Radio Constructor

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Editorial

WHAT THEN?

THE average constructor to-day differs in many respects to his counterpart of yester-year. The components he uses are more efficient, he has generally speaking a greater grasp on theory, his work is more comparable to professional standards, he is more inclined to think things out for himself and he does not try to follow those "practical" point-to-point wiring diagrams of the 1920's. There are dozens of comparisons—mostly to the constructor's credit.

There has been, in the past few years, however, a new factor to contend with. It has caused a somewhat drastic change in the outlook of most constructors and can be boiled down to two words only—Surplus Gear.

It is not to the old hand that we are now directing our observations, but to the newcomer—the enthusiast who started his radio activities since surplus gear has been available. This surplus radio gear has many virtues—but it has its vices as well.

It is cheap, on the whole, and has given many youngsters, who would not be able to afford the price of entirely new components, the opportunity to make a start in the hobby. Communication receivers—and transmitters—are within reach of most people, generally at a cheaper price than if they were a manufacturer's commercial product. One may also buy surplus chassis at a few shillings merely to strip down for the components—thereby saving many times the purchase price. These are some of the advantages; but what of the snags?

Many newcomers to the hobby have never really built much in the way of radio gear. They use surplus receivers, frequency meters, even transmitters, and yet have not actually constructed anything similar themselves. From the angle of progress this is a bad start, though financially it may be necessary to adopt this course. Who can argue when they say "It's cheaper to buy a surplus transmitter than to build one." This is, of course, a very strong point, but is it really amateur radio? Using all ready-built gear one becomes not a radio amateur but merely an operator.

So, in view of the preceding remarks, what will happen when surplus gear comes to an end? It cannot last for ever and many items are already showing signs of "drying up." One day we will find that most of it has come to an end.

When this state of affairs materialises what of the newcomer? His future gear will have to be built from scratch and the questions of design, layout and so forth will have to be met. Will the newcomer drop out of the running? We feel that many may do so when initiative and ability are called for, but the majority will undoubtedly settle down to a new start. It will be a job at first but they will no doubt become real amateurs and constructors in the fullness of time!

W.N.S.

NOTICES

THE EDITORS invite original contributions on construction of radio subjects. All material used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman will redraw in most cases, but relevant information should be included. All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

COMPONENT REVIEW. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 6579.

THREE STATION PRESELECTOR

By C. KIRWAN

MOST good quality audio frequency amplifiers are made with no provision for the reception of radio broadcasts. These must generally be fed to an amplifier from the loudspeaker terminals of a radio receiver, domestic type. The result in most cases is that the distortion and hum level is undesirably high.

The unit I shall describe was constructed to fill an odd corner of a 20 watt amplifier which I use fairly frequently. An attempt was also made to determine whether all those resistors and capacitors which are used in a small superhet broadcast receiver are really necessary. The unit was made with a minimum number of midget components, the aims being sensitivity and quality on Light, Home and Third programmes only.

With no signal, at the voltages used the heat dissipation in the valve electrodes seems quite safe. In order to dispense with screen bias circuits, the screens are operated at the same voltage as the anodes. The high tension voltage must then be less than the usual 250 volts so that the screen currents will not be high.

Automatic volume control is obtained from the primary of the second IF transformer because a higher signal voltage is usually present at this point. A small AVC delay voltage of about 3 volts is obtained by connecting the cathode of the AVC diode to the cathode of the first AF valve. One stage of AVC decoupling is all that is required and the earth side of the aerial coil is connected to the earth side of the first IF transformer.

A midget radio receiver attachment for an audio frequency amplifier

The circuit finally adopted is shown in Fig. 1. The required power supply for somewhat over a 100 volts is obtained through a dropping resistor of 10,000 ohms, 10 watts, and a voltage regulator valve, VS110, for which room was found among the power supply components of the amplifier. The voltage regulator was an extravagance, but there was no other use for the thing at the time. A 5 watt resistor of about 5,000 ohms would function just as well.

If there is room, and if the power supply can spare 0.9 amperes at 6.3 volts and about 30 milliamperes DC, this unit should make a very useful addition to any amplifier. If the DC power supply voltage is greater or less than 400 volts, the 10,000 ohm dropping resistor will not be suitable. The value of the resistor required can be calculated by dividing the supply voltage, less the voltage across the regulator valve, by the nominal current of 30 milliamperes or 0.03 amperes.

The valves are 7-pin miniature types. They can be bought in this country and British makers' equivalents are already on the market, *e.g.*, X77, W77 and D77. It will be seen that many components have been pruned out of the circuit, which is otherwise that of a conventional superhet.

Since the valves are seldom operated except on a signal, when AVC provides a large negative grid bias, cathode bias circuits seem unnecessary.

The "swinging cathode" circuit of the frequency-changer oscillator is somewhat unusual looking, but is easy and reliable in operation. Wearite "P" type medium-wave coils are suitable, but if you wind your own, see that the oscillator coils are tightly coupled.

Tuning is by mica trimmers parallelled by silver mica fixed capacitors. A midget three-bank four-way switch selects the appropriate station tuning. Capacitor values are given in the table below Fig. 1. No objectionable drift in tuning is noticed as the amplifier warms up.

The dimensions of the chassis are shown in Fig. 3. This is cut from 22 swg sheet brass and soldered at the joints for rigidity. The six trimmer capacitors are fixed on a $\frac{1}{8}''$ bakelite panel, on the back of which are mounted the coils and silver mica capacitors. Shielding of aerial from oscillator circuits is not very important but these should be shielded from the frequency-changer anode and the IF circuits.

The coils are wound on $\frac{5}{8}''$ diameter bakelite tube formers, $1\frac{1}{2}''$ in length. The aerial transformer consists of two pile-wound sections of 36 swg enamelled copper wire. The tuned portion has 95 turns wound on a length of $\frac{1}{4}''$. The primary has 30 turns on the same length. The coils are spaced $\frac{1}{2}''$ between centres. The tuned portion of the oscillator transformer is

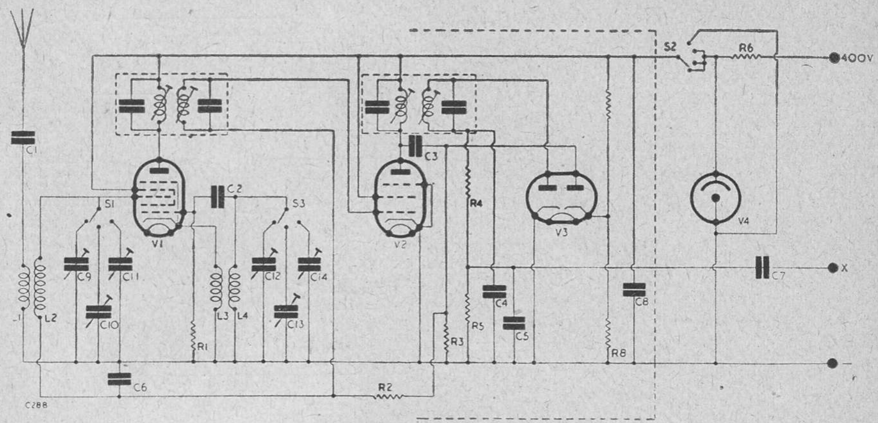


Fig. 1. Three Station Preselector

Component Values

Resistors
*R*1, 100,000 Ω
*R*2, 1 *M* Ω
*R*3, 2.2 *M* Ω
*R*4, 47,000 Ω
*R*5, 250,000 Ω
*R*6, 10,000 Ω, 10 *watt.*
*R*7, 100,000 Ω, $\frac{1}{2}$ *watt.*
*R*8, 2,200 Ω, $\frac{1}{2}$ *watt.*
(*All resistors* $\frac{1}{4}$ *watt except where shown*)

Capacitors
*C*1, 50μμ*F*
*C*2, 100μμ*F*
*C*3, 50μμ*F*
*C*4, 100μμ*F*
*C*5, 100μμ*F*
*C*6, 0.01μ*F*
*C*7, 0.1μ*F*
*C*8, 0.1μ*F*
(*C*1-*C*5 *are mica and C*6-*C*8 *paper*).

Coils
*L*1, 30 *turns*
*L*2, 95 *turns*
*L*3, 25 *turns*
*L*4, 70 *turns*
(*See text*)

IF transformers
*Wearite midget iron-cored, Type M*400.

Valves
*V*1, 6*BE*6, *X*77, *etc.*
*V*2, 6*BA*6, *W*77, *etc.*
*V*3, 6*AL*5, *D*77, *etc.*
*V*4, *VS*110.

Tuning Capacitors
LIGHT Programme—261.1 *metres.*
Aerial (*C*9): 50μμ*F* + 25μμ*F silver mica* + 5-50μμ*F mica trimmer.*
Oscillator (*C*12): *As C*9.

HOME Service—342.1 *metres.*
Aerial (*C*10): 75μμ*F* + 50μμ*F* + 25μμ*F silver mica* + 5-50μμ*F mica trimmer.*
Oscillator (*C*13): 100μμ*F* + 25μμ*F silver mica* + 5-50μμ*F mica trimmer.*

THIRD Programme—514 *metres.*
Aerial (*C*11): 300μμ*F* + 50μμ*F* + 25μμ*F silver mica* + 5-50μμ*F mica trimmer.*
Oscillator (*C*14): 200μμ*F* + 25μμ*F silver mica* + 5-50μμ*F mica trimmer.*

VALVE BASE CONNECTIONS

(*viewed from underside*)

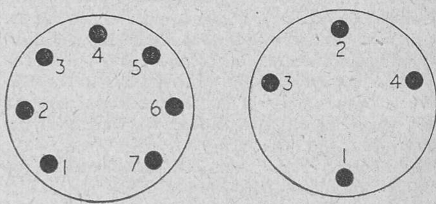


Fig. 2

6*BE*6 (7-*pin*)
1, *Grid* 1.
2, *Cathode.*
3, *Heater*
4, *Heater.*
5, *Anode*
6, *Grids* 2 *and* 4.
7, *Grid* 3.

6*AL*5 (7-*pin*)
1, *Cathode, Diode* 2.
2, *Anode, Diode* 1.
3, *Heater.*
4, *Heater.*
5, *Cathode, Diode* 1.
6, *Blank.*
7, *Anode, Diode* 2.

6*BA*6 (7-*pin*)
1, *Grid* 1.
2, *Grid* 3.
3, *Heater.*
4, *Heater.*
5, *Anode.*
6, *Grid* 2.
7, *Cathode.*

*VS*110 (4-*pin*)
1, *Anode.*
2, *Cathode.*
3, *Blank.*
4, *Blank.*

70 turns of 36 swg wire wound in a pile ¼″ long. This is given a coat of transparent varnish and when the varnish has dried a primary winding of 25 turns is wound on top. The coil ends are anchored and soldered to 22 swg copper wire leads which are fastened in holes drilled at each end of each former.

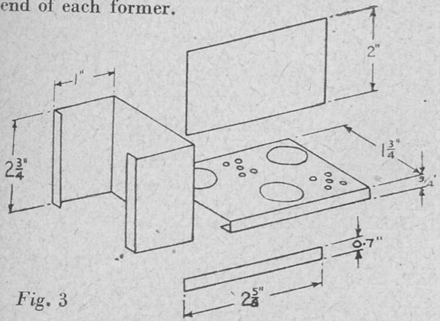


Fig. 3

Sketch showing construction of chassis. Metal is 22 swg brass sheet. Joints are soft soldered.

The coils are fastened to the back of the trimmer panel by the leads which are threaded through small holes in the panel.

The nine leads from the unit to the switch on the front panel and one aerial lead to a terminal beside the switch are bound together and are about a foot long. They are not screened and no instability is caused by this omission. If screening is necessary an earthed length of copper wire can be wound round this cable.

Tuning to the frequency required with a signal generator is a simple matter, but with an aerial each programme can usually be found by varying the oscillator trimmer between maximum and minimum capacitance. If this does not bring in the desired station, a 25$\mu\mu$F capacitor should be taken from those in parallel with the trimmer, or connected in addition to the others. This is to compensate for slight inaccuracies in capacitance or inductance. The other oscillator circuits and the aerial circuits should be tuned in the same way.

