondary contains only a single layer of wire, so that insulation difficulties no longer exist, and the whole thing is very easy to make. Indeed, it can be built from scratch in less than half an hour's work. Its method of construction will be described later.

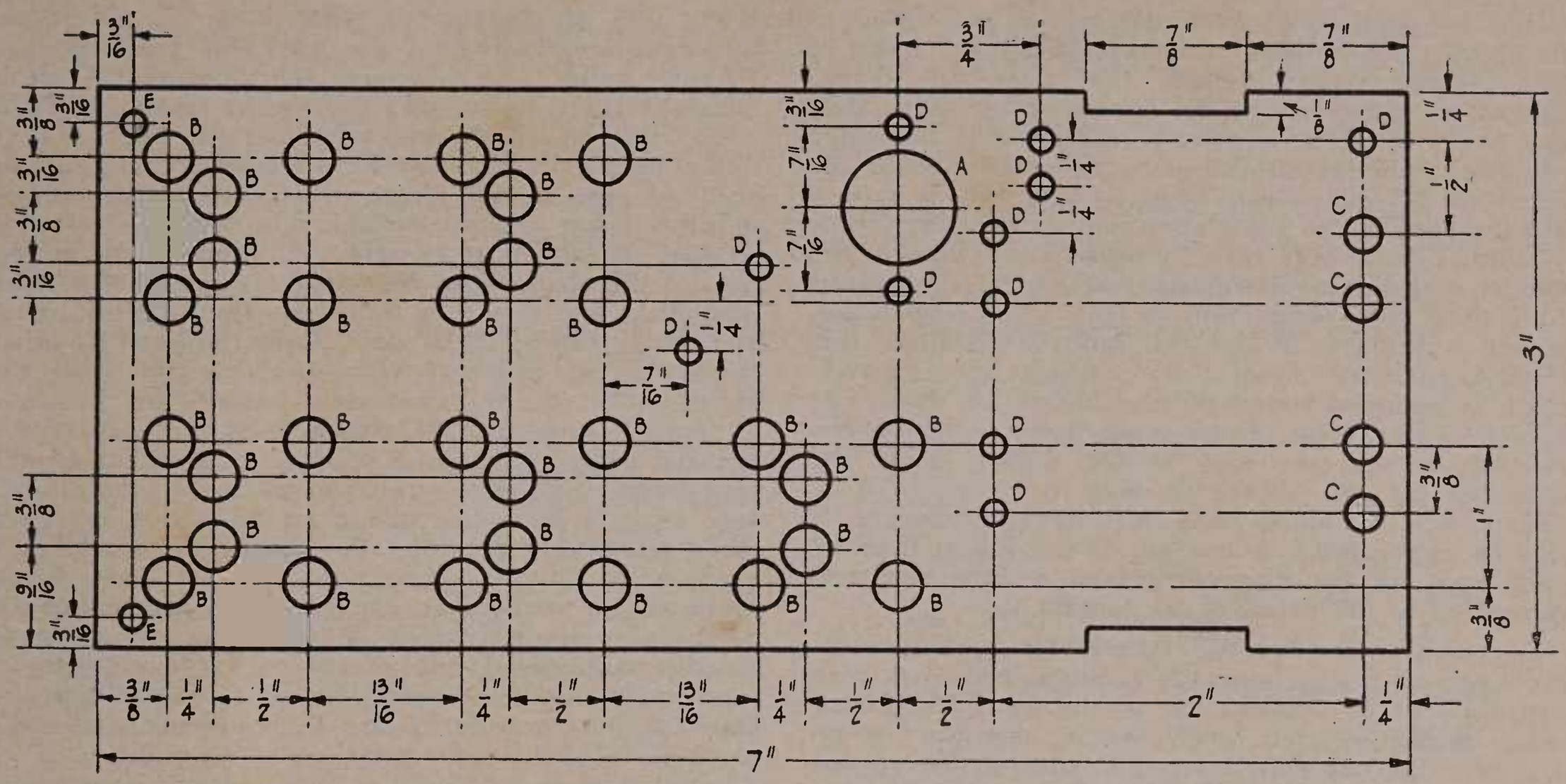
The neon indicator circuit is a refinement that can easily be omitted if one does not feel like bothering about it. Its purpose has already been described. The values required in the voltage divider are given as they were used in the prototype, but it does not follow that the same ones will be satisfactory in the finished article, when built by anyone else. This is not because of any special wizardry in our laboratory, but merely because the actual values need to be adjusted for every bank of condensers used. This is because of differences in the leakage current of different banks of electrolytics. The 220 k. resistor can stay at that value, and the resistance shunted across the neon bulb can be altered until, as the voltage rises, the lamp lights at the chosen voltage. For instance, it is a good idea to set the circuit in such a way that the neon comes on at 20 volts less than the voltage ultimately reached by the supply. Then, there is little danger of taking a photograph with a very weak flash, simply because the condenser has not been given enough time to recharge since the last one. In practice, such an occurrence is quite unlikely, because it rarely happens in amateur photography that two exposures have to be taken as close together as ten seconds or so. In the prototype, the condensers charged up fully in about ten seconds, and lit the neon in about eight—a charging rate that is quite great enough except in extraordinary circumstances.

MAKING THE TRIGGERING TRANSFORMER

This is the only component part that has to be made by the builder specially for the job. It is constructed on a piece of ordinary bakelized paper coil former half an inch in diameter. The secondary is put on first, using 46-gauge enamelled wire. First of all a pair of solder lugs of the rivet-end type are fixed to the coil former two inches apart. The wire is wrapped round one of them and soldered before winding commences. Then, a single close-wound layer is put on until the second lug is reached. The wire is broken off, wound round the finishing lug, and soldered. The winding is then given a coat of polystyrene coil dope, and left to dry, before putting on the primary. Since one end of the primary is connected to one end of the secondary, only one more solder lug is required, and this is put on the coil former opposite one of the secondary lugs. For the primary, solid PVC-insulated hook-up wire is used. It is first soldered to the common terminal lug, and then ten turns are wound on. As the insulation is thick, and resilient, it is possible to double the wire back to the starting end of the former and solder it to the third lug without unwinding. Alternatively, the last turn can be tied down by a piece of waxed thread passing round the former. In any case, once the primary has been treated with poly dope too, it will be firmly held down by this, and will have no tendency to unwind. When the dope is set, a piece of Ferroxcube rod is pushed into the coil former, and can be held there with coil dope. It will be found that the rod of which aerial rods are made is just the right diameter to fit nicely inside the half-inch tubing. We have been informed by Messrs. Philips Electrical Industries Ltd., that they have small lengths of this rod, being broken bits from full-length aerial rods, which they will be pleased to supply at nominal charge, so that anyone having difficulty in obtaining the rod should write to this firm.

However, even if one cannot get this rod at all, it is possible to use the trigger transformer without it. To do this, the 0.01 μfd. condenser is altered to 0.1 μfd. This gives a larger kick through the primary, and provides a satisfactory triggering pulse.

Someone is bound to wonder how it is that the contacts inside the camera will stand up to the job of discharging the condenser, when it is charged to



Detailed drawing of the red fibre base on which the power unit is built.

400 volts or so. The answer is that they will stand up quite satisfactorily, because the contact is a "make" one. That is to say, a quite large current flows for a very short time, but because the contacts are closed, and when opened, do not have to break any current at all, there is no tendency for sparking, and the contacts last indefinitely under these conditions. The voltage on the contacts has very little to do with the question, because as soon as the contacts close, the voltage disappears. All that matters is that the insulation in the camera lead, and of the contacts themselves must be able to stand 400 volts without breaking down, and this they are well able to do.

CONSTRUCTION OF THE GUN

Readers will no doubt be wondering just how the flash gun was converted in order to take the electronic tube rather than the miniature flash bulbs, because the latter have small bayonet sockets, while the SF15 has a small Edison screw base. It so happens that the outside diameter of the tube base is just right to make it a neat push fit in the bayonet socket in the top of the gun's handle. The handle itself is considerably larger in diameter than the socket, so that between the two, the diameter of the tube is increased, with a sharp shoulder occurring at the end of the cylindrical handle. The tube is therefore held in place by making a special washer which will thread on to the screw of the base, and whose outside diameter is just right to enable it to slip into the handle. The washer is dropped in, and the tube is threaded on to it until it is tight, the shoulder preventing the washer from coming any further upwards. The washer is made from a piece of 16 gauge aluminium. A single radial slit is made in it, which enables it to be twisted to take up the form of a single turn thread, which can be screwed on to the tube base.

The next most important point is that the circuit which goes inside the handle of the gun is built into a piece of coil former tubing. This tubing is not made to fit tightly inside the handle, but to fit inside a further piece of insulating tube, which itself fits inside the metal handle. In this way, the outer tubing serves to insulate the circuit from the case very effectively, and the two tubes enable simple contact arrangements to be made for the tube at one end, and the triggering lead at the other. First of all, a copper disc is made which is a sliding fit inside the outer insulating tube. The latter pushes against the washer on which the flash tube is mounted. The copper disc slides down the insulating tube until it makes contact with the centre contact on the tube, and is held firmly against it by the inner insulating tube when this is pushed in. A flexible lead attached to the underside of the copper disc connects it to the circuit. The centre base contact on the tube is its cathode, which connects to the "hot" negative end of the power supply.

In order to make the inner insulating tube fit tightly inside the outer one, the former is made by cutting a narrow slot in a piece of the same tubing as is used for the outer one. The slot is made just wide enough to enable the edges to close together when the slotted tube is pushed into the outer one.

The trigger transformer is mounted at the upper end of the handle. Three solder lugs are rivetted to the inner tube in such a way that the lugs on the transformer can be soldered directly to them. The transformer is not heavy, so that this form of fixing is quite satisfactory both electrically and mechanically. A piece of PVC hook-up wire is soldered to the side of the circuit to which the anode of the flash tube is to be connected. This wire is taken through a small hole in the handle right up at the neck, and is terminated in a small clip, made from a valve socket contact, which slides on to the stiff wire which emerges from the end of the flash tube.

It is essential to connect this side of the circuit to the metal tube of the gun, because the outer braid of the co-axial triggering lead that goes off to the camera is connected to the frame of the gun. One way of doing this is to affix a solder lug to the outer insulating tube, and to connect the earth side of the circuit to this lug. Then, when the assembly is pushed into the handle, the lug makes contact with the latter.

Another small hole must be made in the neck of the handle, and an insulated wire taken up through it from the "hot" connection of the triggering transformer secondary. When the tube is installed, this wire is conected to the wire triggering electrode which is wrapped round the outside of the tube. The builder can exercise his own ingenuity in fitting the transformer and the rest of the works inside the handle of the gun, as exactly how it is done is of no consequence provided that the circuit diagram is adhered to carefully. Above all, **do not forget that the earth sign on the diagram means a firm electrical connection to the metal of the handle.**

The centre lead of the co-axial triggering cable is connected to an insulated contact, provided with a spring. In the original use of the gun, this spring makes contact, electric torch fashion, with the bottom of one of the dry cells housed in the handle. In our case, it must connect to the common terminating lug for one end of the secondary and one end of the primary of the trigger transformer. A wire is taken from this point down to the bottom end of the handle, where it is soldered to another copper disc. This is insulated from the case in the same way as the upper one, by fitting it inside the outer tube, and letting it rest on the rim formed by the inner tube, which is made somewhat shorter than the outer one. Then, when the base of the gun, carrying the triggering lead, is screwed into position, the spring mentioned above presses on the disc, and makes the contact to the centre conductor of the lead.

If the neon indicator lamp is to be used, this can be fitted through a hole made in the side of the handle, and lined with an ordinary $\frac{1}{4}$ in. rubber grommet. The bulb will be a reasonable fit in the grommet, and wires soldered to the base of the lamp, can be used to connect it to the rest of the circuit. The two resistors can be soldered to lugs fitted near the bottom end of the inner tube.

CONSTRUCTION OF THE POWER SUPPLY UNIT

Here again the circuit is so simple that the builder can make it up in any form that suits him, if he does not like the method used in the prototype. In this, the whole thing was built on a piece of heavy red fibre board, drilled as in the diagram. The five sets of holes marked B accommodate the five dual 40 μfd. electrolytic condensers, which are connected in parallel to make up the total of 400 μfd. The holes for the rectifier socket can be recognized easily enough, but the mounting of the transformer may need some explanation. The two $\frac{7}{8}$ in. slots, or notches in the edge of the sheet are made to accommodate the mounting feet on the transformer. These feet are bent round so that they go at right-angles to the board, and the transformer is then fixed in place by a bolt which passes through the two holes in the lugs. What looks in the photograph like the shroud of the transformer is actually an aluminium channel bent in the shape of a rectangular U. The holes in the lower end of this match with those on the transformer's mounting feet, and the bolt goes through all four holes. This supports the aluminium U piece, which is there to support the on/off switch, and the socket into which the lead from the gun plugs. These items cannot be seen in the photograph, but can be seen on the cover photo which appeared in last month's issue of this journal. The U piece is made so that its top is at exactly the same height as the tops of the electrolytic condensers. A piece of paxolin insulating sheet is then glued to the tops of these, and to the top of the U piece with Pliobond or other cement. This prevents accidental contact with the outer cases of the condensers, which are live. An aluminium end-piece is attached to the end of the chassis with self-tapping screws, thus enclosing the transformer end of the unit. To make the whole thing safe even if it is not inside an insulating box, the three remaining sides and the bottom were also covered with paxolin sheet, the bottom one being mounted on spacers at one end, and to the bottom of the aluminium U piece at the other. As we have already emphasized, any alternative form of construction may be used, provided that it is realized that the cans of the electrolytics are live, and are prevented from being accidentally touched by the user.

The British Institution of Radio Engineers

Wellington Sub-section

Notices of Meetings:

May 7th, 1956, 5.30 p.m., Lecture Room, Civil Aviation Administration, Bunny Street, Wellington. ANNUAL GENERAL MEETING.

June 12th, 1956, 5.30 p.m., Lecture Room, Civil Aviation Administration, Bunny Street, Wellington. Speaker: Mr. C. I. C. Scollay, B.E. (Hons.), A.M.I.E.E., A.M.N.Z.I.E., of Wellington Technical College. His subject will be "The M.K.S. System of Units". With the adoption of the M.K.S. units, it is important that all concerned with electrical technology should be familiar with the system. The speaker will compare the C.G.S. and M.K.S. Systems for mechanical and electrical units.

All interested are cordially invited to attend.

Inquiries concerning the Wellington Sub-section of the British Institution of Radio Engineers should be addressed to the Hon. Secretary, Mr. A. Ryland, care of New Zealand Broadcasting Service, Private Bag, Titahi Bay. Telephone 47-633, Wellington.

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AN ADJUSTABLE-VOLTAGE POWER SUPPLY

Most experimenters have at one time or another felt the need for a power supply whose voltage is easily adjustable over a reasonable range, and yet without recourse to electronic means such a supply is awkward to make, and would require special components. However, by using a simple form of valve-regulating circuit, smooth adjustment can be had from very low voltages up to any reasonable maximum. This short article describes a unit that should be in every experimenter's equipment, and which is simple and cheap to build.

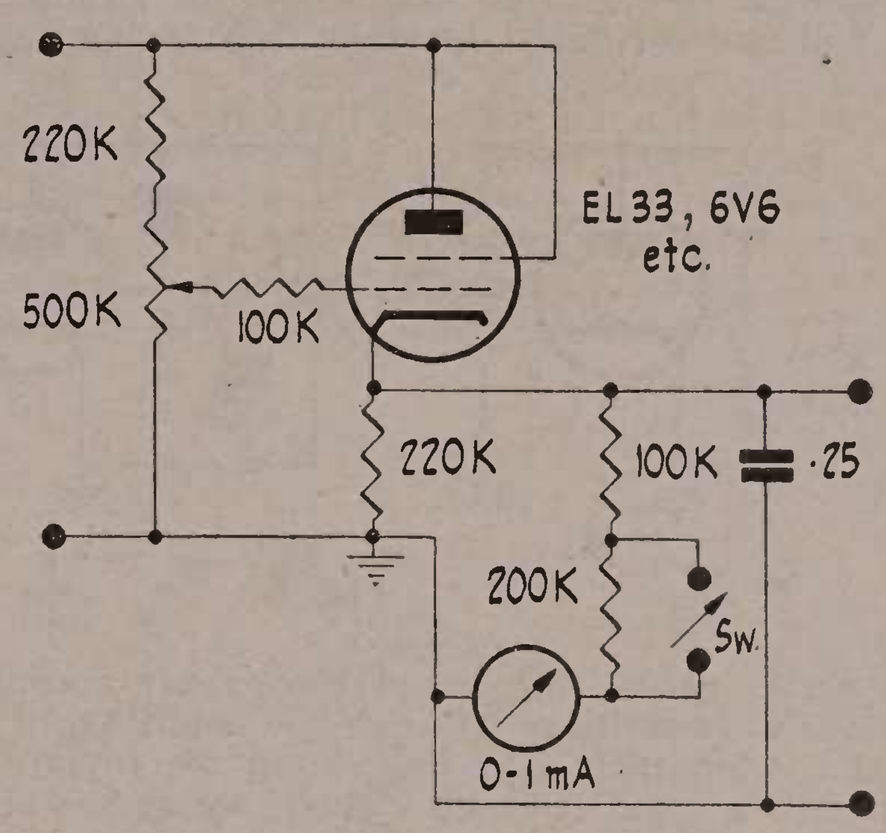
INTRODUCTION

When one is doing experimental work of almost any kind, the inflexible nature of conventional H.T. supplies is often a source of difficulty. Frequently, for example, one wants to vary the H.T. voltage on a circuit in order to assess the effect of such a change on its operation. Sometimes, as when battery-operated equipment is contemplated, one does not want to purchase batteries until the design of the gear is fixed, and its construction complete. It would often be helpful if gear using battery valves could be run, temporarily at least, from an A.C. power supply, but the trouble here is that it is inconvenient and often difficult to get low voltages such as 45 or 30 from an A.C. power pack. The unit to be described in this article will fulfil functions like these admirably, since the output voltage can be adjusted while the equipment is working simply by turning a potentiometer. Voltage output can be as low as 20 volts, if desired, while the upper limit depends on the valves used and on the nature of the power pack used to supply the adjuster unit. Quite heavy output currents can be taken from the unit if desired, while a further possibility is to feed several such units in parallel from the same power pack, thus providing as many adjustable outputs as may be wanted.

CIRCUIT

Input voltage can be supplied to the adjuster from any power pack giving 300 volts or more. The power pack should have the usual smoothing circuit, and, if desired, it can be built on the same chassis as the adjuster. However, if it is more convenient to have the latter separate, it can be built that way, and attached to any power pack that may be available. The adjuster circuit is a cathode follower, using a pentode or tetrode of high mutual conductance, and reasonably large current-carrying capacity. Medium-sized power tubes, such as the EL33, EL34, EL41, 6V6, 6F6, or 6L6 can be used, but the higher their Gm the better. The plate circuit of the tube is in series with the load, which is in the cathode circuit. The grid voltage can be adjusted by means of the 500k. potentiometer, which applies a fraction of the input voltage to the grid. The more positive this is made, the more positive does the cathode become, so that, by adjusting the grid voltage, the output voltage, which is taken from the cathode, is adjusted, too.

As a by-product, a certain amount of voltage regulation takes place, so that, as well as being much more convenient, the electronic adjuster gives better output regulation than a resistive voltage divider would do. Some idea of the degree of regulation can be gained by looking at the curve given in the valve data sheet for plate current versus grid voltage. If this curve is turned round so that the current axis



Note: Heater circuit should not be earthed

is underneath, the curve then slopes downwards from left to right. If a straight line is drawn vertically from each of two current values, these representing the extremes of current variation found in a certain piece of equipment, the points where they intersect the valve curve will indicate two voltages on the grid-voltage scale. The difference between these voltages gives the voltage variation to be expected at the output, provided the valve is not running into grid current. This can happen if the grid is taken so far positive by the control that the cathode is no longer able to follow. In the circuit given, the main purpose of the 100k. grid stopper is to ensure that if this is done the resulting grid current will not be great enough to damage the valve. At very small output voltages, the regulating action gets worse, because the mutual conductance of the tube is very low in this region. However, the main point of interest is the possibility of obtaining very low output voltages, regulation usually being a secondary consideration.

The large resistor connected from cathode to earth is there merely to ensure that some small current flows through the tube at all times. To cater for its use at small output voltages, the voltmeter that was built into the original was given two ranges, 0-100 and 0-300 volts. If desired, a second meter can be installed to measure the output current.

HIGHER CURRENT

With a single valve of the types mentioned above, the maximum current that can safely be drawn from the adjuster will be of the order of 40 ma. If higher current outputs are required, it is a simple matter

(Concluded on page 42)

Circuits for the Experimenter

CRYSTAL OSCILLATOR CIRCUITS (Part 2)

One of the simplest and most popular of crystal oscillator circuits is the one which goes by the name of the Pierce, after its inventor. This is shown in Fig. 8 (a) in the form in which it is usually connected. This is another case of a circuit which is not easily explainable unless some of the "hidden" components are drawn in. In Fig. 8 (b) we have drawn the grid-cathode, and plate-cathode capacities of the valve; it can now be seen that the circuit is a simple Colpitts oscillator, in which the tuning capacities in series across the tuned circuit are composed of the valve capacities, without the addition of any external condensers. If in Fig. 8 (a) we replace the crystal with a parallel-tuned circuit, we arrive at the ultra-audion circuit, which is an exactly similar variation of the basic Colpitts. In this circuit, therefore, the oscillation takes place at the parallel-tuned anti-resonant frequency of the crystal. One of its disadvantages is that the oscillation feedback is controlled by the values of the valve capacities, which means that different performances will be obtained if different types of triode are used. In all cases, it is best if C_1 and C_2 are equal in value, as is the case with a true Colpitts oscillator, in which the tuning capacities are so large as to swamp the valve capacities.

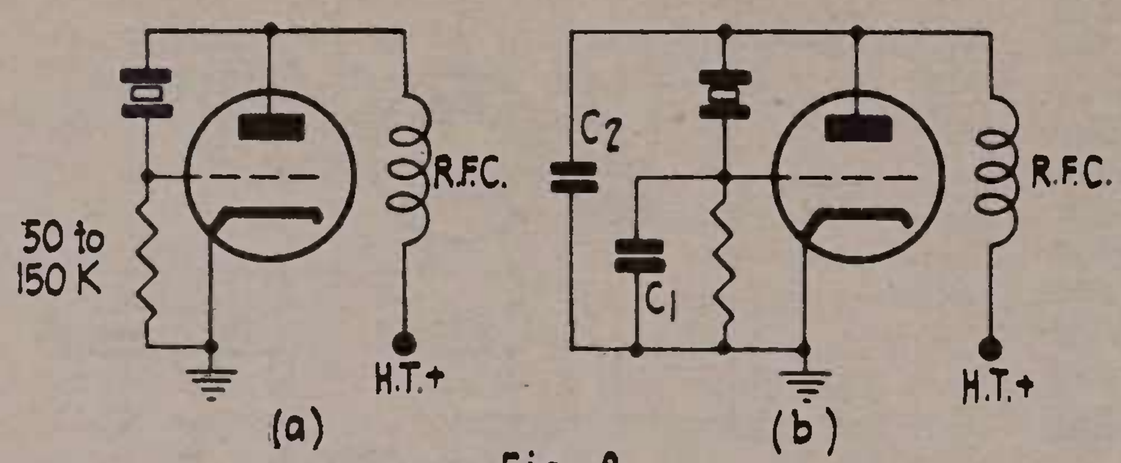


Fig. 8

In the Fig. 8 (b) circuit, C_2 is usually a good deal smaller than C_1, so that, to make the two equal, capacity has to be added to C_1, i.e., between grid and ground. Now, if we look up the valve data books, we will find that the plate-cathode capacity of a triode is almost always a good deal smaller than the grid-cathode capacity, a fact which appears to contradict our statement above. It is nevertheless true, because, in considering only the capacities of the valve itself, we have ignored the fact that the oscillator is, in practice, connected to another stage, so that the grid-cathode capacity of the driven valve is connected in parallel with the plate-cathode capacity of the oscillator. Thus, to make C_1 approximately equal to C_2, it is necessary to connect a trimmer of, say, 0-25 $\mu\mu$f. from grid to earth. The practical circuit is therefore that of Fig. 9. In use, the trimmer should be adjusted to give consistent operation. The setting is not critical, although sometimes it will be found that some capacity is needed to make the circuit oscillate at all. It oscillates at the fundamental crystal frequency, and so cannot be used for overtone crystals.

