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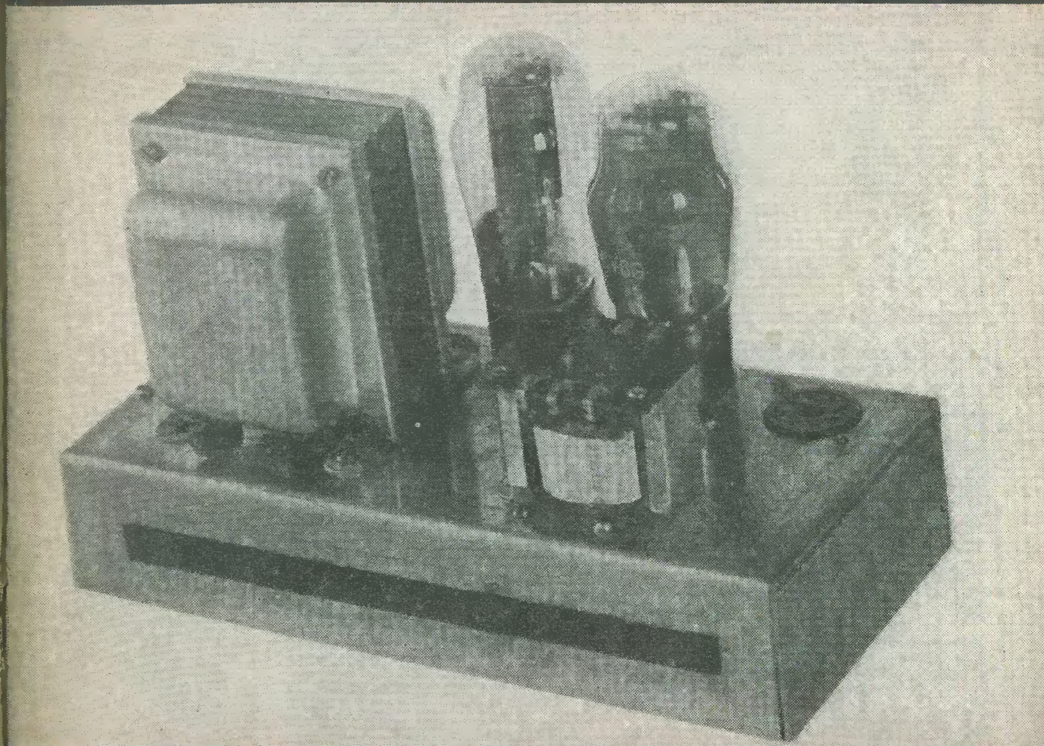
RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



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MAINS OPERATED BRIDGE · WIRE RECORDER · THREE WATT AUDIO UNIT · LARGE SCREEN TV. · Away from the "Four Plus One" · Mainly for the Beginner · Query Corner · Component Review · Electronic Timer

etc., etc.

1/6

Radio Constructor

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Edited by C. W. C. OVERLAND, G2ATV

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EDITORIAL

Recently we have given space on this page to the question of interference to television reception from amateur transmitting stations. It is good to see that this problem is being taken up so vigorously by the R.S.G.B.; it is obvious that with the extension of TV programme time, which must come sooner or later, the amateur will be forced to make his transmissions harmless, or else have to choose between working on the VHF bands or abandoning his hobby. We are very pleased to see that one set manufacturer is co-operating by installing IF wave-traps in all new receivers.

From the viewpoint of TV set owners, the transmitting amateur is very small fry indeed when it comes to interference; the viewer suffers far more from electrical apparatus such as vacuum cleaners, sewing machines and the like, and from car ignition interference. This last is, without doubt, the greatest menace to comfortable viewing, and it is made even harder to tackle because the source is mobile. Noise limiters and spotters fitted to the receiver are only a partial remedy, having the disadvantage of reducing the high frequency response and so diminishing the highlights and detail of the picture.

Many motorists and some transport organisations have voluntarily suppressed their vehicles. We only wish the latter included the London bus! Their diesel engines give no trouble, but viewers nea bus routes will know that their windscreen wipers cause far more interference to both sound and vision than the majority of car ignition systems.

Suggested CIRCUITS *for the* EXPERIMENTER

The circuits presented in this series have been designed by G. A. FRENCH specially for the enthusiast who needs only a circuit and the essential relevant data.

No. 18—AF INPUT BY CATHODE INJECTION

It frequently happens that relatively long eads connecting one piece of equipment to another are required to carry AF at a high impedance level. This method of connection gives rise to trouble, insofar that instability may occur if the leads are unscreened, attenuation of the higher frequencies may be caused by excessive capacitances in the line, and unwanted hum is liable to be picked up. These faults are considerably lessened if the impedance of the line terminations is reduced. The simplest way of doing this consists of fitting transformers at either side of the line.

Transformers, unfortunately, are liable to give rise to trouble in themselves; particularly when they are used in the input circuit of an amplifier. Apart from the fact that they may introduce distortion, they are also, unless heavily screened, susceptible to hum pick-up obtained inductively from neighbouring mains transformers and smoothing chokes.

It is not always necessary to use transformers for impedance conversion, however; and some circuits are shown this month which illustrate an alternative system, that of cathode injection.

Fig. 1 illustrates a simple method of passing high impedance AF through low impedance lines with the aid of valves. The AF source shown in the diagram may consist of a gramophone pick-up, a radio feeder unit, or any similar item of equipment whose output is at high impedance. It feeds into V1, a cathode follower, the lines being connected between the cathode of this valve and earth. The lines are then taken to the cathode of V2, across the anode load of which the AF appears at a high impedance once more. V1 offers no voltage amplification but V2 gives approximately as much gain as it would if used as a straightforward amplifier. In many cases, therefore, V2 can replace the first valve in the amplifier.

It will be noticed that the 750 ohm cathode resistor is common to both V1 and V2. This is quite permissible when the lines have little or no resistance. The common resistor has, of course, half the value of that which would normally be employed with a single valve. In Fig. 1, the impedance at which the lines work is 750 ohms. If it is desired to reduce this impedance a resistor and capacitor can be connected across the cathode resistor, as shown in Fig. 2. This circuit still allows the valve, or valves, to remain correctly biased. The new impedance is equal to the value given by the two resistors in parallel. Lowering the impedance will cause the gain of V2 to be reduced.

Cathode injection can also be used with such low impedance sources as microphones and low impedance pick-ups, etc. (It is assumed that there is a DC circuit through the source). A suggested input circuit is given in Fig. 3, but its employment needs some care. This is due to the fact that the electrolytic coupling capacitor will pass a small energising current which may affect the working of, or even damage, the source of AF. This current could be obviated by using a paper capacitor in place of the electrolytic component, but such a solution is somewhat clumsy. Nevertheless, cathode injection with the electrolytic capacitor should be practicable enough for moving coil microphones and other relatively robust components.

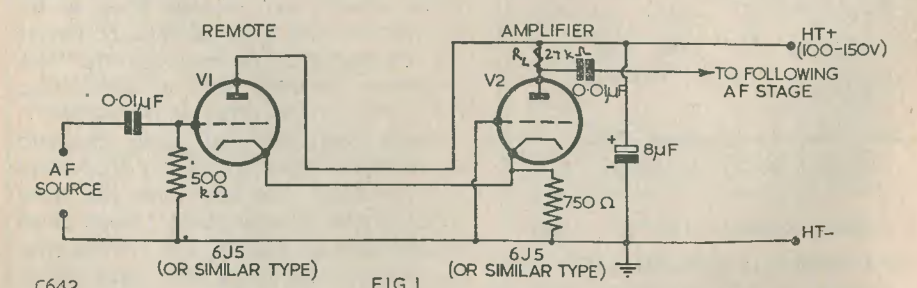

FIG 1

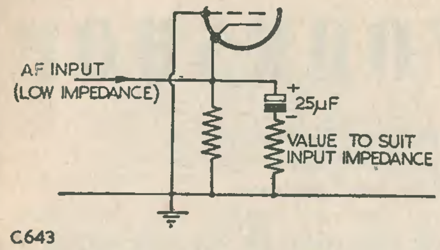

Fig. 2

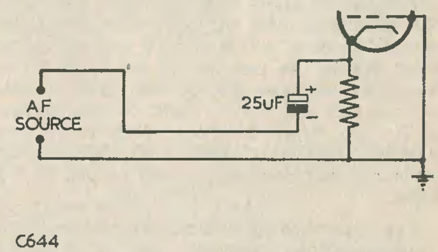

Fig. 3

KIT REVIEW

The M.O.S. "Quality Grand" Amplifier
(Mail Order Supply Co., 33 Tottenham Court Road, London, W.1.).

This amplifier has been designed to cater for those who require faithful reproduction, rather than a source of gain such as is given by the A1 amplifier reviewed in our April number.

It is provided with wide range, continuously variable treble and bass controls, which give both boost and cut about a mean straight line reference level placed at 1,000 c/s. Heavy negative feedback is used over the stages after the equaliser circuits; the feedback loop covers the output transformer, so that deficiencies usually associated with this component are overcome.

There are two input sockets, giving varying degrees of overall gain, and thus making the amplifier suitable for use with any pick-up. The output impedance is 15 Ω.

There are two versions; both are identical except that one uses push-pull 6V6's, and the other push-pull 6L6's with, of course, minor circuit alterations and a larger power transformer. The basic circuit consists of three stages of amplification, using triodes, followed by a triode phase inverter and the push-pull output stage. Resistance/capacitance coupling is employed throughout.

The 6V6 version is priced at £9. 19. 6 and the 6L6 edition at £11. 5. 0. Both kits are complete down to the last nut and bolt and include a comprehensive construction manual. The latter by itself is priced at 4s. 6d.

IN YOUR WORKSHOP

In which J. R. D. discusses Problems and Points of Interest connected with the Workshop side of our Hobby, based on Letters from Readers and his own Experiences.

In last month's issue we devoted our space to a discussion on points peculiar to that popular receiver, the R-1155. It would be interesting to know how many readers have had experience with the equivalent American aircraft receiver which carried out the same work during the war as did the 1155. The American set was the BC-348; and it was quite a nice job, too! There do not appear to be too many of these receivers in this country, and this is rather a pity because the set is extremely easy to convert for use in the home.

The circuit line-up is that of the conventional communications receiver, and it has the additional advantage (additional, that is, so far as aircraft receivers are concerned), of having a crystal gate. The heaters are wired in series-parallel and connect directly to the 24-volt power input. HT is supplied by a dynamotor installed inside the receiver case. The set has an output valve (6K6), after the second detector and is capable of driving a speaker as it stands. A neon stabiliser for oscillator HT is also included.

The set is extremely easy to convert, since all that is required is the removal of the dynamotor and the fitting of a mains power pack in its place. It seems to cope quite well if a 24-volt AC winding is used to drive the heaters; although some amateurs seem to prefer to alter the heater circuit to 6-volt working. As with the R-1155, there is little point in using more than 200 volts HT in the converted receiver. In fact, a higher voltage may possibly shorten the life of the 6K6 output valve.

In short, a very good set; and if any reader sees one for sale at a reasonable price and in good condition, well worth snapping up.

Oscillator Stability

The question of maintaining the frequency stability of high frequency oscillators has been a problem for a long time. Not only does the need for stabilisation make itself felt when wavemeters, signal generators, VFO's for transmitters, etc., are being designed; but it appears also when it is desired to make a really drift-free short-wave superhet. The wavemeter problem is mainly solved when crystal check oscillators are incorporated, although these only enable a relatively short-time stability to be obtained between checks.

A partial solution to this problem, and one which the writer has not seen applied very often, could consist of using 1.5 volt battery valves as oscillators. These valves dissipate an extremely small amount of heat, and inter-electrode capacitance changes due to temperature alterations could therefore be so small as to be negligible. Added to this is the fact that their filaments can be driven from an HT rectifier using a conventional AC/DC/Battery arrangement; and this allows the voltage (before dropping) to be stabilised by conventional means. Two VR 150/30 valves in parallel would give a stabilised voltage of 150 at 60 mA, thus allowing 50 mA for the filament and 10 mA for possible anode and screen-grid current. It would, of course, be necessary to mount the filament dropping resistor well away from the valve and its oscillatory components; and also to use a resistor of a wattage rating in excess of the value dissipated. (A larger resistor would suffer a smaller temperature rise and hence a reduced possible alteration in value).

Incidentally, the use of a valve of this type in, say, an ECO circuit is not at all difficult. If one side of the filament (which is, of course, now the cathode) is connected to the tap in the tuned coil the other side may be fed via an RF choke. Filament current may then be supplied from earth through the coil, and through the choke again to the voltage dropper from the stabilised high-voltage point.

Such an arrangement certainly appears very attractive, the only disadvantage being that oscillations are generated at a fairly low power and that the valve itself is not so robust physically as would be a mains type. The writer would be very interested to hear if any readers have had successful results with an oscillator of this type.

"Wetting"

Relay contacts of the P.O. type cannot really be considered to have a self-cleaning action and, as most readers are aware, they are liable to give trouble now and again. Failures are usually caused by the ingress of dirt or moisture, and the solution consists mainly of keeping the relays enclosed in some sort of protective cover.

When these relay contacts are used for passing very small AC currents, however, they often tend to give more trouble than is otherwise the case. The writer was interested recently to find that this failing is quite well-known and that there is both a reason and a cure for it.

What happens is that, if a relay contact passing a small AC current is not used frequently it becomes covered with a very thin protective film; this film probably being formed by condensation or oxydisation. The film may be only a molecule or two thick, but it is still enough to prevent good contact. The cure consists of applying a constant DC to the contacts via a resistive circuit, this being sufficient to break down the film and enable a good contact to be made. The DC is, of course, isolated by a suitable choke and capacitor circuit. It seems that this procedure is common practice with those Post Office installations in which relay contacts pass small AF currents, and is known as "wetting" the contacts.

TRADE REVIEW

An interesting new plastic drawing appliance for general design work is the "Quickdraw," enabling accurate drawings to scale to be made even by amateur draughtsmen, being particularly useful for example where full drawing office facilities are not available.

As seen from the photograph the appliance consists of a light rigid board contained in a leather folder 14″ square to which is attached a plastic pantograph with a template so shaped as to enable lines to be ruled horizontally, vertically, and at all principal angles, including those required for isometric or perspective drawing. The template is also carefully cut with mathematical accuracy to produce varying angles, triangles and rectangles with graduations in inches and millimetres and circles from 1/16″ to 1″ diameter.

A wide range of work can be carried out without the need for any additional instruments whatsoever, although it can, where necessary be used in conjunction with compasses, scales, or protractors.

It is particularly useful for carrying purposes or household use as the appliance is complete in case thus saving all the necessary impedimenta of drawing board, tee-square etc.

The maximum size of paper which can be used is 13″ × 10″ although smaller reproductions are easily possible, only one drawing pin being used to hold the paper in position by utilising the corner pockets at the bottom of the board.

The "Quickdraw" is marketed by the "Quickdraw" Company of 127 Gunnersbury Avenue, London, W.3., price 63/- complete including postage and packing.

QUERY CORNER

A "Radio Constructor" Service for Readers

An Electronic Timer

I am a keen photographer, and have always felt the need for a device that would give a timing signal after the lapse of a given period. Such a device would be of immense value when developing high speed film in the dark. The actual timing period should be adjustable up to a maximum of about 15 minutes. Is it possible for this particular need to be met by some valve controlled relay?

D. Scholl, Devizes.

Process timers, as devices for giving some signal after the lapse of a predetermined period are usually termed, can provide a most interesting field of investigation. The timer is usually arranged to operate a relay, which in turn may open or close a main circuit to actuate an electric motor, a lamp, or perform some similar function. Our correspondent is interested in timing his photographic developing process, and could best use an electric bell or buzzer to indicate the end of the predetermined time. Other constructors may, however, wish to use the tuner to switch off an electric toaster or time a boiling egg. The writer is usually saddled with the job of making tea and toast on Sunday mornings, and found that without the timer it was virtually impossible to get more than two or three pieces of toast out of a loaf of bread. It is incredible how quickly toast can burn when the cook's attention is temporarily distracted by the job of making the tea. It is expected that other amateur cooks will be interested in this particular application of the timer. In industry, timers of this type find numerous uses in automatically and accurately timing various manufacturing processes.

The circuit which is about to be described is cheap to construct, a feature which has been obtained largely by designing it to operate directly from the AC mains. A single high slope RF pentode is used, the original model employing our old friend the EF50. Any similar valve will, however, be equally suitable. The complete circuit diagram is shown in Figure 1. The switch S1 sets the timer at the commencement of an operating period; the contacts S2 are those of the control relay. These contacts are shown connected in one of the mains leads, a position which they would occupy if the timer is used to switch on or off the mains supply to some other piece of equipment. These contacts may, however, be used to operate any secondary circuit and their connection will depend entirely upon the particular application for which the timer is being employed.

The mode of operation of the circuit is briefly as follows: The valve operates as a half wave rectifier charging the capacitor C2 from the mains input. As the voltage across this capacitor tends to increase a current flows through R1 and R2 in series to charge C1. This current causes a voltage to appear across R1 and R2, which is applied via R3 as negative bias to the valve. This bias reduces the current which the valve passes on each positive half cycle of the mains input, and so retards the rate at which C2 can charge. The timing of the circuit depends largely upon the values of R1, R2 and C1 and, without using abnormally high values, delays up to 15 minutes can be readily obtained. The energising coil of the relay is connected across C2 via a resistor, and hence as the voltage across C2 gradually increases so the current in the relay coil increases. A high resistance telephone type relay is most suitable for the job. These require a current of a little over 1 mA to close the contacts, the resistance of the energising coil being 40 kΩ. The heater of the valve is fed from the mains via a capacitor to drop the unwanted voltage. A resistor can be used, of course, but it will dissipate rather a lot of heat, which will mean that a larger box will have to be employed to accommodate the unit. Alternatively, a small heater transformer may be used and does, perhaps, form the best all-round method of supplying the valve heater. If the capacitor is employed, the heater current of the valve should be checked by means of an AC current meter. This is a precaution which is most desirable on account of the rather large tolerance which the capacitor may have. Paper capacitors must be used for this purpose, and the value adjusted so that the nominal valve heater current flows, 0.3A for an EF50. A resistor R6 is connected across C3 to prevent its retaining a charge. Such a charge might damage the valve heater if the timer were switched on and off several times in quick succession.