The heaters of the radio unit are alight whenever the amplifier is in use but while the HT is switched off the valves do not deteriorate. The unit's output lead is permanently wired to the input circuit of the first audio stage. This consists of a two megohm volume control. For best performance the total resistance connected across the output terminals of the unit should not be less than 500,000 ohms. Tone controls should not be used between the diode and the first audio valve as the diode load should include as little reactance as possible.

The quality of the audio output of the unit is all that can be desired. The bandwidth at peak IF tuning is 25 kilocycles for 3 dB down on either side of the peak. Gain is ample for positions near London, and results certainly seem to indicate that many components usually used in a superhet receiver do not earn their keep.

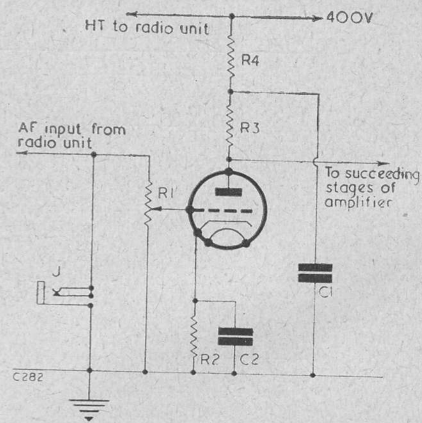


Fig. 4. First Audio Stage (suitable for following diode detector).

Component Values
R1, 2 M (Volume control).
R2, 1,000, ½ watt.
R3, 22,000, 1 watt.
R4, 33,000, 1 watt.
C1, 8.0μF, 450V wkg.
C2, 50.0μF, 12V wkg.
Valve; L63.
J: microphone input jack.

N.B.—In the author's amplifier, this stage is followed by a triode phase-splitter and two triodes in push-pull driving two push-pull KT66 valves, giving an output of twenty watts.

MULTIPLE COUNTING CIRCUITS

Two new electronic counters have been developed by Mullard Electronic Products Ltd.

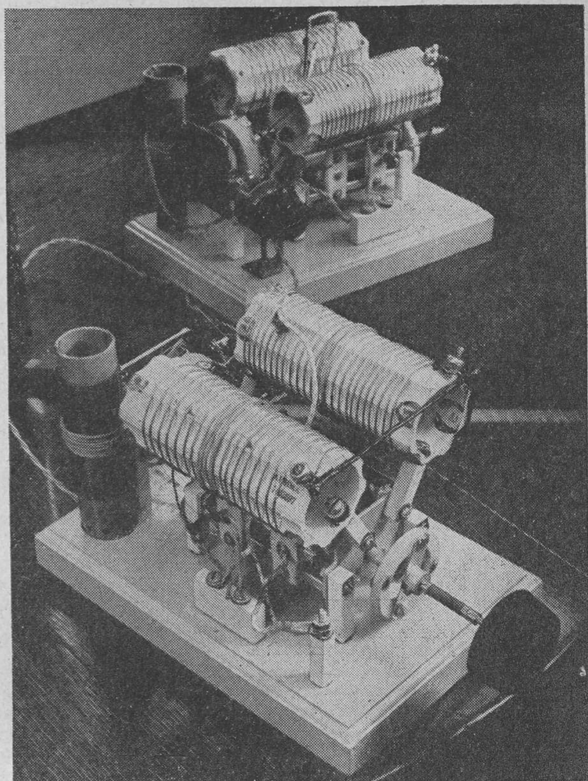
One is the Diode Scaler which uses a chain of biased diodes to form a potential gate. When equality is established between the capacitor and any one of the diode-gate potentials, charging is arrested and a position of equilibrium is created. "Counting" is carried out by arranging for each incoming impulse to move the circuit as a whole from one position of equilibrium to the next.

After all the available gate potentials have been passed, the charged capacitor is quickly discharged, and the cycle repeated. The count at any instant is indicated on a cathode-ray tube.

The second is the Synchronised Saw-Tooth Scaler which uses two 100 kcs saw-tooth waves synchronised to a high-frequency of 500 kcs master oscillator. One of the saw-tooth waves (movable) therefore has five positions of stable equilibrium with respect to the other saw-tooth wave which is fixed.

Counting is achieved by making the movable wave progress through the fixed in a regular manner. Ten positions of equilibrium are created by synchronising the movable saw-tooth on alternate counts.

AERIAL TUNER *from* TU10B



By

W. OLIVER G3XT

THE famous series of American Army tuning-units known as TU5B, TU6B, TU7B, etc., have been widely used by amateur transmitters as a basis for the construction of variable-frequency oscillators; and their obvious suitability for this purpose seems to have eclipsed their usefulness in another direction, namely, as a source of really excellent components for the construction of aerial tuning units.

As the aerial and its associated tuning circuit form the last vital link in the chain, it is obvious that inefficiency at this crucial point can mar the performance of even the best transmitter; and if one is using low power with a consequently small margin of reserve energy, the aerial tuning arrangements may easily make all the difference between success and failure.

The majority of the parts used in building up the efficient and attractive-looking aerial tuner shown in the photographs were obtained from a TU10B which cost only five shillings from a firm selling Government surplus gear. The extremely low price was due to the fact that the 10B in question was minus its outer case and had a slightly damaged front panel—two slight deficiencies which were of absolutely no consequence at all in the present instance, because it was only the internal components which were needed, and these were in perfect condition.

They comprised the following items: (a) three variable capacitors; (b) two ceramic coil formers; (c) one paxolin coil-former; (d) two ceramic flexible couplers; (e) one large ceramic-insulated rotary switch; (f) three RF chokes; (g) two slow-motion drives; (h) a number of ceramic insulating pillars and blocks; (i) some high-voltage fixed capacitors and a few other items.

From this selection of components I chose the following items to make up the tuner: the three coil-formers, the largest variable capacitor, the ceramic switch, eleven of the square-section ceramic pillars, two oblong-section ceramic blocks, one flexible coupler and one large bakelite knob from one of the tuning-drives. The remainder of the useful components can either be put to other uses in the shack, or swopped for the few other items needed!

These extra items include: one wooden baseboard (I used an electric lighting switchblock measuring 9½" x 6½" which was just right for the

This is one of the articles submitted for our Surplus Gear Contest.

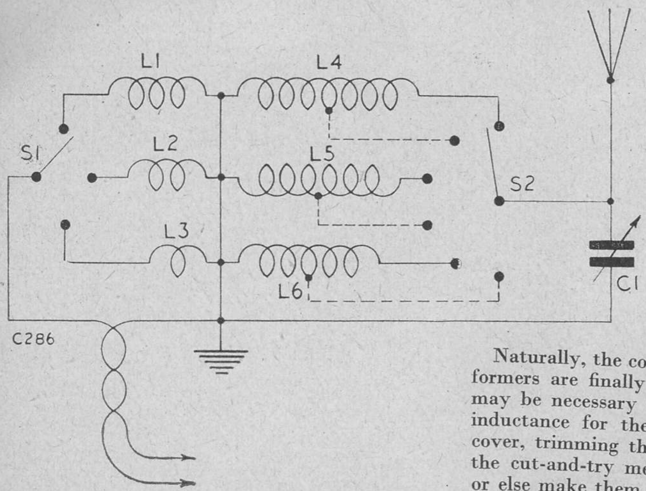


Fig. 2. Circuit diagram of the Aerial Tuner. L1, L2 and L3 are link coupling coils, L4, L5 and L6 are the aerial coils.

purpose); a short metal spindle $\frac{1}{4}''$ diameter; one 3-way rotary wafer switch, and bakelite knob to fit; copper wire for the three coils; and suitable wire or flex for the link couplings. The gauge and length of the wire will depend on what wavebands you wish to cover, so must be left to individual choice. Finally, you will need a small metal bracket for the switch near the back right-hand corner of the baseboard.

The first job, and the hardest (as you will know if you have had practical experience of the high quality of the workmanship in these TU units!) is getting the whole thing to pieces! You will need a strong screwdriver, pliers, preferably some suitable spanners, and one of those square-section keys for loosening the square-slotted grub-screws which secure the knobs, couplers, etc. (If you attempt to shift the well-tightened screws, etc. *without* adequate tools you will probably need a bottle of iodine and a tin of first-aid dressings, because something will have to bust, and in view of the tremendously rugged construction of these units it is more likely to be your hands than the TU10B that will get the worst of the encounter!)

Assuming that you have succeeded in dismantling the 10B and have picked out all the parts required, the rest of the work is easy. The baseboard is drilled as shown in Fig. 1, and the components are re-assembled as shown in the photographs. One of these photos was obtained by a novel technique—an anglewise shot with the help of a mirror, which shows all four sides of the aerial tuner at one glance! Note the method of mounting the two ceramic coil-formers by a V-angled disposition of four ceramic pillars bolted through existing holes in the capacitor end-plates.

The paxolin coil-former is mounted in a circular hole cut near one corner of the baseboard. This former, by the way, carried the original aerial coupling-coil in the 10B, and was fitted concentrically inside one of the ceramic formers.

Naturally, the coils should be wound before the formers are finally mounted in position; but it may be necessary to try out different values of inductance for the wavebands it is desired to cover, trimming the windings by adjustment on the cut-and-try method to get them just right, or else make them a little on the small side and use ceramic trimming capacitors. In any case, please ignore the number of turns shown in the photos, as these were taken immediately on first constructing the unit and before it had been air-tested; consequently two of the coils needed a little subsequent alteration to make them just right. I anticipated that this would be so, and so did not bother unduly about theoretical calculations beforehand!

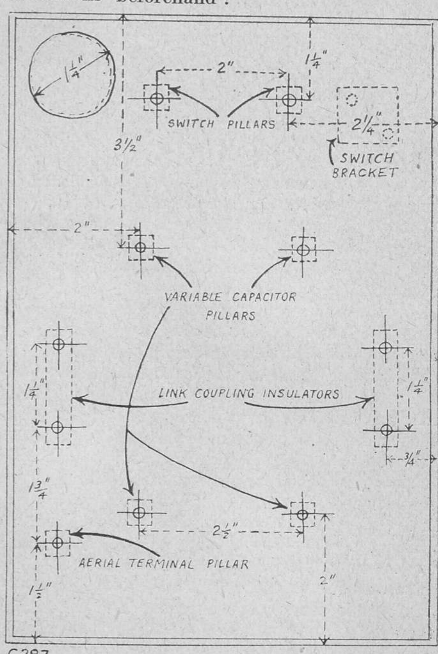
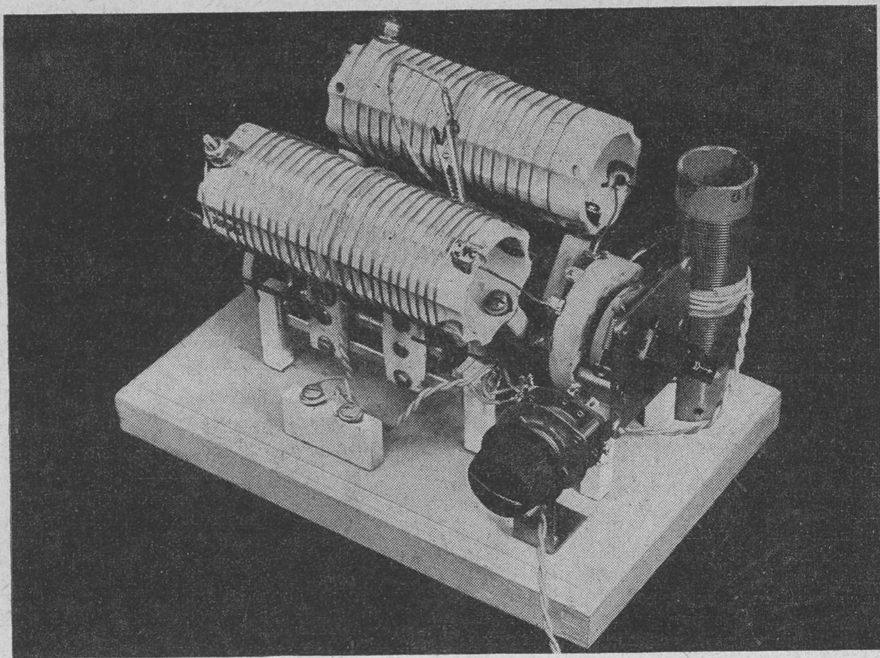


Fig. 1 Sketch of baseboard showing dimensions for drilling.