A MODIFIED PIERCE CIRCUIT

While the circuit of Fig. 9 is one of the best and simplest circuits for fundamental crystals, it does have one major drawback. It is that both terminals of the crystal are "up in the air." For fixed-frequency operation this is seldom a disadvantage, but where it is desired to switch in any one of a number of crystals, it is awkward, to say the least. At the worst, the wiring hung round the socket will prevent the oscillator from working properly, so that, for crystal switching, another arrangement is to be preferred. The circuit of Fig. 10 avoids this trouble, but retains the essential simplicity of the Pierce oscillator. Many readers will no doubt recognize it as the crystal equivalent of the famous Clapp oscillator, so beloved of builders of V.F.Os. Indeed, if the crystal is substituted by a series-tuned circuit, it is identical with the Clapp arrangement. The value of 20 $\mu\mu$f. shown for C_1 and C_2 can be used for all crystals, and output can be taken from the oscillator cathode, as shown. The dotted variable condenser can have a capacity change of 0-25 $\mu\mu$f., and, if desired, this can be included in order to give some slight adjustment of the oscillator frequency, without affecting its stability, provided, of course, that the component used is a stable one whose value will not change after it has been set. The R.F. choke in the cathode circuit can be an ordinary 2½-millihenry one, and will be satisfactory for any frequency at which a fundamental-mode crystal above 3 mc/sec. is likely to be used. It should be mentioned that the frequency stability of both types of Pierce oscillator is better than can be obtained with the simple triode or pentode oscillator circuits, when using the same crystal.

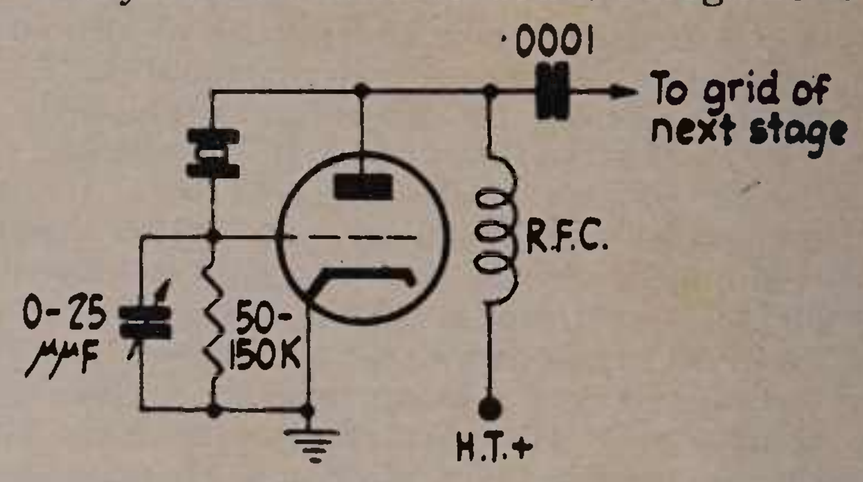


Fig. 9

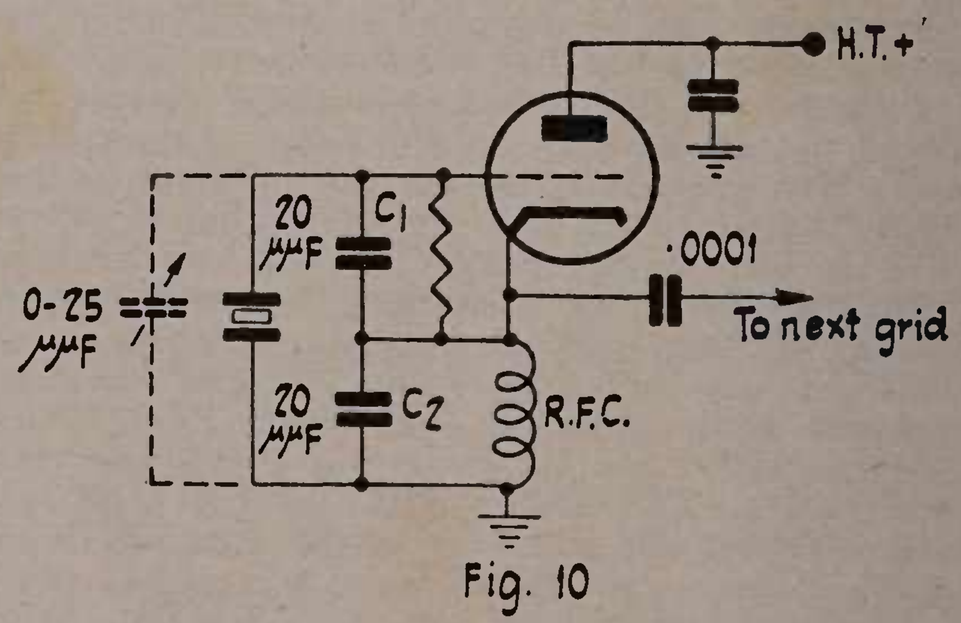


Fig. 10

THE TRI-TET OSCILLATOR

For amateur use, an oscillator circuit which will provide useful output at harmonics of the crystal frequency is very desirable, as it can often result in one

stage less of frequency multiplication when the transmitter's output frequency is a rather high multiple of the crystal frequency. One of the most popular frequency-multiplying oscillator circuits is the tri-tet, shown in Fig. 11. The arrangement, although it may not look like it, is a modification of the simple triode oscillator of Fig. 1. We can imagine that the screen of the tetrode is the plate of a triode, and is earthed as far as A.C. is concerned, by the bypass condenser. The tuned circuit is in series with the plate circuit, even though it is actually connected

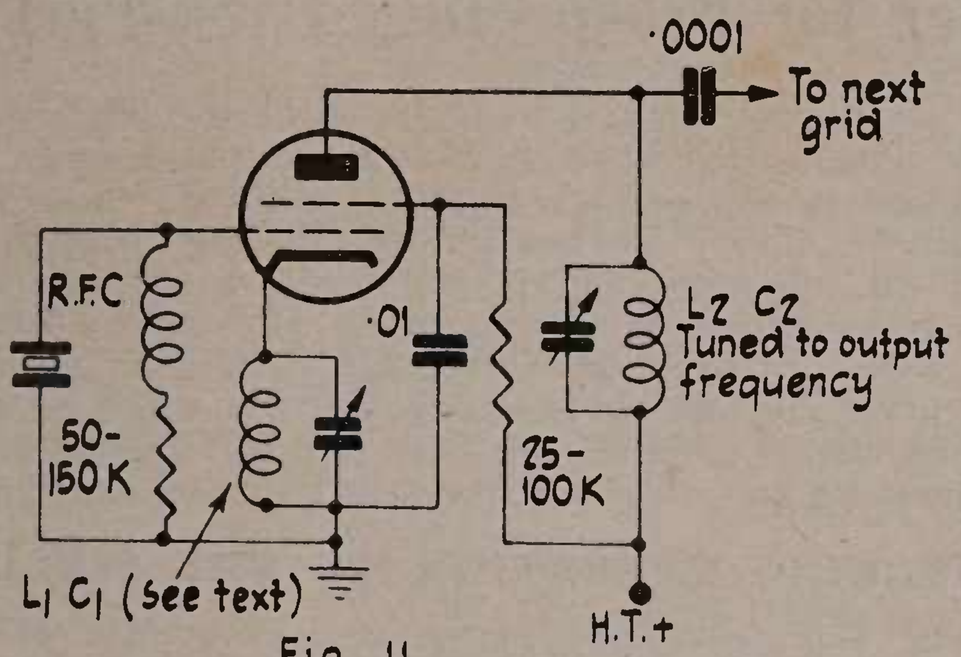


Fig. 11

from cathode to earth. The earthed screen-grid serves to isolate the tetrode plate circuit from the oscillator portion, as in any other electron-coupled circuit. The plate tank is then tuned to any desired multiple of the crystal frequency. Once more, this is a circuit for conventional crystals, and not for overtone crystals. There is often some doubt about how the cathode tank of a tri-tet oscillator should be tuned. Actually, it is not critical, the chief requirement being that it should be tuned to a considerably higher frequency than the crystal fundamental. The closer it is tuned to this frequency, the greater will be the feedback and therefore the crystal excitation.

When the circuit is to be used, as it often is, for output on either the fundamental or on the harmonics of the crystal frequency, a good rule is to tune the cathode tank to the highest harmonic on which output is wanted. When this is done, it will be found that the output on the lower harmonics and on the fundamental is lower than can be obtained by tuning the cathode circuit to a lower frequency, but that **approximately the same output is obtained on the fundamental and all harmonics** up to the one to which the cathode circuit is tuned. This has the effect of simplifying band-changing, because all that has to be altered then is the plate tank circuit, which is switched to the desired output frequency.

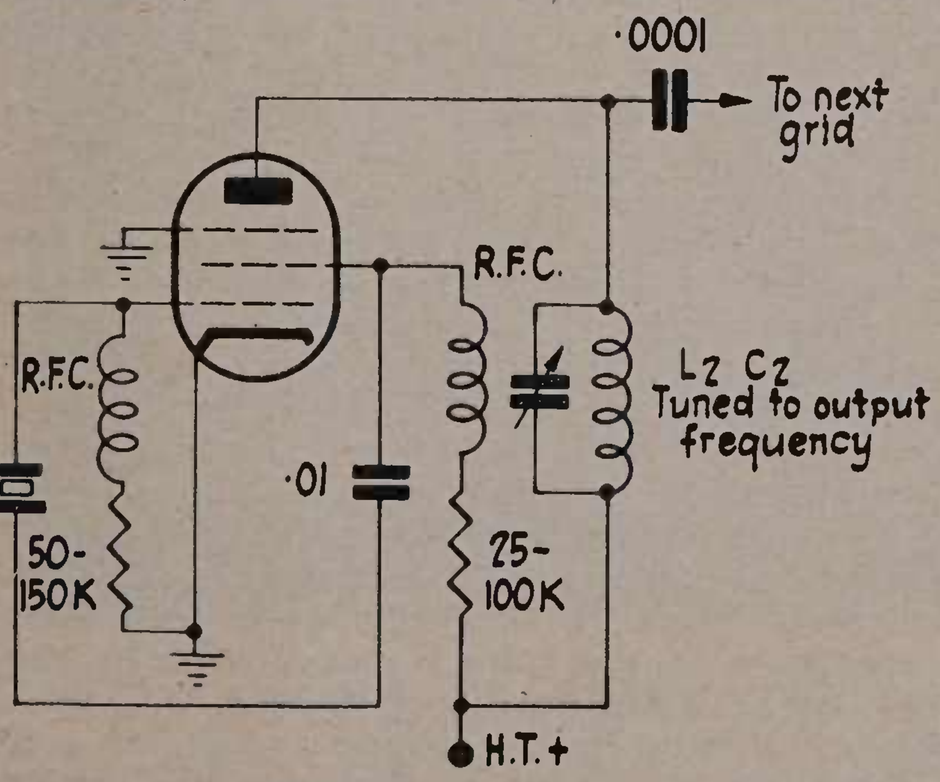


Fig. 12

MODIFIED PIERCE FOR HARMONIC OUTPUT

In Fig. 12 we have an excellent circuit for harmonic output. A well-screened tube such as the 6J7, 6K7, EF37, EF50, or EF55, should be used. It has the advantage of containing no tuned circuits other than the plate tank tuned to the output frequency. The screen-grid, control-grid, and cathode act as a triode Pierce oscillator, just as in Fig. 9, and electron coupling is used between the oscillator and the tube's plate circuit, in which the frequency-multiplication takes place. This oscillator should not be used with tubes that are not well screened, such as the small power pentodes or tetrodes designed for audio use, as in these the screen does not provide the complete R.F. shielding that is obtained in the list of valves above. This circuit will oscillate properly regardless

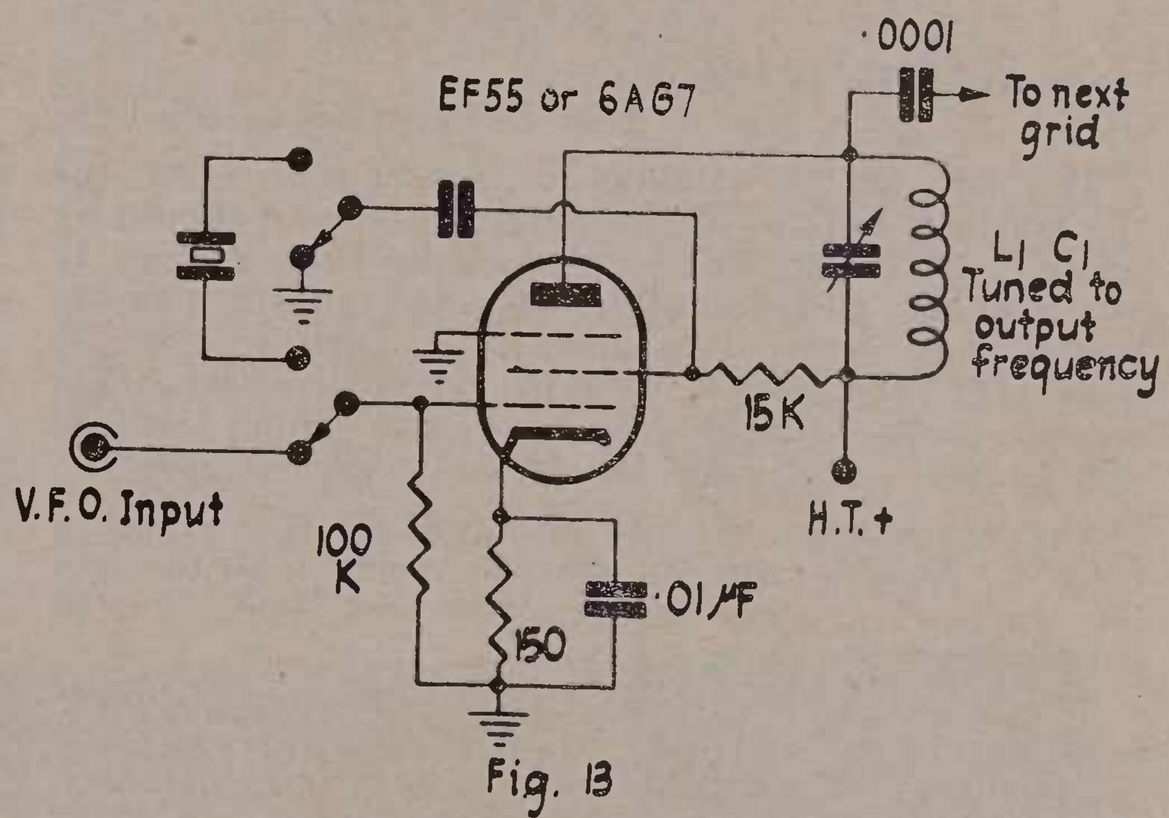


Fig. 13

of the tuning of the plate tank, and the plate loading has little or no effect on the crystal excitation.

There is a simple modification of this circuit which is an excellent one for those who wish to change over from V.F.O. to crystal control with a minimum of trouble. The modified circuit is shown in Fig. 13. A two-pole two-position switch changes the circuit from a crystal oscillator of the Fig. 12 type to an untuned buffer, with the screen-grid bypassed in the ordinary way. Input from the V.F.O. should be from a low-impedance link. Cathode bias is used because it is needed in the V.F.O. position. It does not interfere with the operation of the oscillator circuit. For C.W. operation the circuit is an excellent one in which to key the transmitter, provided that the V.F.O. is sufficiently well shielded. As a crystal oscillator the arrangement keys very well indeed. The values shown are suitable for use with an EF55 or a 6AG7, either of which will give ample output with a plate supply of 300 volts to drive a succeeding stage. A virtue of the circuit is that it operates with very small grid current and crystal excitation. In one case that was measured, it was found that the output as a crystal oscillator was 2.6 watts, with a grid current of only 400 μamps. and a crystal current of only 5 ma. As an oscillator-doubler, the conditions in the crystal circuit were the same, and the output

(Continued on page 30)

The PHILIPS Experimenter
An advertisement of Philips Electrical Industries of N.Z., Ltd.

No. 103—Transistorized Geiger Counter for Prospecting Use—Part 2

THE H.T. TRANSFORMER

The transformer uses a Ferroxcube pot core, type 25/17½/10/3B3. The windings are as follows, and should be put on in the order Primary, Feedback, and Secondary. The turns required are:

Primary (collector) winding—
115 turns of 28 or 30g. En.

Feedback (base) winding—
50 turns of 28 or 30g. En.

Secondary winding—
1250 turns of 38 to 40g. En.

The dots on the windings in the diagram represent the starting ends of all windings, and these should be wired into the circuit as indicated by the diagram. If the primary and feedback windings are incorrectly phased with respect to each other, there will be no oscillation until one of them is reversed, while if the secondary is wrongly connected, the output voltage will be very small—not enough to work the tube.

The transformer is held together by two 10 B.A. bolts at opposite corners, and is mounted to the box by small self-tappers engaging the free holes in the bottom cover.

The box in which the instrument was built is made from one of the inert polyethylene plastics, which are not only excellent insulators, and completely non-absorbent towards moisture, but somewhat flexible, and therefore unbreakable. At the same time, the material is firm enough to enable things to be mounted to it with nuts and bolts, or small self-tapping screws. All the components are mounted in one of these ways. Liberal use is made of ready-made strips of miniature solder lugs, which were held down by self-tapping screws passing through the box, with the heads on the outside. The rectifiers are mounted in this way, strips being placed at each end. Lugs are then clamped in the terminals at the ends of the rectifiers, and are soldered to insulated lugs on the terminal strips. Where the transistors and their sockets can be seen, there are further strips mounted, which are obscured by the transistors. The centre connections on the sockets are soldered to a lug, and seeing that the sockets and the transistors themselves are so light, this single-point mounting is quite satisfactory. The spare lugs on the four short strips so far mentioned, were found sufficient to act as terminating points for the whole circuit. The lay-out is not critical, and provided that there are no component faults, the counter should work from first switching on. These D.C. converter circuits have been found to be very trouble-free, and we have experienced so little difficulty with them that there is really no advice we can offer should the unit fail to work! Transistors have been known to be faulty, so that if the set is not functioning after first switching on, a good plan is to interchange the transistors. One which may work well as an amplifier may not function in the oscillator circuit, although this eventuality is fairly remote. With all due respect to builders, the most likely component to be faulty is the transformer. It is sometimes quite tricky to get six wires out from the small slot in the core without pinching one and perhaps breaking the wire, so that if one strikes trouble, the first step is to **remove the transistors** and then test the windings for continuity.

CHECKING OPERATION OF THE CIRCUIT

The H.T. oscillator works at a frequency of between 2000 and 3000 c/sec., and as the filtering is not perfect, this note can be heard in the phones as soon as the counter is switched on, provided that the oscillator is working. If the oscillator is working, it is not very likely that the Geiger tube will not be functioning. As mentioned above, the background count is at the average rate of 20 per minute, so that if after ten seconds or so no clicks have been heard, this is enough to indicate that something is not working. Should the oscillator be working, but not the Geiger tube, as will be the case if the oscillator note is heard, but no background counts, it is likely that the trouble is in the transformer—possibly a shorted turn, or a miscounting of the number of secondary turns put on. In either case, there may not be enough voltage developed by the H.T. supply to allow the Geiger tube to work.

Another thing that should be checked is that the rectifiers have been connected the right way round. Their polarity is indicated by means of a red ring at one end. This corresponds to the cathode of a thermionic diode, and to the bar on our circuit symbol. Should one or both be wrongly connected, there will be either no voltage at all, or a small voltage of the wrong polarity, on the Geiger tube. It should be emphasized that any attempt to measure the H.T. voltage applied to the tube will fail, unless the test is carried out with an electrostatic voltmeter. Even a V.T. voltmeter will not give a correct answer, as the regulation of the supply is very poor, and even a very high resistance connected across it will drop the output voltage. The reason behind this is that the actual voltage applied to the tube is the no-load output voltage of the supply, because in between pulses no current at all is being drawn from it. Thus, if even a few micro-amperes are drawn off the supply, the measured voltage will be much lower than the open-circuit figure, which is what counts as far as the operation of the tube is concerned. In spite of all this, a V.T.V.M., capable of making D.C. measurements, or a very high-resistance range of a multimeter will at least confirm that the H.T. system is generating some voltage, and of what polarity, should there be any doubt.

"PHILIPS SERVING SCIENCE AND INDUSTRY"

The purpose of the periodical "Philips Serving Science and Industry" is to present to the professional man, technician and layman alike the latest details of the many applications of Philips industrial equipment. It is intended to replace the journal known as "Electronic Measuring" and, as may be seen by those familiar to "E-M", is much more ambitious and wider in its scope.

The following is a list of the articles in Volume 1 which serves as an indication of the subject matter contained in this journal.

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Measuring and recording vibrations in power plants.
Speeding-up woodwork production.
New installation for water purification for the town of Rotterdam.
Oscilloscopes.
The Electron Microscope.
Electronic Voltmeters.
Electrodynamic equipment for vibration tests.
Measuring of surface roughness.
Electronic relay used for leather painting.
Rectifiers for the feeding of telephone exchanges.
Pulse-measurements with Oscilloscopes.
Electronic control in welding.
Philips low-hydogen electrodes and how to weld them.
A new film introducing X-ray diffraction on the principles of X-ray diffraction.
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Applications of X-ray diffraction.
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Use of automatic potentiometer-apparatus and strain gauges in a device for the prevention of chain-failure on slipways.
General notes on rectifiers.
Welding aluminium.
The measuring of strain in a thirty-year-old construction of reinforced concrete.
Electronic control in welding.
The cathode ray oscilloscope GM3156, used as a variable switching element to test the quality of relays and switches.

A limited number of this publication is available for distribution from the Electronic Development and Applications Company Limited, P.O. Box 799, Wellington.

News from Government Departments

NEW METHODS OF ANALYSIS

Scientists are now using methods that permit of examination and accurate analysis of materials that previously were extremely difficult (and sometimes impossible) to analyse by the traditional chemical processes. The method is infra-red double-beam spectrophotometry, and it has been in use in New Zealand for over twelve months.

The Department of Scientific and Industrial Research has installed at the Dominion Laboratory an infra-red double-beam recording spectrophotometer that has made possible the solution during the last twelve months of many baffling problems. Application has been made of the new methods in many spheres, and it may well be that with further developments chemical identification and analysis is on the threshold of revolutionary changes through infra-red spectrophotometry.

In the apparatus dispersed infra-red radiation is split into two beams which are passed through two cells containing a solvent. In one of the cells the material to be examined is dissolved or ground to a fine powder, and the other cell acts as a control. By means of a curve on a graph the apparatus measures and records the degree of absorption by the substance being examined at the wavelength within the infra-red spectrum. From the position and height of the peaks of the curve the concentration of the substance can be calculated. Peaks are shown when the absorption is greatest, that is, when the wavelengths are in accord with the vibrational movements of the atoms within the molecule. Differences in grouping of the chemical elements is revealed and this is particularly useful in the examination of compounds—called isomers—that have the same elements, proportions. and molecular weight, but because the elements are not grouped in the same order this difference may have an important effect on the usefulness of the chemical.

The infra-red spectrum is used because visible-light rays have a frequency too high to excite the molecular vibrations, but it has the disadvantage that glass lenses are not transparent to infra-red rays. The optical parts of this apparatus have to be made of sodium chloride, potassium bromide, or similar crystals that are unfortunately readily soluble in water. Damp air ruins the polished surfaces of these optical parts, and the substances for analysis have to be examined in carefully-dried organic solvents. These solvents also have absorptions, and one improvement being developed is to compress the substance into transparent discs with powdered potassium bromide to eliminate the solvent altogether.

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Crystal Oscillator Circuits

(Continued from page 27)

was 0.9 watts. The input to the plate circuit was 26 ma. at 300 volts. As a buffer, an R.F. input of 1v. R.M.S. will give 0.4 watts output, with correspondingly greater outputs at larger inputs.

CIRCUITS FOR OVERTONE OPERATION

Overtone operation of crystals is quite different from ordinary frequency multiplication. In the latter, the crystal operates on its fundamental frequency, and the multiplication is done electrically by tuning the plate circuit of a class C stage to some multiple of the crystal frequency. The multiplying stage can, as we have seen, be another part of the same valve which is acting as the oscillator.