To use the timer the relay contact should be joined up to the controlled equipment, the switch S1 closed and the mains supply switched on. After the valve has warmed up the switch S1 may be opened to start the timing cycle. The timer is simply reset by closing S1 whereupon the relay will immediately fall out in readiness for the next cycle. The resistor R2 is made variable so that the cycle time can be adjusted. A coarse adjustment might easily be provided by dividing R1 into, say, three equal sections, each selected by means of a rotary switch. Using the values shown on the circuit diagram, the maximum cycle time is about 5 minutes.

It is important that C1 is a low leakage paper capacitor, as any leakage across this component will seriously reduce the maximum cycle time, and may also cause erratic operation. The variable resistor R2 can be fitted with a scale calibrated in minutes and fractions of a minute, the calibration being done experimentally.

It is hoped that some constructors will find this timer an interesting and useful piece of equipment. Its simplicity means that it can in all probability be constructed from parts which are available in the spares box.

QUERY CORNER

"Rules"

(1) A nominal fee of 2/6 will be made for each query.

(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner." Radio Constructor, 57 Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with a more general interest will be reproduced in these pages each month.

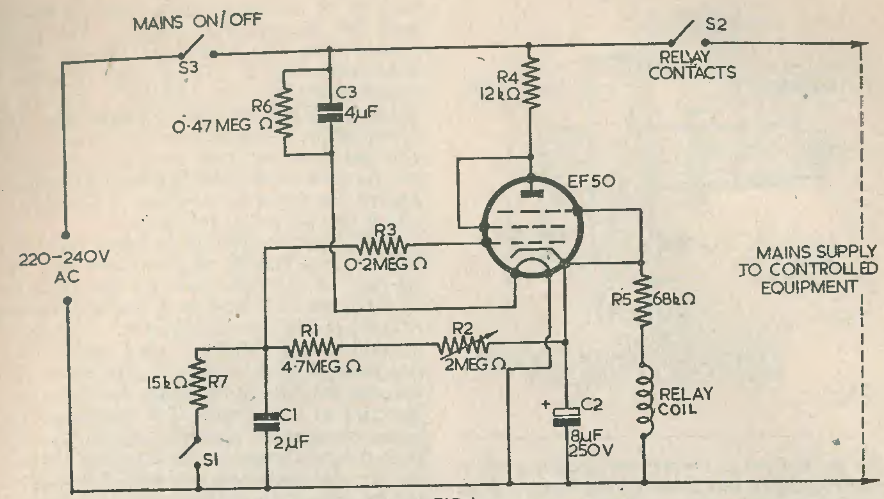

FIG. 1

CIRCUIT OF SIMPLE ELECTRONIC TIMER. NOTE THAT THE CHASSIS IS LIVE AND MUST BE PROTECTED

C629

Ion Trap CR Tubes

A colleague of mine has a commercial television receiver which is now four years old. Whilst the set still operates very satisfactorily, the Mullard tube has developed a dark circular patch in the centre of the screen which I believe

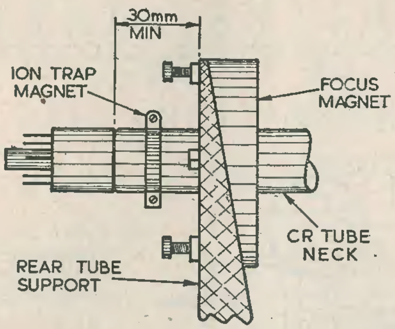

FIG.2
SHOWING POSITION OF ION TRAP MAGNET ON CR TUBE NECK.

C630

to be an ion burn. When replacing the tube, can one be fitted which has an ion trap in order to avoid the risk of a similar burn occurring on the new tube?

E. Owens, Guildford.

The use of a television tube which has an ion trap type of electron gun is a very good safeguard against screen discolourations, thus permitting the maximum possible tube life to be obtained. An ion trap tube can be fitted in place of a standard tube in most receivers in which the tubes are of Mullard manufacture. Providing the position of the focusing magnet around the tube neck leaves about 30 mm of the glass unobstructed between the magnet and the top of the tube base, an ion trap tube can be fitted without any modification to the receiver. In sets where this space is not available for positioning the ion trap magnet, some modification will be necessary. In such cases it will usually be found that the rear tube support will have to be moved or altered to free the tube neck for the ion trap magnet. The normal position for this additional magnet will be clear from Fig. 2. These small magnets are manufactured by the "ELAC" concern and are available from most dealers who stock components. The magnet is supplied with a clip and clamping screw to retain it in position on the tube neck. The procedure adopted in finding the optimum position is a simple one, and is carried out as follows:

Before the receiver is switched on, the ion trap magnet should be positioned just above the top of the tube base on the glass neck. The magnet itself must be in line with the plane of the bend in the electron gun. This point is simplified with Mullard tubes which have a line painted on the tube neck; the arrow on the magnet should point along the line in the direction of the screen. The receiver can now be switched on and allowed to warm up. Then, with the brightness control set somewhere near its normal operating position, the magnet is moved gradually up the neck until the screen is illuminated at maximum intensity. The brightness control may have to be adjusted whilst this is being done, to reduce the screen illumination to within safe limits. Having found the position of the magnet which gives maximum brightness, an effort should be made to obtain a further increase by slightly rotating the magnet either way. It is important that the ion trap magnet is not used to centre the picture, if this involves some reduction in the brightness. In other words, the magnet must be set at the position which gives the greatest brightness. If the picture cannot be centred by the ion trap magnet without a loss of brightness, the centring must be carried out by adjusting the position of the focus magnet.

Once the ion trap magnet is in the optimum position, the clamp screw should be tightened and no further adjustment will be necessary.

MAINS OPERATED BRIDGE

(*Continued from p.* 391)

When removing high capacity electrolytics from the test sockets, do not short circuit them in order to discharge them. This will cause harm, in some cases even complete breakdown. If it is desired to discharge a high-capacity component, connect a fairly high resistance across its terminals, say 100K ohms or more, and leave it in place for a few seconds.

Another feature of electrolytic capacitors, especially the old wet types, is their apparent loss of capacitance and high leakage when left idle for long periods. If one is joined to the leakage test it is quite likely the neon will show a dull permanent glow, leading us to believe that the capacitor has "had it." This might not be so—so do not fling it away. By leaving it on the leak test for a time it will possibly improve, the neon gradually dimming and finally starting to flash. This curious effect is due to the capacitor requiring a re-forming of the contained chemicals if it has rested inactively for a long time. Of course, an electrolytic which refuses to re-form, especially after application of its full working voltage, should be regarded as finished.

A MODIFIED METHOD OF FIXING 2 INCH METERS

by **P. Turner**

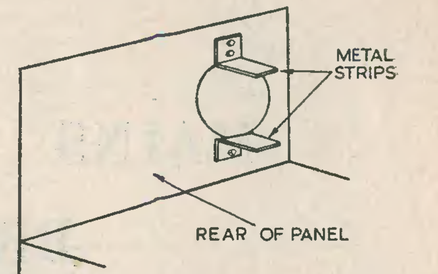

FIG.1
THE HOLDING STRIPS FITTED TO THE PANEL

C652

Some time ago I purchased several surplus moving coil meters of the point five amp. radio-frequency (thermocouple) type. The movement in these meters is usually around three to five mA full scale, with a voltage drop of the order of thirty millivolts. When suitably shunted and swamped, these meters make excellent monitors for HT current in an experimental circuit, thus releasing the multi-range meter for other duties. Once one has determined the correct value of HT current, the meter gives instant warning of any serious trouble by reflecting the changed conditions in the HT line.

Most of my 'bits and pieces' are surplus units, the panels of which were rather battered when I got them. Although the panels have been removed for beating out the dents, and have been generally smartened up, they are still not *quite* flat. In addition, a little flexing may occur as a unit is turned over on the bench to poke about in the under chassis regions. The result of this is that two or three of my meters suffered the misfortune of having one corner of the square fixing flange broken off. I always find such breakages intensely irritating, so a little thought was put in with a view to doing something about it. The result is here detailed.

Two strips of metal about three eighths of an inch wide are bent at right angles and fixed to the back of the panel. (Fig. 1). They are fixed so that the body of the meter is just a nice sliding fit between them. The leg which sticks out is made the same length as the body of the meter. The bolt holes are made so that they fall outside the square flange of the meter. Only very small bolts need be used; countersunk 6-BA's are big enough, and are almost invisible when the head is painted over. It is best to put two in each leg. The meter is pushed into place, and a section is cut from an old bicycle inner tube and is slipped over the back of the meter and the two projecting strips of metal, in such a way as to grip the meter and the strips as well. (Fig. 2). Failing an old inner tube, a number of ordinary rubber bands, say eight or twelve, will be found to give a firm fixing. This will be found to hold the meter quite firmly enough for all ordinary purposes in temporary rigs for experimental work, and yet is sufficiently resilient to prevent damage to the meter flange. In addition, it has the advantage that removing and replacing a meter is a matter of seconds, so that, if economy is the order of the day, then one meter may be made to serve more than one piece of equipment. The inside of the fixing holes in the corners of the flange may be roughened and then filled in with ordinary sealing wax. A touch of black paint over the sealing wax then makes everything neat.

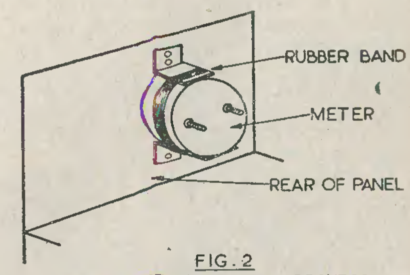

FIG. 2
THE METER PUSHED IN & SECURED WITH A STRONG RUBBER BAND

C653

A MAINS OPERATED BRIDGE

(CONCLUSION)

by W. E. THOMPSON

Three brackets made from ½″ × ⅛″ mild steel strip, bent as shown in Fig. 10, will be needed. The bend can be made by hammering the strip over the vice-jaws. Holes in these brackets are drilled and tapped No. 4 BA. In case it should be thought impossible to secure cover, brackets and front panel with screws when the brackets are obscured by the cover, here's how to do it. Secure brackets to top of front panel, lining up vacant holes at bottom of brackets with holes at rear of the base. Fit cover over brackets, and bring holes at back into line by inserting a scriber through them. The fixing screws can now be inserted and secured. Gently ease back top of cover and remove screws from brackets, and align holes as before with the scriber. Insert and secure screws. Screws can now be run through base to engage with tapped holes in the lips turned up in the sides of the cover.

The paxolin strip for mounting the test sockets can be cut from ⅛″ sheet (group boards from dismantled radar units yield supplies of this material) and the edges trimmed with a plane. The two pieces of perspex can also be cut and trimmed in the same way, but do not drill the holes for the spindles in the perspex at this stage. These holes must be left until the calibration scales are marked, about which more later. The cursor fitted to the large knob controlling Rv (Balance resistor R8) can be made from an odd piece of perspex.

In order that the scale of R8 can be more easily read, it will be found advantageous to have the cursor and knob fitted close down to the scale. This involves setting back the variable resistor R8 behind the front panel so that only the spindle protrudes. A suitable outrigger bracket can be made from an off-cut of the sheet aluminium on which to mount R8, the depth being such that the normal fixing gland of the potentiometer clears the back of the panel. The bracket is held to the panel by screws which also hold the perspex scale, and these will, of course, be those on either of the two diagonals of the scale.

The mains transformer has windings not generally found on available items, although it is known that at least one well-known supplier lists a transformer with the windings needed. Many firms will undertake to make a transformer to specification at reasonable cost, but for those who will wish to make their own, details are given below.

If you have some stampings with the following dimensions, or thereabouts, they can be made use of: Centre limb ⅝″ wide, outer limbs ½″ wide, overall size 3 ins. × 2 ins. A stack about ¾″ thick will be needed.

The bobbin can be made from thin paxolin sheet, the pieces being stuck together with nail varnish or other cellulose adhesive, such as Durofix. (Nail varnish is mentioned since most households possess some these days, and to steal some from the females is cheaper than buying a tube of adhesive, which will only get lost anyway). Allow 24 hours to set, and in the meantime a simple winding device can be made up. The writer does quite a lot of coil winding on a piece of ¼″ mild steel round rod on which a No.0-BA thread has been run on the whole length of 12 ins. This runs in two brackets mounted on a wood baseboard, has a simple handle on one end and a modified cyclometer engaged on the other end for counting the turns. Some form of geared drive is useful when a large number of turns have to be wound, and for high speed winding a tension clutch is advisable.

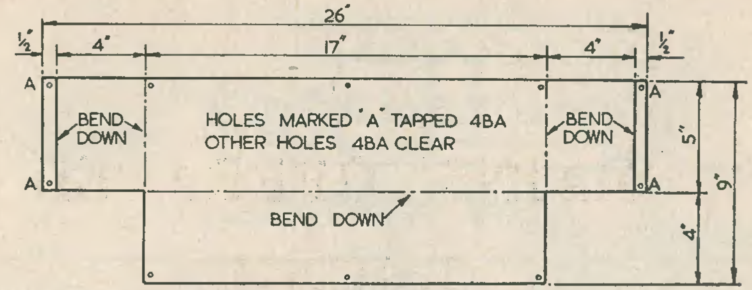

FIG. 9
COVER DRILLING PLAN

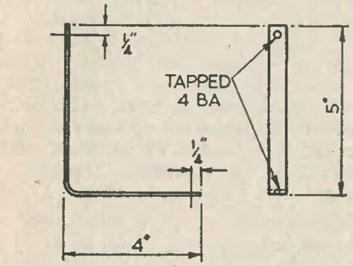

FIG. 10
SUPPORT BRACKETS FOR CASE

MATL.
½″×⅛″ MS 3 OFF

C614

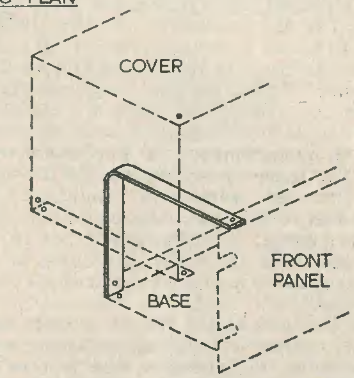

FIG. 11
METHOD OF MOUNTING SUPPORT BRACKETS TO FRONT PANEL & BASE

A piece of hardwood should be cut to fit fairly closely in the tunnel of the bobbin, and it also has a hole through it to fit over the threaded rod. Two plywood cheeks are cut to fit against the cheeks of the bobbin, the whole being secured to the threaded rod with two O-BA nuts.

Put two layers of 5-mil Empire tape on the bobbin before commencing winding. The coils are then wound in the following order:—

Winding		*Rating*	*Turns*	*Wire swg*		*Quantity*
Primary		200–250V	3000	40	Enam	1 oz.
Secondary	No. 1	200V 2mA	2600	44	,,	½ oz.
,,	No. 2	6.3V 0.3A	90	28	,,	½ oz.
,,	No. 3	50V 50mA	700	38	,,	1 oz.

A length of insulated stranded lead-out wire should be soldered to the beginning and end of each winding, the joint being insulated with a small piece of Empire tape. Coils should be wound layer fashion as evenly as possible, though the 44 Enamelled will need some patient handling. Each layer should be separated from the next by a turn of thin paper, and the insulation between coils should consist of two or three turns of Empire tape. A layer of tape over the completed coils gives a neat and protective finish.

The stampings are built up on to the finished coil, inserting T and U pieces from opposite sides alternately. End clamps, made from mild steel strip, are fitted, and if needed a small tag panel can be fixed to these for terminating the lead-out wires. Dry out the transformer in a warm (not hot) oven for a couple of hours, and paint the iron parts with some matt black cellulose to prevent rusting.

Components can be mounted to front panel and base, and wired up. Cut some temporary paper scales and fit in the positions to be taken up by the perspex scales. This is to mark the initial calibrations which will later be transferred on to the perspex.

A suitable decade box having been spirited into the workshop, the job of calibrating can

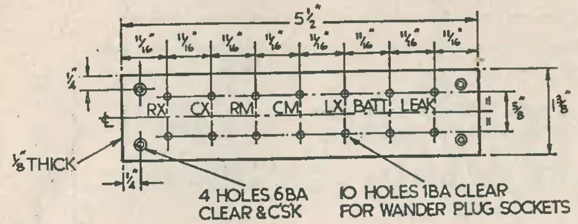

FIG.12
PAXOLIN PANEL, DRILLING PLAN

C615

now be started. Switch on the bridge and allow to warm up, a full green glow being observed on the magic eye. Set the Measure switch to C and R, range switch to 100 ohms, join decade box into Rx sockets and set it to 100 ohms. Rotate R8 until magic eye shows balance, i.e., maximum shadow. Bridge is now balanced at 100 ohms, so mark this point on outer circumference of temporary scale line. The inner circumference will be used later for the inductance markings. Set decade box to 1.0 ohm, rebalance bridge and mark this point. Change decade box to 2.0 ohms and mark the scale, continuing in 1.0 ohm steps, balancing each time, until 20 ohms is reached.

Now increase decade box in 5 ohm steps until 95 ohms is reached, marking scale at each point. The decade box is now set to 110, 120 ohms etc., up to 300 ohms in 10 ohm steps, then up to 1,000 ohms in 50 ohm steps. Finish calibrations with decade box settings at 1.5K, 2, 3, 4, 5 and 10K ohms. This gives the full scale for resistance and capacitance.

The inductance range is now marked on the inner circumference in accordance with the following table:—

Reference point on C and R scale.	*Inductance value marked (Henries).*
0.16	1
0.22	2
0.32	4
0.50	10
0.71	20
1.00	40
1.58	100
2.24	200
3.16	400
5.00	1000

This completes the calibration for R8, and the appearance of the scale is shown in Fig. 13. Mark the extremes of travel of the pointer as indicated by the thick lines terminating the scale; these markings serve to set the knob in the right place when the permanent scale is fitted.