The Aerial Tuner completed. C1 is seen at the front, with its associated switch S2. S1 is at the rear and can be seen in detail in the photograph on Page 541.

The formers have a few grooves near the centre (unlike those in the 5B, which are grooved throughout their length), and these can be taken as a standard for the spacing in the interests of neatness and easy winding. But with this wide spacing the number of turns that can be accommodated is obviously limited, and if you must have a larger inductance for a particular waveband, you can resort to the rather unorthodox expedient of spacing the centre turns and close-winding the two sections towards the ends! It may look a bit queer, but it will work.

The pillar nearest the camera in the mirror-view picture carries the aerial connection, and an adjustable tapping can be used if necessary. But of course the simplest way, even if it does not give such good results, is to connect the aerial direct to the stator of the variable capacitor, which is in turn connected to the moving-arm contact of the wavechange switch which connects to the top end of each coil-winding in turn. This facilitates rapid band-changing.

It should be emphasised that this design is intended not so much as a pattern to be slavishly copied, but rather as a basis for working out your own ideas to suit your own aerial systems, etc. If, for instance, one cared to invest in *two* TU10B's (at a total outlay of ten shillings), one could make a larger and more elaborate tuner, covering more wavebands and having a pair of capacitors to tune twin feeders if desired. In fact, the general scheme could be modified to suit any normal type of aerial tuning system, and this flexibility is one of the features of this idea which should appeal to all transmitters.

As it stands, the unit is intended for use on three wavebands at G3XT—1.8, 3.5 and 7 Mcs. But with extra coils, or (less efficiently perhaps) by centre-tapping the existing coils to convert them to dual-range types, it could be used on other bands. The ceramic rotary switch has six positions, so there is plenty of scope! But of course it might be necessary to use a 6-way instead of 3-way wafer for the other switch, which serves to switch the link couplings to the various coils; but with suitable positioning of the link turns it may be feasible to retain the 3-way switch.

The wiring-up is extremely simple, but should be done with great care, as poor joints will seriously mar the results. The necessary connections are shown in Fig 2, the circuit diagram.

Little more need be said, but in conclusion I might mention that the appearance of this unit, with its symmetrical layout, gleaming white ceramic insulation, cream-enamelled baseboard,

(continued on page 546)

Query Corner

A " Radio Constructor " service for readers

Capacitors for Voltage Dropping

" Is it possible to employ a capacitor of suitable value to drop the excess mains voltage in the heater circuit of an AC/DC type receiver? The use of such a capacitor in place of the normal voltage dropping resistor would seem to have certain advantages.

K. L. Thompson, Reading.

The idea of using a capacitor in series with the valve heaters in order to drop the excess mains voltage is not new. It is interesting to note that during the war years, this system was used by the Continental underground movement on some of the receivers which were constructed to receive British news items. In these instances, the use of a capacitor in the heater circuit solved a major problem, that of supplying the valve heaters without dissipating the heat associated with mains dropping resistors. This was a most important point in those critical war years, when receivers had to be built into the smallest possible space and camouflaged to look like anything but a radio receiver.

The advantages of the capacitor as a mains voltage dropping component are as follows :—

(a) It dissipates practically no heat, and therefore results in a saving of power.

(b) It provides better voltage regulation.

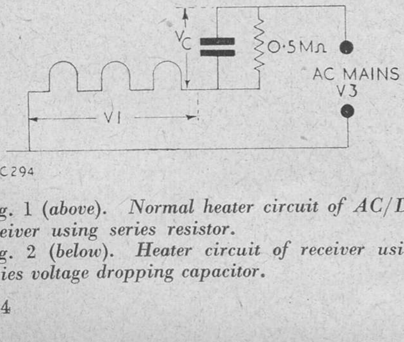


Fig. 1 (above). Normal heater circuit of AC/DC receiver using series resistor.
Fig. 2 (below). Heater circuit of receiver using series voltage dropping capacitor.

(c) The current surge which exists in the resistor dropping circuit when first switching on is avoided. This prolongs the life of both valves and dial lamps.

Needless to say, there are disadvantages in the use of this system, and in the majority of cases these outweigh the advantages. The disadvantages are as follows :—

(a) When using a capacitor for voltage dropping, operation is confined to AC mains only.

(b) The capacitor must be included within the receiver cabinet, this calls for a larger cabinet than would be necessary if a line cord were used for voltage dropping.

(c) A fuse must be included in the heater circuit to protect the valves against a short circuit occurring within the capacitor.

Having dealt with the pros and cons we will now consider the method of determining the value of the series capacitor required for use with any particular combination of valves. It may be remembered from the basic AC theory that the voltage developed across a capacitor will lag behind the current passing through the capacitor by 90°. Because of this the voltage dropped across the capacitor will be the algebraic difference of the mains voltage and the sum of the valve heater voltages. Using the symbols shown in the diagrams, this voltage is given by

$$V_c = \sqrt{V_3^2 - V_1^2}$$

then by Ohms Law $V_c = I\,X_c$. (X_c = reactance of capacitor)

and because $X_c = \dfrac{1}{2\pi f C}$ (f=mains supply frequency in c/s)

the value of the capacitor may be calculated directly by

$$C = \frac{I}{2\pi f \sqrt{V_3^2 - V_1^2}}$$

This may seem a little complex at first but the example worked out below should help to clarify matters.

Assume the mains voltage to be 200 and the total valve heater voltage to be 100V at 0.2A the value of " C " is calculated as being

$$C = \frac{0.2}{2 \times 3.14 \times 50 \sqrt{200^2 - 100^2}} = 3.7\mu F$$

It must be remembered that the conditions hold good for only one main supply frequency, 50 cycles per second being taken in the above example.

Referring back to Fig. 2, it will be seen that if the mains plug is taken from its socket whilst the receiver is switched on, the series capacitor may be charged and it will be possible to receive a shock from the plug. This possibility may be prevented by shunting the capacitor by means of a high resistance, 0.5 megohms being satisfactory. This resistance provides a leakage path for the charge remaining on the capacitor when the heater circuit is broken. Finally, it must be stressed that the capacitor should be capable of withstanding the full AC mains voltage. The working AC voltage of a capacitor is considerably less than the working DC voltage.

Crystal Pick-Ups

" *Wishing to improve the quality of reproduction from my radiogram I changed the magnetic type pick-up for one of the crystal type. However, upon completing this modification, I was disappointed to find that reproduction was unrealistic and appeared 'heavy.' Why should this be?*
E. Crosbey, Cheltenham.

This type of reproduction is frequently experienced when using a crystal pick-up without some form of frequency correcting device. Strangely enough, the basic reason for this lies, not in the pick-up itself, but in the method of making the gramophone records. Recordings are normally made with the aid of electro-magnetic cutting heads. Using this type of head, the side to side movement of the needle increases as the frequency is reduced, assuming that the output voltage remains constant. This means that if the amplitude of the groove in the record is to be kept within reasonable limits at the higher audible frequencies, attenuation will be necessary at the lower frequencies if the grooves are to be prevented from running into each other. In order to achieve this, the frequency response of the amplifier which feeds the cutting head, during the manufacture of the record must be reduced at the lower audible frequencies. This process is used by most record manufacturers, and means that when the recording is played back with the aid of a magnetic pick-up the frequency response is attenuated only at the lower audible frequencies.

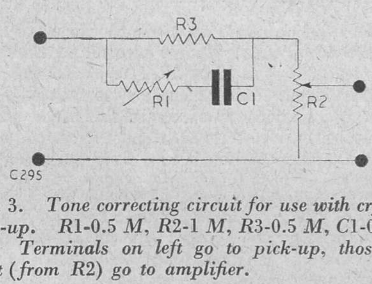


Fig. 3. Tone correcting circuit for use with crystal pick-up. R1-0.5 M, R2-1 M, R3-0.5 M, C1-0.001 μF. Terminals on left go to pick-up, those on right (from R2) go to amplifier.

Conditions are somewhat different when a crystal pick-up is employed as its output voltage is dependent upon the amplitude of the record groove. This means that the crystal pick-up provides a flat response at the lower frequencies but which decreases as the frequency is increased. The foregoing may be briefly summed up as follows. When used with standard recordings the crystal pick-up provides a frequency response which is flat at the lower end of the scale, but reduces as the frequency is increased. The overall response may be flattened out by the use of the simple correcting circuit shown in Fig. 3. The impedance which this circuit presents to the pick-up decreases as the frequency increases, thus a compensating action is obtained. The variable resistance R1 functions as a tone control whilst the potentiometer R2 is a volume control.

The use of this simple circuit between the crystal pick-up and the amplifier will enable good quality gramophone reproduction to be obtained.

" Query Corner " Rules

(1) A nominal fee of 1/- 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 the more general interest will be reproduced in these pages each month.

GECALLOY RADIO CORES.

Salford Electrical Instruments Limited, a subsidiary company of The General Electric Co. Ltd., of England, has just issued a new leaflet on Gecalloy Radio Cores. Very compact and comprehensive this 6 pp. folder gives a list of all the types manufactured by this company with their dimensions in mm. and inches. In the case of Pot Cores, reference is made to those with which Bobbins are supplied.

Request for this leaflet, List R.C. 9402, should be made to Peel Works, Silk Street, Salford, 3, Lancashire.

NEW SOUND EQUIPMENT AT THE TROCADERO

Six Philips' microphones and thirty loudspeakers in the Empire Room at the Trocadero Restaurant contribute to what is believed to be the most advanced sound equipment ever fitted in a hall.

The equipment, incorporating one microphone used for the opening of the Olympic Games by the King, was used for the first time at a major function at the annual dinner and dance of the Skal Club of London.

Two hundred and fifty members of the Skal Club and their friends were present, and the chief guest was Mr. J. A. Beasley, High Commissioner for Australia.

The thirty loudspeakers in the Empire Room are specially built into the ceiling, and the six microphones can be plugged into any of the seven six-way connecting boxes fitted flush with the floor in various parts of the room.

The microphones are controlled during the actual event by a small, six-way switchbox. When one of these switches is depressed, it connects with the microphone concerned and automatically brings into operation whichever loudspeakers have been selected on the large pre-selection panel visible on the amplifier console.

Microphone Among Flowers

This pre-selection panel, which embodies many automatic switches*, is a unique feature and automatically turns off the loudspeakers nearest to whichever microphone is in use. This allows the volume control to be turned up without the risk of howling, thereby allowing the microphone to be placed further from the person speaking.

" As a result," declares a Philips' official, " this is perhaps the only installation in the world where it is not necessary to put microphones on tall stands in front of each speaker's face. In fact, each microphone is sometimes concealed in a bowl of flowers."

*As a matter of technical interest, these automatic switches or relays are so arranged that a loudspeaker pre-selected as " off " for one microphone cannot be connected while that microphone is on, even if a further microphone is switched on for which that speaker has been pre-selected as " On."

(*AERIAL TUNER—continued from page 543*)

copper wire on the ceramic coil-formers and emerald-green plastic-covered on the paxolin, with brilliant red pvc flex for the link couplings, is decidedly attractive. In fact, the XYL, who usually takes rather a poor view of the artistic qualities of the contraptions at G3XT, actually acclaimed this aerial tuner as a drawing-room ornament ! What more could the heart of a ham desire? G3XT

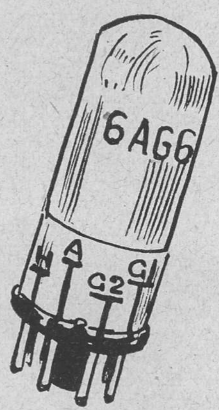
An idea for

MARKING VALVE BASES

suggested by W. OLIVER, G3XT

NOW that the number of different types of British, American and Continental valves runs into thousands, it is an impossible task to remember the base connections for the various types. Moreover, if one is doing a good deal of constructional and experimental work, it becomes a nuisance to have to look up the different basing connections, perhaps in several different reference books, when re-using valves.