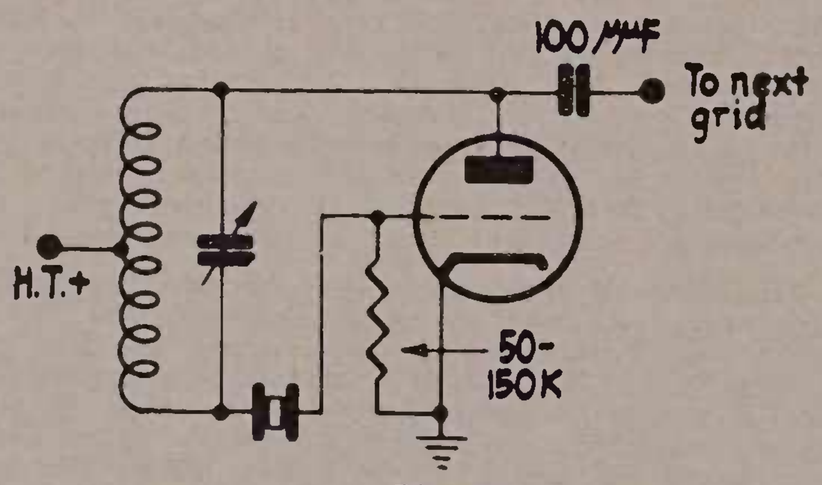


Fig. 14

On overtone operation, the crystal actually vibrates at a frequency that is a near multiple of the fundamental vibration frequency. That is to say, the actual method by which the crystal vibrates is different; for this kind of use, crystals are specially manufactured so that they vibrate in a harmonic mode more readily than in the fundamental mode. It is possible to persuade an ordinary crystal to act as an overtone vibrator, but the behaviour is seldom as satisfactory as a special overtone crystal's.

Because overtone operation results in a different mode of crystal vibration from fundamental operation, the frequency obtained is not necessarily an exact multiple of the fundamental frequency. This fact must be realized when an ordinary crystal is used as an overtone vibrator. The actual output frequency will not be found to differ very greatly from, say, three times the marked frequency, but the departure may well be great enough to put one outside a band, if the crystal is at all near the edge of it. Crystals that are made as overtone vibrators are marked, not with their fundamental vibration frequency, but with the frequency actually obtained when they are used as intended. Some are made for vibration in the third overtone mode, and others are made for the fifth overtone. For example, a crystal marked "45 mc/sec." will certainly be an overtone crystal, for fundamental ones are not made at such a high frequency. It will almost certainly be a third overtone crystal, whose fundamental frequency, if used, would be somewhere near, but not quite on, 15 mc/sec. Or it could be a fifth overtone crystal, with a fundamental near 9 mc/sec. In such a case, the information on its exact type and mode of operation would be supplied with it. In general, circuits for overtone crystals are quite different from those we have been discussing for normal crystals. They are almost always more or less conventional oscillator circuits, using an ordinary tuned LC circuit at the output frequency, and with the crystal added to the circuit in such a way that oscillation can occur only at the crystal frequency. In these arrangements, advantage is taken of the fact that at series resonance the crystal has a very low R.F. resistance, while at parallel resonance its R.F. resistance is very high. For instance, one possible arrangement is to use an ordinary tickler-feedback oscillator circuit, tuned to the output frequency that is desired. The crystal is then placed in series with the tickler coil, so that there is little or no feedback except at the series-resonant frequency of the crystal.

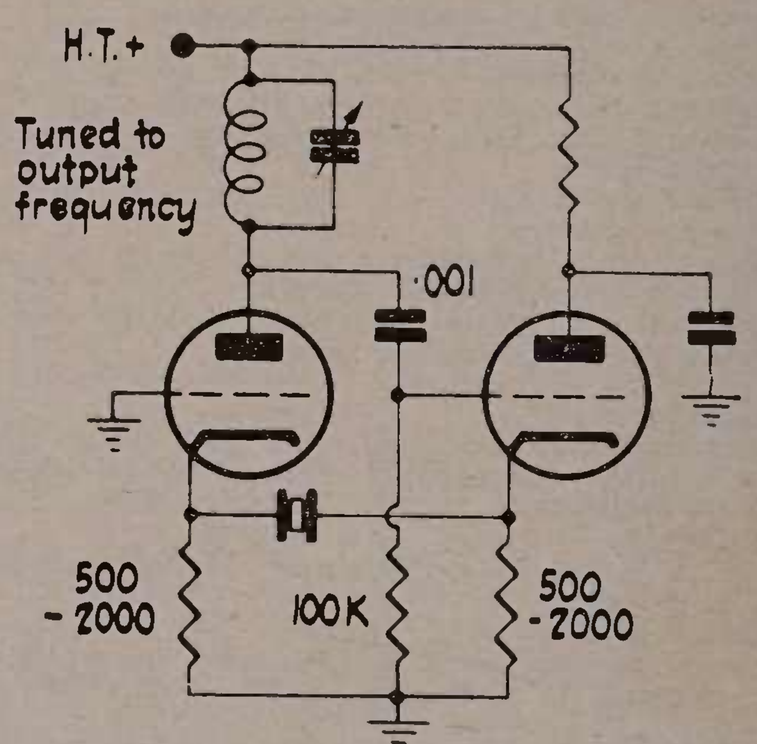


Fig. 15

Alternatively, an ordinary Hartley or Colpitts oscillator circuit can be constructed, with the crystal used in place of the usual grid-blocking condenser. At frequencies other than the series resonant frequency, the impedance to R.F. of the crystal is so high that no feedback exists, and the circuit cannot oscillate. At the crystal frequency, however, its impedance is low, so that there is enough feedback to sustain oscillation.

These circuits are all very nice and simple in theory, but in practice they need careful watching, especially if an attempt is being made to use an ordinary crystal as if it were a special overtone type. The trouble is that when the capacity of the crystal holder is large, as it is with the older types of crystal, this acts as a coupling condenser, irrespective of the crystal, and allows non-controlled oscillation to take place when the oscillator's tuned circuit is resonant at frequencies other than that of the crystal. This trouble seldom occurs with proper overtone crystals, but one must watch out for it when using any such circuit. Even when non-controlled oscillation can take place, careful listening on a receiver will indicate when, if at all, the oscillation becomes crystal-controlled. The usual indication of this is a sudden change of frequency. When the new frequency is found, it is a simple matter to recognize it as a controlled one, because touching the tuned circuit, or doing other things that would normally result in a noticeable frequency shift, does not cause anything of the sort.

When overtone oscillator circuits are used, say, with a 6J6 or other double triode, the spare section can often be used as a stage of frequency multiplication, in the ordinary way, and in this way it is possible to arrive at quite a high frequency after only one valve. For example, one-half of the tube could be used with a 48 mc/sec. overtone crystal, and the other as a tripler, giving output on 144 mc/sec. Schemes like this are often used in crystal-controlled converters for reception of the V.H.F. amateur bands, as well as in transmitters for the same bands.

In Fig. 14 is shown one popular overtone circuit. It is a Hartley oscillator, with the crystal used as a grid condenser. Getting such a circuit operating is quite simple. The crystal is first left unplugged, and, instead, a small condenser of 15 to 25 $\mu\mu$f. is substituted for it. The circuit then acts as an ordinary Hartley oscillator, and if the coil and condenser have been properly chosen, it will be possible to tune the oscillation to the wanted operating frequency. This done, with the aid of a frequency meter, the condenser is removed, and the crystal is plugged into its socket. In most cases it will now be found that the oscillation is still present, but is now crystal-controlled. If it is not, then a slight readjustment of the tuning condenser should be sufficient to ensure that it is.

Sometimes these circuits in which the crystal is used as a series element in the feedback path of a conventional oscillator are a little tricky to adjust. One of the difficulties, for instance, is that when the circuit is adjusted for crystal-controlled oscillation it is found that the oscillator will not start readily, and is impossible to turn on and off by means of a key, or a switch in the H.T. lead. This can be cured by slightly de-tuning the tank condenser, the best direction being found by trial.

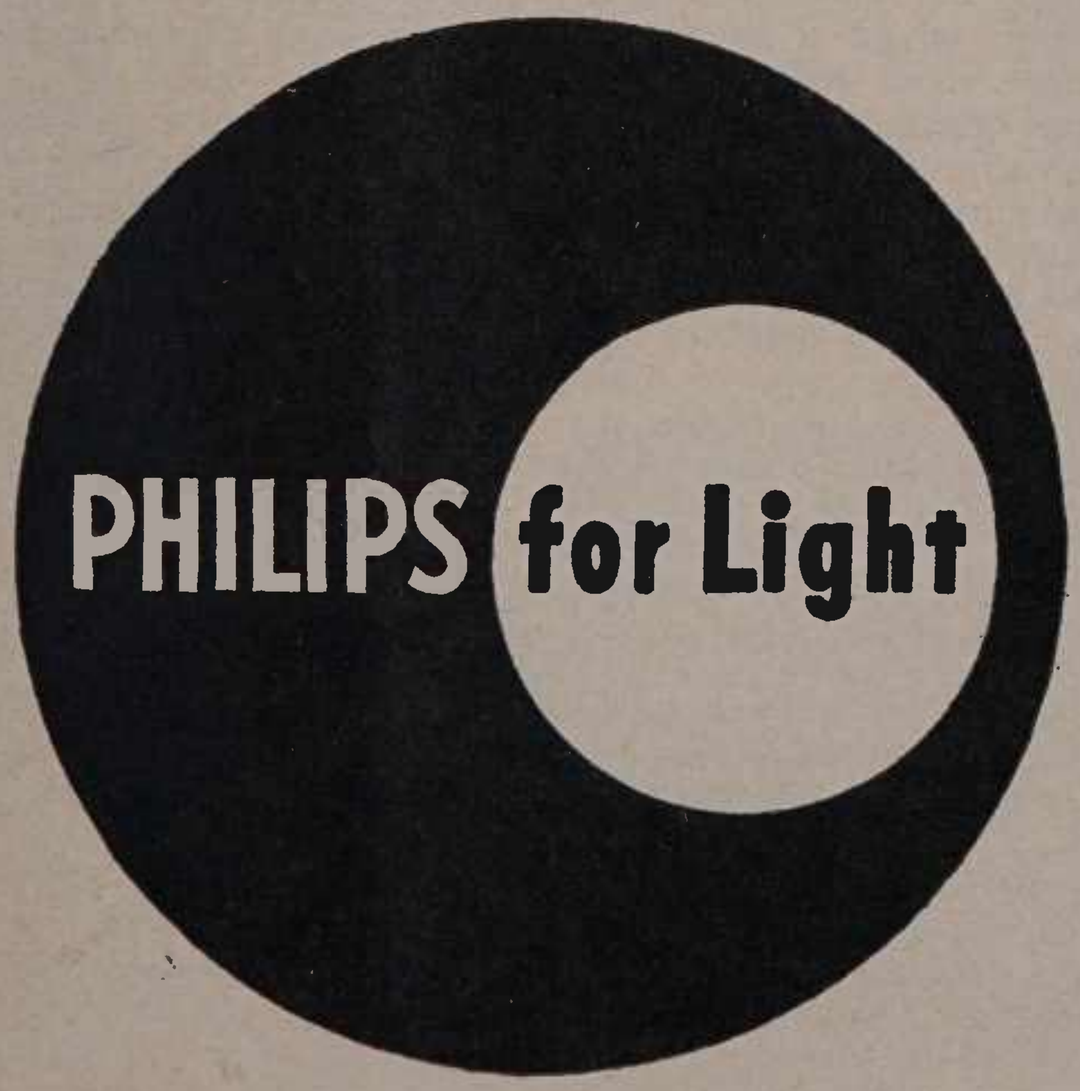
From the above remarks, it does sound as if these overtone circuits are things to avoid, but the difficulties mentioned occur hardly at all with proper overtone crystals. They can be quite frustrating when an ordinary crystal is being used in a harmonic mode as though it were an overtone one. If anyone wants to try these circuits, he would be well advised to use only the small modern types of crystal. With these, the holder capacity is so small that uncontrolled oscillation is much less likely to be encountered. It should be mentioned that with any of these circuits, uncontrolled oscillation may take place if it is tuned far enough from the crystal frequency, but that, as the tuning control is brought nearer, the tendency to uncontrolled oscillation decreases, and controlled oscillation suddenly starts again when the crystal frequency is closely approached. The process of getting overtone circuits going properly is not nearly as fearsome as the above description might suggest, and we have mentioned the possible troubles in order to help those who might strike them unexpectedly. To be forewarned is to be forearmed!

THE CATHODE-COUPLED OVERTONE OSCILLATOR

This circuit is one of the best of the overtone circuits, and is illustrated in Fig. 15. It can use almost any double triode, but the best performance is obtained with the high-Gm ones such as the 12AT7, etc., or their direct equivalents, the ECC81, etc.

The arrangement consists of a cathode-follower and a grounded-grid amplifier, cross-coupled by feeding the output of one to the input of the other. In the plate circuit of the grounded-grid stage is a tank circuit tuned to the output frequency. The output of this stage is capacity coupled to the grid of the cathode follower, and the output of the latter is coupled by the crystal to the input terminal of the grounded-grid stage, which is its cathode. The crystal has a very high impedance at all frequencies other than its series-resonant frequency, and so this is the only frequency at which there is a tendency to oscillate. The remarks made earlier in this article about difficulty with uncontrolled oscillation apply to this circuit, too, but only when an attempt is made to use high-capacity crystals which are not proper overtone types. With the latter, adjustment presents no difficulty whatever.

This review of crystal oscillator circuits is necessarily brief and makes no pretence to completeness; we hope, however, that amateurs and others who have occasion to build or use crystal oscillators will find it helpful.



Notes from the New Zealand Electronics Institute (Inc.)

Wellington Branch

Personalities:

Mr. J. M. Shanks of Civil Aviation has been transferred to Wellington from Palmerston North.

Members congratulate Mr. W. E. A. Garrett of Eltham, on his admittance to the Institute as an Associate Member.

Mr. B. S. Furby, Branch Secretary, has been regraded to Associate Membership from Associate.

Branch Library:

This is available to all members and contains many technical books and all issues of "Radio & Electronics" and "Radio and Electrical Review". Those interested should contact Mr. J. D. McCormick, P.O. Box 5106, Wellington.

Monthly Lectures:

The May lecture will be held in the Conference Hall, Air Department, Bunny Street, Wellington, at 6 p.m. on 2nd May, when Mr. Swan, of the State Hydro Electric Department, will speak on Communications in that Department. Refreshments will be served from 5.30 p.m.

The Annual General Meeting will be held in June.

Radio Interference—Its Prevention and Cure

Many of those who suffer in one way or another from the effects of radio interference may not be aware that there exists a Radio Interference Standing Committee, which was constituted in 1951 *to assist and advise the Post Office in considering problems associated with the suppression of all types of electrical interference likely to affect the reception of radio broadcast programmes. The article which follows has been prepared by the Committee, and we have much pleasure in printing it here. Interference is an increasingly important nuisance to all users of radio communication, and, in our opinion at least, the more everyone concerned knows about it the more likely are its problems to be understood and successfully coped with. We would like to take this opportunity of thanking the Committee, and the Director-General of the P. and T. Department, for making the article available for publication.—Ed.*

INTRODUCTION

As the result of the ever-increasing and widespread use of electrical equipment and appliances, the incidence of electrical interference to broadcasting and other radio services is developing to serious proportions. Radio broadcasting is now a well-established feature of the daily life and business of this country, and it is essential that this and other radio services should be protected from harmful interference.

At the present time very few electrical appliances offered for sale to the public are fitted with suppression devices to limit the amount of radio interference they produce. This means that when an unsuppressed appliance is brought into use and causes radio interference its location must be determined, and the user is then responsible for fitting a suppressor. The difficulty and, in many cases, the length of time needed to locate interfering appliances once they are brought into use is a costly matter. It is obvious that if equipment and appliances were fitted with radio interference suppressors at the time of manufacture or before they were offered for sale the position would be much more satisfactory, and it is the aim of the Post Office to bring this about.

SOURCES OF INTERFERENCE

In the range of equipment used in factories, offices, shops, and for domestic purposes any appliance using a fractional horsepower motor, or a rapidly breaking circuit-breaker such as a thermostat or rotating contact is a potential source of radio interference. In addition, tube lighting systems and decorative electric signs can produce continuous and very serious interference. A list of the more common types of appliances and equipment which cause trouble is set out below.

- Portable electric drills
- Electric fans
- Electric blankets
- Electric toasters (some pop-up types)
- Refrigerators
- Cake-mixers
- Adding machines
- Addressographs
- Hair-driers
- Electric shavers
- Smoothing irons (temperature controlled)
- Electric toys
- Floor polishers
- Accounting machines
- Electric hand tools
- Neon and gas-filled signs
- Sewing machines
- Vacuum cleaners
- Electric hot-water heaters
- Oil-burning furnaces
- Electro- medical apparatus
- Electric cash registers
- Fluorescent lights

OBLIGATIONS

Pursuant to the Post and Telegraph Act, 1928, Regulations and Amendments known as the Radio Interference Regulations, 1934, have been gazetted by Order in Council. These Regulations govern all cases where radio interference is produced, and provide the legal authority to prohibit the manufacture, sale, or use of such equipment. The Regulations also state that it shall be an offence to manufacture, offer for sale, install, or use any such interfering equipment. It will be seen, therefore, that electrical manufacturers and traders have a definite responsibility in so far as producing and selling equipment which is interference-free is concerned.

LIMITS OF RADIO INTERFERENCE

Recently the Radio Interference Standing Committee (on which electrical manufacturers and electrical traders are represented) approved the adoption of interim maximum standard permissible levels of interference tests by the Post Office. These levels fix the maximum values of intensities of interfering noise fields and noise voltages that may be generated by a wide range of electrical appliances over a frequency range from 200 kc/s. to 30 Mc/s. The values fixed are regarded as a reasonable compromise between the interests of users of radio services on the one hand and those of the makers and users of electrical apparatus and appliances on the other. This compromise will assure that in most cases the cost of fitting filters to appliances will not be more than a few shillings. Full co-operation of manufacturers, etc., is required in order to determine the effectiveness of these interim standards and the manner in which they should be applied.

TESTING OF APPLIANCES AND EQUIPMENT FOR RADIO INTERFERENCE

In all cases tests and measurements for radio interference must be made with a standard measuring set which is known as "Noise Measuring Set R.I. No. 1." These measuring sets are designed and built to an international standard, and one is being provided at each Radio Inspector's Office. The sets not only measure the interfering conducted voltages and radiated fields, but also give a true indication of the effectiveness of filters when applied.

PROCEDURE

The following is the procedure to be adopted in submitting appliances and equipment for testing and recommendations concerning suitable filters.

Electrical manufacturers and electrical traders should submit their electrical goods to the Radio Inspector at one of the following centres for testing and recommendations for the fitting of suitable filters where necessary: Whangarei, Auckland, Hamilton, Rotorua, Gisborne, Napier, Masterton, Palmerston North, Wanganui, New Plymouth, Wellington, Nelson, Greymouth, Christchurch, Timaru, Dunedin, or Invercargill.

The Radio Inspector will ascertain by trial the most suitable filter required to suppress any interference to a level within the permissible limits. No charge is made by the Post Office for this service.

Manufacturers and traders should arrange with the Radio Inspector concerned for the tests to be conducted at a convenient time. Wherever possible it is desirable that the firm's electrical engineer or electrical serviceman be present when the tests are made.

In the case of articles which are manufactured or indented in large quantities to the same design, representative samples should be selected at random and submitted for testing. When a satisfactory filter has been developed it should be fitted to all such articles offered for sale.

In those cases where New Zealand firms import interference-prone electrical equipment from overseas, it is recommended that they contact their principals and arrange for the inclusion of filters at the point of manufacture. Generally speaking, it can be reasonably assumed for the time being that where manufacturers already have to comply with their own interference regulations (e.g., Great Britain) the filters so included for the home market should be reasonably satisfactory for this market or should require only minor amendment.

CONCLUSION

In the past a small number of firms have submitted their equipment to the Post Office for testing and filter recommendation, but with the tremendous increase in the use of electrical goods it is hoped that all persons engaged in the electrical trade will voluntarily come forward and arrange to have their goods filtered before offering them for sale. If this is done it should not be long before all goods displayed for sale are adequately filtered. The Post Office has indicated that its desire continues to be the securing of the co-operation of manufacturers, importers, and retailers of electrical equipment and appliances in the matter of preventing electrical interference and to this end will continue to give all possible assistance and advice. However, in cases where those concerned are not prepared to co-operate in this way, it will be necessary to invoke the Radio Interference Regulations.

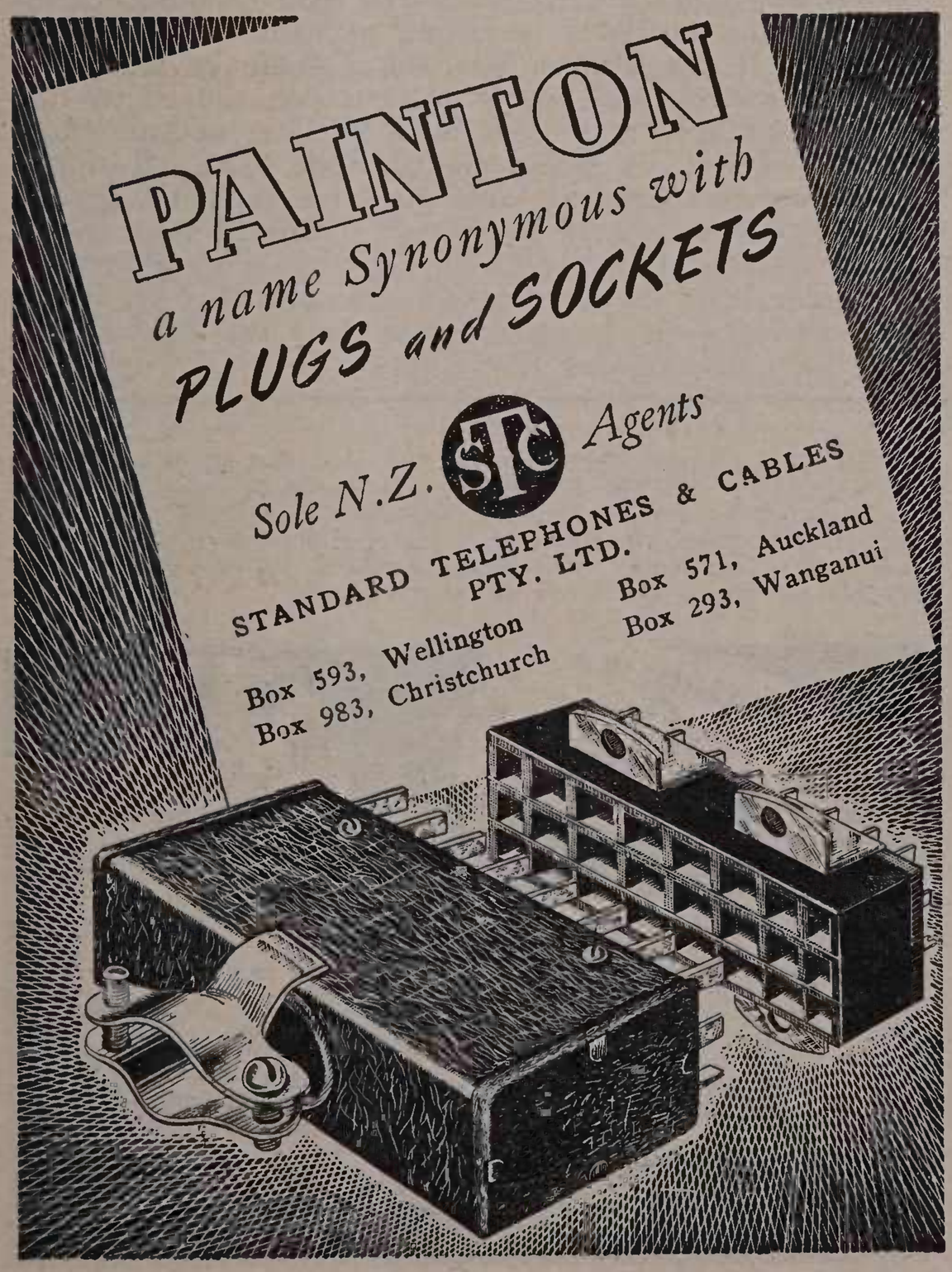
"THE AUTOMATIC FACTORY"

At a display of "Automation" equipment staged in conjunction with the Conference of the Institution of Production Engineers in Britain recently, delegates were given a fascinating preview of the automatic factory of the near future.