The power factor control is now calibrated, a further temporary paper scale being fitted for the purpose. Set range switch to 1.0 μF and put a temporary short circuit across C5, the 1.0 μF standard capacitor. Set R8 to 1, and turn PF control fully to the left. Connect decade box into Cx sockets, set up resistance values and mark scale as shown in the following table. During this calibration R8 must be left at 1 and all bridge balances made with the PF control. When the calibration is completed remove the short circuit from C5.

Value set up in decade box.	*% PF marked on scale.*
160	5
320	10
485	15
650	20
820	25
1000	30
1190	35
1400	40
1610	45
1830	50
2080	55
2370	60

The calibrations having been completed, the markings can now be set up on the perspex scales. These are marked with lines only; figures and letters are written on separate pieces of smooth paper which will be mounted between the front panel and the perspex so that lettering shows through the perspex. Scratch circular lines on perspex with draughtsman's dividers. Place perspex on temporary scale, scratched lines uppermost and carefully prick the positions of all calibrations marks made on the temporary paper scale. With a scriber and steel rule, make radial lines at these pricked points on the perspex, as in Figs. 13 and 14. All marks having been made, cover them liberally with waterproof Indian ink and allow to dry, after which remove surplus dry ink with a slightly damped rag. Some care is needed in this removal process to avoid pulling ink from

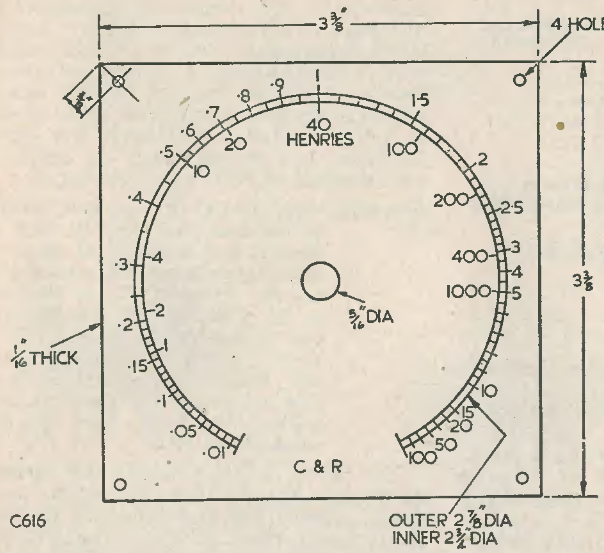

FIG.13
PERSPEX & PAPER SCALES. LINES ARE SCRATCHED ON PERSPEX, LETTERING IS WRITTEN ON PAPER MOUNTED BEHIND PERSPEX. 5/16" HOLE NOT TO BE DRILLED UNTIL PERSPEX IS ENGRAVED.

NOTE
SCALE DIVISIONS ARE TYPICAL ONLY

C616

the scribed lines and to secure legible marks as the finished result. The holes for spindles can now be drilled, making the scales ready for fixing. The paper backings having been suitably lettered, with mapping pen and Indian ink, the completed scales can be fitted to the front panel. Control knobs should be fitted to spindles so that they coincide with the limit of travel markings previously made on the perspex, and should automatically come into correct register to ensure the calibrations holding good.

A few spot checks with the decade box will prove whether or not this is so, and suitable adjustment can be made if necessary.

The functions, theory and construction of the bridge having been given, some notes on its practical use may be acceptable.

To measure resistance: Set Measure switch to C and R and range switch to standard value required. Connect resistor to be measured into Rx sockets, turn Balance control until magic eye shows balance. Reading on Balance control multiplied by

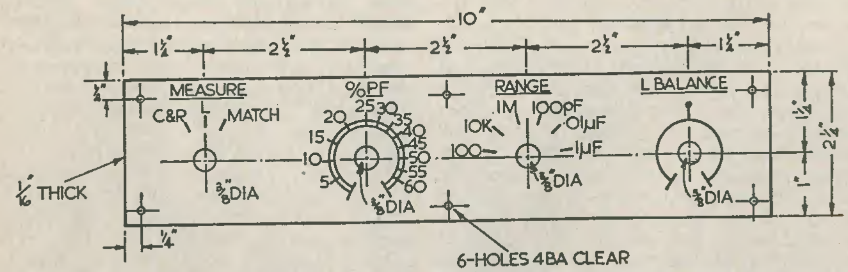

FIG.14
PERSPEX & PAPER SCALES. LINES ARE SCRATCHED ON PERSPEX, LETTERING IS WRITTEN ON PAPER MOUNTED BEHIND PERSPEX. 5/16" HOLES NOT TO BE DRILLED UNTILL PERSPEX IS ENGRAVED

C617

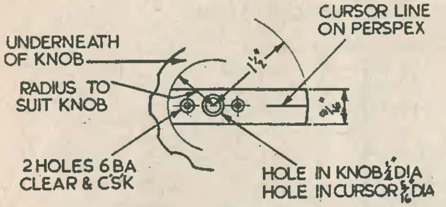

FIG. 15
PERSPEX CURSOR ON KNOB FOR FOR R8

C618

standard value equals unknown resistance value.

Example: Range switch at 10K, Balance at 0.68.

Rx = 10K × 0.68 = 6.8K ohms.

To measure capacitance: As for resistance except that capacitor to be measured is connected into Cx sockets.

Example: Range switch at 100 pF, Balance at 51.

Cx = 100 pF × 51
=5,100 pF or 0.0051 μF.

To measure power factor: As for capacitance except that bridge is balanced by using both the Balance control and the PF control. Note that this measurement can be taken on the 1.0 μF standard range only. Capacitance is computed as given above, and PF is read directly on %PF scale.

Example: Range switch at 1.0 μF, Balance at 34, %PF control at 20.

Cx = 1.0 μF × 34
= 34 μF, with 20% power factor.

Normally the %PF control is always set at zero when taking capacitance readings and should only be moved when inability to secure sharp balance indicates that the capacitor on test has leakage.

To measure inductance: Set Measure switch to L, turn Balance control fully to the right, i.e., beyond the '100' mark. (This short-circuits the 0.25 μF standard in order to initially balance the bridge. It is as well to ensure that R8 has zero resistance at this extreme position). Rotate the L Balance control R10 until magic eye shows balance. Connect coil to be measured into the Lx sockets, shorting Batt. sockets if no DC is being applied to the coil. Rotate Balance control until sharpest possible balance is obtained. It may be necessary slightly to adjust the L Balance control also, but only very small adjustment should be necessary unless the coil being tested has a high DC resistance. The value of inductance is indicated directly on the Balance control. (When measuring *with* a DC component, remove short from Batt. sockets and connect thereto a suitable battery, variable resistor and milli-ammeter in series and adjust current to value required. This should not exceed 100 mA, and battery must be connected plus terminal to Batt. plus socket).

Example: With no DC through coil, balance is obtained between 10 and 20 Henries and is judged to be 15 H. Reading on Balance C and R scale is 0.63. Therefore, $Lx = 40(0.63)^2 = 40 \times 0.3969 = 15.9$ H. This can be regarded as 16 H.
With 25 mA through the same coil, balance is obtained at 10 H. The inductance has therefore been reduced by 6 H when the coil passes 25mA DC.

To match a component: Set Measure switch to Match, Balance control to 1. Insert selected standard into Rm (resistor) or Cm (capacitor) sockets. Connect components to be compared into Rx or Cx terminals as applicable. Degree of mismatch can be noted by moving Balance control to balance bridge sharply. Components needing the least adjustment of Balance control are then selected as most nearly matching the inserted standard. Note that power factor and inductance matching is not catered for in this test.

Leakage test: Connect component to be tested into Leak sockets. Rate of flash on the neon indicates the degree of leakage—slow flashes mean good insulation, fast flashes poor insulation. A full glow indicates very low insulation or short circuit. When testing electrolytics, be sure to connect Leak plus socket to positive pole of capacitor.

Mention was made earlier in the article that on extreme ranges below 10 pF and above 10 Megohms readings became uncertain, due to the high impedance offered on the standard and unknown-value arms of the bridge. This can be slightly improved by increasing the exciting voltage injected into the bridge, and Figs. 16A and 16B show means of doing this. Transformer T3 can be 1 : 3 or 1 : 4 step-up and can conveniently be an old intervalve type, provided that it has a stalloy core. Parallel-feed types with high-mu core material are not suitable. The switch can be a separate toggle type suitably labelled as shown in Fig. 16A, or it can preferably be incorporated with the Range switch, in which case, as Fig. 16B shows, the higher voltage will come into operation automatically whenever the bridge is set

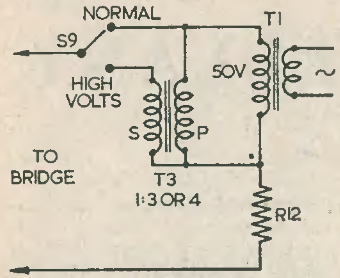

FIG. 16A
METHOD OF INCREASING EXCITATION VOLTAGE ON THE EXTREME RANGES USING SEPARATE TOGGLE SWITCH

C619

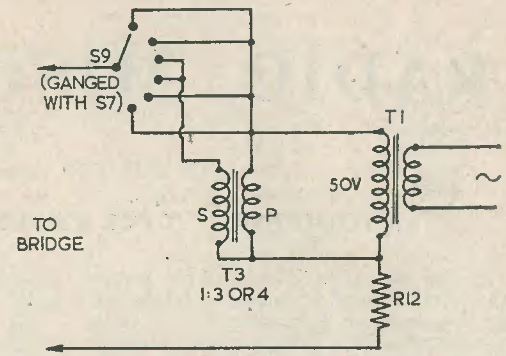

FIG. 16 B
METHOD OF INCREASING EXCITATION VOLTAGE ON THE EXTREME RANGES USING ADDITIONAL CONTACTS ON RANGE SWITCH S7

to the 100 pF or 1.0 Megohm ranges. If Fig. 16B is adopted, the Range switch should be a single wafer ceramic, 2-pole 6-way instead of 1-pole 6-way.

In conclusion, a few points of information and interest. The chassis need not be earthed, and for some type of measurement this is an advantage. A hood fitted over the magic eye (a small one can be seen fitted in the cover photograph Fig. 6) keeps direct light off the end of the valve and assists the observation of balance. A small lens might also be found advantageous, especially when initially calibrating the bridge to ensure good accuracy.

The standard rack form of layout described in the construction is not essential. Disposition of components is not critical and the manner in which they are assembled can be left to the constructor, but keep the mains transformer further than two inches from the magic eye in case stray field should distort the electron beam and prevent sharp balances being obtained.

When checking components 'in situ,' disconnect at least one side of the item under test from the other components to ensure that misleading balances are not obtained. For instance, it is no use trying to get a balance on a cathode by-pass capacitor by just clipping the test leads across it in the set. Since it will have the cathode bias resistor in parallel with it, no true balance will be found due to the permanent leakage through this resistor on the Cx arm of the bridge. The cathode capacitor need only have one end disconnected to ensure a proper reading being made. And, of course, do not expect to get results by trying to measure 'live' apparatus, unless a firework display is required.

It is not possible to make resistance measurements of such things as voice coils of PM speakers, moving coil systems in pointer instruments, chokes or transformers. The permanent magnetic fields in the first two, and the induced fields in the latter two prevent a balance being found anywhere on the bridge. The multi-range meter or other DC measuring device is the thing to use for such cases.

Should it be found that the beam of the magic eye has a 50-cycle modulation (recognised as "flutter" on the green edges when the bridge is at balance) try screening the wiring to the magic eye triode grid; keep such leads as short as possible and away from other components. Some increase in the value of the smoothing components R3 and C3, or both, can also improve an obstinate case of ripple.

Do not use twisted flex for the test leads. Single flexible leads are not only more easily handled but have lower mutual capacitance. Keep the test leads as short as convenience will permit, and when components are connected to them do not hold the item in the hand while balancing the bridge, for hand capacity effect can upset the balance.

Electrolytic capacitors will not suffer damage even though the bridge injects an alternating voltage into them in order to test them. The magnitude of this voltage is not great, and is purposely kept so to avoid causing harm to components.

continued on page 384

RADIO MISCELLANY

CENTRE TAP talks about

ANODISING : COIL PACKS : AC MOTORS

A number of readers have asked for further details of the method of anodising by AC of which I wrote in our April issue, and for their benefit as well as others who may be interested the following supplementary information may prove useful.

The electrolyte is made up in the ratio of 10 ounces of pure Oxalic Acid to each gallon of water. It is mixed by dissolving in half the quantity of boiling water and then allowing to cool. The remaining water, allowed to cool after boiling, is then added.

The groups of bases are suspended in the bath by aluminium or lead strips or bars, and no metal, other than these two, must be allowed to come into contact with the anodising electrolyte. The container, of course, must be non-metallic. The operating temperature should be about 95° Fahrenheit, and the current kept to about 1 amp per square decimeter of the bases. About 90 minutes treatment will be needed to give a satisfactory finish, and as the current falls the voltage should be increased. In areas where there is a chalky deposit in the water, time should be allowed for it to settle, and the clear liquid then poured off.

The objects are then boiled for about ten minutes in clean water, when a final rinse and thorough drying will complete the job. Any dyeing required is done in the boiling, when a further boiling prior to the final rinse is advisable.

A Further Edition?

Several readers have asked "Why don't you give us a 1952 version of the Basic Super-het?" Perhaps I shall in the near future, but I have always been hoping (against hope apparently) that some enterprising manufacturer was going to market a series of coil boxes. Then I shouldn't call it the Basic Super-het, but My Ideal Super-set, especially the de-luxe version which would have both general coverage and bandspread coils.

I am confident that many constructors would cheerfully pay the rather high price for coil boxes—they obviously could not be made cheaply, but the higher price would be offset by the fact that they would be an investment rather than an expense.

My favourite set for use on the amateur bands was built in 1939 and is still used more or less daily. It holds its own with contemporary communications receivers despite its age, and the only attention it has received since it was first finished was when it was rejuvenated by changing to more modern type valves. Oddly enough, it still has the original electrolytics—the good old wet type, and they have never leaked! I checked them recently and they seem to be well up to lots of good service yet.

The coil assembly for this receiver, five switched wavebands up to 650 metres consisting of 20 separate formers, took me nearly three months of my spare moments to get to my complete satisfaction. I have often thought since how much quicker (and more compact) it would have been if I had only decided to make those otherwise unobtainable coil boxes. It would, too, have obviated a tangle of switching and the inevitable losses in the HF bands.

When I first built it, the still new and wonderful 6K8 was all the rage, but I finally decided on a separate oscillator. This arrangement is to be preferred, but I should hardly dare use one in a design for readers. They don't seem to like the idea of "wasting" that extra 0.3 amp heater current when they can see nothing for it. Occasionally visitors raise their eyebrows at it, and I apologetically murmur something about improved performance on ten. They just sniff and tell me they use a converter. I don't need to, and most 10 metre converters use a separate oscillator anyway.

With the armament drive, etc., and the still shorter supplies for civilian use, it does not look as if we shall be getting our coil boxes for a while yet. Incidentally, I enquired about a chassis the other day and very nearly passed out when I heard the price. Far from being interested in the anodising of aluminium, at the moment I should be far more excited about a method of boiling down old chasses and ironing them out as new ones!

A.C. Motors

It looks as if most of the space this month is to be taken up with readers' problems, so I am keeping my fingers crossed and hoping (1) that in future enquirers will use Query Corner and (2) that I shall not lose the other three readers who look at this column regularly. Quite a number ask about the suitability of small AC motors, which can still be picked up very cheaply, for various jobs they have in mind. Queries about individual motors are quite impossible to answer, especially in the absence of more detailed information about the motor and the use to which it is to be put. However, a few points about the commoner types of small fractional hp AC motors may not come amiss, and might well prove helpful in enabling readers to decide whether the motors they have in mind will be suited to their requirements.

Broadly speaking, these motors are named after the principles of their operation, but as two of them have more than one descriptive name beginners are sometimes apt to think of them as being of different types.

The Universal motor is thus often referred to as the "Series," and the "Squirrel cage" as the "Inductor." The other two types commonly met with are the "Repulsion" and the "Synchronous."

Each of these four types have certain advantages and drawbacks and if we know something of these it is much easier to decide whether some of the ex-WD models still readily available are suitable for the job in mind. It must, of course, not be overlooked that each of these four types are found with modifications, but their chief characteristics remain sensibly unchanged.

The Induction (or Squirrel cage) is the simplest in construction. It consists of a stator (the equivalent of the field in a DC motor) and a rotor (the armature of a DC motor). A slotted drum carries copper or brass rods in place of the windings, which are shorted by a ring or end disc. They are really just as simple as that, and thus are cheap either to make or buy. Unfortunately they are bad starters, and invariably need to be touched off, nor will they handle much of an overload. Their range of speed is very limited, and any overload which is intended to drive them faster causes them to stall. This seems a formidable list of disadvantages, but because none of these drawbacks cause serious concern when put to such uses as driving gramophone turntables or ventilator fans, etc., they prove to be quite adequate for such purposes.

The Synchronous motor, also often used for gramophone turntables, can only be run at a definite speed. This can be an asset when used for radiograms or electric clocks. Normally they are not self starting although this can, and sometimes is, arranged by special design. They are cheap to make, but once again they are incapable of doing appreciable work. It is worth noting that ordinarily they will not start unless they are spun at a faster rate than their synchronous speed.

The Series motor is often called the Universal, owing to the fact that it runs on both AC and DC. It is ideally suitable for hard work such as for polishing heads, or even for the XYL's suction cleaner. They will start off under a full load and will handle overloads for long periods without complaint. The speed changes with varying loads, which can sometimes be a nuisance, and they are electrically noisy which, unless suppressed, can be a still greater nuisance.