An excellent way out of the difficulty is to mark the connections on the valve base itself. The sketch herewith shows the simplest and clearest way of doing this. Admittedly, the markings make the valve base look a bit untidy, but this minor drawback is completely outweighed by the saving of time and trouble and the avoidance of any risk of damage to the valve through making a mistake in the connections.



For black bakelite bases, white enamel can be used, for ceramic bases, black or coloured enamel, and it is most convenient to use a quick-drying type. I find that the art enamels made from shellac and methylated spirit are the best, as they dry in a few minutes, resist wear well, and cannot be accidentally dissolved off except by methylated spirit or some equivalent solvent.

The type numbers on the bulbs of glass bulbs often become obliterated or illegible in time, and here again it is a good idea to mark the type number afresh with the enamel, so that it can be seen at a glance. Here again the meth.-shellac enamel is useful, as it resists a considerable amount of heat, when it has dried properly.

The enamel should be thinned a little with a drop of meth. (or other solvent or thinner appropriate to the type of enamel used), so that the lettering can be done easily with a fine artists' paint brush.

COILS *for Superhets*

By F. W. FRERK

THE successful working of a home constructed superhet depends mainly upon correctly designed coils, efficiently made and matched. Experienced home constructors, in articles about their constructions, often forget that they themselves were beginners and take too much for granted. The choice of the coils for a superhet receiver is, however, too important to be neglected.

In our age of ganged tuning capacitors it is rather difficult for the radio fan with his limited equipment, to wind these coils all by himself, although it is, of course, possible. But self-construction of coils is the more unnecessary in that excellent coils are readily available and at that rather cheap. Being small and in themselves uncomplicated, these coils are reliable and can be used for all different types of superhet receivers. There are even completely wired tuning units with all trimmers and padders on the market, which, however, are now rather expensive since they are liable to purchase tax.

Before going into the matter of the choice of coils it is important to know the kind of coils which are wanted and to which purpose they serve. It has to be borne in mind that there are two different types of basic coils in a superhet: the coils for the tuning unit and the coils for the intermediate frequency amplifier, shortly called IF-transformer.

The coils for the tuning unit are of three different windings: (1) The aerial coil; (2) the high-frequency or radio-frequency (shortly HF or RF) coil and (3) the oscillator coil.

The aerial coil and the oscillator coil are in any case indispensable; whether we want one or more RF-stages depends upon the kind of superhet, we have in mind to construct. Usually small superhets are constructed without any RF-amplification at all, and a receiver for one single waveband only may thus be constructed with only two single coils in the tuning unit. There are, on the other hand, coils with all the windings for three wavebands wound together on one former, so that, in using these coils, two coils too would be sufficient to construct an inexpensive superhet for three wavebands.

It is, therefore, a question to be considered with special care, whether to select several coils each for one single waveband or those with three or more wavebands wound on the same former. For midget superhets and mainly domestic receivers the latter coils come in very handy. They need little space, there are usually only five connections to be made and the home constructor has no trouble with the connections to the wave-range switch, because these coils are usually delivered with all the necessary connections already wired with trimmers and padders.

The home constructor of a more ambitious set may, however, often prefer the single purpose coil, in that it gives a free hand in selecting the wave-range. Many listeners have no use for the long waveband, but are interested in one or two more short-wave ranges and short-wave fans often have no use at all for combined coils or waveband switching and stick to plug-in coils, which are also available on the market.

An article for beginners to help them to understand the points to note when considering coils for a superhet receiver.

When buying coils, your dealer will probably ask you whether you want "air-cored" or "iron-cored" coils. The first type of coil is wound on a former of paxolin, plastic or polystyrene with nothing in it but air. The iron-cored coils, normally smaller, are also wound on a former, but are partly filled with an iron-dust core which, by way of a screwdriver can easily be moved up and down the former. By sliding the core in and out of the bobbin a variation of some degree in the inductance of the coil can be achieved. Iron-cored coils adapt themselves easier to accurate and quick matching, but often induce the home constructor to try a further improvement of the matching, which usually fails, with the result that the coils do not match any more. In my experience air-cored coils proved to be as efficient as iron-cored ones, though it cannot be denied that the latter may exhibit greater selectivity, a greater degree of amplification and are in any case of smaller physical dimensions.

Another question is, whether the coils used for the tuning-unit shall be screened or not? In modern superhet receivers the coils of the tuning-unit—contrary to the IF-transformers—are generally unscreened, although the different stages of the set are screened against each other. Unscreened coils have a higher "Q" (the magnification of the circuit), are cheaper, take less space and can be mounted very close to the wave-change switch with consequent improvement of efficiency. Owing to their smallness they permit of a compact and suitable lay-out. A further advantage of the unscreened coil is, that it can be used for sub-chassis mounting, which makes the whole construction of a set cheaper and more compact.

Now then, how many coils are necessary? Well, we need one coil for each wave-range and each stage! First stage in a set is the AERIAL STAGE: That is, we need an aerial coil for each waveband we intend to have. This may be done with one coil for three stages, if we use a combined coil, which normally is made for 16-50 m (short waves), 200-600 m (medium waves) and 800-2,000 m (long waves). Using, however, single coils, like P-, Maxi-Q, Weymouth- or Atkins coils, we need for the same wave-range (16-2,000 m) three single coils of the aerial type. To cover one more wave-band of, say, 34-100 m we have to add one more aerial coil.

The second stage is the RADIO-FREQUENCY STAGE: This stage may be omitted in smaller superhets, but is indispensable in larger sets of the communication-type receiver. There may be one or two stages. Using single coils we want again one coil for each stage, that is to say one for short-waves, one for the medium band and one for long-waves. In case we add one more short-wave band the respective RF-coil has to be added too. If a set with two RF-stages is to be constructed a second set of all RF-coils would be needed.

The third and most important stage of the superhet, the heart of it, is the OSCILLATOR STAGE. It is obvious that the same set of oscillator coils is needed, as *e.g.*, for the aerial stage. So a superhet (16-2,000 m) without an RF-stage can be built either with two combined coils or with six single coils. For a superhet with two RF-stages and four wavebands we want 16 single coils.

Following the common custom, home constructed sets, like commercial sets, are tuned with ganged capacitors (untracked), which presumes that, of course, all coils have to be of the same make and have to match. It is possible, however, to use coils of different makes on different wavebands. One may take iron-cored coils for the medium waveband and air-cored coils for the short-wave band, but it is obvious that the coils within the same waveband have to be of the same make. P-coils and several iron-cored coils on the market should be tuned with a variable capacitor having a capacity swing of 450 to 500$\mu\mu$F, while with the Maxi-Q coils complete coverage of the range from 10 to 1,800 m will be obtained with a tuning capacitor of 330$\mu\mu$F maximum value. If a 500$\mu\mu$F capacitor, for this reason or the other, must be used with these coils, fixed capacitors of .001μF (1,000$\mu\mu$F) have to be connected in series with each section of the gang capacitor.

As each stage of the tuning unit has to be tuned with its own capacitor, for the average small superhet one capacitor is needed for the aerial stage and one for the oscillator stage, which are ganged in one two-gang capacitor. Adding one RF-stage one more section has to be added, giving a three-gang capacitor and if we use two RF-stages it has to be a four-gang capacitor. In special short-wave sets, not to be used as domestic receiver, a single capacitor is often used for the oscillator stage and a ganged-capacitor for the aerial and RF-stages, which means, of course, renunciation of one knob tuning.

Unscreened coils are easily being influenced by the proximity of adjacent earthed objects. If the distance between a winding of a coil and an earthed object is less than half the diameter of the coil former, the inductance of it will be seriously affected.

Finally we have to think of the IF-frequency, we intend to use in our receiver. The modern broadcast receiver is mostly designed with a frequency of 465-470 kcs, but there are fans who prefer 110 kcs and the short-wave boys most likely prefer an IF of 1.6 Mcs to any other frequency. With the intention of constructing normal receivers rather than specialised circuits, we stick to an IF of 465 kcs, for which most of the coils available on the market are designed. If, however, we have in mind to construct a special set, say a short-wave superhet, then, of course, we have to select the coils as well as the IF according to that special purpose.

At least two IF-transformers are needed, in bigger sets three to four IF transformers are ready-made on the market. They consist of two identical coils, mostly wound with Litzendraht, of which one is the primary and the other one the secondary. Each coil has in parallel a capacitor connected, either an air-dielectric one—which are to be preferred but rather seldom to be seen—or mica pre-set capacitors.

Other IF-transformers are permeability-tuned, that is to say, they are also fitted with an iron-dust core that slides within the bobbin of the coil. In this case the tuning capacity is fixed and the inductances of the coils are varied by moving the core in or out. While in older superhets the IF-transformers usually claimed much of the space available on the chassis, the modern transformer is small and may even be of the miniature type measuring only $1\frac{1}{8}''$ x $\frac{7}{8}''$. IF-transformers are either fitted with or without a flying grid lead; which one to choose depends upon the valve used in the IF-amplifier. IF-transformers should always be screened and the screen carefully adjusted to give optimum protection. In the last stage, adjacent to the double diode triode an IF-transformer with centre-tapped coils is an asset. A centre-tap on the output transformer secondary for the signal detector reduces the damping imposed on the tuned circuit by the signal diode. The primary coil may then be tapped for the same purpose. IF-transformers of this kind are also available on the market.

TRADE NOTES

The Radio Component Manufacturers Exhibition

This Exhibition, held at Grosvenor House early in March, had much of interest to the constructor. So much, in fact, that it would be impossible to give each item space in this short review, which will be confined to representative components.

The trend to miniaturisation was very predominant and The Telegraph Condenser Co. Ltd. exhibited many small-dimensioned capacitors such as the "Miniature Metalmites," designed for deaf-aid and miniature equipment. The 200$\mu\mu$F type measured 16mm. x 5mm. Other interesting capacitors were the "Hikonal" Energy Storage types for use with photoflash lamps, etc., Plastic Film Dielectric types in tubular form, and the Visconal impregnated "Cathodray" range which affords improved voltage ratings at higher working temperatures, low power factor, stability of dielectric and power to withstand sharp front short time surges.

Mullard also showed miniature capacitors. The Mullard Drawn types are very small (less than 1mm. in diameter) and have a capacitance of 25$\mu\mu$F per cm./length. Other exhibits by Mullard included miniature valves ; 1.4 types with B7G base for personal receivers, a new "Rimlock" series with B8A base for both AC and AC/DC receivers (the AC/DC valves have the low heater current of 0.1 Amp), a new battery-type valve of only 10mm. diameter which is being used for hearing aids. An interesting item was the "Ticonal" permanent magnets, the range of which has been extended by the introduction of magnets made by powder metallurgy which makes extremely small magnets of high quality available. Then we saw "Ferroxcube," which is a new high permeability low loss HF core material for use in inductances, etc. Perhaps the most interesting of all the Mullard exhibits was their projection television unit—the only one displayed. This is a laboratory development of outstanding interest and will be taken into restricted production shortly. The unit composed a new projection television cathode-ray tube, special components and the associated optical system.

For the VHF enthusiasts, the Mullard ME1001 and VO20 valves will be of interest. The former gives 0.5 watts output at 10 cm. for a power input of 10 watts. Both valves are recently developed disc seal triodes. Amongst the group of power valves, the QQZO4-15 and QQVO6-40 took our attention. The former is a directly heated type giving an output of 15 watts at 185 Mcs and the latter is recommended for general VHF work.

Belling & Lee, as usual, provided many items of interest. Their distributor suppressor in which the moulding is so formed as to screw directly into the distributor head HT lead socket (the HT lead then screws directly into the suppressor) on our approval, though we are admittedly biassed in favour of these units !

The new Belling & Lee B8A valveholder has been developed to take the all-glass semi-miniature type valves with which it is hoped to replace 80 per cent of receiving type valves in the near future. It has been developed in close co-operation with leading valve manufacturers. The manufacturers claim that the valveholder will stand up to all applications to which the valve may be put. Whilst on the subject, it is noteworthy to mention that a B7G valveholder wiring jig and pin straightener for miniature all-glass valves is in an advanced stage of development and will be available in the near future.