Prominent among the exhibits was the Marconi Industrial Television equipment seen "watching" a machine which would normally require the on-the-spot attention of a human observer.

Already the Marconi Industrial TV camera has aroused very considerable interest in industrial circles by reason of its ability to allow the remote observation of innumerable types of machines, gauges and processes. Its compactness ($5\frac{1}{2}$ in. x 4 in. x $11\frac{3}{8}$ in.) and light weight ($4\frac{1}{2}$ lb.) enables it to be set up almost anywhere, while its robust construction has proved to be more than adequate to withstand everyday usage in factory, workshop or office. The associated Control Unit is as simple to operate as an ordinary television set.

After exhaustive and successful trials, Marconi equipments have been purchased by the British Electricity Authority for the remote viewing of water-gauges and of flame conditions in boiler-furnaces. The United Kingdom Atomic Energy Authority is also using Marconi Industrial Television equipment to study conditions inside an atomic reactor.



Plessey

RADIO COMPONENTS

Variable Capacitors, Air and Compression Trimmers, Drives and Couplings, Vibrators, Chokes and Transformers, I.F. Transformers, Wavechange and Toggle Switches, Valve holders and Pilot Lamp-holders, Loudspeakers, Iron Dust Cores and Formers, Potentiometers, Cascap and Caslam Capacitors, Electrolytic Capacitors.

New Zealand Representative:

WILLIAM J. BLACKWELL

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Dry Battery Technotes

No. 9: SOME POINTS FOR AMATEUR DESIGNERS (Continued)

In battery-operated equipment, valves are often operated at nominally zero grid bias. In fact, there is always a small amount of grid bias, provided that there is a large enough D.C. resistance in the grid circuit. In audio amplifier stages other than the output valve, it is quite common practice to insert a 10 or 15-megohm resistor as the grid leak, in order to make use of this effect. What happens is that a small amount of grid current always flows unless a small negative grid bias is applied. This current, flowing in the high-resistance grid leak, produces a small negative potential at the grid of the valve. This, in turn, tends to reduce the grid current, but it can never prevent it completely, so that an equilibrium is set up in which the valve obtains a small grid bias voltage which would not be present if the grid circuit resistance were low. With battery valves, the small amount of grid bias thus obtained is enough to hold the plate and screen currents to a reasonable value.

The same kind of biasing is obtained with the R.F., mixer, and I.F. amplifier valves in battery sets, because the A.V.C. circuit in series with the grid return circuits of all these valves usually has a high enough resistance to allow grid-current biasing to take place.

One method of current saving in battery portable sets is to reduce the screen voltage of the tubes in the R.F. end, in order to reduce the screen and plate currents. If this is done, care must be taken to ensure that the biasing conditions of the valves are not upset. Reducing the screen voltage causes the point on the valve characteristic at which grid current is just prevented from flowing to become more negative. Thus, when the screen voltage is reduced, there may be an increase in grid current, which, in turn, will alter the bias on the valves in an unpredictable manner. Sensitivity and selectivity may both be affected owing to the shunting placed on the tuned circuits by the additional grid current. Both effects are undesirable, and it is advisable not to reduce screen voltage too much.

Another "trick" arrangement that has been used in commercial battery sets, but which has little to commend it, is the use of the R.F. oscillator to supply grid bias for the output valve. The oscillator passes grid current through its own grid leak, providing several volts of bias for itself. The potential developed across the grid leak is negative with respect to earth, and after passing through a suitable de-coupling filter, it can be used for biasing the output valve. At first sight, the scheme sounds attractive, because it avoids the loss of several volts in the B supply to the output valve, as does the conventional back-bias system, but in practice it suffers from too many disabilities. The main one is that the oscillator grid current varies with the tuning of the receiver. The output valve is therefore sometimes under-biased, and sometimes over-biased. In the former case, battery consumption is unnecessarily increased, and in the latter, distortion is produced. Also, should a fault occur in the oscillator, resulting in weak oscillation, or none at all, the output valve loses some or all of its bias, draws relatively enormous current, runs down the B batteries, and may even burn out the output transformer as well as being spoiled itself. Thus, a simple and otherwise harmless fault can have far-reaching and even disastrous effects when this circuit is used. There is a moral in this as well as a direct warning about one particular piece of poor design—namely, that trick circuits should never be used unless their full implications have been investigated and weighed up by the designer.

NEW BOOKS

STUDIO ENGINEERING FOR SOUND BROADCASTING

(By members of the Engineering Division, British Broadcasting Corporation. General Editor, J. W. Godfrey. Published, by arrangement with the B.B.C., for "Wireless World", by Iliffe and Sons Limited, Dorset House, Stamford Street, London, S.E.1. Price 25/-. Postage 6d.)

This book has been compiled for the primary purpose of training B.B.C. technical staff in the general principles underlying operational procedures at the Corporation's studio centres. It is now made available outside the Corporation in the belief that broadcasting staff throughout the world, on both the engineering and non-engineering sides, will find a great deal of interest and practical value in its pages. Some of the information is specific in that it relates to equipment and procedures specially designed to meet B.B.C. requirements, but the greater part of the text, dealing with principles of audio-frequency engineering, has a very general application.

The first chapter explains the development of the chain of acoustic and electrical equipment necessary in transmitting a broadcasting programme. Subsequent chapters deal with transmission quantities; acoustics for broadcasting and microphone placing; amplifier equipment; studio technical equipment, including outside broadcasting, recording and other facilities; control rooms and their equipment; programme circuits on Post Office lines, monitoring facilities; and the broadcasting organization's own communication system.

All six authors are members of the B.B.C. Engineering Division, and each is a specialist in his field; no effort has been spared to ensure technical accuracy, combined with clear and straightforward presentation. The technical level is practical rather than academic, and should present no difficulty to the readers for whom the work is intended.

RECORD TALK

by JOHN GRAY

It was in a way unforunate that the appearance of Tanza's "Opo the Crazy Dolphin" coincided with the demise of that likeable creature, whose antics had so brightened up the news columns of our papers. This is by a long way the best popular song "rushed up" on a local topical theme; in fact there is no "rushed up" effect in the finished result at all. The tune is good, the words clever, the treatment brilliant, and the finished record a feather in the caps of Crombie Murdoch who composed the tune, Noel Peach who arranged it, and Pat McMinn, Bill Langford and the Stardusters, who performed it. For an added attraction (as though it were necessary) "Opo" is backed by a new hit parade number, "Dancing in My Socks" (Z275). Another Tanza of more than passing interest is Colonel Hearne's "Kiwi Soldiers' March", which has appeared on Z281. We note with a wry smile, however, that this march, which it is hinted may be adopted officially, has not only been written by an American, but has been recorded by the U.S. Military Band of West Point. This really should be enough to make New Zealand composers —and bandsmen—blush with shame, and to say so is no reflection on the popular Military Attache who is its composer, nor on his and Tanza's enterprise in having it recorded in America. They have made amends by backing it with a new performance of "Invercargill", recorded by the Wellington Institute Senior Silver Band. This may also be regarded as a salute to the southern city on the occasion of its centenary.

At the time of writing, one or two well known labels are in abeyance owing to the various changes I mentioned recently, so we look to Tanza for, in some cases, the only accessible or the only alternative versions of the newest popular numbers. A welcome coupling is that of "Memories Are Made of This" and "Rock Around the Island", done by the Stardusters on Z271, and the current interest in "Guys and Dolls" has resulted in a PatMcMinn-Crombie Murdoch version of the catchy "Bushel and a Peck". This appears on Z267, and its backing is a Bill Haley number called "Burn that Candle". Some of these efforts tend to be carbon copies of the current American styles, but I do not see that this can really be objeced to and most of Tanza's recent efforts can hold their heads up in any company, no mean achievement.

Mercury are pinning their current hopes on a hit parader, "Only You", which at the time of writing is being pressed in a version by the Platters. The reverse is announced as "Bark, Battle and Ball". There is a small popular release from Philips, who give us the only version of "Tina Marie" which has so far appeared to join Perry Como's. Richard Gray, who made a hit with the rousing "Ain't that a Shame" is refreshingly uninhibited in both "Tina Marie" and the rock-and-roll inspired "Gumdrop" with which it shares P37032. Jo Stafford and Frankie Laine make a reappearance with "A Bushel and a Peck" and "If I were a Bell" on PB145. All girls whose boy friends spend an inordinate amount of time tinkering around with the innards of their automobiles will sympathise with the sentiments of "I Wish I were a Car" (B21744) as done by Mary Healy and Peter Lind Hayes. Mitch Miller has doubtless been encouraged by the rousing reception accorded "The Yellow Rose of Texas". He has gone to the same source and resurrected another old Confederate song, "The Bonnie Blue Flag", which he has re-christened "The Bonnie Blue Gal" and which, with a similar dose of side-drumming to help it along, shares B21727 with a Hawaiian style tune, "Bel Sante". Neither of these two has attained "hit" status, but I fail to see why Philips feel they have to apologise for the fact, as they seem to be doing in their release sheet. A good record will find its public readily enough. The Pete Rugolo fans may be directed to a new coupling, "Shave and a Haircut" and "Latin Nocturne" on B21663, and there is a touch of pleasant harmonising from the Mellowlarks in "Malaguena" and "The Basket Song" (B21660).

H.M.V. have brought out some popular instrumentals. The banjo revival continues in full swing with the arrival of the Ragtime Rascals, whose first offering is "Oh, You Kid" and "Lil ole Banjo" on HR10140. No doubt about it, we are now back in the atmosphere of the nineteen twenties, a period for which those of my generation have a nostalgic affection, and it becomes even more nostalgic when we see such titles as "Somebody Stole My Gal" and "Shine On, Harvest Moon", which are featured by Chet Atkins and his "other guitar" on HR10135. I feel the word should be plural, for this sounds like a whole regiment of guitars. Then we have Eddy Arnold reviving that old lament, "The Prisoner's Song" (HR10172) with the other side dedicated to an even worse fate—"Seven Years with the Wrong Woman". H.M.V. will not mind my saying that the best of their popular discs at the moment are those they have acquired from Capitol. Kit Carson sings of her desire for a "Band of Gold" on 3283, and its companion, "Cast Your Bread upon the Waters", is another of those numbers in which singer and chorus get to work and yell religious sentiments, but this time with quite exhilarating results. Dean Martin's "Memories are Made of This" shares 3295 with "Change of Heart". Other new Capitols are Woody Herman's coupling of "Love is a Many Splendoured Thing" and "House of Bamboo" (3202) and Al Martino is on form with "The Snowy Snowy Mountain" and "Love is Eternal" (3080).

On a London label there is Slim Whitman with "The Singing Hills" and "I Hate to See You Cry" (HL1013) and Jim Lowe's vigorous "Close the Door" is backed by "Nueva Laredo" on HL8171. Collectors of Bill Haley's Comets may now add two more sides on HL 8142, they are "Sundown Boogie" and "Green Tree Boogie". Those who appreciate a more old fashioned kind of vigour, as imparted to straight singing, will welcome Josef Locke's latest on Columbia DB3266. The items are "Soldiers of the Queen" and "It's a Grand Life in the Army", and there should be an even larger public for "Tobermory Bay" and "Shades of Old Blarney", which Locke sings on DB3359.

According to the latest supplement, H.M.V. and their affiliates have unloaded a further ninety-five long and medium play records upon us, and it is a daunting experience to thread one's way through the list. For those in search of light entertainment for the coming winter evenings there is a good choice. Art Mooney's "Banjo Bonanza", for instance, on MGM D136, will both please and arouse memories with its revivals of such tunes as "I'm Looking Over a Four-leaf Clover", "Paddlin' Madelin' Home" and others of that ilk, and the Fela Sowande Group, in their latest "Quiet Rhythm" collection (Decca LF1222) take us back to the "Moonlight and Roses" period. Another of the well made Robert Farnon orchestral suites is released on LK4117 and is dedicated this time to Arthur Schwartz, one of those prolific song writers whose songs are better known than their own names, such is the penalty of this kind of fame. However, if you don't recall Arthur Schwartz, you will at least know such titles as "Dancing in the Dark", "You and the Night and the Music" and "Louisiana Hayride". Those who dance to Victor Silvester have another LP to add to the pile (33S1081) and lovers of film and stage music are well catered for as usual. The sound-track of "Born to Sing" combines the talents of Judy Garland, Fred Astaire, Mickey Rooney, and others (MGM D134) and Glen Miller's orchestra is heard in numbers from the sound-track of "Sun Valley Serenade" on H.M.V. DLP1104. A new London show, "The Water Gypsies", by the talented team of A. P. Herbert and Vivian Ellis, is recorded by the original cast of the Winter Garden Theatre on DLP1097, and there is an entrancing revival of Gertrude Lawrence numbers from "Lady in the Dark" and "Nymph Errant" (DLP1099) as well as re-pressings of the most popular items from two big Ivor Novello shows, "Glamorous Night" and "Careless Rapture" in which the original Drury Lane singers are heard once again (DLP1095). A number of pleasant, restrained items from Melachrino's repertoire have been made into an attractive collection called "Reverie" and released on DLP1083.

Away at the back of the classical list we find some highly interesting medium play discs in London's Ducretet Thomson series, so it might be an idea to concentrate on them for a moment. The fine pianist Albert Ferber plays two short sets of Beethoven variations on MEL 94006. The F major set, opus 34, was once recorded by Schnabel, but the other, on a theme from an opera by Salieri, is new to our catalogue. For much more advanced tastes is a record of piano music by the Viennese atonal school of composers, a sonata by Alban Berg, a waltz by Schonberg, and the Variations by Webern. These are all played by Jeanne Manchon Theis on MEL 94008. The issue is both important and valuable, because for the modest price of a medium play record one can have a representative sample of this controversial school of music in one's collection for permanent reference. As contrast, you need look no further than MEL 94009, which offers piano music of a very different type: two brilliant and exhilarating pieces by Milhaud, "Scaramouche" and "Le Bal Martiniquais", played by the duettists Germaine Smajda and Georges Solchany.

Of these ninety-five LPs, no fewer than twenty-seven, or more than a quarter, are of operatic music. This seems to indicate the strong appeal such music has for record collectors, for the companies just do not issue material that will not sell. Opera lovers have undoubtedly fared best in the LP era; after all, we always had a profusion of symphonies, concertos, and sonatas in the old 78 days, but apart from the dozen odd staples of repertoire, operas were never plentiful. First on this new list we might mention three "vintage" recordings, that is, LP transfers of issues dating back to the pre-war period. Outwardly the most surprising is the resurrection of H.M.V.'s "Mikado" set of 1936, which now appears on ALP 1255-6. Is this necessary, in

the light of Decca's spanking new sets of the whole set of Gilbert and Sullivan? There will be an emphatic "Yes!" from the "things are not what they were" faction, who can now once again bask in the talents of Martyn Green, Darrell Fancourt, Leslie Rands, Marjorie Eyre, and other good old pillars of the D'Oyly Carte tradition. There may even be those who will regret that H.M.V. haven't gone back further still, and revived the old Henry Lytton set! These would be the diehards who claim Martyn Green can't hold a candle to Lytton, just as some who listen to the new Deccas claim that Peter Pratt can't hold a candle to Martyn Green. Already I fear for whoever comes here with the next Gilbert and Sullivan company, and who will inevitably be told he is not as good as Ivan Menzies. All this digression should not deter old timers from investing in this new-old recording of "The Mikado", and they will not need reminding that the sound, as reproduced, is still that of 1936, when modern high-fidelity was as unthought of as penicillin or radar. Another vintage revival, and a strong contender for the Mozart Stakes, is Sir Thomas Beecham's superb "Magic Flute" performance (ALP 1273-5). This has competition from Columbia, from a forthcoming Vienna Decca, and an even more recent Deutsch Grammophon version made in Berlin, but the very latest recording techniques count for less in Mozart than in the music of some other composers. This classic recording, dating from 1937, merits consideration on account of the unsurpassable Queen of the Night of Erna Berger, the lovable Papageno of Gerhard Husch, and the incomparable direction of Beecham. The third revival is for connoisseurs of Wagner, for on ALP 1276 the great team of Flagstad and Melchior are heard in the complete Bridal Chamber duet from "Lohengrin", and a lengthy extract from the second act of "Parsifal". These recordings, made in America in the early 1940s, preserve the art of two of the greatest Wagnerian singers of their generation.

Of the new "complete" sets, three break fresh ground for us. There is Verdi's brooding masterpiece "Don Carlo", his last opera before "Aida", and which keeps a firm hold on the repertoire, at least in Italy. Based on Schiller's play, it deals with largely imaginary events in the life of the Spanish King Philip II, his third wife, Elisabeth of Valois, and his son by a former wife, Don Carlo. Here you will meet the superb Boris Christoff in the role of the unhappy king, one of Verdi's greatest bass parts, and the equally fine Tito Gobbi in the baritone role of the Marquis of Posa. Mario Fileppeschi, a good if scarcely great tenor, is heard in the title role, and Elisabeth is sung by the young soprano Antonietta Stella. Elena Nicolai is cast as the venegful, one-eyed Princess of Eboli, who, by the way, emerges as the heroine of the new cinemascope film "That Lady", which treats of events that occurred twenty years after those narrated in Verdi's opera. "Don Carlo" will never be a popular work in the recognised sense, but its appearance on these four discs (ALP 1288-92) fills a most important gap, and it contains some of Verdi's most magnificent music. Rossini's "Turk in Italy", the other unfamiliar Italian offering, is almost a companion piece to "The Italian Girl in Algiers", and is well done by a La Scala cast including the inevitable Callas and a fine old veteran, Mariano Stabile (33CX 1289-91). Operas of this delicious "buffo" school are now becoming increasingly familiar to us, but quite fresh ground is broken with the appearance of "Ariadne auf Naxos", the enchanting Richard Strass work which was originally composed to go with Moliere's "Bourgeois Gentilhomme". This is the later, extended form of the opera, successfully revived lately at Glyndebourne and Edinburgh. It is done here under the inspiring direction of Herbert von Karajan with the Philharmonia Orchestra and a cast which includes the radiant Schwartzkopf, Rita Streich and Irmgard Seefried—as accomplished a group of feminine leads as one could wish for. Other well known names in the large cast are Rudolf Schock, Hugues Cuenod, Otokar Kraus, and Amy Felbermayer (33CX 1292-4). Almost, if not quite coming under the heading of opera is Rossini's last work, his "Little Solemn Mass", the title of which emerges as one of the composer's jokes, since it is anything but little and certainly not solemn. It is laid out for the expected four soloists, full chorus, and what seems the eccentric accompaniment of two pianos and a harmonium. H.M.V. in their recording by the St. Cecilia Academy Chorus of Rome under Renato Fasano (ALP 1278-9) provide everything but the harmonium, which they replace by an orthodox organ. If ever a composer praised God with joy in his heart, it was Rossini. This is, rightly or wrongly, a delightful piece of music.

There are other very attractive things in this exciting release. I have never heard anything more purely beautiful than Fischer Dieskau's singing of the Mahler "Songs of a Wayfarer", in which he is accompanied by the Philharmonia Orchestra under Furtwangler (ALP1270). Fritz Reiner and the Chicago Symphony give a superb reading of the most spectacular of the Richard Strauss tone poems, "Thus Spake Zarathustra", and they find space also, on ALP1214, for the "Dance of the Seven Veils" from "Salome". The Rome Opera chorus sing some excerpts from Verdi, Puccini, and Mascagni on ALP1277, and there is yet another release of Beethoven's ninth symphony, as conducted by Furtwangler at the re-opening of the Bayreuth Festival Theatre in 1951 (ALP1286-7). This has both the excitement and the drawbacks of recordings made during public performances, and comes as a worthy memorial to one of the greatest conductors of this century. David Oistrakh, the fabulous violin virtuoso from Russia who has recently added America to his career of musical conquest, is heard in the Khachaturian violin concerto on Columbia 33CX 1303. The performance, one feels, could scarcely be more authentic, as the accompaniment by the Philharmonia Orchestra is here directed by the composer himself. Russian music of an older period is contained in a disc of compositions by Balakirev. In addition to the tone poem "Thamar" this contains also the picturesque "Russia" and an orchestration of the great "Islamey" fantasy which has been the despair of so many pianists. The music is once again played by the hard-working Philharmonia, conducted this time by Lovro von Matacic (33CX 1280).

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Item and Country of Origin	Number	£(N.Z.)
Transformers for Receiving Sets (72101.17):		
United Kingdom	14,026	2,113
Australia	8	42
Netherlands	660	214
Germany-Federal Republic	6	299
U.S.A.	8	11
Total	14,708	2,679
Valves for Receiving Sets (72104.1):		
United Kingdom	207,817	57,063
Canada	505	176
Australia	120,005	21,178
Germany-Federal Republic	4,026	713
Netherlands	451,688	86,680
U.S.A.	49,211	6,107
Total:	803,252	171,917
Valves for Transmitting Sets (72104.2):		
United Kingdom	1,458	9,260
Australia	53	548
Netherlands	510	2,144
U.S.A.	283	899
Total	2,304	12,761
Receiving Sets, Built Up But Not Mounted in Cabinets (72104.6):		
United Kingdom	85	881
Australia	2	63
Netherlands	1	11
U.S.A.	7	88
Germany-Federal Republic	222	102
Total	317	1,145
Receiving Sets Mounted in Cabinets (72104.7):		
United Kingdom	727	8,731
Canada	2	18
Australia	12	456
Germany-Western Zone	2	25
Netherlands	10	171
U.S.A.	13	546
Total	766	9,947
Transmitting Apparatus—Other than Valves (72104.8):		
United Kingdom		13,859
Australia		2,573
Denmark		109
Germany-Federal Republic		621
Netherlands		1,899
Total		19,061
Other Wireless Apparatus (72104.13):		
United Kingdom		207,194
Australia		45,951
Denmark		348
France		1,802
Germany-Western Zone		7,827
Italy		215
Netherlands		31,211
Sweden		4,471
Japan		155
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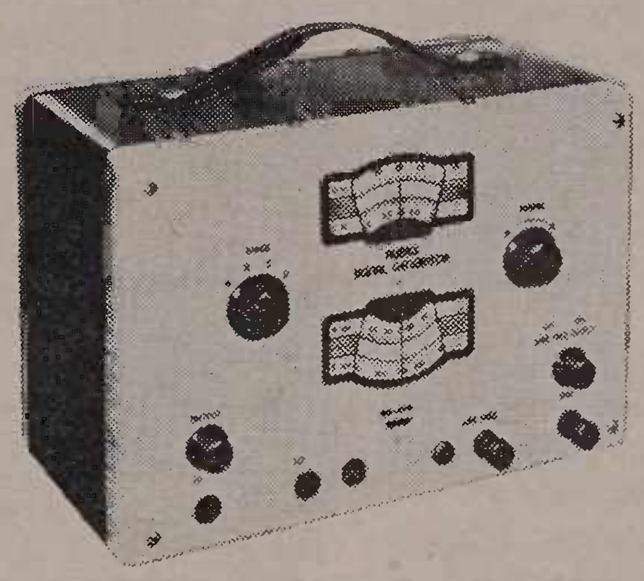

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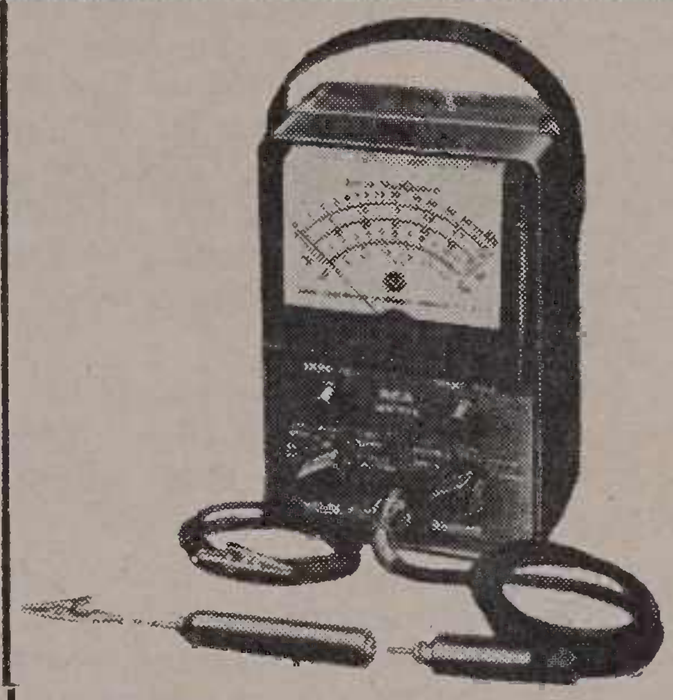

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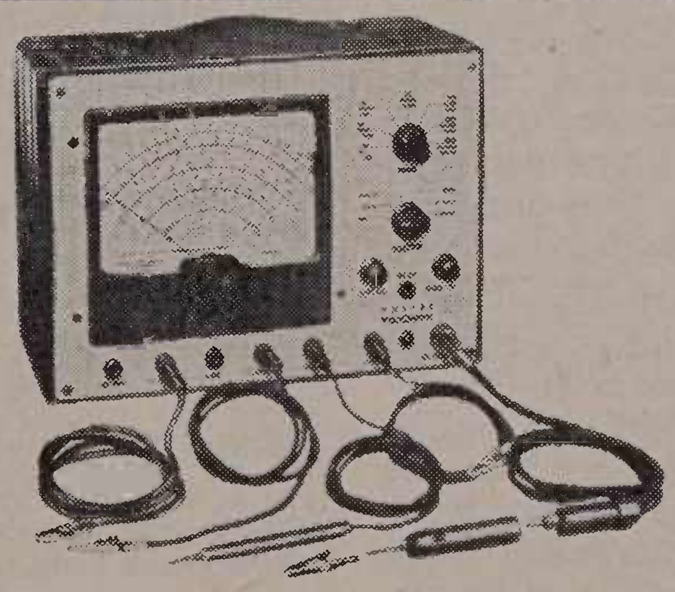

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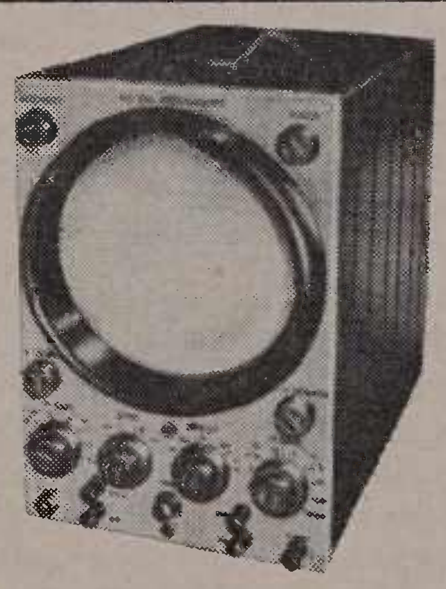

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ELECTRICAL AND TRADE SECTION

PORTABLE ELECTRIC TOOLS

(Reproduced from "The Practical Electrician's Pocket Book for 1955)

Portable electric tools are such an integral part of our everyday life that it is difficult to find a trade or profession in which these "pocket power units" do not play their part, even in such divergent spheres as surgery and agriculture. Portable tools, which were accepted and used mainly for maintenance purposes a decade ago, are now widely used for production work, performing their duties beside machine tools, or for assembly purposes.