The Repulsion motor is constructionally of similar design to the Series, except that the stator is connected to the AC supply and the brushes short circuited. Their speed can be varied by changing the position of the brushes on the commutator, and the movement of the brushes beyond a given point causes a reversal in the direction of rotation. This is an obvious asset which can often be put to good use. They are good starters, although perhaps not quite up to the Series type in this respect, and excellent workers. So good, in fact, that they are often put to much harder work than they were originally intended for, and still stand up to it for a long time. While it isn't advisable, many people seem to run them really hard for all sorts of general utility work, easing them off only when they begin to show signs of overheating. Surprisingly enough they stand up to such abuse a lot longer than one might reasonably expect.

Invisible Mending

A good many readers, I should imagine, have come up against instances of cracked or broken bakelite radio cabinets. These cabinets are particularly popular for midget universals, and consequently come in for much semi-portable use. To keep them light and cheap they are usually of rather flimsy construction, and the very nature of the sets which they house renders them especially liable to rough handling and precarious balancing in odd positions. Universals run hot, too, and bakelite gets brittle with age, and to make it worse the brittling process seems to be accelerated by the dry heat to which these cases are subjected. Small wonder that there are so many casualties among them, and for this reason many readers will be directly interested in a practically

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WIRE RECORDER FROM OLD GRAM. MOTOR

by D. GREIG, F.R.S.A.

My early efforts at making up a mechanism suitable for the playing of wire proved a tedious, costly and, in the main, a thoroughly disappointing affair.

So many things bothered me.

The necessary reduction in the revolutions of my electric motor to the final take-up speed gave me a headache, and for once the purchasing of ex-government equipment failed to help. The gearing in these instances was either much too bulky and heavy or else, maddeningly, far too small and fragile. My speed control was a heartbreak from the word go, and memories of the beating I took over the punishing exactitudes of the level winding are still haunting me. My flywheel sounded as though it was whipping up eggs, and set up a later vibration which was the final cause of my dispiritedly chucking it all in.

It is only now, after the fire and sword, that peace and balm are mine. The very day on which continued defeat had forced resignation upon me with the insidious hint that there was much to be said for tape, that happy solace—in the shape of a greasy old gramophone motor—became mine.

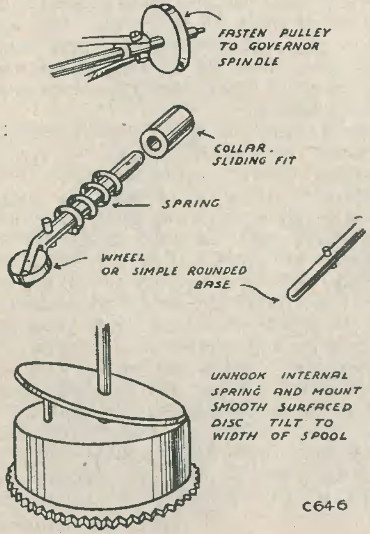
With the use of this the whole thing absurdly becomes a piece of cake. All the tricky work has, here, been expertly done for you. The cogs really mesh with that little extra exactness that means so much—the normally noisy one being thoughtfully fibre centred for you. There is a ready made speed control and chain of reduction gears. My old demon, the level wind, is laid by the heels, and you can pension the cursed flywheel off as a paperweight. When everything is finally mounted, cushioned with suitable shock absorbing rubber, it runs smoothly and quietly with just a gentle hum, not unlike a transformer calling to its mate.

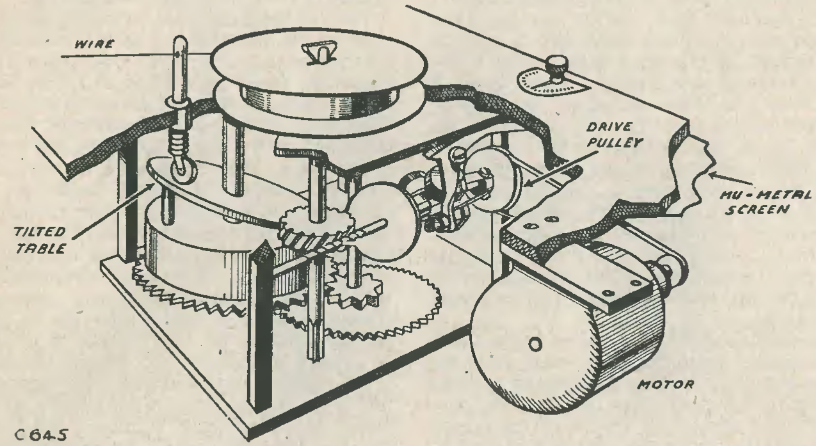
It is also extremely neat and compact, with just the spool spindles and rocker arm tips showing coyly above the deck. By setting up alternative guide rollers and installing two sets of the appropriate heads, the outfit can be made to take either wire or tape; the speed regulator here handling the difference without any trouble.

Most important of all, perhaps, it is extremely cheap. Old gramophone motors with broken, or (more commonly) unhooked springs can be bought for a song at scrap yards. I bought a pair for the price that I paid for a single worm drive !

The conversion is really very simple, and should be readily understood from the drawings.

First, dismantle the gramophone motor, after letting it run down. This is usually done by removing the four nuts holding the rubber





shock absorbers. The top plate will then lift off allowing you to take out the gearing. The winding gear should now be dismantled by drawing out the pins, and this with its check spring or ratchet wheel can be put away in the oddment box. If your motor is the superior type with double drive springs, remove the upper one complete with its cage and dump that also. The spring in the lower should be either unhooked from the shaft or removed altogether. Even a broken one should be unhooked for it will later make an annoying clicking sound as the two ends pass whilst revolving. Should you wish to remove a spring, don't be foolhardy about it. A spring will leave its cage with all the shattering abandon of an evil spirit from Pandora's box. I have found it best to get a good grip on as many of the internal twists as possible with a pair of reliable pliers, and, with the cage held firmly in a vice and the whole set-up smothered safely in a large cloth (a sack is better—Ed.) ease out the spring with a series of smooth pulls. To replace a spring it is best to start from the centre, and wind it home by turning the cage and pushing the coils home. If well greased it is a fairly simple task.

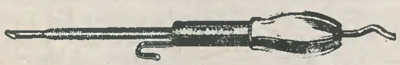
Having removed or unhooked the spring, a tilting platform must now be made to mount on the upper surface of the cage. This can be made of any smooth serviceable material, such as metal, hardwood or paxolin. It should be as large as possible and can be fixed with a permanent tilt or, if different spool widths are to be tried, hinged at the contact and made to give variable degrees of slope by an adjustable screw-thread or other arrangement on the other side. The tilt is best lined up on the completion of the machine. The centre hole for the shaft must have good clearance in the case of an adjustable table. The gearing of these gramophone motors varies but little. After all, they each had the same job to do, and I have found that a spool width of a little under half an inch gives a satisfactory level wind.

The rocker arm should be made of any hard non-magnetic material and can be formed with a swan necked base and small wheel. If this is fitted there is no tendency for it to try to spin, as the wheel will trail, and this will save any unnecessary friction on the recording wire. The arm could be square in section to overcome this, but it would then mean a square collar which would be hard to make. This collar, through which the arm alternates, should be fixed firmly into the baseboard in such a position that it will drop the rocker arm's base on to the inner edge of the table below, and just clear the edge of the take-up spool which fits on to the shaft normally carrying the turntable. A spring should be fitted below the collar to ensure its obedient return against the pull of the wire.

In order to drive the gramophone motor, you have now to fasten a pulley wheel to the shaft holding the governors. This wheel must be as large as clearance will allow, and must at all events be larger than that on the electric motor. For a belt I have found a leather thong or thick leather bootlace best; the two ends cut flush, holes bored, and the ends drawn up closely together with a few turns of needle and thread. This, again, is best done last with everything in position, so that the tension can be correct. The electric motor must obviously be suppressed, and I find it best to use one with a little too much power and then to underfeed it by means of a dropper. This allows you to juggle until you have the perfect balance. This motor, along with the other, should be mounted on rubber, and the baseboard should be lined with mu-metal or other screening material.

The spools should be made of some sturdy non-magnetic material, and must have the choice of being joined to their shafts or being allowed to run free. For this, I have found a short slot across the centre of each spool face, and a cut down the centre of the shafts, the most simple way. A triangular piece of metal forms a key and can be shifted when necessary from one spool to the other.

For the feed, and wind-back spool, I have fixed up an identical rig at the other end of the baseboard, except for first removing the governors from their shaft and ignoring the speed control. This gives me a very rapid wind-back with no more labour than the changing of the spool key and the pressing of a switch. It is, however, a luxury and not strictly essential. A good working outfit can be made with just the one gramophone motor, and the spools reversed for the wind-back, the speed control being of great help in this direction. With this, it is not practical to use a swan necked rocker arm. A straight round based type will enable you to change the direction of the wire without re-threading. A straight rocker arm should also be installed if you mean to use the machine for tape, as you will want to withdraw it completely to make room for the larger standard sized spool. In this case, of course, the mechanism for its pressure against the tilted table face must be above the deck and readily removable.



RADIO MISCELLANY

continued from page 393

"invisible" repair I have recently examined. In fact, it was invisible to the extent that it could only be detected after a close inspection.

The method used entails carefully glueing the broken edges with the thinnest possible film of glue. Surgical tape is fixed on the inside of the cracked or broken edge, and the glue is not sufficient to squeeze out when the edges are pressed together. Thus a shallow hollow is left along the crack on the outer surface. This is then filled in with sealing wax run in with a hot soldering iron—not hot enough to scorch the surface of course.

This may sound alright for red cabinets, but you will be agreeably surprised at the wide range of colours sealing wax is available in at any good stationers, and you can further extend the range by melting two together to match intermediate shades.

No doubt readers are already questioning the feasibility of pushing molten sealing wax into cracks when they are very fine. Well, I'm told, that can easily be got over by painting in with a mixture of sealing wax dissolved in methylated spirits.

Anyway, if it doesn't pan out as well for you as it did for the reader who successfully used this system, there is still one consoling thought. You can always cover the case with rexine!

Trade News

Solder Kits

Radio enthusiasts and model makers will be interested in the 2/– Multicore Solder Kits containing four specifications of Ersin and Arax Multicore Solders. Arax Multicore Solder is a non-resin acid-free cored solder wire with washable flux residue. It will solder all metals except aluminium and is available in similar specifications to the Ersin type solder.

More Tugs Employing V.H.F.

More tug companies are equipping their vessels with Pye Marine V.H.F. radio-telephones. From fixed stations installed on the Thames and the East Coast these companies can now maintain constant two-way communication with vessels which, hitherto, had to rely on ordinary land telephone if and when they came alongside.

The Cement Marketing Company, Ltd. is to equip two of its tugs towing cement up and down the Thames. Their V.H.F. fixed station will be at Northfleet.

Silvertown Services Ltd., a subsidiary of Tate and Lyle, are re-equipping all their tugs with the latest type of Pye V.H.F. in the frequency band 156–165 mc/s.

The British Electrical Authority have ordered a fixed V.H.F. station to be installed at their Ipswich depot so that their colliers, the "Barford" and "Cliff Quay" can communicate there.

Other companies who have recently placed orders for V.H.F. with Pye's marine sub-division—Rees Mace—include Braithwaite and Dean, Ltd., Whitaker Tankers, Ltd. of Hull, and James Piggott, a tug company operating in the Grimsby area.

"Marabu" Equipped with Radio Dolphin

The 26-ton yacht Marabu, which will join in the Newport-Bermuda six hundred miles race on June 21st, has just been fitted by Rees Mace Marine Ltd., with the Pye "Radio Dolphin" marine radio telephone.

The demand for the low-cost "Radio Dolphin" sets has increased to such a degree that, to cope with this and the new yachting season, Rees Mace are expanding their installation and fitting-out staffs in all depots. A "Radio Dolphin" set can now be installed within twenty-four hours anywhere in Great Britain or the Channel Islands.

Mr. J. M. Wardle, who has had twenty years experience in installation, maintenance and operation of marine radio equipment, has been put in charge of all depots in Great Britain.

Telecommunications Engineer, Mr. J. A. Gordon has joined Rees Mace as special travelling consultant and will go to all yachting centres to make certain that users are getting the full benefit out of the Pye Radio telephone equipment.

World's First Five Core Solder

A closely guarded secret, disclosed at the opening of the R.E.C.M.F. Exhibition on April 7th, was the development by Multicore Solders Ltd. of the world's first five core solder.

This new type of Ersin Multicore Solder has five separate cores of flux with each core situated very close to the circumference of the wire. Extremely rapid melting of the solder and quick liberation of the flux is achieved by the flux area being concentrated in the outer 10% area of the cross section of the wire.

Advance samples of the new five core Ersin Multicore Solder were shown at the Exhibition, including wire which was little thicker than a hair. When magnified the five separate cores could be clearly seen.

Production of bulk supplies of Multicore five core solder will commence later in the year when new plant is installed at Multicore Works at Hemel Hempstead.

T.V. Afloat

As from March 14th, ships entering the Clyde will be able to have a television set installed on board when they come into dock.

These sets, made by Pye, can be rented by the day for a few shillings as an extension of the service already established on the Thames and Mersey by Rees Mace (Marine) Ltd., a subsidiary of Pye.

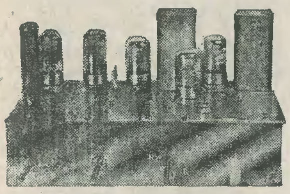
The service is greatly appreciated by ships companies, for television sets cannot normally be hired except on a long-term basis with, in many cases, a wait of three months before the set is installed.

Coloured Joints

The principal exhibits of H. J. Enthoven and Sons Ltd., at the R.E.C.M.F. Exhibition was 'Superspeed' Activated Rosin Cored Solder Wire in various alloys and gauges on reels and in service dispensers, and their outstanding feature will be this type of solder with tinted cores giving red; blue; green; yellow and purple colour to soldered joints for various identification purposes.

They also exhibited 'Superspeed' Cored Solder Ribbon; 'Enthoven' Lamp Solders; Plumbers, Tinmans and Blowpipe Solders; Solid Solder Wire and Washers; 'Entocene' Solder Paint; 'Telecene' Activated Rosin Based Flux and 'Tricene' Soldering Fluid.

ELPREQ PAGES



5 VALVE IF/AF AMPLIFIER

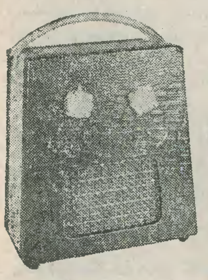
Chassis size 11½" x 7" x 3" deep. Holes are drilled so that tuning condenser and coil pack may be fitted if same are required. Complete with 8" speaker and one of the latest valve line-ups as follows: 14S7 Triode Hexode, 7B7 IF Amplifier, 7C6 D.D.T. 35A5 output, 35Z3 Rectifier. The IF's are preset at 465 Kc/s AC/DC mains operated. **£6.10.0** A.C. only model available if required.

RECEIVER TYPE 25/73

Receiver portion of the TR. 1196 undoubtedly one of the most useful little receivers that has ever been offered from Government Surplus Stores, because once the existing tuning unit is removed a standard coil pack can be fitted which makes a very efficient superhet at a very small figure. Alternatively for breaking up there is a pair of standard 465 kc/s dust cored IF transformers which would cost 12/6–15/– and dozens of other items, tuning condensers, coils, preset condensers, pot meters etc., etc.

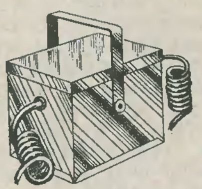
The price is only **9/6** plus **1/6** post and packing less valves, or **27/6** plus **2/6** post, packing and insurance with valves. The valves are as follows: 2 VR.53, 2 VR.56, 1 VR.57, and 1 VR.55.

PERSONAL RADIO CABINETS



Correct dimensions to take P.W. 'Mini Four' and similar midget superhet or TRF. Internal dimensions 6½" high x 5¾" wide x 3" deep. Special plastic grained finish, **15/9** plus **1/6** postage & packing. De Luxe Model covered with brown crocodile leathercloth and banded with grey lizard leathercloth **22/6** plus **1/6** packing & postage.

WELDING TRANSFORMER



12v. 50 Amp Output from 200-230v AC mains.

Primary and secondary separated by a special screen to prevent interference, this screen is brought out to the terminal block. Complete in metal case with carrying handle, price **£3.15.0** plus **5/–** carriage and packing.

THE RESULTS OF OUR FEBRUARY GUESS WHAT COMP.

Each month in our pages of the Wireless World we illustrate some article and ask readers to guess what it is.

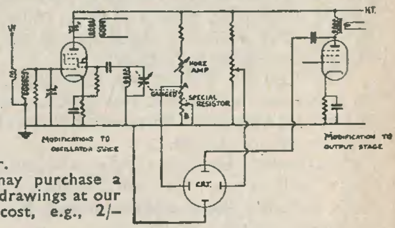
In the February issue we deviated slightly from our usual competition and asked for novel uses of our IF/AF Amplifier. It was our original intention to give prizes for the best suggestions but on giving the matter further consideration we found it most difficult to come to a decision as to which was the best, nevertheless temporary prizes were given. We feel however that it will give considerably more satisfaction to the originators of the ideas if these could be judged and graded in order of popularity, your reaction to the suggestion will enable us to judge which is the most popular and we will reward the person concerned.

RECEIVER WITH SPECIAL PHASE INVERTER CONTROL CIRCUIT

An article was submitted which described a special control circuit; the inventor claims that this gives a performance vastly superior to normal superhet receivers. He further claims to have used the circuit with most surprising results. A provisional patent to protect this circuit has been filed by the inventor but he is quite willing to allow it to be used non-commercially without payment of fee.

VISUAL PANORAMIC ADAPTOR

Another article submitted showed that with the smallest amount of modification the IF/AF Amplifier could be used in conjunction with a Cathode Ray Tube to enable the operator to observe at a glance the condition of a section of a particular waveband.



An amateur for instance could watch his various bands and could see when a new transmission commences and when it is convenient to operate his own transmitter.

Anyone interested may purchase a copy of this article and drawings at our approximate copying cost, e.g., 2/– post free.

A VERSATILE LABORATORY INSTRUMENT

Another suggestion submitted was that the unit would make a very versatile laboratory instrument, only the minimum of additional parts are required and after calibration the constructor could use it as:— (1) Audio Signal Generator, beating the variable IF Oscillator against the crystal. (2) 500 kc/s Frequency standard. (3) IF Alignment Oscillator. (4) Ultra sonic generator up to 35 kc/s.