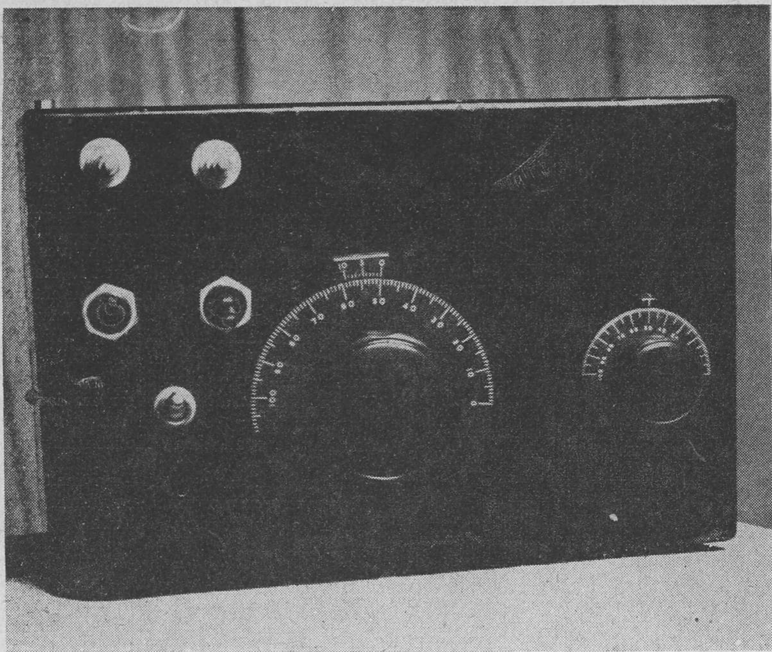
Other exhibits by this firm included Blanket Thermostats, Communal Amplifiers covering the television frequencies, Television Aerials of all types and so forth.

Standard Telephones & Cables Limited also had many items for incorporation in miniaturised equipment. Two types of relay, hitherto never exhibited, measured $\frac{5}{8}''$ x $1''$ x $1\frac{1}{8}''$, requiring coil energising power of 1 watt and having coil resistance of from 1 to 2,500 ohms were particularly interesting. Operating times are from 4 to 10 milliseconds and release times from 2 to 5 milliseconds.

Another S.T.C. exhibit was a new design of High Frequency Attenuator in which the control of the pads is by means of push-button switches. It employs cracked carbon resistances and has been tested to a frequency of 25 Mcs and up to an attenuation of 50 dB. The attentuator is made in two decade boxes (0-90 dB and 0-9 dB) giving together a maximum attenuation of 99 dB in steps of one or ten dB respectively. It is set to the required value by pressing the button appropriate to the value of attenuation required. When pressing a new value, the button previously pressed is released. S.T.C. also exhibited several new types of valves, a range of "Jones" plugs and sockets, selenium rectifiers, quartz crystals, etc.

This does not claim to be a comprehensive review of the exhibition, but is merely a record of some of the exhibits that roused our interest. To all the exhibitors and to the R.C.M.F. we offer our congratulations on a fine show.

At the British Industries Fair to be held simultaneously in London and Birmingham from May 2nd to May 13th, television, electronics and sound recording will be featured. We will give details of the most impressive exhibits in a forthcoming issue.



A trustworthy FREQUENCY METER

Described by F. K. PARKER

EVEN if you are only a short-wave listener and not a transmitting amateur, a frequency meter is a most essential piece of equipment.

It may be stated that the apparatus is extremely suitable for use of those who do possess a transmitting licence. This frequency meter can be depended upon to give rock-steady stability over long periods of constant use.

A rough idea of the performance to be expected is given by the fact that the frequency meter VFO section was made to beat with WWV on 20 Mcs and left there for a period of 4 hours. At the end of this period the oscillator had not drifted at all. The simplicity of design of this frequency meter makes this an easy piece of equipment to build, but because of this simplicity it must be stated that it is more than worthwhile putting great care into the construction of this instrument.

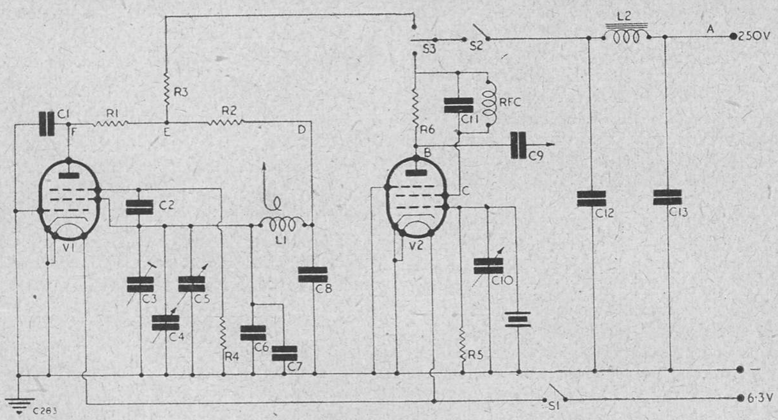
The frequency meter is designed to work from power supplied from the receiver, and on this count the consumption of both LT and HT have been kept to a minimum, consistent of course with the correct operating voltages on the valves.

Circuit

Two valves are used in the instrument. The first, V1, an EF50, is used in a transitron VFO circuit. The reason for the use of this circuit is that it requires only one valve to operate it efficiently, and there are no taps or variable coupling coils to be dealt with, hence any type of coil may be used in this circuit. The Eddystone 6W 6-pin coil is recommended.

The tuned circuit of the VFO is made up of 6 capacitors and the inductor L1. The functions of these capacitors are as follows :—

For the transmitting amateur or the SWL



Component Values for the Frequency Meter

Capacitors		Resistors	Coils
C1, 0.001μF	*C9, 100μμF*	*R1, 25,000 Ω*	*L1, 1.7 Mcs coil (Eddystone 6W).*
C2, 200μμF	*C10, 75μμF*	*R2, 25,000 Ω*	*L2, 30 H, 20 mA LF Choke.*
C3, 3-30μμF	*C11, 100μμF*	*R3, 50,000 Ω*	***Switches***
C4, 1-10μμF	*C12, 8.0μF*	*R4, 50,000 Ω*	*S1, Single-pole, one way.*
C5, 70μμF	*C13, 8.0μF*	*R5, 750,000 Ω*	*S2, Single-pole, one way.*
C6, 15μμF	***Valves***	*R6, 100,000 Ω*	*S3, Single-pole, two way.*
C7, 50μμF	*V1, EF50*		
C8, 0.01μF	*V2, EF50*		

C3 3-30μμF Band setter and trimmer.
C4 1-10μμF Correction capacitor.
C5 70μμF Main Tuning ,,
C6 Fixed " Ballast " capacitor.
C7 ,, ,, ,,
C8 Padder from cold end of coil. 0.01μF.

A 100° dial was used for the main tuning capacitor, and capacitors C6 and C7, and adjusted so that the fundamental 1.7-2 Mcs are spread over 85° on the dial. C3 is adjusted so that with the capacitor C4 set to 50° on its own 100° dial 2 Mcs falls at 10° on the dial. Then the capacitor C4 is set so that 2 Mcs is exactly 10° on the dial of the main tuning (C5).

The other valve, an EF50, is a 100 kcs oscillator, and this is used to identify exactly the position of all 100 kcs points in the range of 100 kcs to about 30 Mcs. The 100 kcs oscillator is made to beat with WWV on 20 Mcs and the variable trimmer C10 adjusts the crystal to 100 kcs exactly.

The screen grid of the EF50 (C2) is tuned by a 100μμF trimmer capacitor and the inductance used is any good quality short-wave RF choke. This capacitor C4 is adjusted by means of an oscilloscope or the receiver S meter, or magic eye. The output from the 100 kcs oscillator is taken from the anode of the EF50 via a 100μμF fixed capacitor.

For harmonics from the 100 kcs oscillator of the order of 30 Mcs, it may be found necessary to connect the output to the antenna terminal direct, but on the lower frequency a short stiff piece of wire about 8″ long is all that is required for strong beat notes on the receiver.

Components

The two EF50 valves used could be replaced in both circuits with HF pentodes of similar characteristics, *i.e.*, EF39 or 6K7, etc. But it is essential that the transition oscillator valve type is one of those whose suppressor grid G3 is brought out to a separate connection.

Capacitors C6 and C7 should be of the ceramic cup type. C8 may be a tubular paper type.

C1 is a mica capacitor, and need not be of the silver mica type, although the latter is to be preferred. C2 is of the silver mica variety, and this capacitor should be of a reliable make, and of close tolerance value.

Variable capacitors C4, C5, C10, C11 should all have good insulation, ceramic insulation for preference. Many good ex-Govt. capacitors are on the market at low prices.

All resistors are ½ watt carbon gold tolerance types, and if no deviation from the values stated is made the performance will come up to the highest expectations. Do not, under any circumstances, attempt to alter the values of R1 and R2 as these resistors are correct for the correct working of the transitron oscillator.

Switches S1 breaks the heater line on both sections of the frequency meter. S2 breaks the HT line on the meter, while S3, an spdt switch, gives HT to either 100 kcs crystal oscillator, or VFO.

The smoothing equipment is optional in many cases, but as the HT line of the author's communications receiver and HT was taken from a point before the receiver smoothing equipment was reached, it was found to be necessary.

The 100 kcs crystal was not of the GEC substandard type frequently used by other builders of frequency meters, but of the RCA V-cut type.

Construction

The complete unit was housed in a steel box 10″ x 7″ x 5″. The transitron VFO unit is mounted right way up on the left in the photograph 2. The band-set capacitor, a Phillips trimmer of the concentric type (ex-RF unit 24) is visible to the right of V1. Directly behind V1 is the correction capacitor C4. This is an old 75$\mu\mu$F stripped of all vanes but one rotor and two stators. Be sure when you are stripping this component that after reassembly the spindle is tight to turn, as if this capacitor is loose it may well be jolted out of position, and the calibration of the instrument upset.

Be quite sure when mounting C5 that the bracket is perfectly rigid and strong, as vibration here will cause you no end of trouble.

The VFO chassis is bolted to the ' floor ' of the cabinet. The cabinet itself is mounted on five rubber feet, a further protection against vibration and jolting.

The 100 kcs crystal has been removed from its socket to show the locking device on the capacitor C10 spindle. This should be aligned with a hole for setting purposes in the side of the chassis.

The crystal socket is just visible in front of C10. It will be seen this crystal has a 3-pin base, and pins 1 and 3 are used.

Immediately below V2 are the smoothing capacitors, each of 8.0μF, which are clipped and bolted to the cabinet bottom.

The switches S1, S2 and S3 are mounted on the cabinet front direct, behind the valve V2.

The layout is perfectly straightforward, and beyond the points mentioned, no obstacles demanding extra care should be encountered.

In the photo of the frequency meter viewed from the front, the two feed through insulators top left provide RF output from 100 kcs crystal and VFO respectively.

Switches S1, S2 and S3 are seen to the left of the main tuning dial of the capacitor C5. This dial, it will be noticed, is fitted with a vernier control, and can therefore be read to 1 part in 1,000, which is very nice. The actual fundamental is 1.7-2 Mcs, which occupies 85° on the 100° dial.

The correction capacitor C4 is on the right side of the main tuning dial.

Test voltages :—

A	230
B	40
C	220
D	25
E	65
F	15

Meter Triplett 1,000 OPV.

These readings are only rough checks, and all of them will be affected by changes in valve emission in different valves used. In all cases the actual voltage present is greater than that as read by the meter.

Calibration

The utmost care must be taken in calibrating the instrument, as this is of vital importance. It is suggested to the constructor that he checks and re-checks the circuit wiring, and leaves the meter sufficient time to warm up before any attempt is made to get started.

The first step is to switch on the 100 kcs oscillator, and find a beat with WWV on 20 or 15 Mcs. Do not expect very strong harmonics, as the harmonic on 20 Mcs is the 200th of the fundamental, and therefore only just audible, and very little reading will be given on the receiver S meter.