The fundamental requirements of a portable tool are: high power to weight ratio, robust construction, good centre of gravity, ease of manipulation and ability to stand considerable momentary overload.

The motor most generally used in portable electric tools is the series-wound universal type which, when geared to requirement, has high starting and stalling torque. This feature is desirable for many of the duties performed. The motor can be classed as a variable speed type; it runs equally well on A.C. and D.C. at a high free speed, usually 10–12,000 r.p.m. for the larger units, and 15–18,000 r.p.m. for the smaller; such speeds being necessary to develop sufficient power. This motor is very similar in appearance to the conventional D.C. motor, the main observable difference being in the field stacking, which is laminated.

A second general class of motor used, one that will run at constant speed with varying load, is the single phase or three-phase induction motor. Its speed is either 1,500 r.p.m. or 3,000 r.p.m. on a 50 c/s supply; it is mainly used for bench grinders and flexible drives. These motors are usually larger in size and heavier in weight for a given output than the universal type and therefore are built into machines that are not normally supported in the operator's hands.

Another type of motor used in portable electric tools is the high-cycle motor, a three-phase induction type operated on a supply frequency of 200 c/s. It maintains a constant speed under a variable load until stalling point is reached. High-cycle motors are extremely powerful for their weight and, since they have no brush gear or wound armatures, maintenance costs are low. This renders them eminently suitable for rapid production, particularly in the heavier industries. As a motor-generator or frequency changer is necessary to supply the 200 c/s. current for these motors, they are not extensively used except where it is worth while to install a number of them to cover some phase of production activity.

High-cycle motors have a high rotor speed, usually 12,000 r.p.m. on 200 c/s.; they have a synchronous speed of 3,000 r.p.m. on 50 c/s., but then develop insufficient power.

The direct current motor is used in some instances, either shunt or compound wound, having relatively constant torque-speed characteristics and a power to weight ratio similar to universal motors. D.C. tools are mainly used by industrial concerns who generate their own current by reason of certain process work and by contractors on site work using mobile D.C. generators.

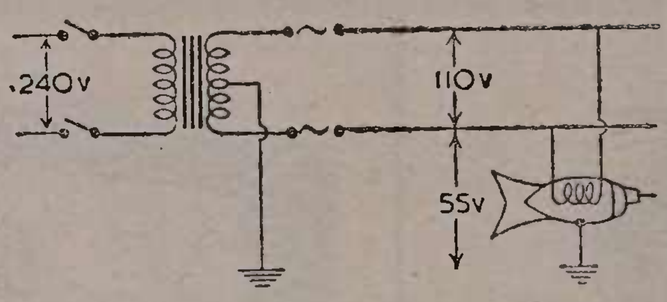
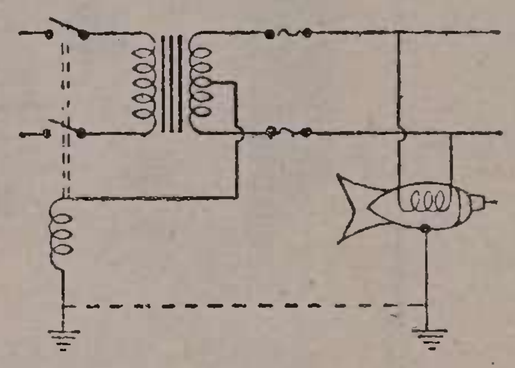
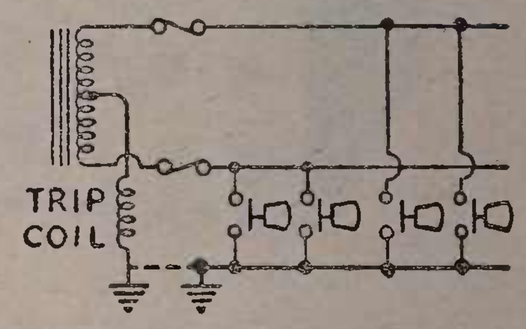


Fig. 1—(left) Double-wound centre-tapped transformer reducing tool voltage to safe limits. An earth leakage trip provides further protection and can be used with a number of emergency buttons—(Figs. 2 and 3 below).





Operating Data of Typical Portable Electric Tools

	Spindle speed r.p.m. *No. Load*	Spindle speed r.p.m. *Rated Load*	Input Watts. *Rated Load*
1/4 in. Light Duty Drill	2,250	1,300	130
1/4 in. Standard ,, ...	2,000	1,100	175
1/4 in. Heavy Duty ,, ...	2,000	1,250	325
3/8 in. Standard ,, ...	900	600	325
3/8 in. Heavy Duty ,, ...	900	625	355
1/2 in. Standard ,, ..	400	275	355
1/2 in. Heavy Duty ,, ...	500	330	480
5/8 in. Standard ,, ...	300	180	470
5/8 in. Heavy Duty ,, ...	450	265	620
3/4 in. Standard ,, ...	250	155	580
3/4 in. Heavy Duty Drill	375	200	750
Screwdrivers—No. 10 Wood Screw	750	350	185
No. 14 ,, ,,	500	440	210
No. 18 ,, ,,	500	430	320
Portable Sander—7 in. Heavy Duty	4,200	2,650	800
Portable Grinders 5 in.	4,500	2,450	580
,, ,, 6 in.	3,800	1,900	800
Portable Saws 7 in.	3,200	2,200	1,100
,, ,, 9 in.	2,500	1,600	1,500
Electric Hammer—1/8 in. concrete	3,000	2,200	750
,, ,, 2 in. ,,	2,800	1,950	1,200
Flexible Shaft Machines, Blowers and Industrial Vacuum Cleaners	various.		

RATING OF TOOLS

As the type of duty for portable electric tools can vary, manufacturers usually supply three main types —light duty, standard duty and heavy duty.

Light duty tools are light in weight, fitted with high speed motors, mainly all plain bearings, and are recommended for light, intermittent work only. This class is usually confined to the smaller drills. Standard duty tools are widely used for maintenance purposes

and general duties in small workshops where a continual production cycle is not found necessary. Heavy duty tools are usually extremely robust and powerful, maintaining a more constant speed under a varying load than the light and standard models. They are mainly used by the production side of industry where operating times, costs, and reliability are of importance, and continuous production calls for long hours of constant service. The same high manufacturing standards and electrical insulation are present in all three classes of tools.

MAINTENANCE

Portable electric tools are often operated under arduous conditions, so to ensure trouble-free service they must receive regular maintenance. The most frequent causes of breakdowns other than downright abuse are: motors clogged with abrasive dust; ventilation holes choked up, thus restricting the forced air ventilation and allowing the motor to overheat and badly worn carbon brushes that cause violent sparking with resultant damage to the commutator—which may lead to eventual armature breakdown.

The universal motor, since it runs at a high speed, wears out the carbon brushes more rapidly than does a slower speed motor. Consequently, the brushes need frequent inspection and should be replaced when they are down to a third of their original length. New brushes should slide freely in their holders to avoid a stuck up carbon brush which again results in sparking, loss of power and commutator trouble.

The carbon worn from the brushes usually gets mixed with fine metallic dust and oil vapour and tends to be deposited on the brush gear and in the armature windings. If allowed to accumulate, it will cause leakage currents to pass to the frame and in extreme cases may cause insulation to break down due to arcing. Regular blowing out of the tool and motor with compressed air, or a portable blower to remove such dust, will ensure freedom from this type of breakdown which is all too common where maintenance is neglected.

It is neither necessary nor desirable to interfere with the commutator when replacing carbon brushes —unless the old brushes have worn down so much that the brush spring has rubbed the commutator.

Most portable electric tools have grease-sealed bearings fitted on the armature shaft. Such bearings need no further lubrication during their useful working life. Tools fitted with plain bearings need lubrication at regular intervals, but excess must be avoided particularly with armature bearings, otherwise the oil may foul the commutator and be thrown on to the brush gear.

Many light duty tools are fitted with the porous or sintered type of plain bearing. These bearings are self lubricating over a period, but will not run indefinitely without further attention. They need lubricating sparingly with a very thin oil, ensuring that the oil retaining felts are well moistened.

When the grease in a gearbox needs changing, flush out the casting and bearings with a mixture of paraffin and petrol, inject a few drops of lubricating oil into the bearings, and refill the case with sufficient new grease to surround the gears. Again, excess must be avoided as it may be forced out through the spindle and armature bearings.

Three-core flexible cables should have frequent and careful inspection, particularly when the tool is being used in shops where the cable may foul obstructions. All cables should be replaced when they show signs of serious abrasion or are perished due to contact with oil or grease. A special check should be made at the points where the cable leaves the machine and enters the plug as these are usually the points where maximum stress is put on the cable.

All screws should be tested for tightness, not forgetting those securing the conductors to the switch. Many a switch has failed by a screw working loose through vibration, thereby causing arcing which can persist in such a confined space.

The earth conductor in flexible cables should have frequent and thorough testing for continuity. When a tool is in use there is no indication whether the frame is safely earthed. The accepted method of testing the continuity of the earth wire by "Megger" or a lamp in series with the mains is not considered adequate. If the wire is partially broken through and only one or two strands intact, both tests will show continuity. It is obvious, however, that the next time the cable is strained or flexed the remaining strands may fracture.

The recommended test for the earth conductor in a flexible cable is to pass through it a current of 25 to 30 amperes at a low voltage for approximately 10 seconds. Then, if one or two strands only are intact, this high current will part them. To ensure further safety, this same current should be passed from the frame of the tool to the earth pin in the plug, to make certain that the connections are tight.

There is marketed today efficient and inexpensive equipment for this high current earth wire testing.

HINTS ON USE

Ensure that the voltage marked on the tool is the same as that of the supply. Typical voltage ratings for tools are 110–120, 120–130, 165, 200–230, 235–250. Tools run on a higher voltage will result in high speed and overheating—on a lower voltage, low speed and loss of power.

Electric drills, especially in the smaller sizes, run at high speed, therefore high speed twist drills bits should be used; carbon steel bits will quickly blunt and get very hot. Always use correctly ground twist drill bits as when blunted they are wasteful of time and effort. They should be ground by an expert or in the special attachment marketed for the purpose.

For fast drilling, maintain an even pressure to ensure constant and high cutting speed, easing the pressure when "breaking through". The same principle also applies to grinders, sanders and other tools using abrasives, since abrasives cut more efficiently at high speed.

When using electric screwdrivers for running in wood screws, apply light pressure at first to start the screw thread cutting the wood, then increase the pressure consistent with the size and length of the screw. To remove screws, apply heavy pressure to start the screw turning, then release pressure to run screw out, keeping the clutch fully engaged.

Electric hammers should not be switched on until in contact with the work with firm pressure applied. Switch off when it is necessary to change the position of the tool bit. Running a hammer when no useful work is being performed results in increased maintenance costs as no-load vibration is more destructive than full load hammering.

Portable tools should be treated with care, kept clean, and when not in use, put away in a safe place. No portable tool should be laid down on a bench where other work is being performed. A small screw or piece of metal inadvertently dropped through the air ventilation holes may ruin the motor.

SAFETY PRECAUTIONS

By reason of their portability and size, electric tools are frequently used in situations and on types of work which can be classed as relatively dangerous. As the tools in most cases have metal frames, which the operator holds in his hands, the importance of adequate earthing cannot be stressed too heavily.

The attention given to earth wire in a flexible cable is most important, since there is no proof that it is performing its duty, unless previously tested. The method of ensuring that the earth wire is sound has been dealt with in the maintenance section.

Connecting electric tools to lampholders cannot be deprecated too strongly. The lampholder, and switch contacts, are not designed to carry the currents demanded by the majority of electric tools and the absence of facilities for earthing makes this practice a very unwise procedure.

All portable electric tools should be fitted with robust three-pin plugs, the plug body having means whereby the cable can be secured to eliminate strain on the connections.

It has been the practice for many years to use tools wound for the mains voltage. Consequently, should the insulation of an unearthed tool break down, the operator is liable to a severe shock. The use is recommended of the 110 volt secondary being centre-tapped and connected to earth as shown in Fig. 1. Breakdown pressure between frame and earth is only 55 volts.

A system which gives indication of insulation failure and subsequent "earthing" by switching off the supply is shown in Fig. 2. A double-wound transformer is used, the secondary having a centre tapping which is connected to earth through the operating coil of an earth leakage trip. The earth leakage trip operates on a very low current even with an earth resistance of 600 ohms or higher. This system permits the use of emergency stop buttons which can be fitted between either of the secondary live lines and earth, as in Fig. 3.

This can be of value in factories where quantities of electric tools are being used, giving the operators protection from accidents not caused by an electrical fault. Also, it permits the daily testing of the earth leakage equipment itself.

Many tools can be run from these transformers, the kVA rating of which need only be approximately one half of the total kVA of the tools likely to be used as all the tools are rarely in use at once.

FASTEST "STOP WATCH" TIMES ATOMIC EVENTS

The world's fastest "stop watch" for clocking the action of atomic particles has been developed at the Westinghouse Research Laboratories in Pittsburgh, Pennsylvania.

Capable of timing atomic events that take place in less than one thousand millionth of a second, the stop watch is actually a photomultiplier tube.

It is so fast that its top speed cannot be determined exactly until laboratory measuring instruments catch up with it. Calculations show that it is probably ten times faster than the one thousand millionth of a second already recorded.

The electronic stop watch, designed to aid nuclear studies, strengthens weak pulses of radiations and detects the time intervals between them, says Dr. Clarence Zener, director of the Westinghouse Research Laboratories.

It will be used to time the flight of speeding atomic particles.

"It will permit us to measure, with a new order of precision, the speed and, therefore, the energy of atomic particles as they "smash" into atoms and produce nuclear reactions, or as they are ejected from the atom during such reactions. This precision, we believe, will give us new insight into the causes and effects of nuclear reactions and, perhaps, into the structure of the atomic nucleus itself," said Dr. Zener.

Electrons released by a radiation pulse entering the tube of the "stop watch" strike the front surface of an exceedingly thin non-metallic film. This knocks free several more electrons which then bombard a second film. After many such stages, several million electrons are obtained for each one initially released.

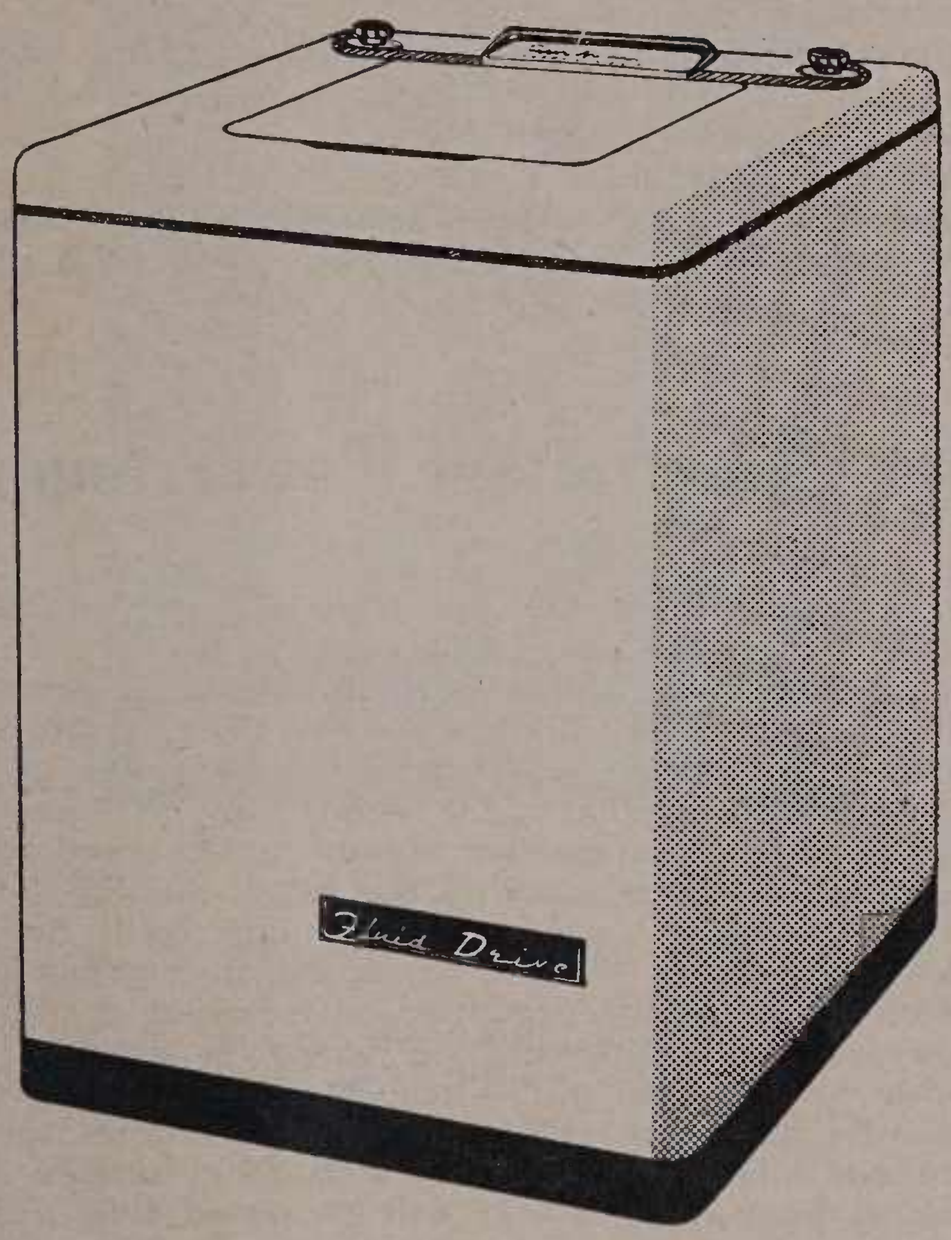
Conventional photomultiplier tubes, Dr. Zener pointed out, use thick metal plates instead of thin films to obtain the extra electrons.

The electron tube capable of timing successive flashes of light less than one thousand millionth of a second apart. Dr. E. J. Sternglass, Research Scientist at the Westinghouse Research Laboratories is shown adjusting a source of radiation beamed into the tube.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

THE FULLY AUTOMATIC "SIMPSON" CLOTHES WASHER



The A. R. Harris Company Limited of 72-76 Manchester Street, Christchurch, proudly introduce the greatest boon to the modern housewife—the Simpson Completely Automatic Agitator-type Clothes Washer.

Like most "automatics" in North America, the Simpson Automatic Washer uses the tried and proven "agitator" washing action. Many tests have proved that only the turbulence caused by the agitator swing is consistently effective.

This "four-way" agitator washing action, plus three spin rinses, thorough "deep-overflow" rinse and extra high speed spin-drying, ensures a cleaner, whiter wash for all types of fabrics—and all automatically.

One of the outstanding features of the Simpson Automatic is its exclusive "fluid drive", as used in expensive cars, which ensures a smooth, powerful drive to the spin-tub, eliminates vibration, and with it the necessity to bolt down or bed the washer in any way.

The Simpson agitator incorporates vital modern developments; it is of hard, non-porous moulded plastic that cannot rust or corrode. Vanes are designed to create the "four-way" washing action that gives every item—silk handkerchief or double-bed sheet—the most thorough, yet gentle of washings.

Anyone with a hot water system can use a Simpson Automatic. It isn't even necessary to have a laundry. There is no bolting down, no bedding and no plumbing. Installation is entirely costless, providing the washer can be installed within five feet of a water outlet. It's modest dimensions (width 25¾ in., depth 27¼ in., height 36 in.) and adjustable levelling legs permits its use even in the kitchen. Hoses connect to hot and cold water taps and it drains into any drainage outlet—tub or sink.

An important feature is the low hot water requirement for maximum cycle. With water control set at "Hot", total hot water consumption for a full 8-pound wash (dry weight of clothes) is only 14 gallons. An exclusive automatic "weigh-fill" feature makes the Simpson the most completely foolproof automatic available. It assures correct water level for each operation, regardless of water pressure, and by simply pressing a small button, waste of water for small washes is eliminated.

Moreover, the flexible Simpson Automatic cycle can be lengthened, shortened, repeated, or any part skipped by very simple dial control.

Using the principle of extra high-speed centrifuge —at 650 r.p.m., higher than any other "automatic" available—the Simpson Automatic spin-dries clothes drier than wringer-dry. No heavy pressure is used. Consequently, no possible damage can occur to buttons, zippers, buckles, and dress ornaments; or to delicate fabrics either. Yet the extra high-speed centrifugal "throwout" of moisture is so thorough that practically no dampness remains, and, as weight of excess water is removed in the tub, no heavy lift-out is required.

The Simpson Completely Automatic Clothes Washer brings all the "very latest in Automatics" and is quality built under licence to the same American design as most American automatic washers today.

Inquiries will be welcomed by A. R. Harris Company Limited, 72-76 Manchester Street, Christchurch.

* * * *

A STYLISH NEW AUTOMATIC TOASTER

After a number of years' research the Ultimate Pop-up automatic toaster has at last been released. Of a standard to be expected from an Ultimate appliance, this new toaster incorporates the latest techniques.

(Continued on next page)

In the past some well defined difficulties have been experienced with this type of appliance, but careful attention to detail has enabled Ultimate engineers to "design out" difficulties and to present a toaster that is reliable and efficient.

It cooks two slices of bread simultaneously and pops them up when perfectly cooked. An adjustable timing device gives a range of cooking times, and an emergency button is provided to take care of the unforeseen. A crumb tray ensures neatness and tidiness in the home where this labour-saving device is used. The finish is high quality chrome with heat resistant bakelite fittings.

The thermostat is based on a bi-metal strip and is ruggedly constructed for a long life of reliable service. The elements are interchangeable and any servicing that may be required will be able to be undertaken with ease and speed.