COMBINED T.V. SOUND & ORDINARY BROADCAST RECEIVER

An interesting suggestion was that with the simple addition of a coil pack it could be used as a radio receiver to make a combined radio and T.V. sound receiver. So many T.V. sets that are nothing but ornaments when T.V. is not being broadcast could be made that much more useful by this addition.

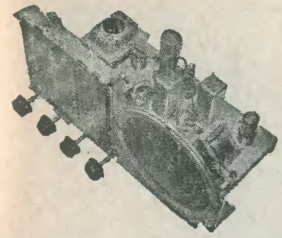
T.V. TESTER (TELETRACER)

Another idea was that by very simple additions a T.V. tracer could be made which by tapping the test prods on the grids and anodes of the vision and sound valves, both vision and sound signals could be traced right through to the tube and loudspeaker respectively. Similarly from the syncseparator and blocking oscillator valves the user will get a powerful indication of the sync and blocking oscillator pulses.

OTHER SUGGESTIONS ARE:

HIGH GAIN AMPLIFIER
LF SIGNAL GENERATOR/WAVE METER.
BEAT FREQUENCY AF OSCILLATOR.
CARRIER TYPE INTERPHONE.
METAL DETECTOR (FOR MOVING BELTS, ETC.).
IMPEDANCE BRIDGE.
SHORTED TURNS TESTER.
SECOND FREQUENCY CHANGER & AUDIO STAGE OF A DOUBLE SUPERHET.
INTERFERENCE MEASURING SET.
FIELD STRENGTH TEST SET.
HARMONIC CHECK SET.
RECEIVER FOR CARRIER TYPE OF WIRE HF COMMUNICATIONS.
'Q' METER.

Copies of the technical data and diagrams (if any) which accompanied the suggestion will on request be supplied free to the purchasers of our IF/AF Amplifier.



THE ELPREQ SUPERIOR FIVE

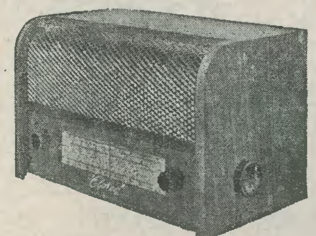
This is a long, medium and short wave superhetrodyne receiver for A.C. mains working, built by one of our famous manufacturers, fully aligned, tested and guaranteed. Complete as illustrated, less knobs. **COVERAGE:** L.W. 800–2,200 metres; M.W. 200–500 metres; S.W. 16–50 metres. **CHASSIS:** Heavy gauge cadmium plated steel, size 15¼in. x 8in. 2½in. **DIAL:** 7½in. square, edge lit, glass, printed in three colours. **SPEAKER:** 8in. P.M. built on to chassis but easily removable. **TUNING:** two-speed tuning with nylon drive. **VALVES:** all by B.V.A. makers, ref. Nos. 6K8, 6V7, 6R7, 6V6 and 6X5. **EXTENSIONS:** sockets are provided for pick-up and low impedance extension speaker. **TECHNICAL POINTS:** (a) I.F. filter; (b) delayed A.V.C. to 1st and 2nd valves; (c) controls to vary tone and volume; (d) tone correction; (e) high gain amplifier comprising triode section of D.D.T. and pentode gives undistorted output of 4 watts with good frequency response. **GUARANTEE:** 12 months wirtten guarantee included with each receiver. **CIRCUIT:** diagram is available free with chassis or separately price **1/9**. **CABINET:** no ready cabinets are available at present but constructional details of an easy to make type is given free with circuit diagram. **PRICE:** complete ready to work **£10/19/6**. Non-callers please add **10/6** to cover carriage and insurance. **H.P. TERMS: £3/13/0** deposit and nine monthly payments of **18/9** each (carriage extra sa above).

THIS MONTH'S SNIP

Is a parcel of toughened glass which we can offer at approximately a quarter of its cost. This glass, as many readers will know can be dropped and will not break. In fact it is most difficult to break and so is useful for dozens of applications in addition to its original purpose of protecting viewers against flying glass in the event of an exploding Cathode Ray Tube.

We offer a parcel of five panels, each 10¾" x 9¼", for **7/6** post free.

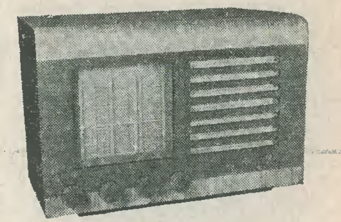
THE WOLSEY CABINET



This very attractive wooden cabinet is available complete with metal grille and back at **29/6** plus 2/6 post and packing.

The front dial is not included at this price but will be supplied at 4/– extra if required. Actually we believe most of you will wish to make up your own from bakelite or perspex.

A bakelite dial is available which makes this cabinet suitable for our 69/6 chassis, the price is **3/3** post free.

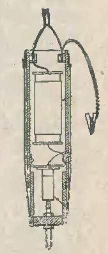


SUPERIOR CABINET

With beautifully veneered full grained and highly polished finish, dimensions 19" wide x 10" deep x 12½" high. This cabinet will take our 'Superior Five.'

In the cabinet the set will look well worth £18 – £20. Price **3 gns.** each. Post, packing and insurance 7/– extra.

RADIO STETHOSCOPE

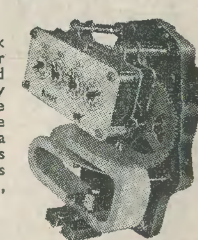


A novel device aptly called Radio Stethoscope is described in a recent edition of the "Radio Constructor." This is compact and can be slipped into the pocket rather like a fountain pen. With it in most districts a receiver can be checked from the grid of the first valve right through to the output without a signal generator. The stethoscope will operate in both L.F. and R.F. circuits without alteration. It is a complete fault finder.

The only parts needed to make the simple circuit tracer are a pair of crocodile clips, a germanium crystal, and a paper tubular condenser and we will supply whole outfit for **6/6** post free, and with each outfit we will give re-print of the article as it appeared in the "Radio Constructor."

NOTE.—If you wish to make it up as a pocket unit then you will need a few other odds and ends, solder tags, etc., from your spares box.

FERRANTI ELECTRIC METER MOVEMENT



A complete check meter except for case, brand new and unused. Has many uses, one for instance is that of telling the numbers of hours a piece of apparatus has worked. Price is only **17/6** post etc., 2/–.

Orders by post are dealt with by our RUISLIP depot. To avoid delay address to:—E.P.E. Ltd., Dept. 3, Windmill Hill, Ruislip, Middlesex.

Except for heavy and delicate items where carriage charge is specified, orders over £2 are post free, under £2 add reasonable amount bearing in mind a 15 lb. parcel costs 2/–. Postable items can be sent C.O.D. additional charge approx. 2/6. List 6d.

Early closing, Wednesday—Ruislip, Saturday—City.

ELECTRONIC PRECISION EQUIPMENT

WINDMILL HILL, RUISLIP MANOR, MIDDLESEX AND AT 152-153, FLEET STREET, LONDON E.C.4

3 WATT AUDIO UNIT

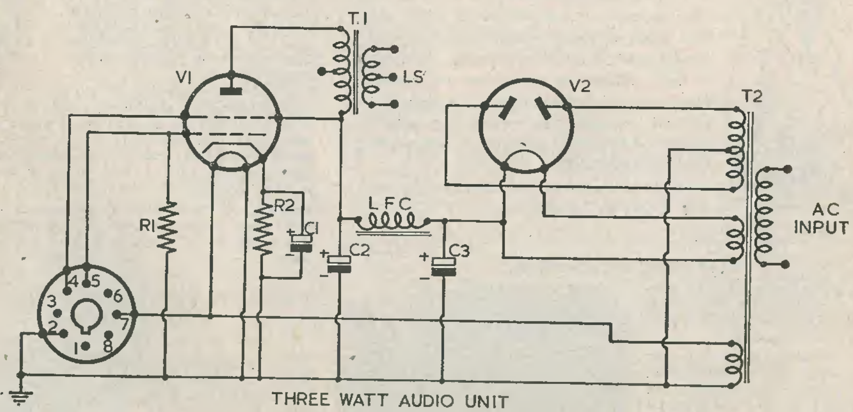
by J. N. ROE, M.I.R.E., F.R.S.A, G2VV

Most of us at some time or other have found ourselves wishing we had a stand-by amplifier and power pack. Perhaps there is an RF tuning unit to try out, a gram player to check over, a receiver with a 'suspected faulty' audio stage, all of which could be quickly tested with the aid of a self-powered audio unit. The unit presented here is intended for general purpose work on the bench, or for inclusion in a complete receiver where the tuning end is already provided.

Circuit and Construction

As will be seen from the circuit diagram and photographs, the design embodies only a mere handful of components and no attempt has been made to incorporate tone controls or gain control. Provision for these factors rests with the type of equipment feeding the unit. In the case of a usual tuning unit the gain control and mains ON/OFF switch is incorporated.

The chassis illustrated measures 9½ in. × 4½ in. × 2 in. and is of bent aluminium construction. Positioning of components is not important although—in common with every radio design—long leads are to be avoided. The LF smoothing choke is mounted under the chassis since, being unshrouded, it allows a more finished appearance on the top deck.



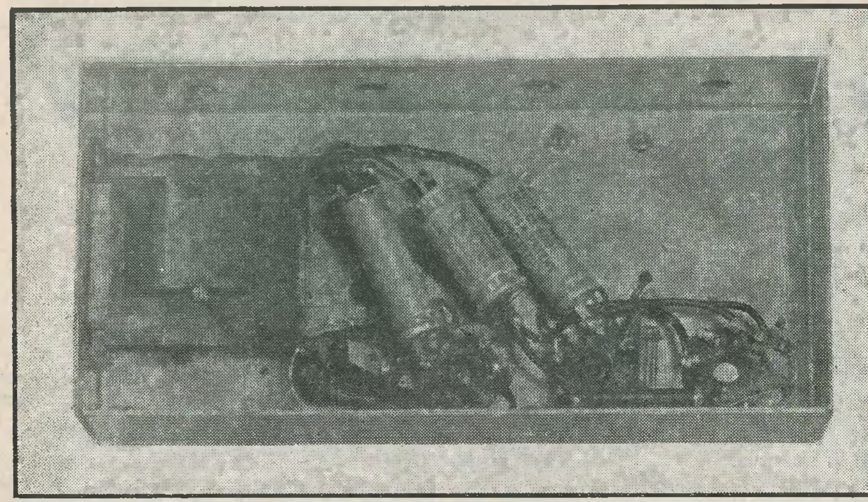
C649

TABLE OF VALUES

C1 = 25 μF 25V working, electrolytic.
C2, 3 = 8 μF 450V working, electrolytic.
R1 = 470 kΩ ½ watt.
R2 = 250Ω 1 watt.
LFC = 10 Henries 80–100 mA.
T1 = Output Transformer (illustrated Ashworth MOP1).
V2 = 5Y3

T2 = Mains Transformer
Primary 200–250 Volts.
Secondaries = 5 Volts at 2 Amps
6 Volts at 4 Amps
350–0–350 at 100 mA.
(Illustrated Ashworth Type FS3X)

V1 = 6V6.



Under-chassis view — see also cover illustration

The octal socket at the right is used for inter-connection between the audio unit and the tuning unit, or other apparatus under test. To avoid confusion, the socket numbers on the octal holder are wired in accordance with normal valve use, i.e., pins 2 and 7 heaters, pin 5 grid, etc.

In this particular model one side of the valve heater supply is common to earth. Such an arrangement has been used for convenience, but care must be taken in testing RF feeder units, etc., to ensure that its associated heater circuit is earthed in the same manner. Also, when using apparatus with its own power supply, in conjunction with the audio unit, remember it may have the heater circuit *centre-tapped* to earth. This connection should be removed and one side of the heater circuit wired, temporaily, to earth.

Where desired, a transformer having a centre-tapped heater winding may be used in this audio unit. In such cases pins 2 and 7 on the valveholders and interconnection socket must be left above earth. The centre tap will then be connected to earth and to one of the free pins on the inter-connection socket.

The particular mains transformer shown has a 4 volt tapping on the heater winding, and by wiring this to a free pin on the interconnection socket the unit is made more versatile.

The speaker output transformer illustrated has multi-ratio tappings on primary and secondary windings.

No grid input capacitor is included in the unit, as most RF feeder units embody this component included in the anode of the output valve (usually a 6Q7). Where output is taken from an HT point (such as the anode of a valve on a receiver on test) the connection to pin 5 in the inter-connection socket should be made via a 0.01 μF capacitor.

In cases where some 'top cut' is felt desirable, a capacitor may be included across the speaker transformer primary winding. Values from 0.001 μF to 0.005 μF will probably be found to produce the required effect.

The actual inter-connecting plug and wiring used with this unit comprises an octal valve base, a length of twin flex and a similar length of TV 80 ohm co-axial cable. One side of the twin flex is wired to pin 4 (HT positive), the other side to pin 7 (unearthed heater). Inner wire of co-axial to pin 5 (6V6 grid

continued on page 413

LARGE SCREEN TV.

THE RADIO CONSTRUCTOR'S 16 inch TELEVISOR

PART FOUR

Before proceeding to the timebases, the attention of constructors is drawn to the modifications to be carried out on vision strips. It is assumed, of course, that there is one in existence, but in the event that any reader requires a complete vision strip we strongly advise them to secure a copy of "Inexpensive Television." Several well-proven circuits, both of home built and modified surplus units, are given in this publication. These may easily be modified to the stages given here. The detector stages are easily recognised, although to avoid confusion it may be mentioned that sometimes detection and DC restoration are combined in a double-diode.

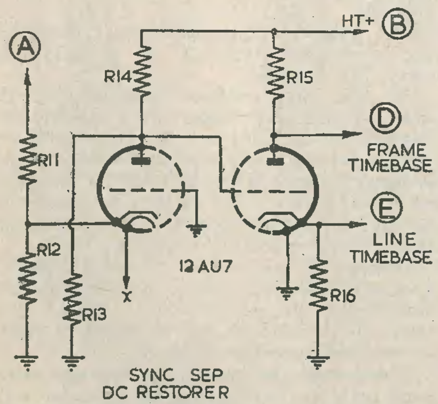


FIG.13
CIRCUIT OF SYNC SEPARATOR
(ON SAME CHASSIS AS TIMEBASES)

C638

For values see page 405

In any receiver to be used, the modifications required begin directly after the last tuned circuit.

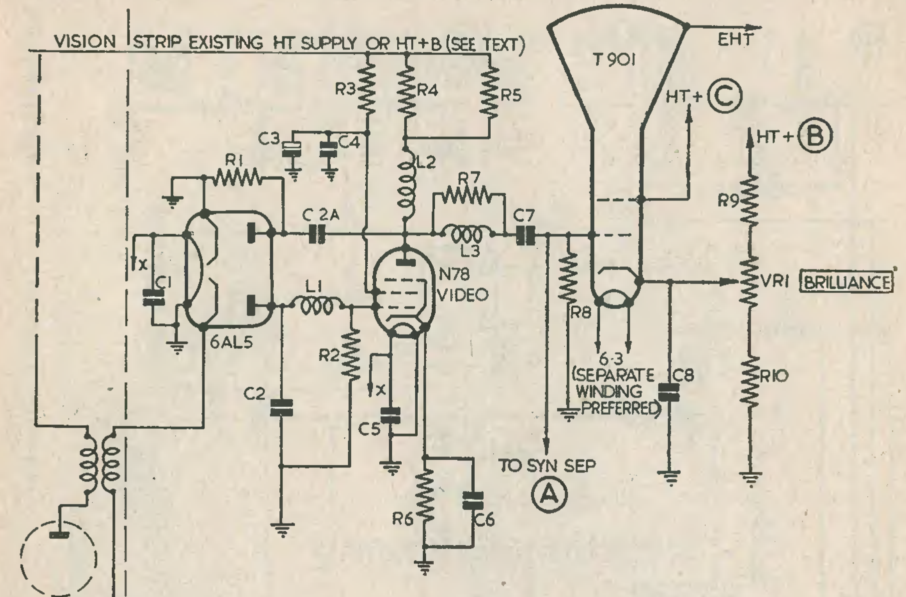
The new detector is combined with a noise limiter which effectively clips those annoying interference peaks emanating from ignition sources, etc., and this is well worth while including.

The output from the detector is fed into a video correction choke L1: three such chokes, L1, 2 and 3, are required, and these should be identical. Commercial chokes are readily obtainable, but again details of suitable home wound inductors are to be found in the above mentioned book. The inclusion of three chokes in the vision strip was found to be of tremendous advantage, the bandwidth being maintained after amplification by the video stage with a consequent improvement of detail in the final picture.

A number of valves were tried in the video stage, but with none was achieved such definite colour shading from peak-white to black as with the N78.

The sync separator is very simple, yet an excellent interlace is obtained, due to the clean, large pulse amplification derived from the N78. One half of the sync valve is devoted to DC restoration, and its close proximity to the modulated grid of the T901 ensures a clean picture. Background, as an instance, can be seen with a noticeably more defined detail.

The 2 MegΩ resistor added to the grid of the tube is not essential, but is added to guard against accidental failure to join the connections marked "A." This resistor should be wired on the installation in close proximity to the tube. Readers may know, to their cost, what happens when a grid is left 'in the air.' In any case, it would be quite impossible to black out the tube, and no variation of the Brilliance Control would achieve this.



LAST TUNED STAGE ON VISION STRIP

FIG.14
NEW DETECTOR & VIDEO STAGES + NOISE LIMITER

C637

For values see page 405

Note: Attention is drawn to the various connections from HT, and to the requirements of the focus coil. Permanent magnet focusing is not too satisfactory, at the present time, for such beam intensities as are used in 16" TV. In consequence, a rather large current is required to flow through the focus coil. It may, in fact, be necessary to arrange for the HT supply to the video and sync stages to pass through the focus coil to ensure a sufficiently large current flow. This measure should only be put into effect when the constructor is convinced that no optimum position can be found when setting the coil on the tube, or with full swing carried out with both focus control and pre-set variable resistors VR7 and VR8, or with the most careful setting of the ion trap magnet. (See last issue).