Having found the beat note on 20 Mcs, set the variable capacitor C10 to exact beat with WWV, and lock the capacitor in that position.

Next switch on the transitron oscillator, and set the receiver to 2 Mcs (crystal check this). Set the main tuning dial to exactly 10°, and rotate correction capacitor until a beat note is heard. If one does not show up, adjust the capacitor C3 until beat is obtained with C4 at 50° and C5 at 10°.

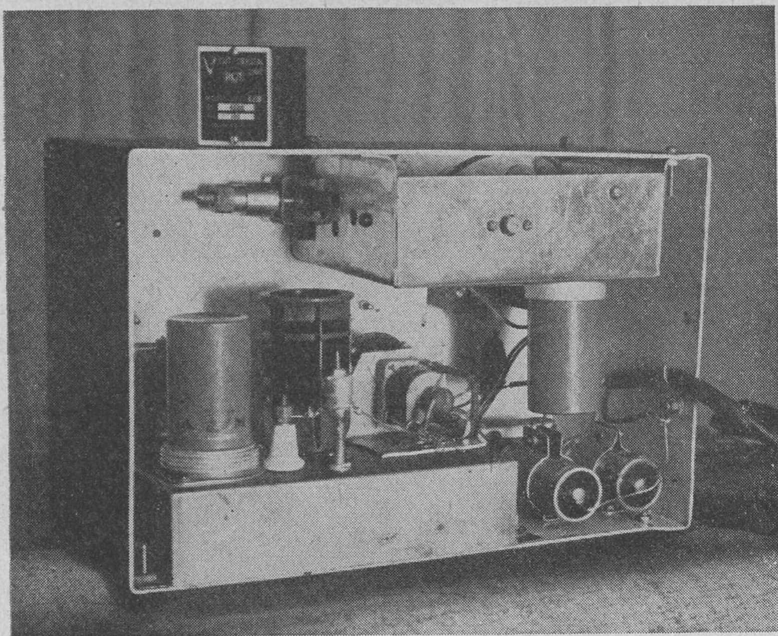
The instrument is now ready to calibrate with graphs. First set the receiver to 6,800 kcs crystal check. Why 6,800 kcs ? Well, 6,800 is 1,700 x 4. So that for every 25 kcs we move C5 on 1.7 Mcs, we shift 100 kcs on 6.8 Mcs. This provides us with 25 kcs check points on our graphs.

The frequency meter could be calibrated, of course, from 17-20 Mcs, but this was found to be rather confusing when identifying the correct 100 kcs harmonics. Of course, calibration over the range of 17-20 Mcs provides 10 kcs check points, but 25 kcs points were considered sufficient.

In all, 12 graphs were made for the 1.7-2 Mcs band, providing 2 check points at each graph. The capacitor C5 must have straight line capacity or the graphs will be slightly out on some ranges, because there are only 2 check points to one graph, so that a straight line is the only thing you can draw.

Extreme care must be exercised over the drawing of these graphs, because the frequency meter is as accurate as its calibration and no more.

Graphs for 3.5 Mcs band were taken off the original 1.7 Mcs graphs. Separate graphs have



The Frequency Meter with the back removed. The positions of the main components will be clearly seen.

been made for 7-14-28 Mcs. This saves a good deal of time when the meter is in use on the HF bands.

In conclusion, it should be said that if the instrument is built to the circuit diagrams with the original values of the components, no difficulty will be experienced by the user, and the performance will be equal to that of many more complicated and expensive frequency meters.

With a piece of equipment in your shack you can identify BC stations and give the frequencies of amateurs to 2.5 kcs, which is very useful to anybody. The band edges are easily found by the use of the 100 kcs crystal, and it is interesting to see just how many phone hams operate between 7,300 and 7,320 kcs !

Points to Watch

Total capacitance across L1 incorrect.

Rigidity of C5.

Make sure that you have the correct harmonics when calibrating.

Check every 100 kcs point twice to avoid error.

Beware of hand capacity effects when adjusting C3.

Do not over couple the VFO stage to the receiver.

Reduce the setting of the RF gain control if the signals are too strong.

Make sure the VFO and 100 kcs oscillator are functioning correctly before calibration.

Check HT + HT— for resistance, as you may not be able to replace the receiver mains transformer.

VHF Transmitting Valves

A lecture on the manufacture of VHF transmitting valves was recently given to the City and Guild College Radio Society by Mr. E. Morgan of the General Electric Company's Valve Department.

The lecture was illustrated by a 16mm. coloured film to which Mr. Morgan gave a running commentary and amongst the valves shown were types that will be used in the radio television link between London and Birmingham.

Philips Plan Transfer of London Lamp Factory

The electric lamp factory of Philips Electrical Ltd. now situated at Harlesden, London, N.W.10, where lamp production running into many millions per annum is achieved, is to be moved to Hamilton in Lanarkshire, Scotland.

While the tungsten and discharge lamp section of the Company's lamp production is being transferred to Hamilton, it is also proposed to transfer fluorescent lamp manufacture from Blackburn to Hamilton so as to centralise the manufacture of Philips Lamps.

LOGICAL FAULT FINDING

The third in a series of articles to assist the home constructor in tracing and curing faults

By J. R. DAVIES

3 : CRACKLING

THE term "crackling" is rather loose. It covers here a large amount of troubles, including "static." Let us examine the various sub-divisions into which it may be broken down.

1. "Static" and Interference. This covers the entire field in which man-made interference and "static" spoil the reception of the receiver. The term "man-made interference" does not, of course, include such forms of interference as adjacent, or second-channel, interference.

2. Crackling caused within the receiver. *i.e.*, crackling caused by faulty connections, etc., but not that caused by wave-change switches and similar components, which are treated separately in the following paragraph.

3. Crackling caused by faulty switches and volume controls.

4. Crackling caused by an arc or sparking between two points in a receiver at high potential to each other.

1. Static and Man-Made Interference

Interference *external* to the receiver can be picked up from two sources. It can be picked up by the aerial (including its down-lead) and earth connections; or via the mains connection, if a mains set is being used.

Let us first examine the case where interference is picked up by the aerial and earth system. The interference may be the form of unidentifiable and intermittent crackles, of the characteristic noise given by an electric motor or similar machine in the neighbourhood, or of identifiable crackles of which the cause is known (*e.g.*, noise is heard every time a trolley-bus passes down the street).

Whatever the cause, interference on the aerial-earth system can always be recognised because as soon as the aerial and earth connections are removed the interference stops. (If a portable receiver is used, the frame aerial will usually give variations in interference strength as the set is rotated.)

The cures for interference picked up by the aerial are pretty well-known. If the noise is unidentifiable and intermittent there may be a bad connection somewhere in the aerial-earth system itself. If this is not the case and, say, the same trouble is experienced elsewhere in the more immediately vicinity, it is adviseable to give the house lighting system a good check. The GPO will always assist in tracking down unidentifiable interference.

If the interference is identifiable and cannot be stopped (*e.g.*, the trolley-bus), the only cure is to fit an aerial as far away from the source of trouble as possible, or to fit a special aerial of the anti-interference type. This latter type of aerial is advertised by various firms so often in the technical journals that there is no need to enlarge here.

Interference picked up via the mains can also be identified quite easily. If a battery set, connected to the same aerial and earth as the mains set, does not suffer from the trouble, it is obvious that the interference is being received on the mains wiring. If the interference is not excessive, a simple filter using a pair of capacitors such as was used in Fig. 4 (b) to combat mains modulation may be successfully used. If unsuccessful, a more elaborate filter, such as that shown in Fig. 6, may be fitted. The chokes shown in the diagram may be home-constructed, using thirty or more turns of medium-gauge cotton-covered wire on a 3″ former. Commercial suppressors are readily obtainable.

2. Crackling Caused Within the Receiver (Faulty connection)

This is a very simple fault to diagnose. In almost every case the receiver gives a crackle each time the chassis is tapped.

Occasionally, it is difficult to discover which component is intermittent or otherwise faulty. A light tap on each suspected component with an insulated rod is far better than heavy thumps all

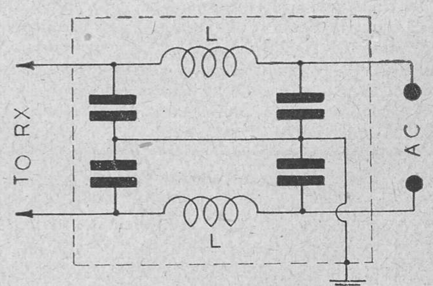


Fig. 6. A mains interference filter that may be successfully home-constructed. All four capacitors should have a capacitance of $0.01\mu F$ *and a working voltage of at least* 750, *preferably* 1,000 *volts.* "*L*" *is an RF choke—see text.*

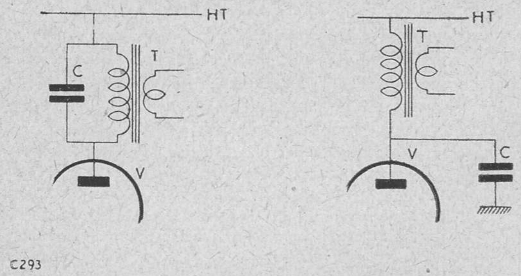


Fig. 7. Illustrating the two alternative positions in which the tone compensating capacitor mentioned in the text may be found.

over the chassis. The latter may stop the set from working altogether and make the job harder!

A bad connection or "cold" soldered one may be the cause of the trouble and this is somewhat difficult to discover sometimes. Tapping the *wires* to that connection will usually locate it, however.

3. Crackling Caused by Faulty Switches and Volume Controls

Wave-change switches and push-button units are very prone to causing crackles. The cleaning of a wave-change switch is a pretty simple matter provided that the contacts have not lost their springiness or are not broken. If the wave-change switch is of the wafer, or Yaxley, type, it is usually inadvisable to attempt to tighten the contact pressure unless you have the proper tools for the job. A good cleaning fluid will usually clear the trouble.

The best cleaning fluid for switches, particularly those with self-cleaning contacts, is trichlorethylene. Carbon tetrachloride, however, is nearly as good and has the advantage of being easier to obtain. There is a faint possibility that too much of it on the skin may cause dermatitis but the amount used by the radio serviceman will cause no trouble whatsoever. Carbon tetrachloride may be obtained from the chemist pure, or mixed with other ingredients in certain patent cleaners. The chemist will advise. It also appears, in a cheaper but less pure form, as the fluid used in fire extinguishers of the pump type. It is worthwhile dissolving a very faint trace of "Vaseline" in the tetrachloride before use. This covers the contacts with a slight film after the tetrachloride has evaporated and protects them from oxydisation. It should be mentioned that there are various commercial switch-cleaning fluids on the market; these being sometimes advertised in the technical journals.

The process of cleaning the switch consists simply of applying the cleaning fluid to the contacts and working the switch backwards and forwards a few times to clear the dirt out. The cleaning fluid evaporates very quickly and causes no damage to other components if small quantities are used.

An enclosed switch of the toggle variety should, of course, be replaced when it becomes faulty.

Crackling volume controls can nowadays be replaced very simply. During the war, when it was impossible to get new components, it became the fashion (born of necessity) for some servicemen to run a soft pencil around the track! This is very bad practise as the value of the volume control becomes altered; and the only proper cure is replacement.

4. Crackling Caused by Arcing or Sparking

If a set has a badly manufactured component or if it collects a lot of dust or moisture, breakdowns, or arcs, may occur inside the receiver. They make themselves noticeable as sharp "cracks" or intermittent (occasionally continuous) "sizzles" in the loudspeaker.

Once an arc has started it usually becomes progressively worse. The first spark that occurs causes a slight chemical breakdown of the dust, and, perhaps, of the insulating material between the two points. If there is any carbon present in either of these two, it will begin to be deposited as a carbon track between the two points carrying the potential difference. As can be seen, the effect is cumulative, the situation becoming worse after each successive spark, until a complete breakdown occurs.

Arcing in a receiver falls under two headings :—

(*a*) Arcing between two points at DC or AC potential, and

(*b*) Arcing between two points at AF potential.