Specifications:

Dimensions: 12 in. long, 7½ in. high, 6 in. deep.

Rating: 1200 watts, 230 volts; A.C. only.

Flex: 6 feet heavy duty, complete with factory-fitted 3-pin plug.

Price: £8 17s. 6d.

A little more—for a lot more! It's an Ultimate!

Manufactured and distributed by Ultimate-Ekco (N.Z.) Co. Ltd., P.O. Box 1166, Auckland.

* * * *

AN APPEALING NEW LOWBOY

Ultimate-Ekco have just released their latest Lowboy radiogram and within a very short time it has established itself as an instrument possessing great appeal to both dealer and public alike.

The "Sherwood", a 5-valve broadcast radiogram in a light oak cabinet, features one of the nicest designs of recent times, for it is based on cabinet trends from overseas. Particularly generous space for record storage will be appreciated by the disc connoisseur and the performance on both radio and gramophone will quickly be recognized as superb by every music lover. The gram. unit is a Garrard 3-speed automatic and the whole is engineered to meet the exacting standards of an Ultimate.

The radiogram was introduced to the many thousands who attended the Auckland Easter Show, and the response was enthusiastic to say the least. The public were quick to recognize quality and to appreciate that here is a set designed to beautify the home.

From the dealer's point of view the margin offered is excellent and with the usual trouble-free performance of an Ultimate, after-sales attention is at a minimum.

Specifications:

Valves: 6BE6 Freq. Changer. EF41 I.F. Amplifier. 6AV6 Det.-voltage Amplifier. EL41 Power Amp. 6X4 Rectifier.
Output: 3 watts.
Record Player: 3-speed automatic.
Speaker: 12 in. Rola.
Dimensions: Height 30 in., Width 33 in., Depth 15 in.
Code Name: Sherwood.
Price: £69 19s. 6d.

Trade inquiries should be addressed to the manufacturers and distributors: Ultimate-Ekco (N.Z.) Co. Ltd., P.O. Box 1166, Auckland.

* * * *

Adjustable Voltage Power Supply

(Continued from page 25)

to connect tubes in parallel. Indeed, when making up the unit, it is not a bad plan to install two or three sockets and wire corresponding tube elements in parallel. If this is done, even if it is not intended to install more than one valve for a start, the others can be plugged in as and when they are needed. There is one precaution that should be observed when connecting valves in parallel this way. Small stopper resistors should be used in each plate lead. As the valves are used as triodes, the plate and screen pins on each socket can be strapped, after which a stopper of, say, 100 ohms should be wired in as close as possible to the plate pin. Then, to connect the plates in parallel, the connections are made not directly between the plate pins, but between the outside end of the stopper resistors. It will be noted that a grid stopper has been shown even for a single tube. When connecting them in parallel, a stopper should be installed for each one, just as for the plates, and the outside ends of the stoppers paralleled. If these stoppers are omitted, it may be found that peculiar jumps in the output voltage take place as the adjusting potentiometer is moved slowly. These, if they occur, will most likely be due to R.F. oscillation of the valve. It is the purpose of the stoppers to prevent this from taking place.

There is an advantage in using valves in parallel, even when only small output currents are wanted. Doing so causes the mutual conductances of the valves to add together, so that, with two valves in use, the voltage regulating effect mentioned above is twice as good as with only one valve in use. Needless to say, when parallel valves are used, the rest of the circuit remains the same. That is to say, only one adjusting pot is used, its moving arm being connected to the parallel grids. The cathodes can be connected directly together without any special precautions.

A further advantage of paralleling tubes is that their plate resistances are then smaller when connected together, in the same way as their mutual conductances are increased. This has the effect of enabling a higher voltage output to be obtained for a given input voltage, since the minimum voltage drop through the composite tube is less than that through a single valve.

TRADE WINDS

Mr. A. J. Wyness

Mr. A. J. Wyness, Managing Director of His Master's Voice (N.Z.) Ltd., left by air on Easter Monday for Hollywood, California. There on April 6 he attended the official opening ceremony of the Capitol Tower, the new two-million-dollar Hollywood office for Capitol Records Inc. This is a perfectly round thirteen-storey structure, the first of its kind in the world.

During his visit, Mr. Wyness stayed at the Hollywood Knickerbocker Hotel where he was the guest of Mr. Glenn E. Wallichs, President of Capitol Records Inc.

Messrs. J. F. Lockwood, and L. J. Brown, of E.M.I. International Ltd., Hayes, Middlesex, which now holds a controlling interest in the progressive Capitol organization, were also present at the ceremony.

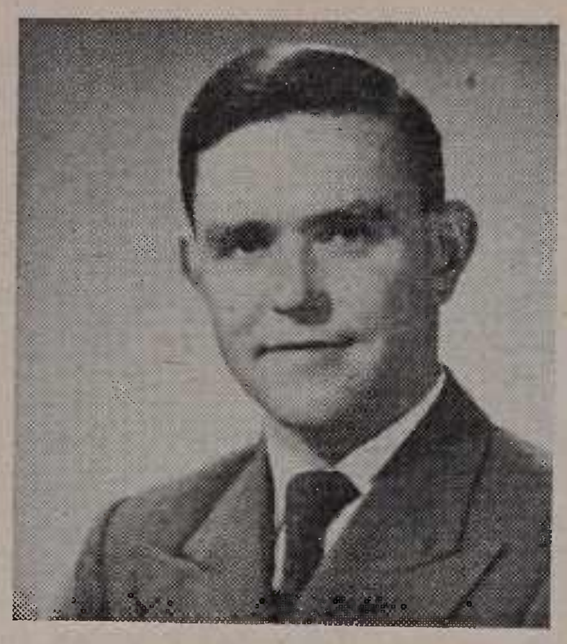
EUROVISION

Eurovision television programme exchange between seven countries has now been established on a permanent basis. Programmes are being seen simultaneously by people in Britain, France, Switzerland, Western Germany, and Berlin, the Netherlands and Belgium. Austria is about to join and Denmark perhaps later this year.

Much progress has been made since programmes were exchanged on temporary links in 1954. In Britain, the Post Office has established a permanent co-axial cable link between London and Swingate, near Dover, which will take the place of the radio links operated by the B.B.C. The radio and cable links within Britain that bring the programmes within reach of nine-tenths of the population amount to 1,200 miles. The radio links across the English Channel to Cassel in France, and to various Continental transmitting stations, amount to 4,400 miles. The television audience in Britain is now estimated at about fourteen million people, and the Continental audience has grown in a matter of years from a few thousand to about two million.

The B.B.C. will take programmes from the Continent on an average of once a week.

Programmes can be sent simultaneously to all the Continental countries on the Eurovision network, each with its own commentary.



Mr. Peter Proctor, newly appointed Manager for Russell Import Co. Ltd.

TELEVISION FOR TRAFFIC CONTROL AND OTHER PURPOSES

Recently Pye Ltd., of England, demonstrated to the British Army and Police Authorities how industrial television could be used to transmit pictures from a helicopter to the ground for traffic control and other purposes. A "Sycamore" helicopter provided by the Bristol Aeroplane Company flew, with a miniature Pye industrial television camera mounted in its dooway, at heights between 500 and 1000 feet, transmitting pictures of the countryside to a screen on the ground. Installations at Avonmouth docks, four miles away, were clearly visible on the miniature screen, as well as traffic movement on the Gloucestershire roads.

To facilitate loading and unloading of the 400 lb. of transmitting equipment, the unit was mounted on a stretcher normally carried when the aircraft is engaged on ambulance duties. To remove the complete apparatus, which took only a matter of minutes, it was necessary merely to disconnect the electrical leads attached to the aircraft and unload the stretcher.

The helicopter offers wide scope in the field of air-to-ground TV broadcasts and, in many instances, provides a far more satisfactory medium for this work than fixed-wing aircraft. The ability to hover over a given spot at the most suitable height is particularly valuable, not only in handling traffic control problems and commercial outside broadcasts, but also in cases of emergency such as civil defence reconnaissance of devastated areas and the survey of damage by flood and fire.

The possible application of the helicopter as a "flying eye" in military operations is also extremely important, and air-borne TV would enable commanders in the field to watch operations actually in progress—an invaluable aid in the speedy redisposition of fighting units.

BRITISH RADIO SHOW

H.M. the Queen has again consented to be patron of the National Radio Show to be held this year at Earls Court, London, August 22 to September 1.

This will be the first Radio Show to be held since commercial television began (on September 22, 1955) and plans and particulars issued by the Radio Industry Council show that for the first time the I.T.A. and the commercial television programme contractors will be co-operating in the exhibition.

The whole-hearted co-operation of the B.B.C. is once again assured with a large studio and outside broadcast arena in and from which programmes will be released and transmitted daily. Other exhibits on the first floor will include a careers and electronics display and, it is expected, exhibits by the three Services.

The main part of the exhibition on the ground floor will, as before, be devoted to the stands of the individual manufacturers, many of whom will also have offices and demonstration rooms for VHF and high-fidelity sound as well as television.

CLASSIFIED ADVERTISEMENTS

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

Lighting Notes

By "Continuity"

(Reprinted by courtesy of "Electrical Industries Export," 6 Cavendish Place, Regent Street, London, W.1.

Artificial lighting is an artificial method of increasing the power to see. That sounds obvious enough; but, unfortunately, this particular point is forgotten by many who cater for the electric lighting requirements of the public.

If I sit in a darkened room with one candle shining over my left shoulder, I can read a newspaper. If I place another candle straight in front of me, although I have doubled the lighting in the room, I have substantially reduced my power to see, because human eyes are to an extent like cat's eyes inasmuch as a direct light on the eye closes the pupil and thus reduces the power to see.

Ophthalmic surgeons will bear out the fact that a very great deal of premature sight failure is due in large measure to faulty lighting, ill-designed for the purpose for which it is intended.

Now, we are not opthalmic surgeons, nor have we any direct responsibility for the health of our customers, but the more we can learn about the proved impact of lighting on the well-being of our customers, the more we can add to the health of the community and therefore to the status of our industry.

I mentioned opthalmic surgeons; they may be compared to illuminating engineers as such, but it is a fact that opthalmic opticians are the contractors in the field of opthalmics where the surgeon is the consulting engineer.

I don't suppose there is an opthalmic optician in business who would be prepared to specify lenses without first having examined the eyes—and, of course, referring the customer to an opthalmic surgeon where there is evidence of disease of the eye

We are in much the same circumstances. If we wish to shift the responsibility out of commerce into professional ranks, we can always do so by advising the customer to call in a consulting engineer. At the same time, there is no reason why we should not school ourselves to give sound advice in the matter of lighting, provided that we do not get out of our depth.

Not enough use is made of the various associations, societies and committees which, from time to time, produce a wealth of informed directives on matters which touch closely the work of the electrical contractor. This service is not free, inasmuch as there is almost always a small charge for the actual documents, but when one considers the immense amount of thought which has gone into their preparation and production, the actual cost is infinitesimal.

DESK LIGHTS

Many people ask for desk lights, and this seems to me to be a very proper request. I myself suffer from poor eyesight, and in my office a 40W lamp as an appropriate desk light a foot or so away from my work is quite adequate, I find, while a 100W ceiling fitting is not.

The sale of a desk light or even the installation of a socket outlet is not as profitable to the trader as that of a substantial ceiling fitting, but that lost in immediate profits is likely to be gained in reputation for understanding the job, even if the trader recommends the former.

FLUORESCENT AND INCANDESCENT LIGHTING

As between fluorescent lighting and incandescent lighting, it is usually not difficult to advise a customer properly; but there is rather too great a tendency to treat the newcomer, fluorescent lighting, as the natural successor to the obsolescent incandescent lighting. Fluorescent lighting, it is true, does mark a great advance in economy and softness of lighting. At the same time it is quite uncontrollable from the point of view of projection, whereas the incandescent lamp, being nearer to a point source of light, is more amenable to directive projection. Of course, there is on the market a coiled fluorescent tube which, to a limited extent, can be used for directional purposes, but this does not really alter the fact that fluorescent lighting is a system of general lighting or indirect lighting and does not really come into the category of direct lighting.

An important aspect of this difference is to be found in the lighting of restaurants, jewellers' shops and the like, where jewels should be seen at their best. The facets of the cut stone do not respond well to fluorescent lighting, while the stellar effect of filament lamps draws out of them all the richness and gaiety which was intended. Just as it is advisable to carry a sample of tweed into daylight in order to get a true impression of its effect, so a jewel should be examined—so far as the wearer is concerned—under artificial filament lighting; for that is the conditions in which it is most likely to be seen on the neck or finger of the wearer.

CLASSIFIED ADVERTISEMENTS

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

RADIO OPERATING

Correspondence Course specially compiled to meet New Zealand Examination Syllabus. Free prospectus.

NEW ZEALAND RADIO COLLEGE
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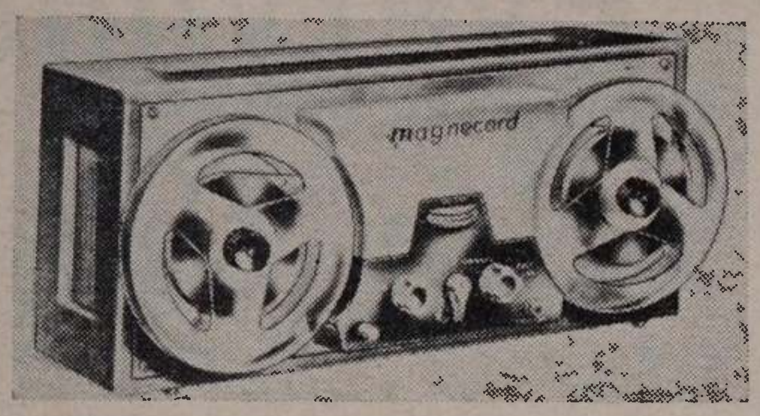
LATEST OVERSEAS DEVELOPMENTS

THE "CITATION" TAPE RECORDER BY MAGNECORD



A newly streamlined, popular priced, portable tape recorder for home, school and business use has just been introduced by Magnecord. Named the "Citation" it boasts a VU meter for accurate volume control, as well as other features generally demanded by the hi-fi expert or semi-professional.

Certain specifications of the new Magnecord "Citation" are: The F-35B Magnecorder is a two-speed, full-frequency range tape recorder. At 7½ in. per second, frequency response is from 50 to over 10,000 cycles; at 3¾ in. per second, frequency response is from 50 to over 5,000 cycles. The Magnecord VU meter indicates proper volume setting, eliminates distortion and hard-to-erase tapes. Also included is a full 10-watt amplifier-speaker system in a single case. If desired, the speaker-amplifier can be used alone as a public address system.

Further information and detailed specifications can be secured by writing Magnecord Export Dept., 89 Broad Street, New York, N.Y., U.S.A.

* * * *

PHAOSTRON'S NEW MODEL NO. 777 VACUUM-TUBE VOLTMETER

Just introduced, the model '777" VTVM is a completely self-contained, ready-to-use test instrument in an unbreakable metal case. Its accessories and the HF co-ax cable, DC probe, AC line cord and instruction book all fit in the genuine California Saddle Leather carrying case that is furnished with the instrument.

The new "777' features 42 unduplicated ranges; a dial illuminated by 5000-hour self-contained lamps, die case chrome finished bezel; an unbreakable, ultra compact metal case. Its permanent accuracy (3% DC, 5% AC) is supported by large, easy to read scales 4⅞ in. long, colour coded—green for ohms, black for AC, DC and red for P.toP., as well as 2 zero centre scales for FM discriminator alignment. Easy to operate, it has only 2 jacks for all measurements, separate range and function switches, chrome bar knobs and a dual purpose handle which also serves as AC line cord reel.

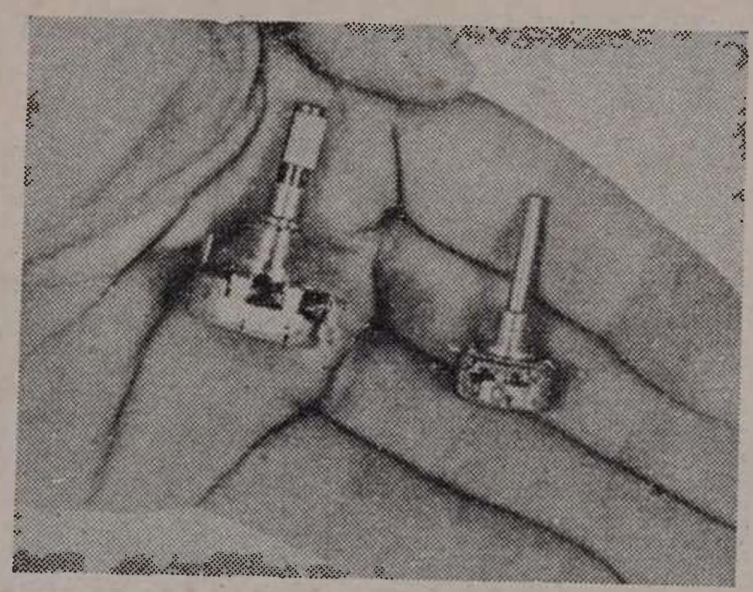
Further information is available from Phaostron Export Department, 89 Broad Street, New York 4, N.Y., U.S.A.

* * * *

NEW MINIATURE STACKPOLE TYPE F VOLUME CONTROL

The Stackpole Carbon Company has developed an amazingly small and amazingly efficient variable composition-resistor—the Type F Volume Control.

Despite its small size—only 0.637 in. or 1.618 cm. in diameter, as compared with 15/16 in. or 2.381 cm. diameter for previous standard controls, this sturdy control is currently doing a full size job in miniature radios and in a variety of electronic equipment.



The important mechanical specifications for Type F include:

Control diameter: 0.637 in. or 1.618 cm.

Shaft diameter: 0.124 in. or 0.315 cm.

(Available with knurled, slotted or flatted shaft).

Bushing diameter: 0.250 in. or 0.635 cm.; ¼-32 thread.

Notably quiet and smooth in operation, the Type F Volume Control gives stable, long-life performance even under wide humidity variations. They are rated for 0.3 watts through 10,000 ohms; for 0.2 watts above 10,000 ohms; with a maximum voltage of 350 volts.

Single and double pole switches for Type "F" controls will be available within a few months.

Further specifications and particulars are available from Ad. Auriema, Inc., 89 Broad Street, New York, N.Y., exclusive export agent for Stackpole Carbon Company.

* * * *

TAPE DUPLICATION SYSTEM

AMPEX CORPORATION has perfected and is marketing a Tape Duplication System capable of delivering more than 2500 hours of tape recorded music in a single, eight-hour working day.

Until the advent of this new system by AMPEX, the pioneer tape recorder manufacturer, making copies of tape recorded material was a painstaking, time consuming, uneconomical process because recordings had to be copied at the same speed as the original recording.

The Ampex Tape Duplication System speeds up the process of making copy tapes by factors as high as 320 to 1. This speed-up is accomplished by running tapes as high as 16 times their normal speed, copying tracks of dual track tapes at the same time and making 10 copies simultaneously.

For complete information, write directly to the Export Managers of the AMPEX CORPORATION, ROCKE INTERNATIONAL CORPORATION, 13 East 40th Street, New York 16, N.Y., U.S.A.,

* * * *

HOSPITAL EQUIPMENT DEVELOPMENT

Believed to be the first equipment of its kind in the world for use in X-ray examinations of the brain, the English Electric Co. has recently produced a new type of timing device.

Known as angiography of the brain, this examination is one of the most delicate of X-ray operation. It involves injecting the patient with a solution which is opaque to Xrays, thus rendering visible the brain's network of arteries in X-ray photographs. The solution which is injected is dissipated throughout the brain within a matter of from 5-10 seconds, and speedy and accurately time-controlled X-ray exposures are then required. Hitherto, the timing of the exposure has had to be done either manually or by the use of cinematography, neither of which has proved satisfactory.

This new timing device comprises a cassette changer, electronic sequence and exposure timer and a mobile carrier, thus enabling a radiographer to use a sequence of X-ray exposures to predetermined exposure times and with controlled time delays between exposures.

Circuits for Everyone in the

"R and E" Digest of Circuits No 3

price 3/6

In a digested form, this 88-page book contains basic constructional data on all the equipment described in "Radio and Electronics" and its successor, "Radio and Electrical Review," from February, 1951, to June, 1954, inc. As with the two previous Digests, the scope of this book is extremely wide, ranging from the simplest to the most advanced radio sets, amplifiers, test gear, etc. All essential data are given, together with references to the original descriptive articles which appeared in "Radio and Electronics."

NOTE: None of the material in "Digest No. 3" has appeared in the two previous Digests.

ORDER FROM YOUR NEAREST BOOKSELLER OR RADIO DEALER, OR FROM

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FOR THE SERVICEMAN

THE PHILIPS RADIOPLAYER, MODELS BZ356A AND BZ357A

REPLACING THE GANG DRIVE CORD

(See Fig. 1)

It is necessary when replacing the gang drive cord to remove the chassis from the cabinet. Open the brass "C" ring, retaining the bakelite drum on the shaft, and remove the drum. Turn the tuning condenser to the maximum capacity position and attach the spring A3 646 57 securely to the drum by bending

Fig. 1

the lug on the drum over one end of the spring. The small diameter part of the bakelite drum has a slot across the rim and two small grooves to position the drive cord. Under the slot is a round hole into which the brass tube on the cord is fitted with the long end of the cord (21 7/16 in.) toward the back of the drum. Slide the drum on to the shaft and replace the brass "C" ring.

When the long slot in the rim of the large diameter part is at the 12 o'clock position, a hole in the shaft mounting bracket above the chassis will line up with a hole in the smaller diameter part of the drum. A short pin or nail placed in these two holes will hold the drum in position while further threading-up operations take place.