The Frame Timebase

So much has been written about timebases that the reader is surely familiar with the operation of the several different types in general use. Oddly enough, the greater number of failures examined by the writer have been caused by bad soldering. Constructors are urged to make absolutely certain of the mechanical soundness of their work before blaming the circuit or components. All components should be checked before use, where possible.

The list of components given is of those actually used by us in the prototype. Alternatives may, of course, be employed in many instances, but in others there is always the possibility that results may be affected to some extent. We should advise, in particular, the use of the valve types shown. The Brimar 6CD6G line output, for instance, withstands exceptional flyback voltages, whereas other types may possibly collapse.

Readers should note that the sync and oscillator valves must be wired so that a 6.3V heater supply be may used. The 12AU7 requires that pins 4 and 5 be joined together to form one heater connection, pin 9 being taken to chassis for the other.

The frame blocking oscillator transformer

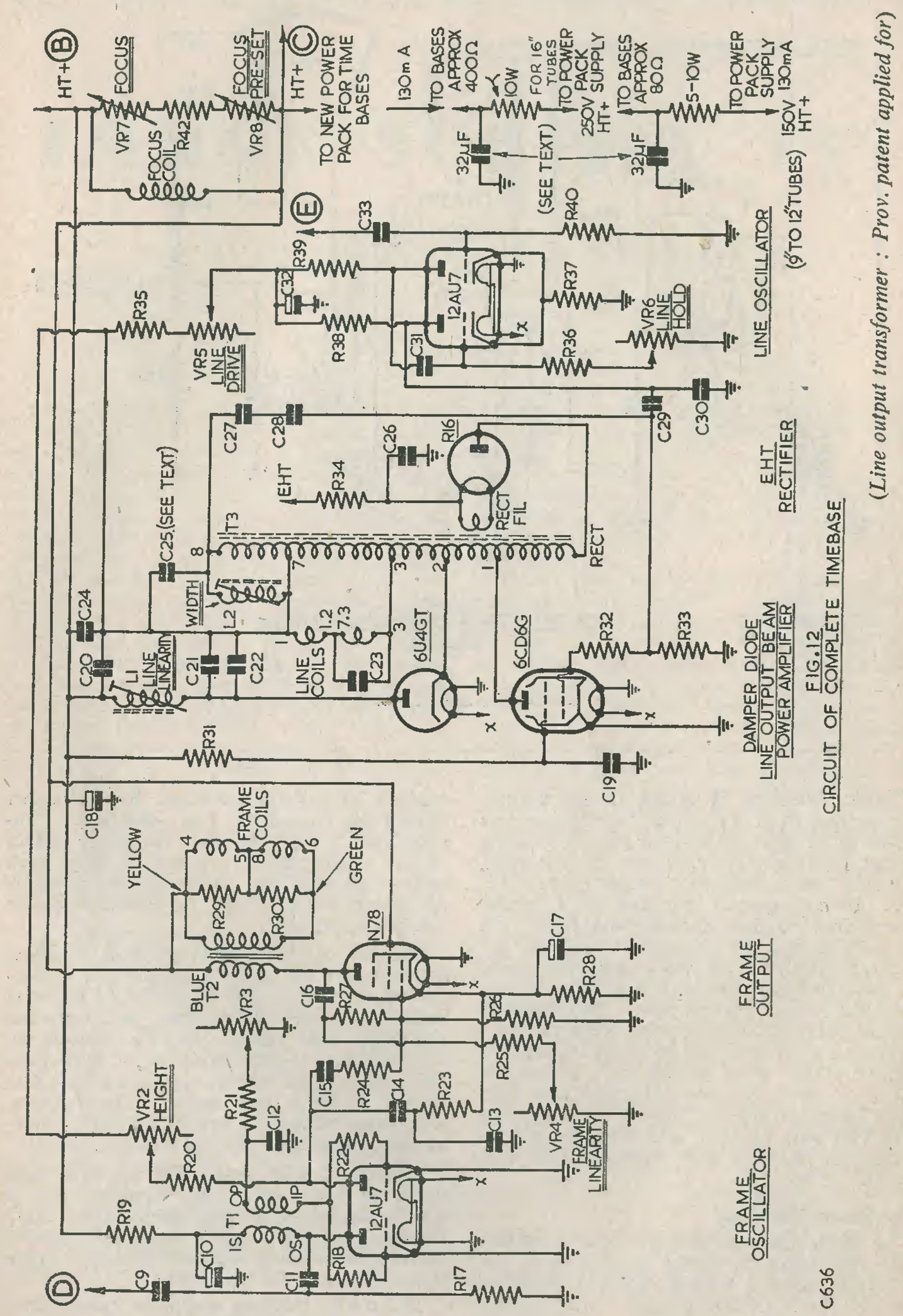


FIG. 12 CIRCUIT OF COMPLETE TIMEBASE

(Line output transformer : Prov. patent applied for)

LIST OF COMPONENTS USED IN THE PROTOTYPE

Resistors

R1, 4.7 MegΩ ±20% /¼W Erie
R2, 5.1 kΩ ±20% ¼W Erie
R3, 22 kΩ ±20% ¼W Erie
R4, 10 kΩ ±20% ¼W Erie
R5, 10 kΩ ±20% ½W Erie
R6, 47 Ω ±20% ¼W Erie
R7, 22 kΩ ±20% ¼W Erie
R8, 2 MegΩ ±20% ½W Erie
R9, 100 kΩ ±20% ¼W Erie
R10, 68 kΩ ±20% ¼W Erie
R11, 5.1 kΩ ±20% ¼W Erie
R12, 220 kΩ ±20% ¼W Erie
R13, 1 MegΩ ±20% ¼W Erie
R14, 3 MegΩ ±20% ¼W Erie
R15, 33 kΩ ±20% ¼W Erie
R16, 3.3 kΩ ±20% ¼W Erie
R17, 100 kΩ ±20% ¼W Erie
R18, 10 kΩ ±20% ¼W Erie
R19, 220 kΩ ±20% ¼W Erie
R20, 470 kΩ ±20% ¼W Erie
R21, 100 kΩ ±20% ¼W Erie
R22, 10 kΩ ±20% ¼W Erie
R23, 6.8 kΩ ±10% ¼W Erie
R24, 220 kΩ ±20% ¼W Erie
R25, 68 kΩ ±20% ¼W Erie
R26, 2 MegΩ ±20% ¼W Erie
R27, 3 MegΩ ±20% ¼W Erie
R28, 220 Ω ±20% ¼W Erie
R29, 470 Ω ±20% ¼W Erie
R30, 470 Ω ±20% ¼W Erie
R31, 10 kΩ ±20% 2W Erie
R32, 47 Ω ±20% ¼W Erie
R33, 1 MegΩ ±20% ¼W Erie
R34, 47 kΩ ±20% High Voltage type Erie
R35, 22 kΩ ±20% ¼W Erie
R36, 47 kΩ ±20% ¼W Erie
R37, 2.2 kΩ ±20% ¼W Erie
R38, 220 kΩ ±20% ¼W Erie
R39, 47 kΩ ±20% ¼W Erie
R40, 330 Ω ±20% ¼W Erie

Potentiometers

VR1, 100 kΩ (with on-off switch if required) Morganite
VR2, 2 MegΩ Morganite
VR3, 100 kΩ Morganite
VR4, 100 kΩ Morganite
VR5, 100 kΩ Morganite
VR6, 100 kΩ Morganite
VR7, 500 Ω wirewound Colvern
VR8, 500 Ω wirewound pre-set Colvern

HT voltage droppers—see diagram and text.

Condensers

C1, 1,000 pF T.C.C.
C2. 10 pF T.C.C.
C2A, 0.05 μF T.C.C.
C3, 8 μF 350V wkg. T.C.C.
C4, 1,000 pF T.C.C.
C5, 1,000 pF T.C.C.
C6, 2,200 pF T.C.C.
C7, 0.1 μF 350V wkg. T.C.C.
C8, 0.1 μF 350V wkg. T.C.C.
C9, 0.001 μF T.C.C.
C10, 32 μF 350V wkg. T.C.C.
C11, 22 pF T.C.C.
C12, 0.1 μF T.C.C.
C13, 0.01 μF T.C.C.
C14, 0.1 μF 750V wkg. T.C.C.
C15, 0.5 μF 750V wkg. T.C.C.
C16, 0.1 μF 500V wkg. T.C.C.
C17, 50 μF 12V wkg. T.C.C.
C18, 32 μF 500V wkg. T.C.C.
C19, 0.05 μF T.C.C.
C20, 0.02 μF 500V wkg. T.C.C.
C21, 0.05 μF T.C.C.
C22, 0.01 μF T.C.C.
C23, 47 pF T.C.C.
C24, 0.02 μF 500V wkg. T.C.C.—see text.
C25, 1,000–3,000 pF silver mica T.C.C.—see text
C26, 0.001 μF (CP57HOO) T.C.C.
C27, 82 pF ceramic T.C.C.
C28, 82 pF ceramic T.C.C.
C29, 0.005 μF T.C.C.
C30, 680 pF T.C.C.
C31, 390 pF T.C.C.
C32, 0.5 μF T.C.C.
C33, 47 pF T.C.C.

Coils, Transformers

Deflection Coils Assembly, DC300 Allen Components.
Focus Coils, FC302 Allen Components.
Line Linearity Control, GL16 Allen Components.
Width Control, GL18 Allen Components.
Frame Output Transformer, FO305 Allen Components.
Line Output Transformer, LO308 Allen Components.
Frame Blocking Transformer, K7842 Igranic.

Valves

Detector and Noise Limiter, Brimar 6AL5.
Video, G.E.C. N78.
Sync Sep and DC Restorer, Brimar 12AU7.
Frame and Line Oscillators, Brimar 12AU7 (2).
Frame Output, G.E.C. N78.
Damping Diode, Brimar 6U4GT.
Line Output, Brimar 6CD6-G.
EHT Rectifier (if purchased separate from line output transformer), Brimar R16.

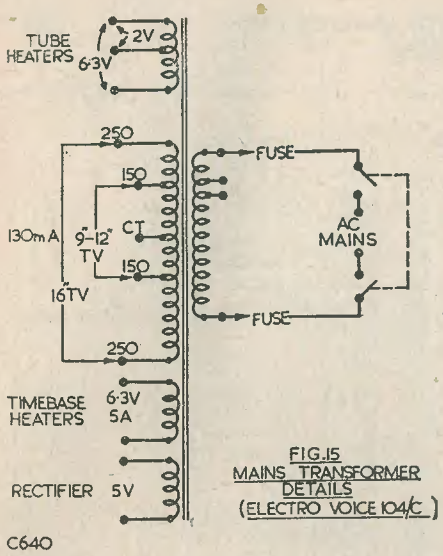


FIG.15
MAINS TRANSFORMER DETAILS
(ELECTRO VOICE 104/C)

is the Igranic Type KP7482, and the clean leading edges to the sawtooth output must be attributable in no small measure to the efficiency of this component.

An N78 was again used as a frame amplifier, and has proven very efficient in this position. Connecting points are shown from the frame output transformer to the deflecting coils, and the resistors R29 and R30 may be soldered direct across the coils for convenience.

The Line Timebase

Some constructional details will be given here, but suggested layout diagrams for the complete unit will be given at a later stage.

C27 and C28, the feedback condensers, should be of the ceramic variety. C23 is soldered to the deflecting coils. C25 should be of high quality, and a silver mica type is very suitable. Due to the variation in quality of the Ferrox-cube, this condenser may have a value of anything between 1,000 and 3,000 pF. Approximately ¼" of scan at each end of the picture may be increased or decreased to suit individual requirements by varying the value of this condenser.

There is a large element of "robbing Peter to pay Paul" in a timebase incorporating flyback EHT, and this should be constantly borne in mind. For instance, if the rail voltage (HT) is raised, usually the scan and EHT outputs increase. In the case of C25, however, this effect is not so obvious, and it may be varied to arrive at a balance between the several factors of HT, valve efficiency, C25 itself, and the resultant picture satisfactory to the constructor's needs.

R34 should be carefully soldered into place to avoid corona or brush discharge, and the sketch will clearly show an approved method. The wire ends are brought round and connecting leads carefully taken over the joins. Solder is added until the joins become to all intents and purposes one piece, finishing off with nicely rounded blobs of solder. **Note:** Care should be taken that the resistor is not overheated, or its value may be altered.

Referring to the EHT rectifier, Allen Components Ltd., inform us that the line output transformer will be available with or without this valve. Constructors intending to furnish their own valve should observe normal EHT technique when attaching the valve to the transformer.

Power Supply Considerations

Caution: Due to the presence of Ferrox-cube in the line output and flyback EHT transformer, the ABSOLUTE MAXIMUM PERMISSIBLE HT transformer output rating is 250V for a 16" tube. For 9" or 12" tubes, it is 140V maximum.

Even these figures are slightly too high, and reference to the timebase circuit will clearly show the arrangement of dropping resistors, subject to the resistance of the smoothing choke employed.

WARNING. Some readers may contemplate using a high voltage mains transformer, and using resistors to drop the excess voltage. **THIS PROCEDURE SHOULD NOT BE ADOPTED.** Should the resistors fail and in so doing cause a direct path of a voltage greatly exceeding the specified HT, a most dangerous situation would arise. The EHT would surge to some 20 kV, and even if the 16" tube was able to withstand this voltage an even more perilous state of affairs would occur. **Gamma and X-rays are present at voltages exceeding 15 kV, and the constructor himself would be exposed to physical damage.**

Should the foregoing transpire when using a smaller tube, it is certain that the tube would collapse, and again the operator would be in peril.

Please believe your writer—it is a risk not to be entertained.

Note: The dropping resistors shown in the circuit diagram are intended as a controlling measure and may in fact not need to be included, as the required resistance may well

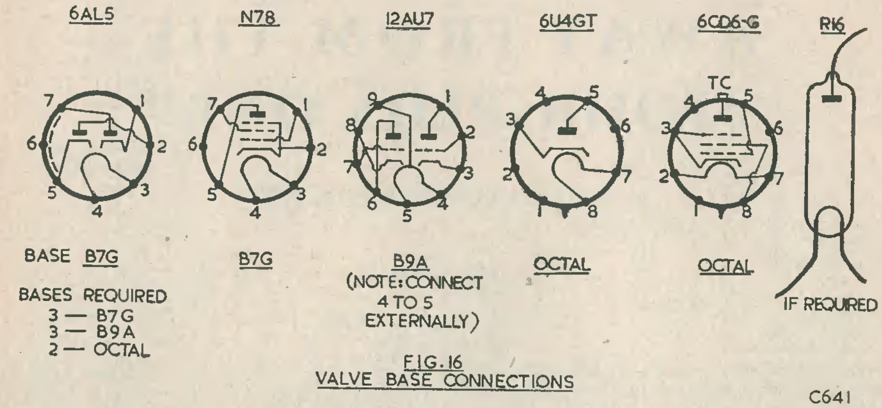


FIG.16
VALVE BASE CONNECTIONS

already be present in the smoothing choke.

Any-Tube Power Supply

In the prototype we took advantage of a most useful mains transformer, the Electro-Voice type 104/C (H. L. Smith Ltd). This component has the following secondaries: 250/150-0-150/250V 150 mA, 6.3V at 5A, 5V rectifier winding, and 2V/6V tube heater winding. A further edition of this transformer is available, known as the 104/D, which gives 250 mA. This is suitable for supplying a complete receiver.

With this transformer, it becomes obvious that the constructor may try out his new timebase on any old tube which is available. Thus, having established a good, linear raster, it is with some additional confidence that his pride and joy—the 16" tube—may be fitted.

Alternatively, there may be many readers who are just commencing TV construction and wish to start with a small tube, or for reasons of economy may wish to increase picture size by instalments. Such a transition is easily accomplished with the circuitry described in this series.

Pointers for Using 9" to 12" Tubes

(1) Ascertain HT voltage is approximately 140.
(2) Ascertain Heater is connected to appropriate tapping.
(3) Wire base to suit tube.
(4) Apply paper wrapping around tube neck to fit deflection coils.
(5) Ion trap magnet may not be required —check on tube data.
(6) R10 may have to be increased in value to 10 kΩ.

No power pack has been described. It is felt that many readers will have suitable well-smoothed units already built up, in which a mains transformer of the type described may be installed.

Points about Connections

Component connection points are clearly shown in the circuit diagram, but there may be some confusion with regard to the deflection coils.

Reference to the frame coils shows Nos. 4, 5, 8 and 6. The reason is, of course, due to the fact that the coils of both frame and line transformers are wound in separate halves. Thus, in the frame coils, when 5 and 8 are joined together this becomes the centre tap as seen in the circuit.

Referring now to the line coils, one half-section is numbered 1 and 1.2, and the other 7.3. and 3. In this case, 1.2 and 7.3. are joined together to form the centre tap. Readers should carefully study this, so that the picture will in all respects be properly polarised.

continued on page 410

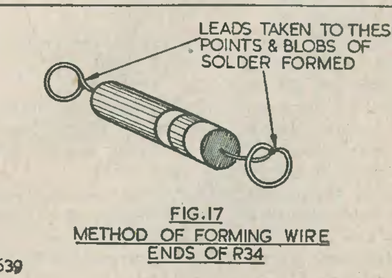


FIG.17
METHOD OF FORMING WIRE ENDS OF R34

AWAY FROM THE "FOUR PLUS ONE"

by F. L. BAYLISS, A.M.I.E.T.

PART THREE

So far in this series, we have considered two 2-valve receivers which, whilst as excellent as possible from the "quality" point of view, are limited in that respect by virtue of the inherent defects of the superheterodyne.

These defects are (a) the possible introduction of modulation distortion due to the use of a valve oscillator (and other causes) and (b) the possibility of a too-narrow IF passband, or a poorly shaped frequency response curve within that band.

There is, too, the high noise-to-signal ratio, compared to a good TRF circuit, unwanted but often unavoidable second-channel interference, and heterodyne whistles resulting from, or rather enhanced by, the ultra-sensitivity of the first stage.