The DC or AC type of arcing is best located by turning the volume control right back and listening for the "crack" of the sparking in the chassis. Usually a visual check will show where the set is "burning" up. When the faulty component is found it should be replaced, as it cannot be readily repaired, due to possible breakdown of the insulating material, as mentioned above.

Arcing between two points at AF potential is easy to diagnose. It nearly always occurs in the form of staccato cracks whenever the volume is turned up, or whenever a certain note is played loudly (the AF section of the receiver being, of course, resonant at that note's frequency).

Incidentally, the AF potentials developed across a speaker transformer primary often extend to a peak value as high as 500 volts, or even more !

AF arcing will be found to occur in the following places :—

(i) in the speaker transformer or at its terminals,
(ii) the wires leading to the transformer,
(iii) between the anode pin of the output valve-holder and the chassis, or an adjacent pin,
(iv) in the tone correction capacitor connected across the speaker transformer primary (See Fig. 7),
(v) in the output valve itself, or between its pins.

The arcing can usually be seen, and may be heard if the loudspeaker voice coil is disconnected temporarily.

SUMMARY

Crackling

1. Static and Man-made Interference

Decide whether in aerial-earth system or via mains wiring and treat accordingly.

2. Crackling Caused Within the Receiver (Faulty Connection)

Faulty component or connection may be isolated by judicious tapping.

3. Crackling Caused by Faulty Switches and Volume Controls

Switches may be cleaned with carbon tetrachloride or replaced as necessary. Volume controls should be replaced.

4. Crackling Caused by Arcing or Sparking

(*a*) Between two points at AC or DC potential. Simple inspection with volume turned down should locate arc.

(*b*) Between two points at high AF potential. Occurs almost inevitably in loudspeaker transformer primary circuit. Again, simple inspection will locate fault.

To be continued

BOOK REVIEW

Radio, Television and Electrical Repairs. Published by Odhams Press Ltd., London. Edited by Roy C. Norris, 448 pp., demy 8vo., 10/6.

We have seen many books dealing with this subject, but have no hesitation in saying that this is the most practical and most comprehensive which has so far come to our notice. The reason for this probably lies in the fact that it is edited by Roy C. Norris, Technical Editor of the radio trade publication " *Electrical and Radio Trading*."

In our opinion this is an ideal reference book for the service engineer, particularly for the " small man " who has to tackle everything that comes his way in the matter of radio and electrical repairs. This book will also appeal to those of our readers who have the reputation of being " handy around the house."

The 27 chapters, with the aid of over 400 very detailed line illustrations, commence with a description of basic principles and components, the theory being enlivened by practical examples. This is followed by a description of basic radio circuits and preliminary tests. Test gear, fault location, alignment, components, speakers, pick-ups, and gramophone motors are covered by the remainder of the chapters devoted to radio receivers. The next section describes television circuits, test gear, faults, symptons and cures, and this is followed by a chapter on aerials and extension speakers.

Chapter 17 leaves radio for domestic electric wiring and its maintenance, and further chapters deal with small appliances, fires, vacuum cleaners, motor rewinds, cookers, hot-plates, washing machines and refrigerators and motors for them, and electric water heating. The concluding chapter deals with battery charging.

To sum up, a nicely produced book with clear and detailed illustrations, which will prove helpful to those with an electrical " bent."

C.O.

THE EDITORS INVITE . .

- **Constructional articles suitable for publication in this journal. Prospective writers, particularly new writers, are invited to apply for our " Guide to the writing of Constructional Articles " which will be sent on request. This guide will prove of material assistance to those who aspire to journalism and will make article writing a real pleasure !**

A Needle-Armature Pick-Up

CONSTRUCTIONAL DETAILS OF A CHEAP BUT EFFECTIVE HOME-MADE INSTRUMENT

By W. GROOME

TO a gramophone enthusiast with an urge to experiment with "home-spun" pick-ups, the immensely powerful little "Eclipse" permanent magnet is a gift from heaven. The writer has a couple which have been used in instruments of nearly every type. Even in these expensive days they cost only half-a-crown each, so that pick-up experiments need cause no serious financial sacrifice !

The pick-up to be described must represent the last word in stark simplicity, both in action and construction, yet its performance is of really high quality, and certainly superior to the ordinary heavy armature type. The moving parts have been reduced to one only—a miniature needle with no other metallic attachments, so that the instrument will be kind to your record grooves. The needle, vibrating between tiny pole-pieces, sets up a small current in the coil, which surrounds its blunt end. (Fig. 1).

One piece of rubber, cut from a pencil eraser serves as coil former, needle-holder and damping. This is cut to fit tightly, and fill completely the inner 'U' of the magnet, and is of the same thickness, about $\frac{5}{16}''$. At a distance of $\frac{1}{8}''$ from the small end a $\frac{1}{8}''$ slot is cut in each side. These slots or grooves should be cut as deep as possible, without weakening the part too much. Remember that the needle is passed in between them. This is shown clearly in Fig. 2.

Two small "J" shaped staples, made of brass wire, are pushed through the rubber to serve as terminals for the coil. The fine wires are soldered to the rounded end of each staple; the long leg of each, protruding through the rubber takes the more robust lead from the carrier-arm. A hole to take the brass assembly screen completes this part, except for the winding. This consists of as many turns of 40 SWG enamelled copper-wire as the slots will accommodate. The two

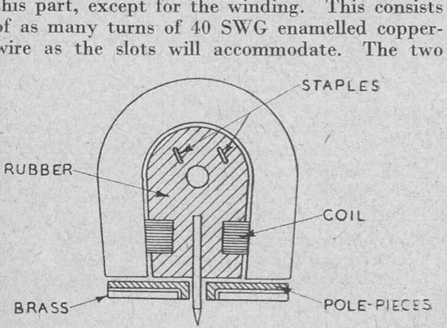


Fig. 1.

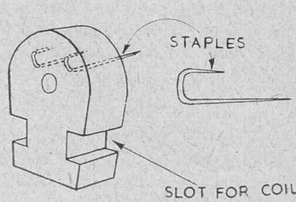


Fig. 2.

ends are then bored and soldered to the rounded heads of the staples. A narrow strip of cellulose adhesive tape is wrapped round the coil to prevent shorting to the magnet after assembly.

The two pole-pieces are shaped from thin transformer iron, soldered to a piece of thin brass with the bent ends in the hole, the ends being 1/10" apart. Greater output could be obtained by closer spacing of the pole-pieces, but as this is a common cause of distortion it is preferable to make a small sacrifice here which can be easily made up in the amplifier. Incidentally, as some people find difficulty in soldering ferrous metals the following tips may help to make an easy job of jointing the pole-pieces. Clean the surfaces to be soldered until they are bright, dust off any filings or emery dust, use a paste or spirit flux (not resin), have the iron really hot, and tin the cleaned areas. Tin the brass, and finally put the pieces together and heat again until the solder runs. If slight distortion occurs through the heat, squeeze the assembly in the vice until it is flat enough to fit snugly against the machined surfaces of the magnet. Fig. 3 shows the pole-piece assembly.

All parts of the pick-up itself have now been described. Assembly is simple—just press the rubber part into the magnet. The needle—a "Silent Stylus"—is push-fitted in the rubber so that it passes centrally through the coil. The point may be used to make the hole in the first instant. The hole closes tightly on the needle, and it has been found that the needle does not become loose even after many changes. This type of needle will play a hundred sides, although with several pick-ups of various types using it, the writer's over-critical ear seems to detect a slight deterioration in quality after 40 or 50 sides.

The cover and carrier-arm are best left to the reader to suit his own ideas, the design shown being just a suggestion. A metal cover (non-ferrous) is preferable, as it gives electrical screening. The back and front are identical, and are of the same shape and size as the magnet, except for a slight increase in length, to enable them to extend over the pole-pieces. A hole in each corresponds with the hole in the rubber. The carrier arm is of brass tube $\frac{1}{4}''$ to $\frac{1}{2}''$ diameter, flattened, bent, and drilled one end as shown. The back cover-plate is soldered to this with its hole concentric with that in the flat end. The two extra holes in this plate are for the leads. The length of the arm and position of the pivot depend upon the constructor's motor-board space. One method of pivoting, using an old volume-control spindle and bushes, is shown in the drawing.

The constructor is urged to devise some method that will enable the pick-up to be removed from the arm, or twisted round for ease in needle changing. The writer's is detachable, but as the contents of his junk-box will not be the same as the readers, the odds and ends used are not described here. A counter-balance may be made by rolling up a narrow strip of lead, and when its optimum position has been found a dab of solder will secure it to the carrier-arm.

Figures 4 and 5 show how the whole job is put together. A short wire is soldered to one of the staple ends, and passed through one of the holes in the back-plate. This is the negative lead, and packing pieces (not shown) are fitted both sides of the rubber part to keep the plates from touching the coil, for it is not in grooves on the flat sides. They should be exactly the same shape as the magnet.

A brass bolt and nut passing through back, rubber, and front holds the parts together. The

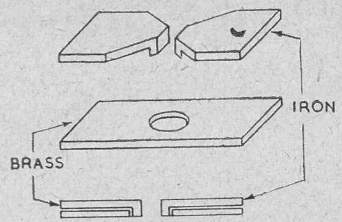


Fig. 3.

pole-pieces are slipped into position, and although the magnet will hold them firmly, a dab of solder at each corner will secure them to the case.

As it is of the low impedance type, the pick-up should feed into a matching transformer, and a 15 ohm microphone transformer will be ideal. There are several types in the surplus market, and although some seem to chop the base off, one of three the writer has tried has an excellent response. In common with several instruments of the needle armature and miniature moving-iron types, this little pick-up will be found to accentuate the treble. This is an advantage in a way, for pretty hefty bass-boost may be employed without making the output sound muffled. If the treble is still too evident a capacitor of .005 to .01μF connected between the anode and earth in the first amplifier stage will remedy it.

The output is not so great as that of the ordinary armature type of instrument, and a pre-amplifier may be needed. With VR65, VR65A and VR91 valves, costing 3/6, 2/6 and 5/- each respectively, a one-pentode pre-amplifier is a matter not of

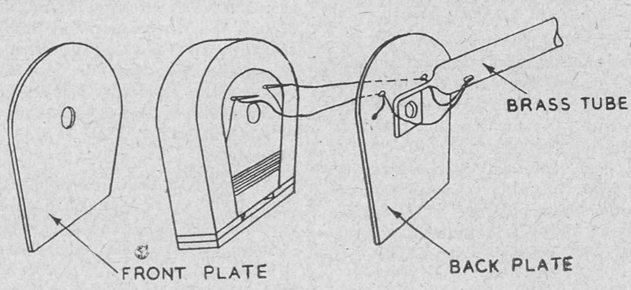


Fig. 4.

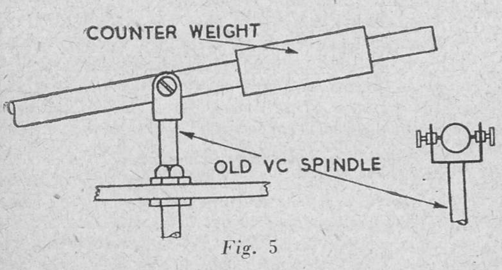


Fig. 5

expense but merely of a few hours' work. It should, of course, include the required tone controls.

As the frequency response depends largely on the type of rubber used and on the transformer, the writer feels that no benefit will result from giving correction data. A few experiments with a variable potentiometer and various sizes of capacitor will soon solve the problem in most cases.

PYE AND THE BOAT RACE.

Perfect weather and the most exciting race in the history of the Oxford and Cambridge Boat Race, came as a reward to the engineers who made their own Boat Race history on March 26, when the whole of the race was televised from beginning to end.

The B.B.C. treated the whole job as a major operation and succeeded in doing something that had never been done before—televising from a moving vehicle the scene of other moving objects —for a public broadcast. To do this it was necessary not only to move the camera, but a complete television broadcast station as well, and all the necessary power supply to go with it. The launch *Consuta* was equipped as the mobile unit, and along the banks eight other cameras were placed to give strategic coverage of various phases of the race. The Pye Outside Broadcast Control Unit, which has recently been delivered to the B.B.C., was used at the finish and the Pye cameras were given the important task of making sure that good pictures of the final struggle came over the air.

