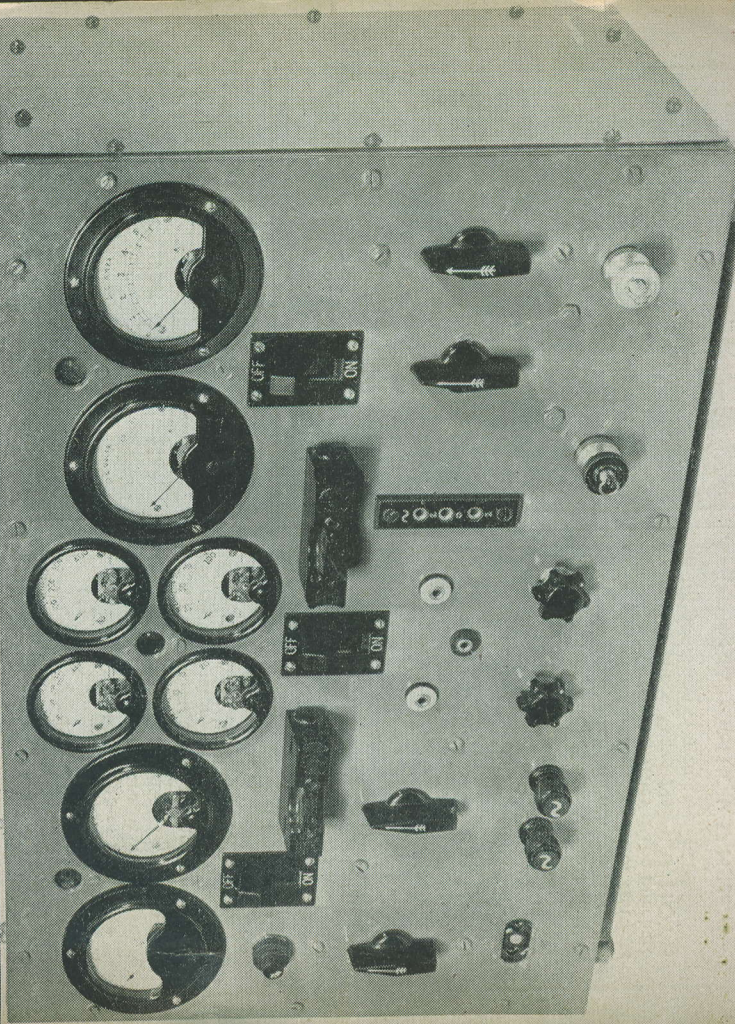


RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



IN THIS ISSUE . . .

- Universal Supply Unit
- Modifying the SCR522
- Regenerative Preselector Unit
- Aerials
- Tape Drive Mechanism
- Two-Circuit Mixer Unit
- Remote HT Supply
- Focus on 144 Mcs.

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- (1) The International Short Wave League is an organisation of short wave listeners, amateur transmitters, and others interested in short wave radio communication.
- (2) Its objects are to encourage, in every way possible, friendly intercourse and understanding between peoples of every country, through the medium of a common interest in their hobby.
- (3) Membership is open to anyone, of whatever race, creed, or colour, provided there is a genuine interest in short wave radio and a desire to further the aims of the League.
- (4) The membership fee consists of an annual subscription of 2s. 6d., or its equivalent. There is no entrance fee.
- (5) Contests, Set Listening Periods and Dedicatory Broadcasts are regularly arranged, in order to further the aims of the League.
- (6) Organisation consists of an HQ staff, Country, County and Town representatives, and local I.S.W.L. Groups. These latter are the essential units of I.S.W.L. activity, as they stimulate and keep together local I.S.W.L. members.
- (7) Many free services are available to help members to get the best out of their hobby. Amongst these is a QSL Bureau which is unique in that it handles both amateur and broadcast 'veries.'
- (8) A section of 'Short Wave News' is devoted each month to I.S.W.L. affairs, and carries news of contests and Group activities. The purchase of 'Short Wave News' is **NOT** a condition of membership.
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Editorial and Advertising Offices—57, Maida Vale, Paddington, London, W.9
 Tel, CUNNINGHAM 6518.
 Edited by C. W. C. OVERLAND, G2ATV

April, 1951

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Editorial

Fuses. Cheap to instal; with modern fittings easily replaceable—but how many readers make it a habit to fit fuses in all apparatus which they construct?