The back part of the cord makes one complete turn round the drum in a clockwise direction, then passes over the tuning spindle, making two and a half turns in a clockwise direction, progressing towards the chassis. The brass ferrule on the end of the 3 in. flex cable fits into the left-hand slotted hole in the bakelite drum mounting bracket, and the ferrule on the other end of the 3 in. flex cable fits into the rear slotted hole on the pulley mounting bracket on top of the tuning condenser. The front part of the cord (18 13/16 in.) makes 2½ turns round the small diameter of the bakelite drum in an anti-clockwise direction, then passes under the tuning spindle, making 2½ turns in an anti-clockwise direction progressing away from the chassis. The brass ferrule on the end of the 3 3/16 in. flex cable fits into the left-hand slotted hole in the bakelite drum mounting bracket, and the ferrule on the other end of the flex cable fits into the front slotted hole on the pulley mounting bracket on top of the tuning condenser, passes round the tuning condenser drum in an anti-clockwise direction, through the hole in the side of the drum, over the capstan, and the cord tag on the end attaches to the end of the spring. Remove the pin holding the bakelite drum in position, and pass the back cord round the tuning condenser drum in a clockwise direction. Do not pass the cord round the pulley as

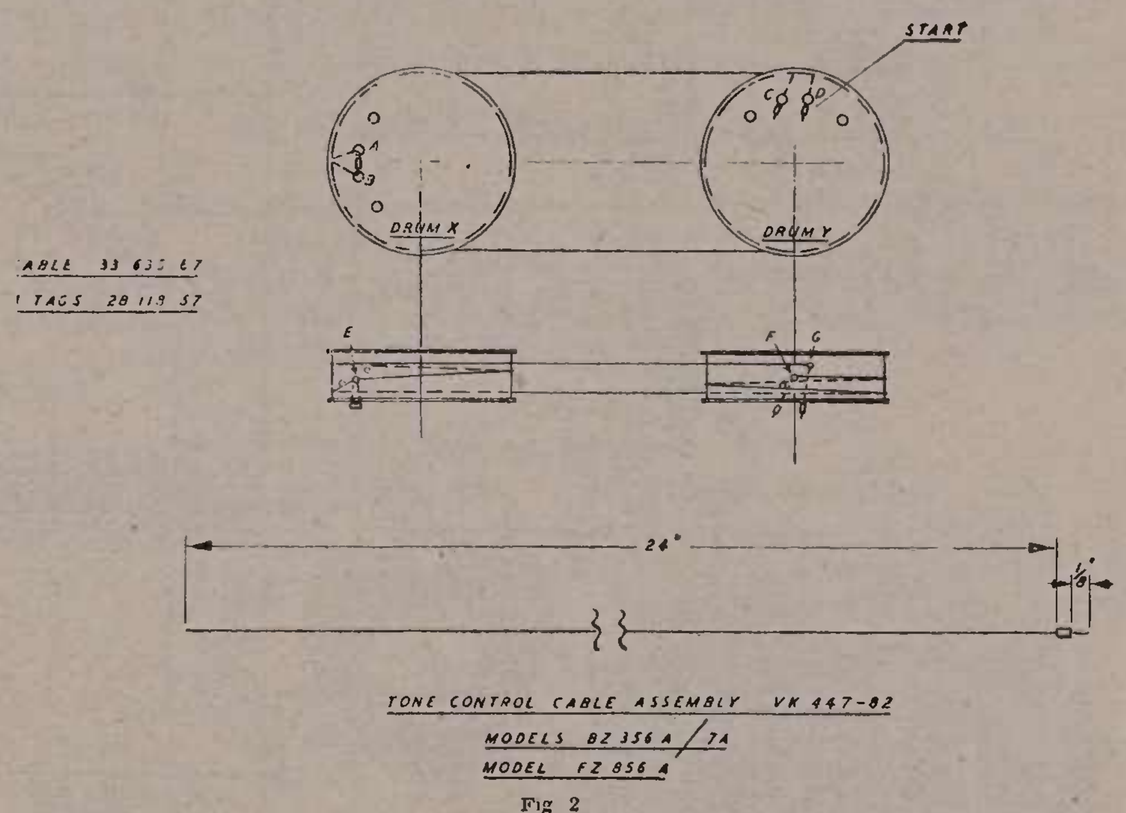


Fig 2

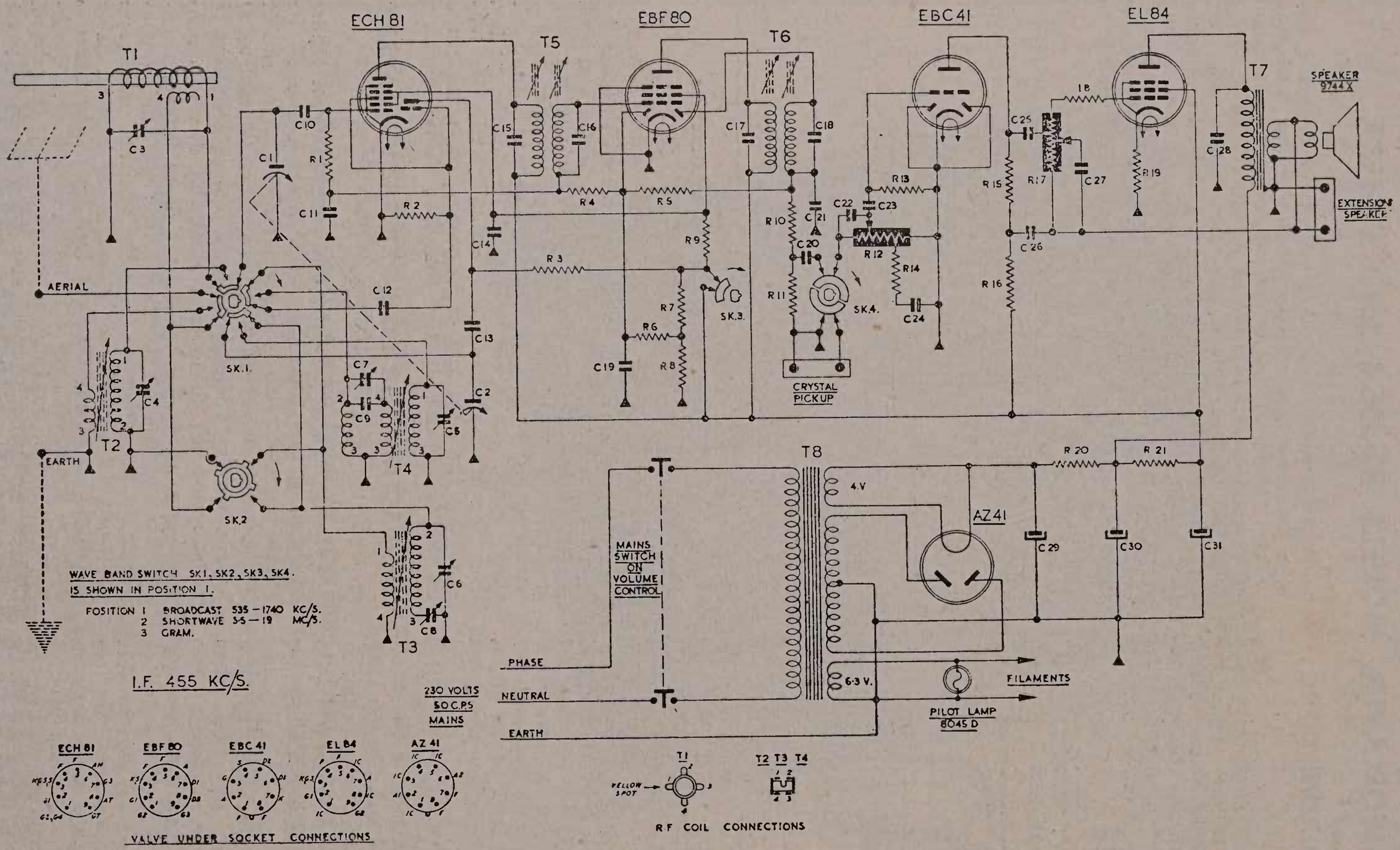
shown in the diagram, but pass the cord through the hole in the side of the drum, round the capstan, and hook the end of the cord over the spring. By turning the tuning spindle in a clockwise direction, tension will be put on the spring, so that the slack will appear in the back cord, which can then be placed round the pulley. Turn the drive shaft a few times to equalize the tension over the cord and, if necessary, place the turns on the drums and shaft so that they do not bind.

REPLACING THE POINTER DRIVE CABLES

(See Fig. 1)

Turn the tuning condenser to the maximum capacity position and place the small brass clamp of the 15¼ in. piece of cable in the longest slot in the rim of the large diameter bakelite drum, which should be at approximately 12 o'clock position. The cable makes 1½ turns round the drum in a clockwise direction progressing towards the back of the drum. Keeping tension on the end of the cable, turn the tuning condenser to the minimum capacity position, taking up the cable on the drum. Pass the 30 5/16 in. cable round the three pulleys, and feed on to the bakelite drum at approximately 7 o'clock position in a clockwise direction, making 1¼ turns round the drum. Stretch the spring slightly, and place the small brass clamp into the slot at the 10 o'clock position on the drum. The cables should now be adjusted on the drum so that they do not cross, and both cables should progress towards the back of the drum when taking up cable.

(Continued on next page)



CONDENSERS

C1 12-500 mmfd ganged condenser
C2 12-500 mmfd
C3 3-30 mmfd. air trimmer
C4 3-30 mmfd air trimmer
C5 3-30 mmfd air trimmer
C6 3-30 mmfd air trimmer
C7 6-60 mmfd air trimmer
C8 150-750 mmfd padder
C9 100 mmfd ceramic
C10 150 mmfd ceramic
C11 .05 mfd 350v. paper
C12 47 mmfd ceramic
C13 233 mmfd ceramic
C14 .02 mfd 500v. paper
C15 110 mmfd ceramic
C16 195 mmfd ceramic
C17 110 mmfd ceramic
C19 500 mmfd mica
C18 195 mmfd ceramic
C20 .01 mfd 500v. paper
C21 100 mmfd ceramic
*C22 3.9 mmfd ceramic
C23 .01 mfd 500v. paper
C24 .02 mfd 500v. paper
C25 .02 mfd 500v. paper
C26 .01 mfd 500v. paper
C27 1500 mmfd ceramic
C28 .002 mfd 750v. paper
C29 40 mfd
C30 40 mfd 350v. triple electro
C31 20 mfd

RESISTORS

R1 1meg. ¼w. carbon
R2 47k ¼w. carbon
R3 27k 1w. carbon
R4 4.7meg. ¼w. carbon
R5 2.2meg. ¼w. carbon
R6 10meg. ¼w. carbon
R7 47k ¼w. carbon
R8 100k ¼w. carbon
R9 22k 1w. carbon
R10 100k ¼w. carbon
R11 270k. ¼w. carbon
R12 2meg. tapped at 400k potentiometer
R13 10meg. ¼w. carbon
R14 39k ¼w. carbon
R15 100k ½w. carbon
R16 100k ½w. carbon
R17 500k tapped at 50k potentiometer
R18 1000 ohms ½w. carbon
R19 150 ohms 1w. carbon
R20 370 ohms 4w. wire wound
R21 1800 ohms 4w. wirewound

*This condenser deleted in later production.

COILS

T1 Ferroxcube rod aerial coil, VK 469-70.
T2 Shortwave aerial coil, VK 469-55.
T3 Broadcast oscillator coil, VK 471-50.
T4 Short wave oscillator coil, VK 471-37.
T5 Micro "12" I.F. Transformer, A3 126.84.
T6 Micro "12" I.F. transformer, A3 126-84.
T7 Output transformer, VK 671-01/03.
T8 Power transformer, VK 631-02/01.

MODEL BZ 357 A

VOLTAGE TABLE

All readings taken with a primary input of 230 volts 50 c/s. Full load primary current should not exceed 220 mA.

Valve	Function	Filaments	Plate		Screen	Cathode
			Hexode	Triode		
ECH81	Frequency converter and oscillator	6.2	210	95	70	—
EBF80	I.F. amplifier demodulator and delayed A.V.C.	6.2	210		70	—
EBC41	Audio voltage amplifier	6.2	80		—	—
EL84	Power output pentode	6.2	245		210	6.3
AZ41	Full wave directly heated rectifier	4.0	290	290	—	285
8045D	Pilot lamps	6.2	—		—	—

The above voltages are measured between the points indicated and chassis with a meter having a resistance of 20,000 ohms per volt on D.C. ranges and 1,000 ohms per volt on A.C. ranges. Variations up to ± 5 per cent. are permissible. Band switch in the position "Broadcast," tuning condenser at maximum capacity.

REPLACING THE TONE CONTROL DRIVE CABLE

(See Fig. 2)

Turn the drums to the position shown in the diagram (tone control in the low position). With the cable shown in the diagram, push the free end through the hole "D" in drum "Y," then up through hole "g," making a quarter of a turn in an anti-clockwise direction round the drum "Y" and 1¼ turns round drum "X" in an anti-clockwise direction. Feed the cable through holes "E" and "A," and slide a cable clamp (28118.57) over the cable.

Pull the cable tight and pinch the clamp securely. Push the cable through hole "B," then through hole "E" again, and pass the cable round drum "X" a quarter of a turn in an anti-clockwise direction. Pass the cable under drum "Y" for 1½ turns in an anti-clockwise direction, then through holes "F" and "C." Slide a cable clamp over the cable, pull tight, and clamp securely. Cut off superfluous end of the cable.

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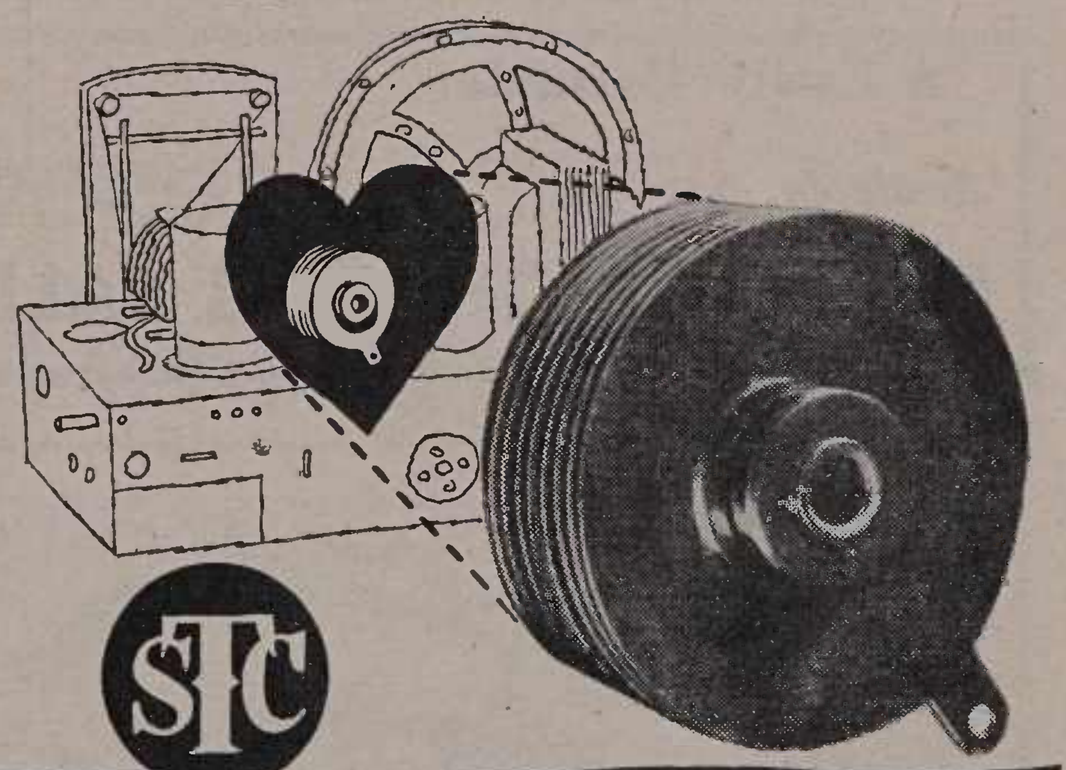

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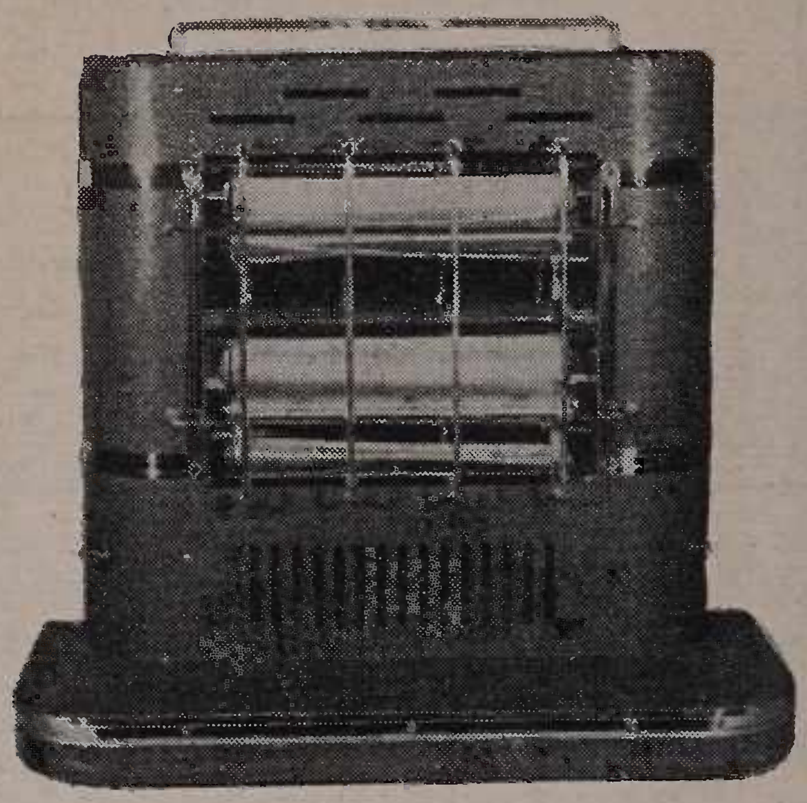

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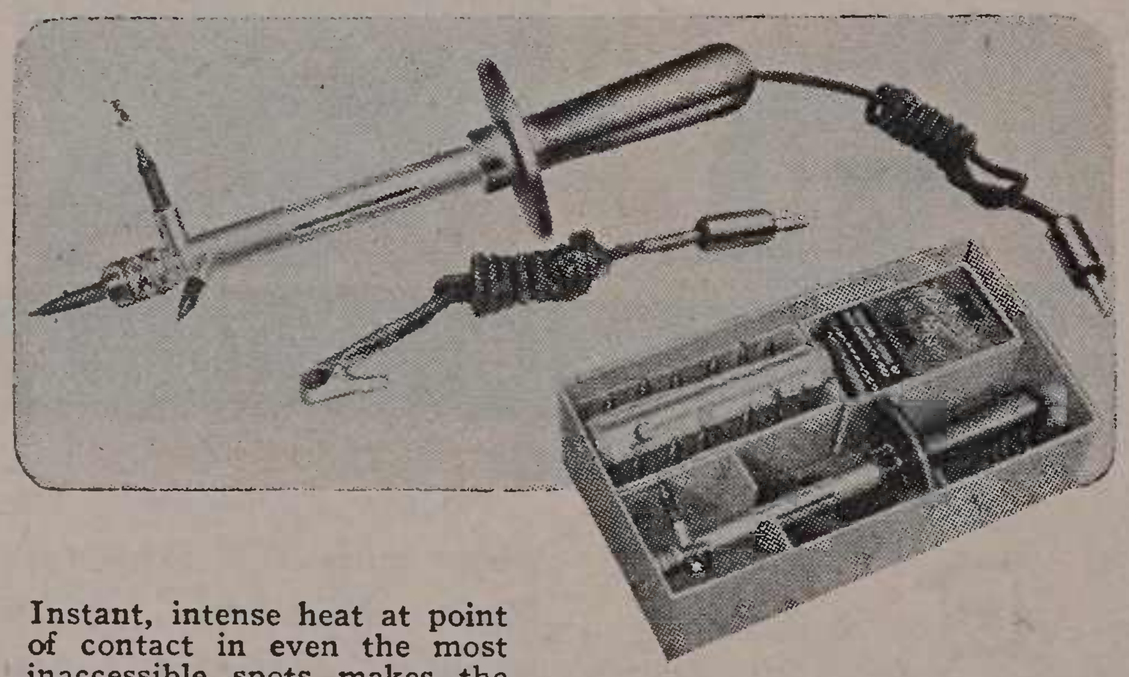

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Autocrat 8-valve, 6-volt car radio, serial No. 29173; black crackle finish, push-button tuning, white oblong dial with chromium frame and yellow numerals and word "Autocrat" in red across dial; 8-inch speaker. Radio of broadcast type and in three sections—tuning, amplifying and speaker. All three sections in cardboard box with no markings.

Philips AC/DC 5-valve, mantel radio, serial No. 97582; black plastic cabinet 14 in. x 9 in. x 5 in., with two white strips down front and four control knobs.

Philips Model 210 in brown bakelite case 24 in. x 12 in. x 9 in.; brown fabric over speaker; rectangular dial with wave-band switch in centre and tuning knobs either end. Back cover board missing.

Autocrat portable car radio, serial No. 20497; silver grey cabinet with four control knobs in front, one having bent gold piece on it.

Telerad 7-valve mantel model radio, serial No. 1396; brown veneer cabinet 12 in. x 14 in. x 12 in.; two wave bands, magic eye on top central portion of panel, Rola 8K speaker, Syvania rectifier 6X5. Manufactured by Stanley Clark Radio Co., Wellington.

Pye 6-valve mantel model, serial No. 74058; light oak cabinet.

Autocrat 5-valve, 6-volt, single unit car radio, serial No. 21176; brown metal cabinet 12 in. x 12 in. x 6 in., with 4 control knobs.

H.M.V. "Little Nipper" 5-valve, broadcast radio, model 495, serial No. 20152; brown plastic cabinet 9 in. x 8 in. x 5 in. with long narrow dial on top front edge.

Pacemaker portable radio, serial No. 17402; dark chocolate-coloured plastic cabinet with hinging type dial; white plastic expanding handle; radio slightly damaged having small hole on right top back corner with selotape on inside.

Wellington:

Clipper Five auto radio, model 55, 6-volt, serial No. 66939; grey metal cabinet.

Pacemaker AC/DC portable radio, serial No. 52558-112959.

Ultimate 9-valve radio chassis, serial No. 161492, model RBD. No speaker or cabinet.

Columbus model 504 radio, serial No. 53901; white plastic cabinet 12 in. x 6 in. x 5 in. with black dial and three tuning knobs.

Autocrat car radio, serial No. 23645.

Upper Hutt:

H.M.V. "Clyde" 6-valve, dual-wave radiogram, model 526D/CR serial No. 26200.

Blenheim:

Ultimate "Troubadour" 7-valve battery/electric portable radio, serial No. RBO169778; brown plastic cabinet with cream handle and tuning knobs.

Christchurch:

Autocrat 6-valve autoradio; brown cabinet with rectangular dial and separate speaker.

H.M.V. model 475/D, 5-valve radio, serial No. 9497; brown cabinet in shabby condition.

Unknown make old model radio in brown wooden cabinet with round top approx. 2 ft. 6 in. x 18 in., with three knobs for tuning, volume and tone control in front.

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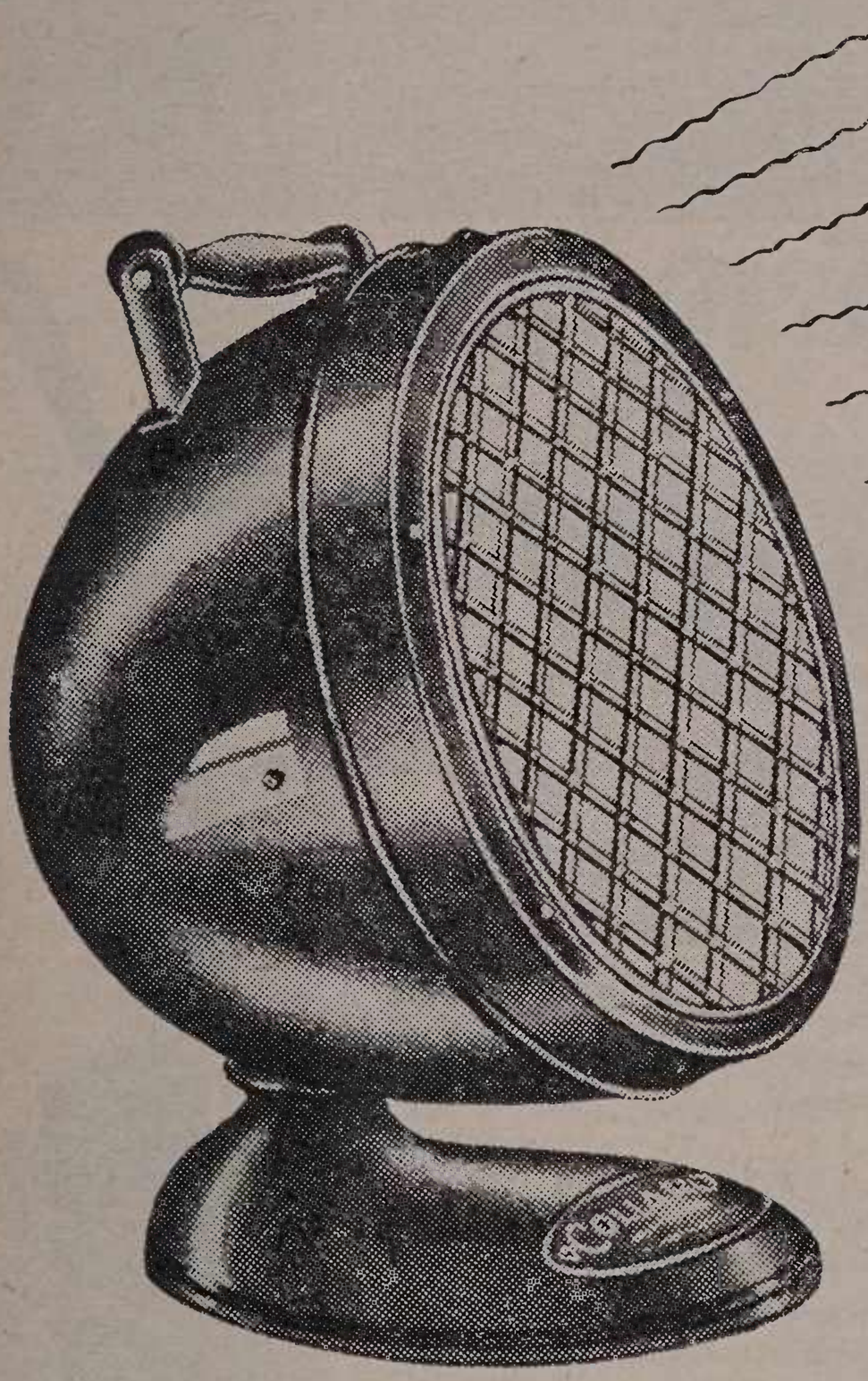