All these defects are, of course, avoided by the use of a TRF receiver, and, indeed, the latter is often chosen by the discriminating constructor who is content with good quality, and local station reception only. (The BBC make very extensive use of TRF circuits).

If, however, such a TRF receiver could be converted to superhet working at the turn of a switch, and without a too-complicated or expensive circuit arrangement, we would get, of course, the best of both worlds—have our cake yet eat it, too—and in the three valve receiver of Fig. 1 this is precisely what has been attempted.

The Circuit—VI

The aerial input is taken via L1—an ordinary aerial coil—to the control grid of V1, a variable-mu RF pentode.

Coil L2 has a main winding tuned to 465 kc/s and a small coupling winding. The former is the anode load on V1; the latter is connected between the suppressor and earth.

L2 is thus a fixed-frequency oscillator coil that heterodynes the aerial signal, to produce a beat of the latter plus 465 kc/s.

This beat frequenty is taken to L3 via C6 and switch S1B.

Coil L3 is an ordinary oscillator coil, but with added turns at the lower end to bring the inductance up to that of an ordinary aerial coil when switch S2B and S2C is switched to "TRF."

For superhet working, however, the additional turns remain out of circuit, and the padding capacitors C9 and C10 are switched into the coil tapping points.

Thus, with S2 switched to "SUPERHET" (as shown in Fig. 1) C13 tunes the V1 beat frequency output, and one gets the much enhanced sensitivity due to the oscillator in the V1 anode circuit.

With S2 switched to "TRF," the padders become inoperative and the additional turns of L3 are brought into circuit. L3 thus tunes as an ordinary HF coil, whilst the coupling coil of L2, now shorted out of circuit by S2A, is no longer operative, and allows the main winding of L2 to function as a medium impedance RF choke.

With S2 switched to "TRF," L3 thus functions as an aperiodically-coupled tuned-grid coil, the secondary of which possesses an inductance similar to that of L1.

Switch S1 (A, B and C) is the wavechange switch, and this functions irrespective of the position of S2.

The Circuit—V2

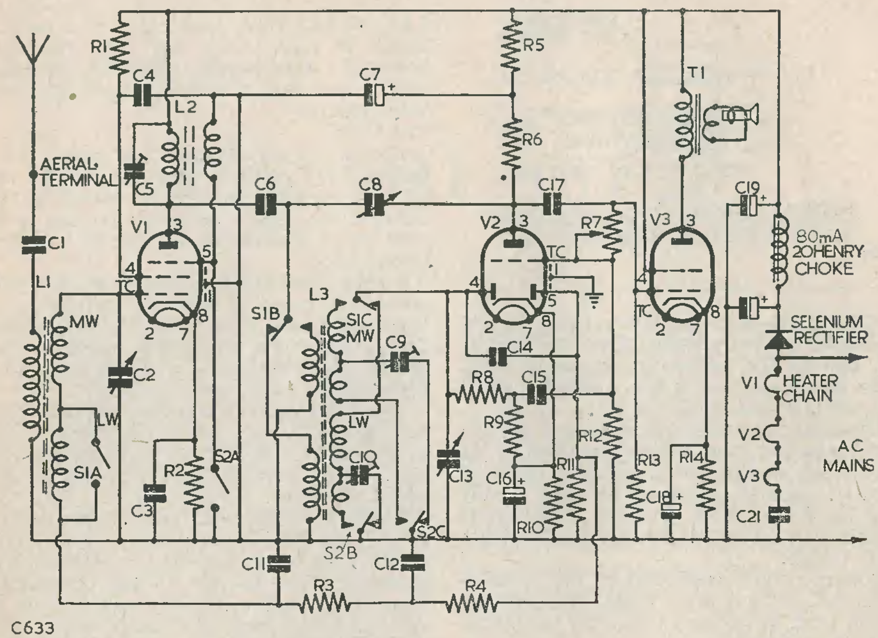
To maintain the quality when the circuit operates at TRF, the tuned signal across L3 is demodulated by one diode of V2, a Mullard EBC33, and then taken to the grid of the triode section of the valve via C15, but without RF filtering. The audio output from V2 passes to V3 via C17, but the RF residual is collected at the anode of V2 and taken, via the reaction capacitor C8, back to the aperiodic winding of L3 to give a reaction boost to the signal and enhanced selectivity when the receiver is working as a superhet.

This use of the input coil as a reaction coil also, is a variation of the original Reinartz circuit, and is capable of very good selectivity indeed. It is essential that the L3 aperiodic windings should be connected in correct (positive) phase, for the functioning of the reaction circuit.

The second diode of V2 supplies AGC. delayed by three volts, to the grid of V1.

The Circuit—V3

When working TRF, there should now be an audio signal of extremely good quality available



LIST OF COMPONENTS FOR FIG. 1

R1,	82 kΩ, ½ watt.	C3, C4, C15, C17,	0.1 μF Tubular Paper.
R2,	330Ω, ,,	C5,	100 pF Preset.
R3, R4, R9, R12, R13,	500 kΩ ,,	C6,	300 pF Mica.
R5,	10 kΩ ,,	C7,	8.0 μF Electrolytic. 350VW.
R6,	100 kΩ ,,	C8,	300 pF Reaction.
R7,	2 MΩ Potentiometer.	C9,	600 pF Preset.
R8,	50 kΩ, ½ watt.	C10,	300 pF Preset.
R10,	2.2 kΩ, ,,	C11, C12,	0.02 μF Tubular Paper.
R11,	1.0 MΩ, ,,	C14,	50 pF Mica.
R14,	500Ω, 1 watt.	C16, C18,	25 μF, 25V Electrolytic.
L1, MW and LW Aerial Coil.		C19, C20,	16 μF + 16 μF ,, 450 VW.
L2, 465 kc/s Coil (see text).		C21,	2.75 μF Mansbridge Paper, 1,000 Volts DC working.
L3, MW and LW Osc.—HF Coil (see text).			
S1, (A, B and C) 3P, 2W Yaxley Switch.		60 mA 20 Henry Choke.	
S2, (A, B and C) 3P, 2W ,, ,,		60 mA 250 volt Selenium Rectifier.	
T1, Output Transformer Ratio 50 : 1, EL32 to 3Ω.		V1. Mullard	EF 39.
C1,	0.002 μF Mica.	V2. Mullard	EBC 33.
C2, C13,	500 pF Two-gang Tuner.	V3. Mullard	EL 32.

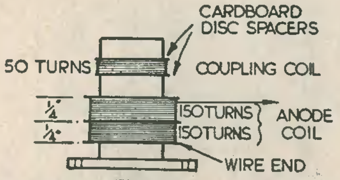


FIG.2
METHOD OF WINDING L2 (⅜" ALADDIN FORMER)
ALL TURNS WOUND IN THE SAME DIRECTION

C634

at C17. This may be taken to a modest push-pull output stage (after phase-splitting) of, say, two EL32's, giving an output of some seven watts, yet with a total receiver current still not in excess of 80 mA HT.

This would seem the logical thing to do, and such an output stage will be described in the next article in this series, but in a different receiver. It may, however, be used equally well in this receiver, but for constructors needing only an output pentode this latter has been shown.

Volume control is effected by the potentiometer R7, giving negative feedback of between 20 per cent. at maximum volume, to 100 per cent. at minimum.

Power Supplies

The three valves specified, connected in series, require 0.2A heater current, and this is accurately supplied (1 per cent. less, in fact) by a 2.75 μF, 1,000 volt paper capacitor, C21.

Alternatively, C21 may be replaced by a 1 kΩ, 40 watt power resistor, or by a ten feet length of 0.2A, 100 Ω per foot, three-way line-cord. Alternatively, of course, the circuit may be powered by a mains transformer and valve rectifier.

The Coils

L1 may be any MW or LW aerial coil—Osmor "Q" coils, for instance—but L2 and L3 will probably have to be wound by the constructor. There are actually very good coils on the market now, suitable for modification to L2.

I refer particularly to the single iron-dust cored coil, tuned to 465 kc/s, that forms the load on the AGC valve in the TR1196 receiver. This, or one coil of an old IFT, would be ideal, and an added fifty turns of 36 swg to form the coupling coil would complete L2.

In the absence of a ready wound unit, however, wind L2 on a ⅜" Aladdin former as shown in Fig. 2. L2 should be tuned to 465 kc/s, either by the core or by C5, with the aid of a signal generator.

Similarly, Wearite PO type coils are suitable for L3, but the additional turns required (and the direction of winding) must be determined by experiment on the part of the constructor, since the author wound his own coil on an Aladdin former, and thus cannot help.

The Aladdin version of L3, however, is given in Fig. 3, and the constructor should have no difficulty in interpreting the sketch.

An RF Stage

The receiver may, of course, be preceded by an RF stage—another EF39, for instance—without materially affecting the value of C21 but even as it is should be found quite sensitive enough on either "TRF" or "SUPERHET" for receiving all the more powerful home and foreign transmissions, at good volume.

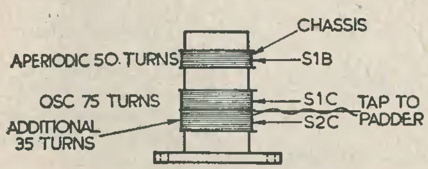


FIG.3(a)
MEDIUM WAVE L3 COIL. ALL TURNS WOUND IN THE SAME DIRECTION

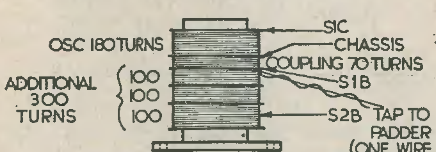


FIG.3(b)
LONG WAVE L3 COIL

C635

LARGE SCREEN TV.

continued from page 407

Care should be taken to avoid damaging or obliterating identification letters and numbers on components during assembly.

The connections to the focus coil may be reversed. This is subject to the amount of shading observed on the picture.

Acknowledgment

The *Radio Constructor* gratefully acknowledges the kind co-operation of Messrs. IKO Patents in the development of the circuit given here, and that of other manufacturers in regard to the constructional problems which arose.

Mainly for the Beginner . . .

THE CAPACITOR

By H. E. SMITH, G6UH.

The Capacitor

The Capacitor, commonly known as the "Condenser," is, in its various forms, one of the most important components in any radio receiver, amplifier, or power supply. Most types of capacitor consist of two or more metal plates insulated from each other. The insulating medium, whether it be air, waxed paper, mica, or any other insulating material, is called the "dielectric." When a DC voltage is applied to a capacitor, a steady current cannot flow because of the "dielectric," but it will become "charged" i.e. one plate, or set of plates, will be given an excess of electrons, while the other will be deficient in electrons, the former being negatively charged and the latter positively charged. When a capacitor is used in circuits where *Radio Frequency* is concerned, such as for the tuning capacitor for an RF amplifier, we must remember that Radio Frequency (or high frequency) is an *alternating* voltage, and when this is applied across the capacitor, quite different things happen. The capacitor becomes charged first in one direction, and then the other, at the frequency of the voltage applied. It is an interesting thought, that on a frequency of 14 Mc/s this rapid charge and reverse charge takes place 14,000,000 times per second. This phenomena is actually equivalent to an alternating current flowing *through* the capacitor, and thus capacitors are used to prevent the flow of direct current while allowing the passage of alternating current.

Capacitors offer a certain resistance or impedance to the passage of the alternating currents. This is known as capacitive reactance. It is expressed in ohms, and its value is inversely proportional to the capacitance and the frequency of the voltage applied. The formula for arriving at the capacitive reactance is:—

$$X_c = \frac{10^6}{2\pi f C\,(\mu F)}$$

where X_c = Reactance in ohms
π = 3.1416 f = Frequency in cycles
C = Capacitance in microfarads.

Reactance/frequency charts are given in most handbooks, and are extremely useful for ascertaining the impedance offered by a certain

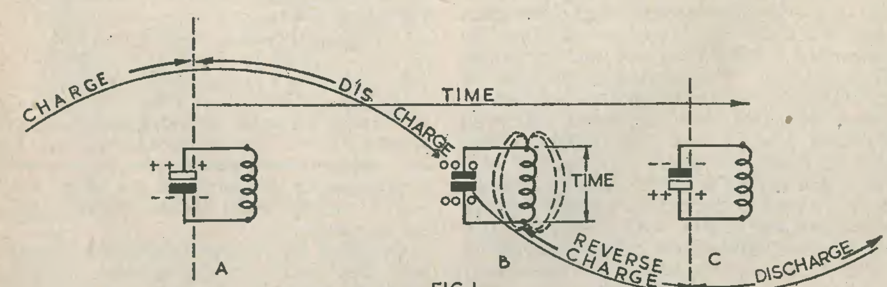


FIG.1
DEPICTING CHARGE & REVERSE CHARGE OF A CAPACITOR IN ALTERNATING VOLTAGE CIRCUIT (RADIO FREQUENCY OR A/C)

C631

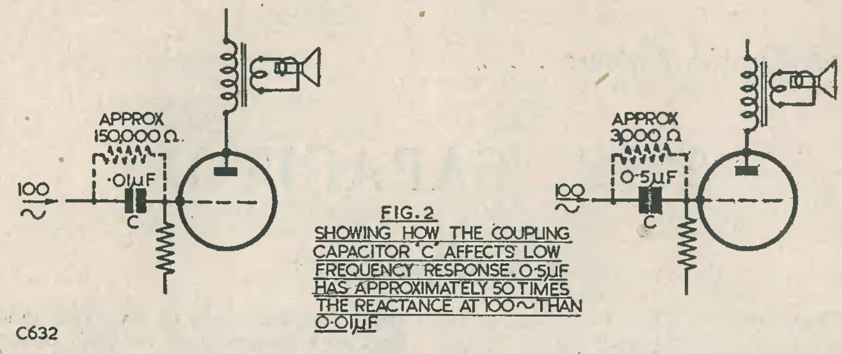


FIG. 2
SHOWING HOW THE COUPLING CAPACITOR "C" AFFECTS LOW FREQUENCY RESPONSE. 0·5μF HAS APPROXIMATELY 50 TIMES THE REACTANCE AT 100~ THAN 0·01μF

value capacitor for any given frequency. Capacitors may be connected in parallel to obtain a greater total capacitance, or in series. The series connection allows the use of capacitors designed for a certain working voltage to be used in circuits exceeding that voltage. When used in this manner, the total capacitance is lowered, and if, therefore, two 500 pF capacitors are wired in series, the total capacitance in circuit is 250 pF. The formula for capacitors in parallel is one of simple addition of each value, while that for several in series is as follows:—

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3} \text{ etc.}$$

For only two in series, it becomes slightly simpler:—

$$C = \frac{C1 \times C2}{C1 + C2}$$

From this point, we could discourse on the use of a capacitor in power supplies or its value as a decoupler for radio frequencies, but it may be more interesting to see what the relationship is between a coil and capacitor, and frequency. The capacitor and coil in Fig. 1 (A) are, for the purposes of this comparison, imagined to be connected up in an oscillatory circuit, and the capacitor has become initially charged. In a fraction of a second this charge is short circuited through the coil, causing the electro-magnet lines of force as shown in Fig. 1 (B). This electro-magnetic field immediately collapses at the end of the cycle, and the capacitor immediately re-charges in the opposite polarity. This sequence repeats itself at the same speed for a given value of capacitor and a given inductance. If the capacitor is made smaller, the time taken to charge and discharge it will be correspondingly less. The whole system is thus speeded up and oscillations take place at a higher frequency. If the capacitor is left of the same value, and the inductance of the coil decreased, the *inductive* reactance is decreased, and the time taken to discharge the capacitor through the inductance is decreased, also resulting in a higher frequency being developed within the system.

Thus it will be understood that the smaller the capacitor value, and/or the smaller the inductance, the higher will be the resultant frequency of operation. If this coil and capacitor are now visualised as being wired into the grid circuit of an RF amplifier or detector grid circuit of a SW Receiver, it will be seen that in order to receive a signal on, say, 14 Mc/s the capacitive and inductive values must be suitable to *resonate* the circuit at this frequency. The capacitor, usually referred to as C, and the inductance referred to as L, are usually combined in the term L/C ratio. Some L/C constants for Amateur Band operation are:—

Mc/s	L(μH)	C(pF)	LxC
7	22.5	22.5	506.25
14	11.25	11.25	126.55
28	5.63	5.63	31.64

These L/C ratios would perhaps be considered " low C " in actual practice. A " high C " circuit would contain an inductance of approximately one tenth of the above value, with a corresponding increase in the value of the capacitor.

Doubling the value of both the capacitor and the inductance *halves* the frequency. Reducing the value of both by one half *doubles* the frequency. Doubling the frequency can also be achieved by reducing the value of one *or* the other to one quarter of its original value.

Capacitive reactance is utilised a great deal in tone control and coupling circuits. Taking a simple resistance coupled amplifier with a coupling capacitor of 0.01 μF, its reactance at a frequency of 80 cycles per second is approximately 200,000 ohms. Not much chance of getting any really good bass response from this amplifier! Raise the value of the coupling capacitor to 0.5 μF and we obtain a reactance figure of only 5,000 ohms at 60 cycles, falling to 40 ohms at 8,000 cycles. (Fig. 2). By using the correct value of capacitor in a " tone control " or " top cut " circuit, such a capacitor will present almost a short circuit to the higher audio frequencies while the lower frequencies remain unaffected.

3-WATT AUDIO UNIT

(*Continued from p.* 401)

input) and the outer screening wired to pin 2 (earth, heater, HT negative). An additional lead will be required where a 4 volt heater feed is employed—in addition to the existing 6 volt supply.

For bench work the leads may be terminated with insulated clips for quick connection to apparatus under test. It will be seen that the unit may be employed as a power unit, and when used in this manner the 6V6 should be removed.

Conclusion

Under normal operating conditions the output of the audio unit should be around 3 watts (about equal to the average 4 valve domestic receiver) and it is capable of good all round quality using an 8-in. or 10-in. PM speaker.