Assembly. Easy enough to mount every thing rigidly. No chance of this touching that, or of an item coming adrift. But also, how easy to make just a 'hook up'.

Wiring. The knack of soldering is soon picked up—yet only carelessness is needed to make a 'dry' joint.

Insulation. The safeguarding of wiring, or of components, is not an expensive matter. Still, it does mean a few more minutes before the job can be tried out.

Testing. It's such a fag to switch off, connect up test gear, then switch on and wait until warmed up before a reading can be taken. It's far easier to stick this lead here, and that one there.

IS YOUR GEAR SAFE? Yes, that is the heading of one of our advertisements. But it bears thinking about. And when you are satisfied with your gear, still it is wise to take precautions against accidents. An unexpected shock, and you have dropped your testmeter, or an expensive valve. A slip of a screwdriver, and you are off from work for a spell. An advertisement by an insurance company in these pages is not so incongruous, after all, is it?
 G2ATV.

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THE EDITOR invites 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 draughtsmen will redraw in most cases, but relevant information should be included. All Miss 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. 6518.

Suggested CIRCUITS for the EXPERIMENTER

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

No. 5 A Regenerative Preslector Unit

This circuit illustrates a preslector unit with controlled regeneration, which is intended for connection between the aerial and the aerial terminals of a short-wave receiver. Apart from its use as a preslector, in which function the unit is capable of removing second channel interference with a superhet, and of attenuating adjacent channel interference when used with a straight receiver, the main purpose of the circuit is to increase the sensitivity of the equipment to which it is connected. This increase in sensitivity is occasioned by the use of the regenerative tuned circuit immediately after the aerial. It will be appreciated that, when properly adjusted, the effective "Q" of such a tuned circuit may be made very high indeed, thus occasioning a signal/noise ratio from the aerial stage which is higher than that afforded by the input circuits of many, if not nearly all, superhet or straight receivers.

Regeneration is provided by the valve V1, V2 being a buffer whose function is to pass the aerial signals to the subsequent receiver. The connection to the receiver is made via coaxial cable. The HT and heater supplies for the preslector may be obtained, if desired, from the receiver.

A special switch, S1/S2, is used to switch the preslector "in" or "out". When the preslector is switched "out", HT is removed from V1 and V2, and the aerial is connected directly to the coaxial cable which feeds the receiver. On switching to "in", HT is applied to the preslector, and its input and output aerial circuits are completed. In addition, the lead which previously connected the aerial straight to the receiver is now connected to chassis (by S1), this course being advisable to prevent capacitive feedback along this lead (the capacitance being present in the wiring and contacts of S1

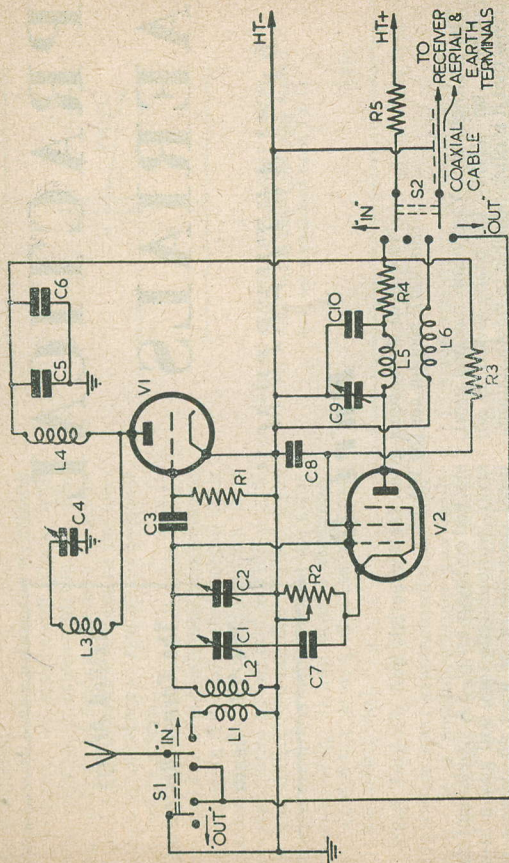
and S2) when the preslector is operating. It may be noticed that the aerial tuned coil L2 is tuned by C1 and C2, these being band-set and band-spread capacitors respectively. Unless an extremely good slow-motion drive is available bandspreading is almost essential, since the tuning of the aerial stage is very sharp. Regeneration is provided by the variable capacitor C4. To allow an accurate regeneration setting to be obtained, this component should also have a slow-motion drive.¹