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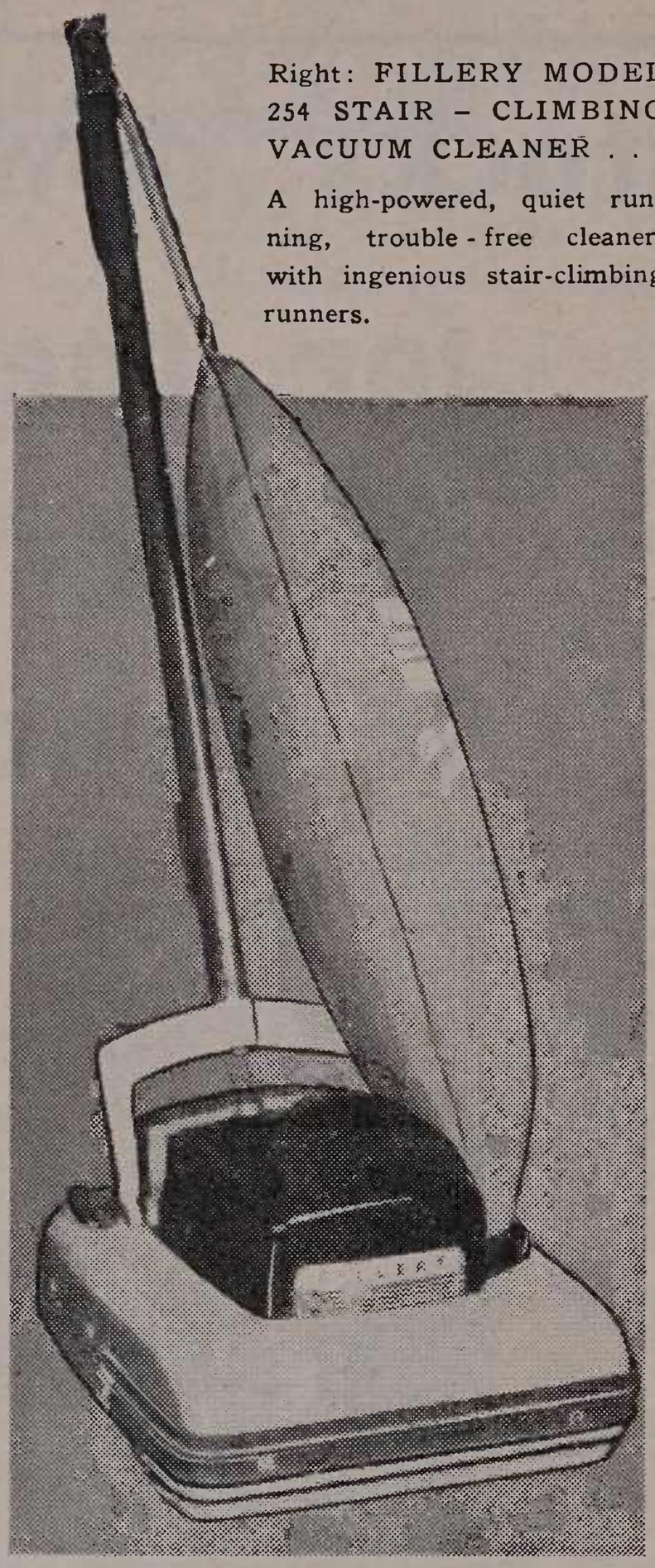

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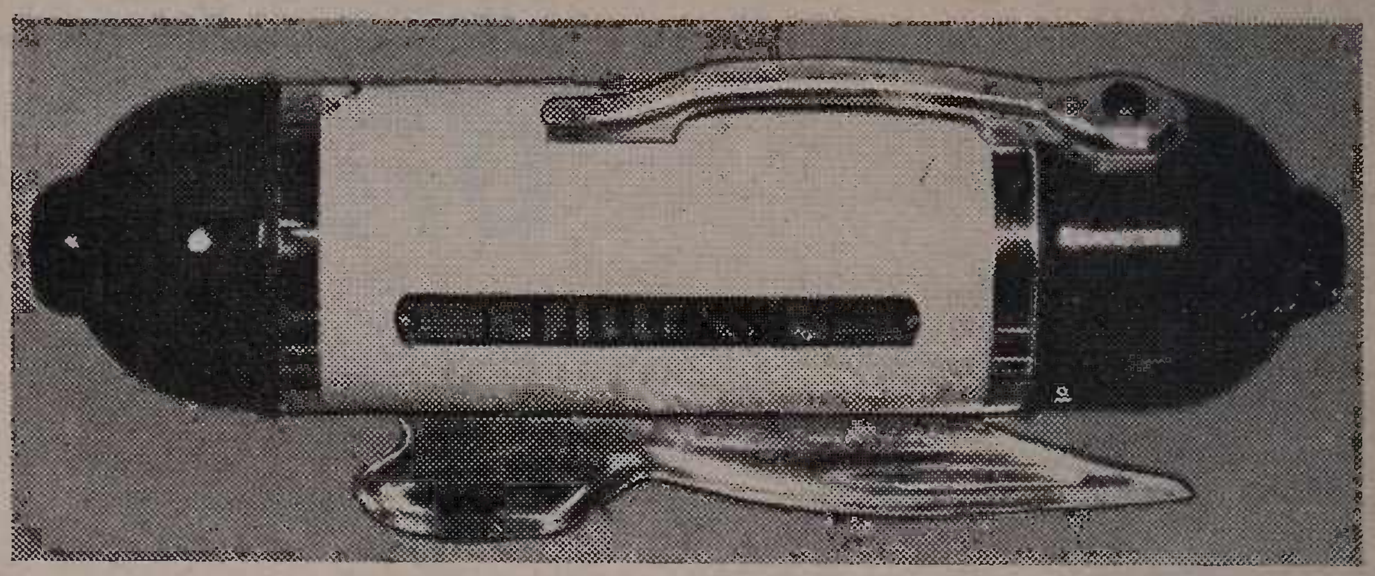

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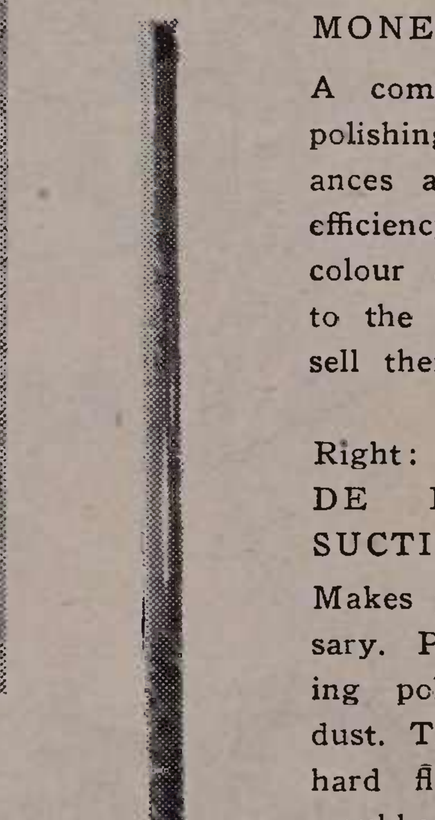

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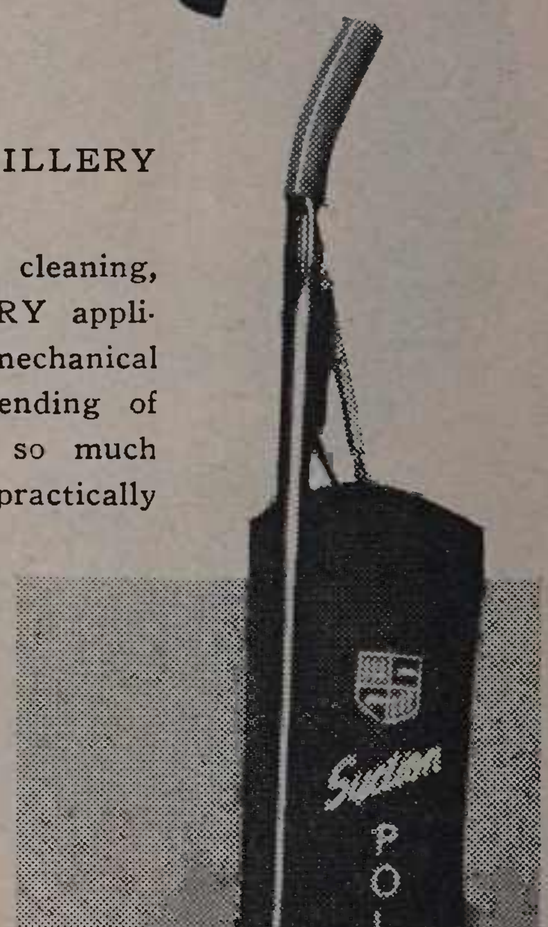

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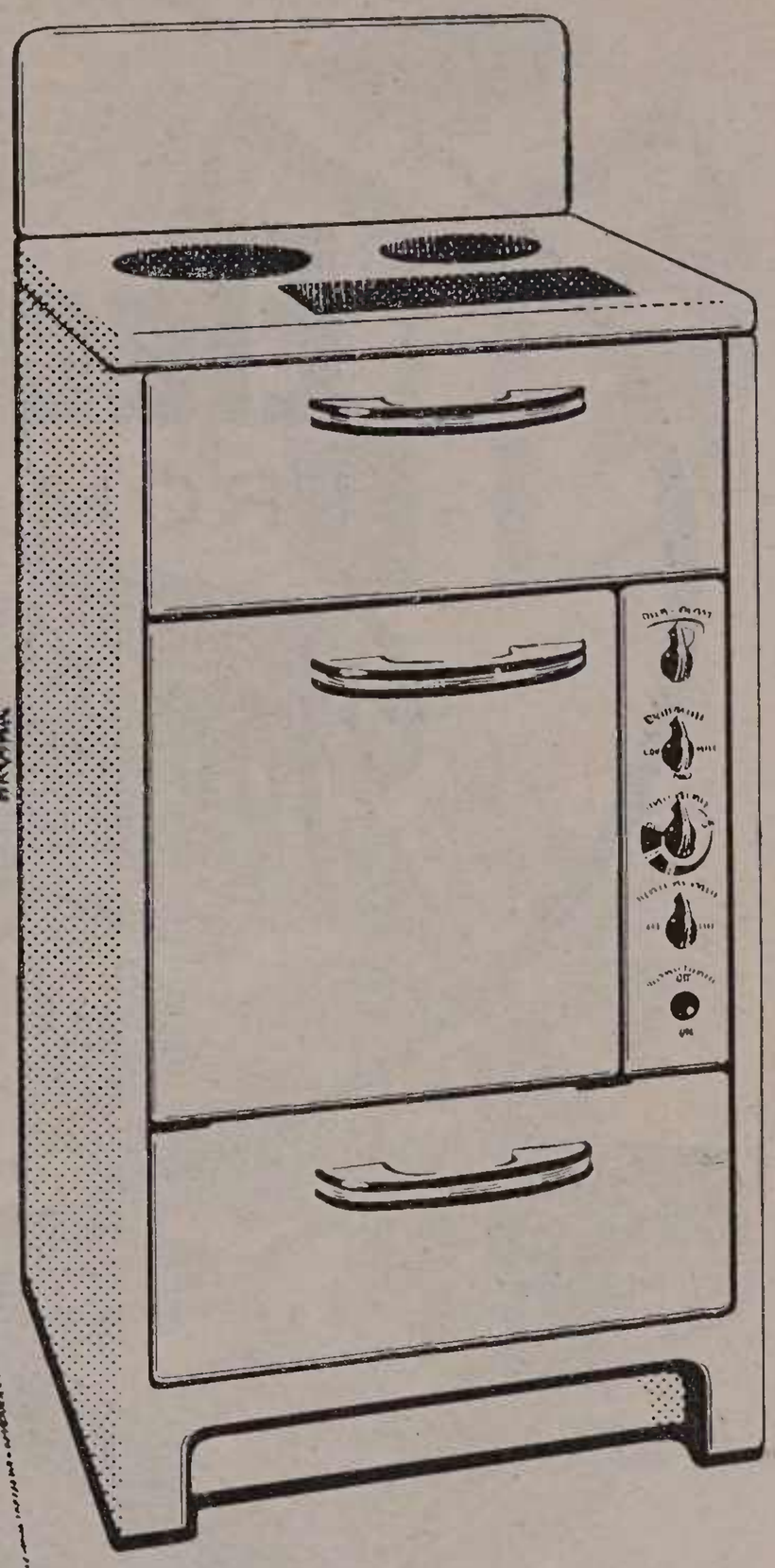

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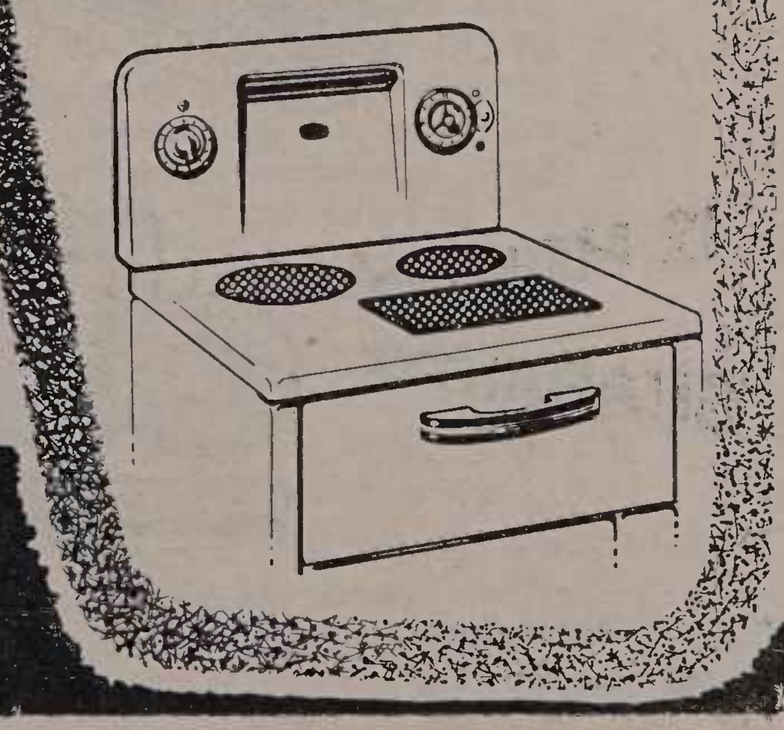

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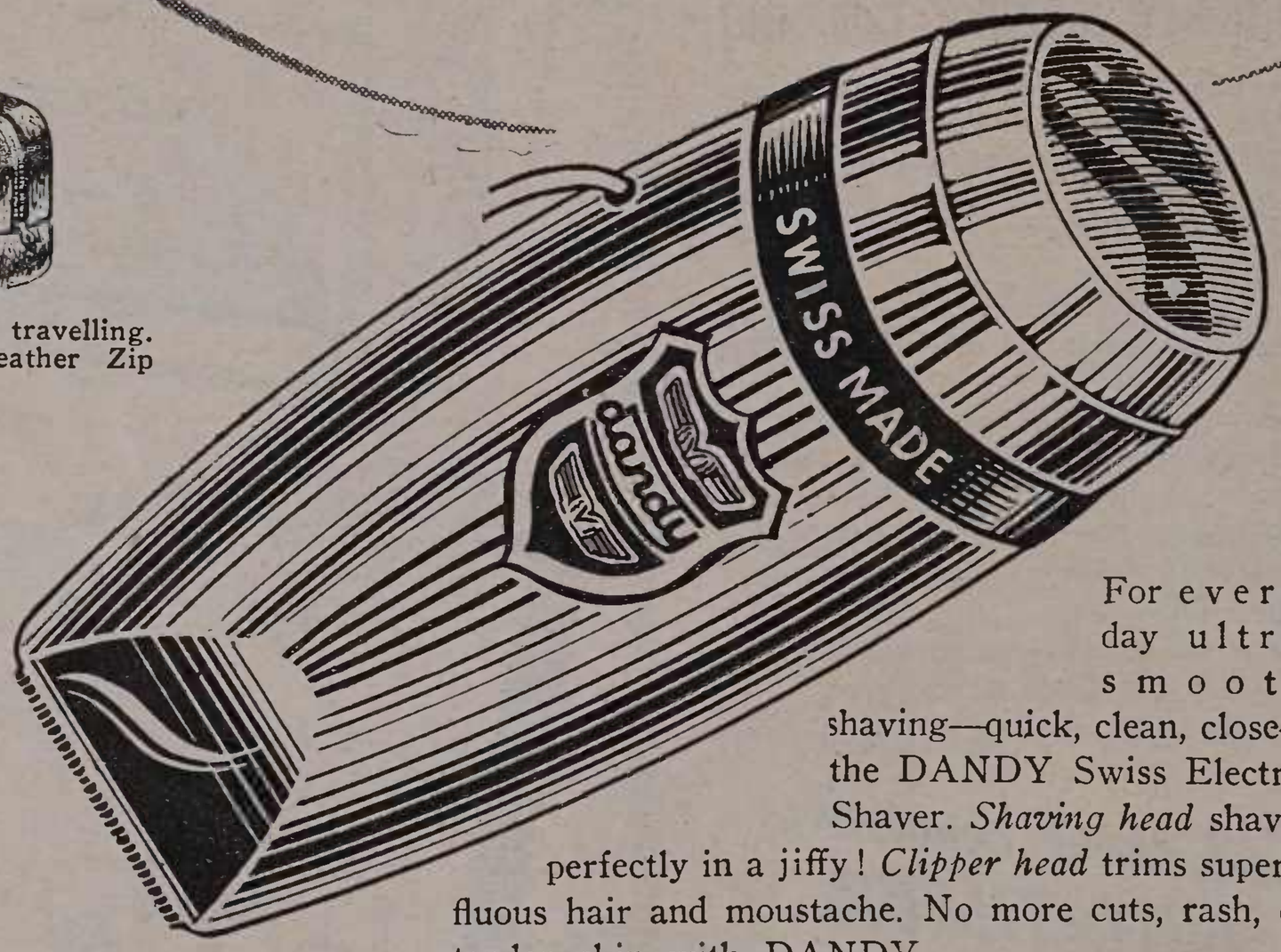

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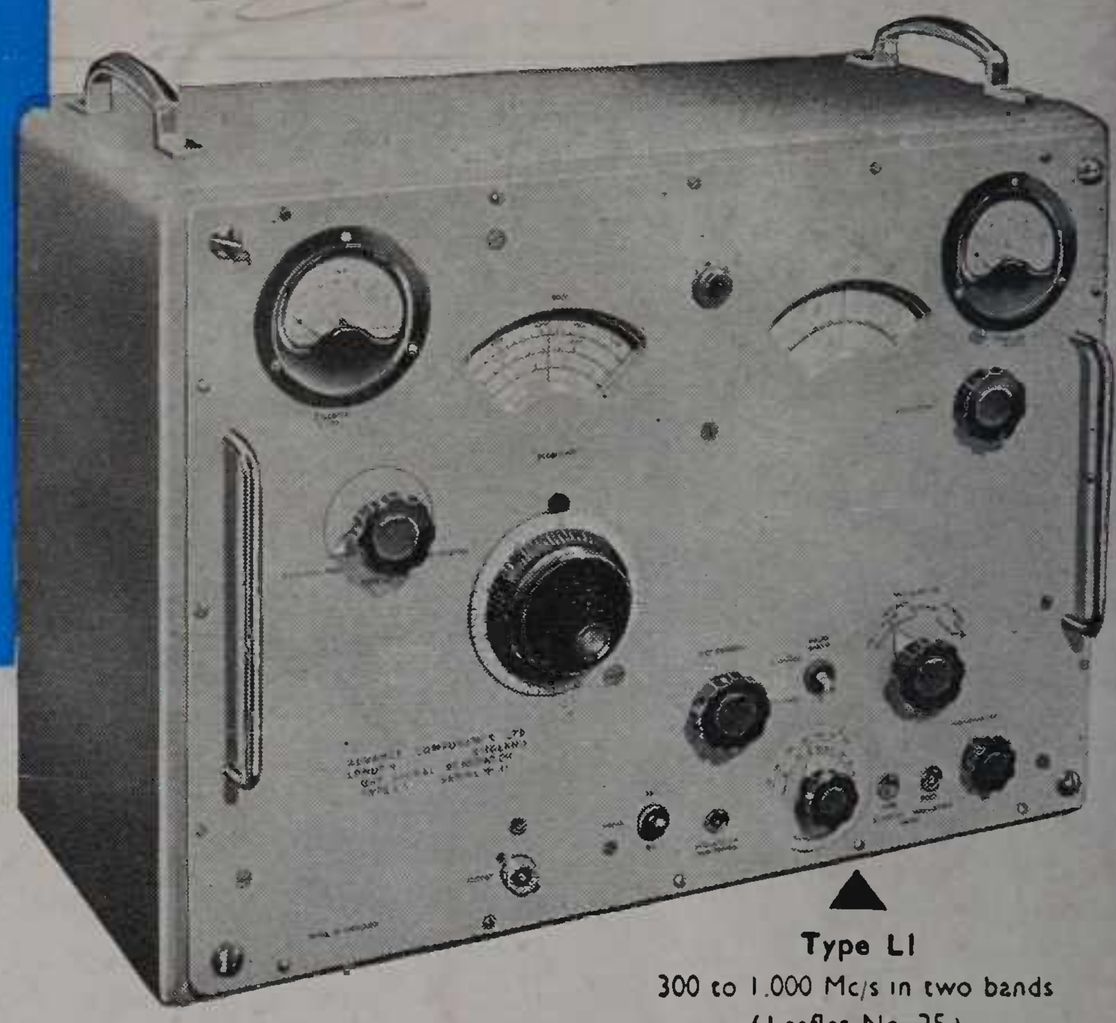

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300 to 1,000 Mc/s in two bands
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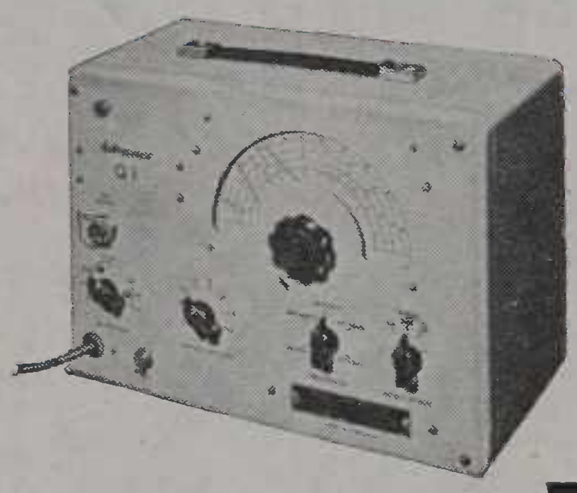

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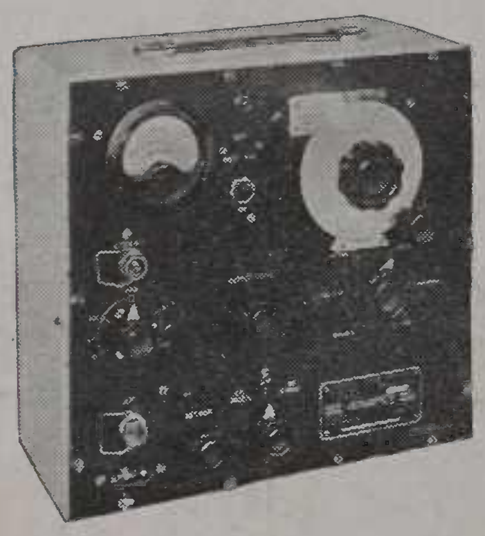

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Model B, 30 kc/s to 30 Mc/s in six bands
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Type J1
15 c/s to 50,000 c/s in three bands
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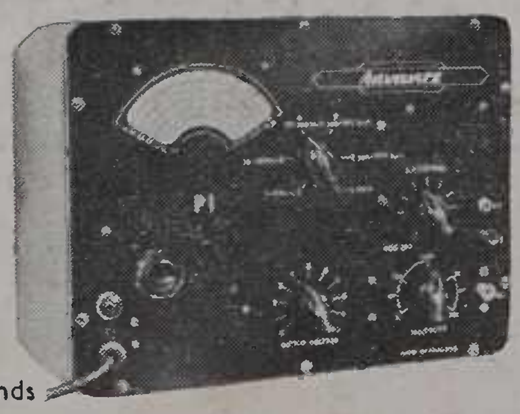

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