Some careful tests have been made using an RF feeder unit employing an EF39 RF stage, ECH35 frequency changer, EF39 IF and EBC33 output to the 6V6 feeding two 8-in. speakers. The over-all results were very satisfactory, with more than 'average room' volume. Considering its humble cost, the audio unit will very quickly pay dividends for the time spent in its construction.

CATALOGUE RECEIVED

We have received from Henry's Radio, of 5 Harrow Road, London, W.2., a copy of their new catalogue, containing 28 pages packed full of items of interest to the radio enthusiast. Attractively produced on art paper, the catalogue is obtainable at 3d. post free on application to the above address.

International Radio Controlled Models Week-End - Blackpool 1952

On August 16th and 17th, 1952, the above Radio Controlled Models event for Boats and Aircraft will be held at Blackpool, Lancashire, and it will be the first joint event of its kind to be held in England, with an International Contest for Model Boats on the Saturday (16th August) and an International Contest for Model Aircraft on the Sunday (17th August). The latter event will be held on the Stanley Park Aerodrome, Blackpool, commencing at 10 a.m., and the Boats Contest will be held on a portion of the Lake in Stanley Park, Blackpool. This Contest will have sections for all types of radio controlled boats.

Printed copies of the rules for these contests will be available about April 30th, along with entry forms, etc., and anyone interested should send a stamped addressed envelope now to the address below, and all details will be sent as soon as available.

There have been hints from both the U.S.A. and India that they may be represented, and Sweden and France have also intimated that they will in all probability be competing in one or other of the Contests.

Both contests are being organised by the International Radio Controlled Models Society, and an interesting and enjoyable week-end is anticipated at Blackpool for August 16th and 17th, 1952.

Details, etc., may be obtained from— Mr. R. Lawton, 10, Dalton Avenue, Whitefield, Near Manchester (WHItefield 2781).

MAILBAG

Help Wanted

Dear Sirs,

I am writing to you with a request for assistance, if it be in your power to do so.

Is it possible for you to supply, either from your library, or to purchase, a copy of the circuit diagram of H.R.O. Junior, as I have come into possession of one of these receivers, and unfortunately, it has suffered some damage through misuse, which I would like to rectify if at all possible, but without circuit am somewhat at a loss. I would be extremely grateful if you could assist me in this matter, and inform me at your earliest convenience, whether available, or/and, cost of purchase or charge on loan.

Yours faithfully,
G. C. Barrow.
45, Old Oscott Hill,
Kingstanding,
Birmingham, 22.c

COMPONENT REVIEW

PREMIER 3-BAND COIL PACK

(Premier Radio Co., 207 Edgware Road, London, W.2.)

Premier Radio of 207 Edgware Road, London, W.2., have favoured us with a sample 3-Band coil pack, of which they have a limited number for disposal at the bargain price of 29s. 6d.

The unit is completely wired and pre-aligned, and is most useful in that it incorporates an RF stage. The ranges covered are 13–30, 40–120 and 200–557 metres when tuned with a standard 500 pF tuning gang. The oscillator section is designed to work with 465 kc/s IF's.

This pack has obviously been designed and built with a view to obtaining high efficiency. Air dielectric trimmers are incorporated, and the medium wave coils are Litz wound. The SW coils in the RF section are wound with extra heavy gauge wire.

Mechanically the construction is very rigid, heavy gauge aluminium being used throughout, and each section is screened from the others. The switching is so arranged that all coils not in use on any one band are earthed to avoid any absorption effects. The over-all measurements are 6″ × 4½″ × 2¼″.

A circuit of an AC mains 3 band receiver, designed by Premier Radio for use with this coil pack, is reproduced here, together with a list of component values.

COMPONENT VALUES FOR CIRCUIT ON NEXT PAGE

Valves

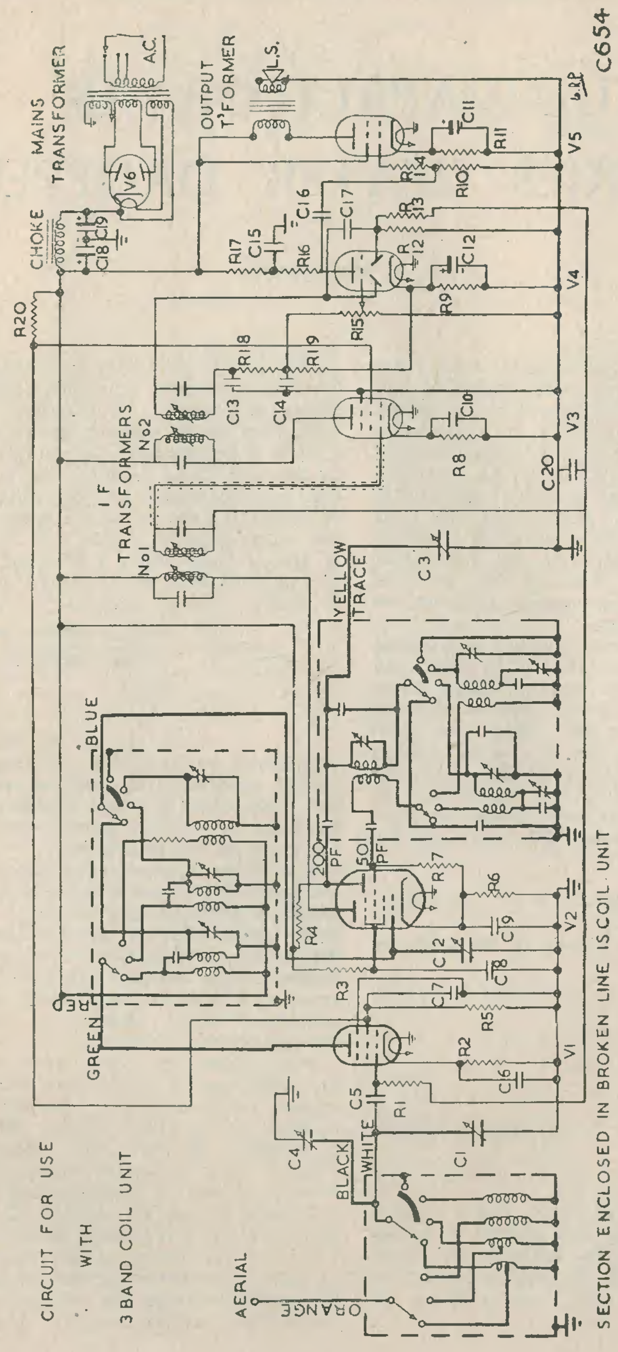
V1.	R.F. 6K7 or equivalent
V2.	F.C. 6K8 or equivalent
V3.	I.F. 6K7 or equivalent
V4.	Det. 1st L.F.6Q7 or equivalent
V5.	Output 6V6 or equivalent
V6.	Rec. 5Z4 or equivalent

Condensers

C1,2,3	500 pF 3 gang Condenser
C4.	Aerial Trimmer
C5.	100 pF Silvered Mica ±20%
C6,7,8,9,10	0.1 µF Tubular 500v D.C.
C11.	25 µF P.V.30 Electrolytic
C12.	25 µF P.V.12 Electrolytic
C13,14.	100 pF Silvered Mica ±20%
C15.	1 µF Tubular 500v D.C.
C16.	0.05 µF Tubular 500v D.C.
C17.	20 pF Silvered Mica ±20%
C18.	16 µF Electrolytic 500v wkg.
C19.	8 µF Electrolytic 500v wkg.
C20.	0.1 µF Tubular 500v D.C.

Resistors

R1	470 kΩ ½ watt
R2	300Ω ¼ watt
R3	150kΩ ¼ watt
R4	39kΩ ½ watt
R5	47kΩ ½ watt
R6	470Ω ½ watt
R7	47kΩ ½ watt
R8	470Ω ½ watt
R9	1kΩ ½ watt
R10	470kΩ ½ watt
R11	300Ω ½ watt
R12	470kΩ ½ watt
R13	470kΩ ½ watt
R14	22kΩ ½ watt
R15	1 MegΩ Volume Control
R16	22kΩ ½ watt
R17	10kΩ ½ watt
R18	100kΩ ½ watt
R19	470kΩ ½ watt
R20	39kΩ ½ watt



Circuit Designed and Recommended by Premier Radio For use with their Coil Pack described on previous page

THE CAPACITOR AS A SERIES HEATER DROPPER

by **W. E. THOMPSON**

The practice of connecting some form of resistor in series with valve heaters so that they may be connected directly to the supply mains in AC/DC receivers is well-known, but the employment of a suitable capacitor in place of this resistor for purely AC operation does not seem to be so widely appreciated among constructors. Perhaps if we have a quick look over the theoretical considerations for the resistor case we shall better understand how a capacitor can be used in its stead, and more readily recognise the advantages it can offer.

Fig. 1 depicts the heater circuit of a typical superhet, using 6KA, 6K7, 6Q7, 25L6 and 25Z4. Each of these has its heater rated at 0.3A, so no shunt resistors are required for them. The two dial lamps are 6.3V 0.3A each. Adding the individual voltage ratings gives the total voltage drop E_h along the heater chain, 81.5V, so the voltage E_r to be dropped by the series resistor R must be the difference between this value and the mains voltage, that is,

$$E_r = E_m - E_h$$
$$= 240 - 81.5$$
$$= 158.5 \text{ volts.}$$

The current in the circuit is 0.3A, so by Ohm's Law.

$$R = \frac{E_r}{I_h}$$
$$= \frac{158.5}{0.3}$$
$$= 528.3 \text{ ohms.}$$

The watts dissipated by this resistor will be,

$$W_r = E_r \times I_h$$
$$= 158.5 \times 0.3$$
$$= 47.55 \text{ watts.}$$

It is immediately apparent that a resistor capable of dissipating this amount of power must, of necessity, be fairly large. It is also clear that nearly 50 watts is being converted into wasted heat, and is doing no useful work in the set.

The resistor itself can be of several forms, the most convenient being either a line cord, a mains dropper, or a barretter. The line cord takes up no space in the set and therefore is very practical for midget sets, but on the other hand it usually has to be longer than actually needed for the primary purpose of connecting the set to the mains, owing to the ohms-per-foot rating of such cords. A typical value for a 0.3A cord would be 60 ohms per foot, so a cord for our resistor R in Fig. 1 should be,

$$\text{Length} = \frac{\text{Required resistance}}{\text{Ohms per foot}}$$
$$= \frac{528.3}{60}$$

× 8. 8ft., or 8 ft. 10 ins.

It should be noted that this length is fairly critical, so should the cord become damaged and need repair, it is not possible to shorten it except by a small amount, otherwise the valve heaters will be over-run.

The mains dropper type resistor, mounted within the set, dispenses with the rigid requirement of specified length for a connection cord, since ordinary flexible lead of any length can be employed. As stated earlier, however, this resistor will give off a fair amount of heat, and this aspect needs to be considered when allotting a position for the component in the set.

With either the above type of resistor, the regulation is poor, since the resistance cannot compensate for changes in voltage or current to any large degree. The barretter is designed to have good regulation over a fairly wide range of voltage change, so it makes automatic compensation for normal variations in supply voltage. Due to this design feature, it is possible to add or subtract valves in the heater chain without having to make adjustment to the series dropper; the barretter keeps the voltage across the heater chain sensibly constant. It is, perhaps, more correct to say that the barretter keeps the current constant, for that is its true action, but if the current is kept constant the voltage drop across the heater chain must obviously be corrected automatically, within the limits of control the barretter can handle.

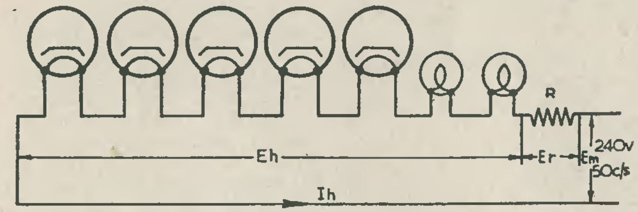


FIG. 1

C620

This method of losing unwanted voltage still does not overcome the heat problem, and in addition to this the barretter itself is not a very rugged component. The thin iron wire filament is rather frail, and it is possible that frequent failures are the main reason for the barretter not being popular.

Thermistors have characteristics which enable some regulation to be attained, and they are quite small, but again their operating temperature is high, so care has to be taken in positioning them with relation to other components.

It seems, then, that whatever we do, we are up against either heat where it is not wanted, or length and size where it is not convenient to have it. Here is where a capacitor can, at one fell swoop, eliminate the heat problem entirely, for it will consume no power and therefore give off no heat. Capacitors take up space, however, so are not always the ideal answer where midget sets are concerned. The size is governed to some extent by the voltage rating, which must be a primary requirement.

In Fig. 2, R has been replaced by a capacitor C. Our problem here is purely simple mathematics and the application of a little AC theory. C must, of course, simulate R, but we must take account of the out-of-phase voltage across C. In a capacitor of low power factor, the resistive component is negligible, and for all practical purposes the impedance has the same value as the reactance, so we will base our calculations on this logical assumption.

The mains voltage, due to the phase angle introduced by C, is the vectorial sum of the voltages across the heater chain and C in series, that is,

$$E_m^2 = E_h^2 + E_c^2$$
$$\text{so } E_c^2 = E_m^2 - E_h^2$$
$$\text{and } E_c = \sqrt{E_m^2 - E_h^2}$$
$$= \sqrt{(E_m + E_h)(E_m - E_h)} \quad .. \quad (1)$$

Now the capacitive reactance,

$$X_c = \frac{E_c}{I_c} \text{ where } I_c \text{ is current in } X_c$$

And since I_c is the same as I_h

$$X_c = \frac{E_c}{I_h}$$

Therefore, from (1),

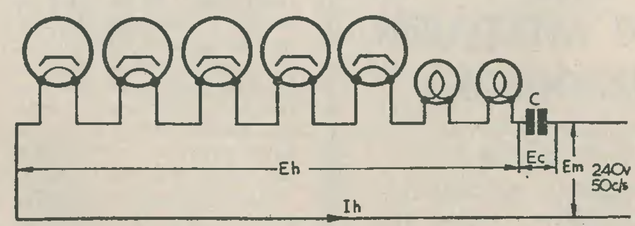


FIG. 2

C621

$$X_c = \frac{\sqrt{(E_m + E_h)(E_m - E_h)}}{I_h} \quad .. \quad (2)$$

In terms of frequency, the capacitive reactance can also be expressed as,

$$X_c = \frac{10^6}{2\pi f C} \text{ where C is in } \mu F$$

$$\text{from which } C = \frac{10^6}{2\pi f X_c} \mu F \quad .. \quad .. \quad (3)$$

Applying in (3) the term for X_c obtained in (2), we derive a general formula,

$$C = \frac{10^6 \times I_h}{2\pi f\sqrt{(E_m + E_h)(E_m - E_h)}} \mu F$$

And as 50 c/s is the standard mains frequency in this country, we can simplify this still further to,

$$C = \frac{10^4 \times I_h}{3.14\sqrt{(E_m + E_h)(E_m - E_h)}} \mu F \quad .. \quad .. \quad .. \quad (4)$$

We can now insert in this formula the values which are known in Fig. 2 to find the value of C required, thus,

$$C = \frac{10^4 \times 0.3}{3.14\sqrt{(240 + 81.5)(240 - 81.5)}}$$

$$= \frac{3 \times 10^3}{3.14\sqrt{(321.5 \times 158.5)}}$$

$$= \frac{3000}{708.3}$$

$$= 4.232\ \mu F.$$

A suitable combination of capacitors in parallel can now be chosen to make up this value (preferably by measurement on an accurate bridge).

If one cares to plot a curve assuming constant mains voltage and heater current, it will be seen that the line representing capacitance is fairly straight over a range of heater chain voltages from zero to about 80. Above this value the curve tends to rise exponentially, indicating that the regulating effect is becoming less efficient. It behoves us, then, to keep the heater chain voltage below 80, and the smaller we can make it the better. For instance, take the case of four 6.3V 0.2A valves in series—for these, C works out to 2.668 µF. If now we want to add one valve in the chain, we find that under these new conditions C needs to be 2.675 µF. This is a difference of only 0.007 µF, which can be neglected. Taking things the other way, for only three valves we find that C becomes 2.661 µF; which is again a difference of 0.007 µF. A value of 2.67 µF would therefore cater adequately for either three, four or five 6.3V 0.2A valves, without adjustment.

There are some precautions we must observe concerning the capacitor. It must have a fairly high DC working volts rating, and 2½ times the R.M.S. voltage of the mains should be regarded as the minimum. Obviously, since raw AC is imposed, electrolytic capacitors must not be used; good quality paper, preferably oil-impregnated, components being necessary.

Small power factor is imperative; even slight leakance is sufficient to make the capacitor hot under load, and it will soon break down. Consequently, capacitors such as these with high insulation will hold a charge for some time after the mains have been switched off, so it is good policy to wire a 0.5 megohm or 1.0 megohm ½W resistor directly across the tags of the capacitor, so as to discharge it. This resistor should have no adverse effect upon the working of the capacitor.

Although it can be shown theoretically that under certain conditions of the input waveform a heavy momentary surge can take place at the moment of switching on, the chances of hitting the right spot for this to occur are comparatively small, and even if one did, the duration of such transient is rather shortlived. The thermal inertia of valve heaters would appear to be capable of withstanding such very short pulses without much bother, but quick-heating devices like dial lamps might on the odd occasion be caught in a weak moment, when of course they would have a glorious but brilliant career before dying. Despite the likelihood of this happening, I have yet to experience it in the small superhet we use at home. It has been working with a capacitor dropper quite a long time now, long enough, one would think, to have had at least one of the two dial lamps burn out. This set consumes a little over 18 watts for heater and HT power. With a resistance dropper this figure would be over 50 watts. To my mind, this speaks volumes for the capacitor dropper.

One final point—the aerial and earth must be connected via suitable isolating capacitors, as is usual for sets with direct connection to the mains.

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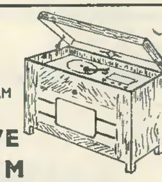

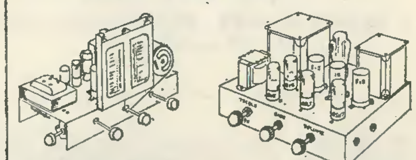

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