The tuned circuit, L5/C9, in the anode circuit of V2 is made purposely flat (it being damped by the anode resistance of the valve) in order to remove the necessity of continually keeping it in step with C2 when searching for stations. It will probably be found that one setting of C9 will cope for about a third, if not more, of an amateur band. Despite the flat tuning, however, it would be advisable to fit this capacitor with a slow-motion drive as well.

The coils L1, L2 and L3 may be provided in practice by using a normal six-pin plug-in coil. L5 and L6 may consist of a four-pin coil, the usual aerial winding providing L6. For L4 a really good short-wave reaction choke is required.

The valves V1 and V2 may consist of a "detector-type" triode, and a variable μ R.F. pentode respectively. Although mains-type valves are shown in the diagram, it may possibly be found that 2-volt battery valves will give quieter and more stable operation. (If battery valves are being used, the gain of V2 may be adjusted by a screen-grid potentiometer). The

1. Those constructors who have their own "pet" reaction circuits (potentiometer-controlled, etc.) may, of course, use them instead of the capacitor circuit shown here; although it has been the writer's experience that the capacitive feedback circuit is as good, if not better, than most others.



C258

CIRCUIT OF THE PRESECTOR UNIT

List of Component Values

- C1—Bandset—say 150 to 250 pF
 C2—Bandspread—say 15 to 30 pF
 C3—100 pF
 C4—200 pF
 C5—0.01 μ F (mica)
 C6—0.25 μ F (paper)
 C7—0.02 μ F (mica)
 C8—0.02 μ F (mica)
 C9—150 to 250 pF (to correspond with C1)
 C10—0.02 μ F (mica)
 R1—1 Meg Ω
 R2—10 k Ω
 R3—100 k Ω
 R4—10 k Ω
 R5—5 k Ω

decoupling resistor R5 will not be required if a separate HT battery supply is used.

Construction

As every reader who has experimented with O-v-O and O-v-1 short wave receivers will know, layout in a circuit of this type is of the utmost importance. All RF carrying leads must be kept as short as possible; and, if this can be done, ceramic insulation should be used throughout. The chassis cannot be relied upon for tuning-capacitor earth returns, and it should also be borne in mind that the capacitor C10 is part of the tuned circuit C9/L5. The switches S1/S2 should preferably be ganged in some manner; although two separate switches may be used if the layout renders ganging impossible. The lead connecting the aerial tuned circuit to the grid of V2 should also be kept very short. The best method of making this connection consists of entirely enclosing the V1 circuit in a screening "box", and allowing the grid of V2

(a top-cap grid is essential) to "peep" into its anode circuit, also, should be screened.

Operation

The only disadvantage of course, the necessity of keeping the main receiver below oscillation level, is kept in mind that the capacitor C10 is part of the tuned circuit C9/L5. The switches S1/S2 should preferably be ganged in some manner; although two separate switches may be used if the layout renders ganging impossible. The lead connecting the aerial tuned circuit to the grid of V2 should also be kept very short. The best method of making this connection consists of entirely enclosing the V1 circuit in a screening "box", and allowing the grid of V2

FIG. 1. 6 SWG 4" EBER CASE

PRACTICAL AERIALS

by "AETHERIUM"

Part 8

Note—All dimensions given for the aerials in this VHF section are for 145 Mcs.

The multi-element Yagi beam has one great drawback on VHF. Its beam width is so narrow that it is often possible to miss a station, unless the beam is pointing to within a degree or so of the correct direction. This difficulty can, of course, be overcome by the use of accurate bearing calibration on the rotating mechanism. Another point is that a station situated in London has to put out a far larger percentage of calls to raise Dx stations, as the beam has to be moved in a different direction for each call. A Dx station calling the London area is not faced with this problem, and if situated say in Plymouth, has the chance of 30 or 40 QSO's without moving his beam.