In the launch, amid a conglomeration of radio and television gear, two neat boxes, about the size of suitcases, were placed—the Pye transmitters. Along the bank, at carefully-chosen sites, three standard B18T receivers, which were *made on the line here at Cambridge*, had the important task of receiving the signal from the launch for re-broadcasting from Alexandra Palace.

The network of land lines and radio links that were necessary ran into several miles, and sitting here in Cambridge, it was a wonder to anyone as untechnically-minded as ourselves how the picture could ever appear. In the lab. our research people eagerly watched the screen, as critical of the whole thing, as professionals always are of their handiwork, and convinced that better and brighter pictures were possible. In the main works a good crowd had assembled to see the race, and there was no doubt about their opinion of the broadcast. It was the tops. Indeed, no one had any time to worry about technicalities, for from the moment the race started and the Cambridge boat began to lag behind the race was all we could think about. With everything Cambridge made—it just had to be a Cambridge victory, and so it was.

With never more than a length and a quarter separating the crews, and with a finish that was the closest in history, hundreds of thousands of people had the thrill of a lifetime as the picture came through on the screen in more than 120,000 homes. When the celebrities were being interviewed after the race—a very hoarse cox, and a very tired stroke among them—the President of the Cambridge Boat Club was asked what he thought of the race. "It was wonderful," he said; "I was watching it from the television set in the boathouse—it was the best view of the race I have ever had." And what better tribute could be paid to the work of not only the engineer, but the Pye workers as well?

(Reproduced from "Pye News").

BRITAIN'S FIRST COMMERCIAL ULTRASONIC GENERATOR

The Mullard Ultrasonic Generator (type E7562), now on the market, is the first commercial generator to be produced in this country. It is designed to fulfil the need for an experimental unit of wide flexibility.

The generator, comprising a control panel with meters, power oscillator, output voltmeter, relay panel and power supply, is mounted in a tubular frame. Trolley wheels are provided for ease of transport and the cover is adequately ventilated. Four pull-out handles simplify lifting the generator and a removable panel—with quick release fasteners at the rear of the cover—gives access for fuse and valve replacements.

The RF output is generated directly by a silica triode capable of producing one kilowatt of RF power. Four plug-in coil assemblies, which are rapidly interchangeable, are provided for operation around nominal frequencies of $\frac{1}{4}$, $\frac{1}{2}$, 1 and 2 Mcs.

The valve is matched to the crystal impedance by tapping the anode down the coil in the output circuit. Fine tuning of the output circuit and adjustment of grid coupling are effected by means of variometers.

The oscillator is housed in the upper portion of the frame with the control panel immediately above. On the lower deck is the power supply comprising two grid-controlled mercury vapour rectifiers, the filament transformer and the HT transformer.

The quartz crystal is contained in a metal case. It is connected to the generator by means of a co-axial cable. The crystal has silver electrodes fired on both sides to which the driving voltages are applied.

To give the maximum ultrasonic output in the forward direction the generating crystal is air-backed. The limitations on the temperature at which the transducer can work are set by the polythene of the cable and the rubber sealing rings. If silastic rubber is used and the back of the holder is adequately cooled, the crystal can safely be immersed in liquids at temperatures up to at least 150C.

Another Entry in the "RC" Surplus Gear Contest.

The Class "C" No. 1 Wavemeter

Conversion for AC Mains

By P. F. T. REDMAN, ISWL/G186

DURING the past few months the need for a reliable yet cheap wavemeter has become an absolute MUST for all transmitting Hams and also to a certain extent the short-wave listener. It was while I was scouting around the old favourite haunts that I saw this particular bargain going for the fantastic price of 7/6 and needless to say I bought it straight away without a second thought. On arriving home I investigated its capabilities and found that it covered the 1.8, 3.5 and 7.0 Mcs bands direct and had ample output on harmonics to go up to 28 or even at a pinch the 56 Mcs bands so I decided to try converting it for AC mains operation.

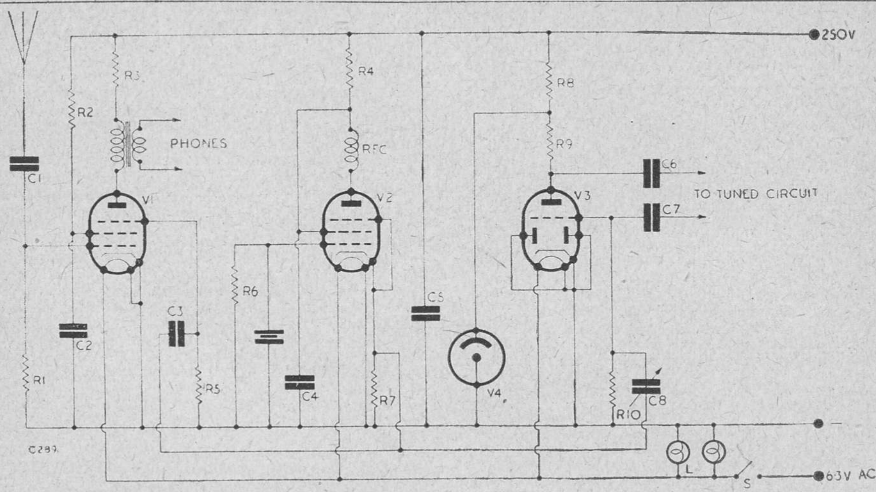
At first it was rather difficult to decide whether or not to employ a triode-hexode or two separate valves; the latter won the day in view of simplicity, In order to make it suitable for checking VFO's, etc., I added a 100 kcs crystal oscillator and provided reasonable care is taken with the wiring up it will be found to be absolutely stable. In my case, just to make it better still, I added a neon stabiliser across the oscillator HT and it was well worth the extra trouble involved. The wavemeter as it stands has 3 wavebands and covers one ham band in the middle of each scale, there being plenty of band spread due to it employing a spiral scale in conjunction with a variable inductance for tuning. This combined with the large C to L ratio is the main cause for its stability.

Modifications

The first thing to be done is to remove the battery valve which is a triode-pentode and also the valve holder. After that one can see just how much room is available for mounting the valves (three in number) and their associated components. At first it appears that there is nowhere near enough room but by placing the valves horizontally that snag is easily overcome. It was decided to use 6.3 volt valves since they are the type that most hams have lying around the shack. The types employed are EBC33 as oscillator, EF36 as RF amplifying stage and another EF 36 as crystal oscillator. This arrangement proved entirely satisfactory. It should be pointed out that almost any similar types of valve may be employed. The LT switch is left as it is and leads from the power pack are taken to one side and to the valves and dial bulbs from the other. On the front panel I have mounted purely for my own convenience two switches, one to switch the wavemeter oscillator and the other to switch the crystal oscillator so that I can check the wavemeter at will. This is really a necessity, since otherwise one is liable to make errors due to the crystal oscillators harmonics giving false readings, *e.g.*, being mistaken for the wavemeters output which may be on an entirely different frequency!

The power requirements of this wavemeter are very low, due chiefly to the valves employed and an added advantage of using these valves is that by only consuming a low wattage they therefore dissipate very little heat which again helps stability. The next thing to be done is to mount the valve-holders on the sub-chassis and to commence wiring-up. It is easiest if you start with the heaters and then go on to the cathodes, followed by connecting-up the screen-grids and finally the anode circuits. In the lid of the wavemeter will be found a circuit diagram of the wavemeter as connected for battery operation and all that you have to do is to imagine that the triode-pentode is two separate valves and connect-up according to the circuit diagram. I have drawn the circuit as it would appear after it had been modified for mains, since it is not necessary to give the battery version as that is in the lid of the unit. The circuit of the crystal oscillator will, as you can see from the diagram, be a standard arrangement which is a reliable circuit. The RF oscillator is operated at a slightly lower potential than the rest of the unit since it has the neon stabiliser across it, if one likes the whole unit can be run from a voltage stablised power pack in which case it would not be necessary to have the neon in circuit. The type of neon employed doesn't matter very much, in my case I am using a small de-based 230 volt neon with the voltage dropping resistor removed in order that it will operate with about 135 volts, but this voltage is not at all critical, anything from 90-180 volts being sufficient. The rest of the valves, it is advisable to operate at their rated voltage which in this case is round about 200-250 volts. If desired this unit could be made an AC/DC job by putting the heaters in series, but in that case care must be taken to keep the dropping resistor well away from the oscillator, preferably outside otherwise the stability of the wavemeter as a whole will suffer.

If the constructor does decide to run it as an AC/DC job it would be advisable to build the power supply and neon stabiliser as a separate unit and to run the complete wavemeter at about 130 volts using an S130 neon. These are in plentiful supply at the moment and I believe they cost about 5/- or 7/6 at which no one can grumble. The coupling from the crystal oscillator to the RF amplifying stage has to be extremely weak otherwise it will overload it, and as a result it will not be possible to receive the heterodyne beat note of the transmitter being checked. Although



Circuit of the Modified Wavemeter Class C No. 1. Component Values

Capacitors	*Resistors*	
*C*1, 300$\mu\mu F$	*R*1, 20,000 Ω	*R*9, 20,000 Ω
*C*2, 0.1μF	*R*2, 100,000 Ω	*R*10, 100,000 Ω
*C*3, 30$\mu\mu F$	*R*3, 10,000 Ω	
*C*4, 0.1μF	*R*4, 10,000 Ω	*Valves*
*C*5, 0.5μF	*R*5, 1 *M* Ω	*V*1, *EF*36
*C*6, 0.001μF	*R*6, 100,000 Ω	*V*2, *EF*36
*C*7, 0.001μF	*R*7, 1,000 Ω	*V*3, *EBC*33
*C*8, 20$\mu\mu F$	*R*8, 30,000 Ω	*V*4, *Neon*
		L, dial lamps.

I have not as yet had time to try it, these units appear to be ideal for use as a very stable VFO unit and if anyone is lucky enough to buy two of them it would be worth his while to use one for frequency checks and the other as a VFO and both could easily be run from the same stabilised power pack provided adequate RF decoupling is used between the two units, otherwise they would interact with each other and prove unstable. While we are still on the subject of wiring up I had better add that all wiring should be done with a fairly heavy gauge of wire in order that it will be rigid. The sub-chassis should preferably be made of 16 gauge metal but in my case I had to make do, as is often the case, with a strip of sheet tin, which provided the ends are bent over will be reasonably rigid. At first it would appear that the wavemeter has not got any outside aerial but on looking closer you will notice that what appears to be a handle on the front panel is in reality an insulated metal rod and they use this, which is both effective and out of the way, with no fear of being damaged !

Well, by now you should have the wavemeter all set up ready for testing . . . for this you do not for the initial test require anything except a pair of earphones. First set the wavemeter on band number one and tune it to approx. 1.8 Mcs, then listen for the heterodyne beat note of the 100 kcs crystal oscillator, not forgetting, like I did first time, to switch the xtal oscillator *on* ! It saves no end of futile searching, you know !

If the wavemeter appears to be right off tune the frequency can be adjusted by means of trimmers which can be adjusted from outside, thereby avoiding hand capacity effects, by removing a cover-plate on the bottom of the case. When I bought my unit it had been out in the rain and had as a result got rather stiff on the tuning control but this was soon overcome by a spot of oil. All the reduction gearing is very robust and is spring loaded to make up for wear and tear. The rotating wiper contact is self-cleaning so that will not cause any trouble, but if the set will not operate after a thorough check-up on the wiring it should be checked to see that it is making contact. A break here would make the wavemeter oscillator inoperative due to the HT line being broken and also the tuned circuit. The phone output transformer is a medium impedance one and the best phones to use would be ones of about 2-4 KΩ although it will operate low resistance phones fairly well but with a drop in volume.

Conclusion

I would be interested to hear from any other ham if he does decide to get one of these wavemeters, BUT please don't write to me asking for the places where you can buy these since it's absolutely impossible to say with any certainty if a particular shop has these in stock. So all that I will say is good hunting, and I hope that you all manage to get one of these very good pieces of British made workmanship.

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