Stacked Arrays

One good answer to this problem is to use a

Stacked Arrays

The Corner Reflector

The "Y" Beam

from the horizontal. The beam width is also reduced to something like 15 degrees. A six-element stack with wire mesh reflector is detailed in Fig. 2. The differing methods of feeding the two stacks in Figs. 1 and 2 are necessary because of the lowered radiation resistance caused by the addition of the reflecting screen.

Stacks of this type may be built up to 8 or 12 elements, and the wire mesh may be dispensed with and separate reflectors fitted behind each of the radiators. Arrays of eight fed elements are, however, more usual, and anything over this becomes difficult to handle. When eight elements are used, it is better to feed the array in the centre (Fig. 3) and always remember that for centre-fed arrays, the centre cross feeder is not transposed.

The Stacked Turnstile Array

This array is used commercially for VHF operation. It is omni-directional and easily constructed. Figs. 4 and 5 show all details and dimensions. As can be seen, the elements are Delta matched and the whole array fed with 300 ohm ribbon feeder. The 90 degree phase difference produced by the additional length of 600 ohm feeder is to prevent unwanted interaction between the two sets of elements and feeders, which would cause cancellation of signals in certain directions. It is important that this type of array should be mounted on a wooden mast. A metal mast will have an adverse effect on the impedance of the feeders, and so upset the matching.

The Corner Reflector

This array is sometimes considered to be too unwieldy for operation on 145 Mcs. Its overall dimensions, however, are approximately 8

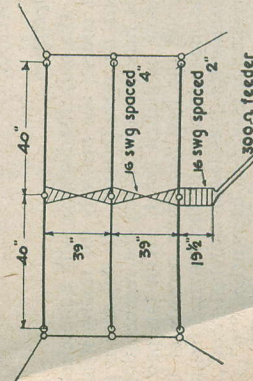


FIG. 1. 6-ELEMENT STACK.

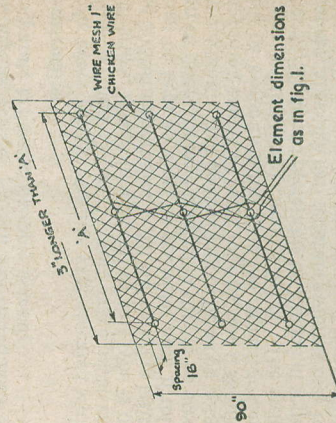


FIG. 2. 6-ELEMENT STACK WITH MESH REFLECTOR

C 249

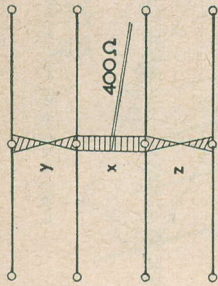


FIG. 3. FEEDING 8-ELEMENT STACK. When fed at centre, the cross feeders 'X' are not transposed as at 'Y & Z'.

C 250

feet by 4 feet, and it is a worth-while type to construct.

If made according to the dimensions and spacings given, the gain figure will be approximately 12 dB over a dipole. Fig. 6 gives complete details. The framework could be constructed from 1 1/2" square section wood (Fig. 7), and this could be mounted on a rotating mast. 80 ohm twin feeder should be used.

General Notes

As stated previously, all dimensions in the VHF section are for 145 Mcs, but all the aerials described are quite suitable for the 420 Mcs band, provided the element lengths and spacings are calculated correctly.

When using rotating aerials, make sure that the feeder is well clear of the beam as it rotates, and is secured in such a fashion that no strain is exerted on the actual connection point to the beam or array.

Each dipole 39" long

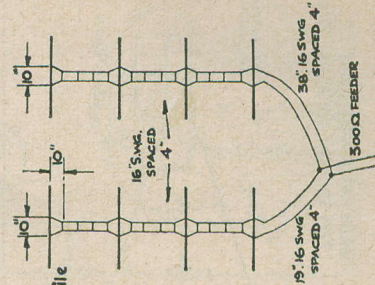


FIG. 5. Details of turnstile array

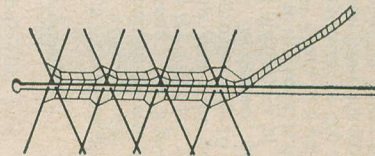
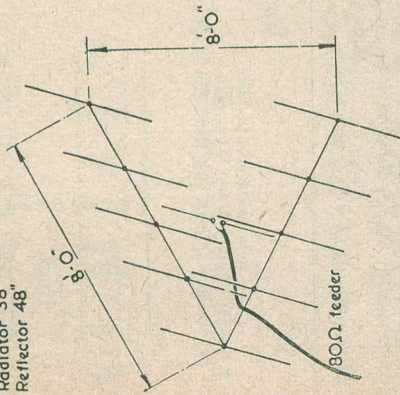


FIG. 4 Arrangement of turnstile array

Element lengths for 1/4 dural tubes
Radiator 38"
Reflector 48"



No. of reflectors per side is not important, as many as possible is the rule.
Spacing - Radiator to rear reflector - 40"

FIG. 6. Corner reflector aerial

Always use the shortest possible length of feeder, and don't leave half of it coiled up on the floor because you "don't like cutting it".
When using a stacked array constructed of wire and hung between two points, pull it up tightly, and use straining ropes to pull the lower elements out straight.

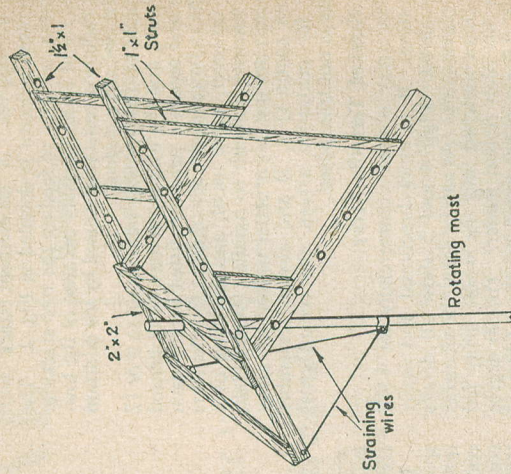


FIG. 7. Suggested arrangement for installing a corner reflector.

Don't forget that it is the aerial on which you are relying to deliver a signal to your receiver which will overcome the noise generated within the first tuned circuit. Look to the insulation, and use good feeder of well-known make.

Concentrate on reception. You will never work a distant station if you cannot hear him, but if you can hear him, you will almost certainly work him.

The "V" Beam

This type of aerial becomes a possibility for VHF working. On the LF bands its length becomes far beyond the capacity of the average Amateur. Fig. 8 gives details of a typical "V" beam for 145 Mcs, with each leg seven wavelengths long; the gain figure (bi-directional) is approximately 10 dB. The beam width is about 20 degrees, giving a total coverage of some 40 degrees of the horizon. One drawback to this aerial is that two masts are required. A "V" beam of 3 wavelengths per leg could be accommodated in the average roof space, but as the gain from this would be only just over 6 dB, it would be better to install a 3-element Yagi or a bi-directional stack.

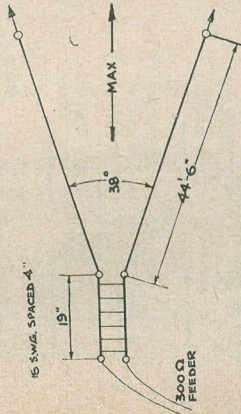


FIG. 8. V BEAM FOR 145 Mcs
Bi-directional gain 10 dB

c 233

QUERY CORNER

A "Radio Constructor" Service for Readers

Speakers as Microphones

Can you tell me if a moving coil microphone having a diameter of 3 inches will be suitable as a loudspeaker in an intercom. system such as is described in the August 1950 edition of the Radio Constructor?

K. C. Rowe, Essex

We would not recommend the use of a moving coil microphone as a loud speaker, mainly on account of its rather small power handling capacity. The cone suspension of the microphone is very light and could be easily damaged by feeding too much energy to it. The better arrangement is to use a miniature loudspeaker as a combined speaker-cum-microphone; such units having a diameter of 5 inches or less make quite good microphones for handling speech. The use of a larger speaker should be avoided, as the larger cone will reduce the upper frequency response when the unit is employed as a microphone.

Silencing Radio on Gram.

I have an R.1155 receiver to which a gramophone pick-up has been connected. Operation on both radio and gramophone is satisfactory, but it is sometimes possible to hear a radio signal whilst records are being played. What is the best method of preventing this background interference?

J. Andrews, Hanis.

The unwanted coupling between the radio side of the receiver and audio amplifier, when the latter is being used for gramophone reproduction, undoubtedly occurs across the contacts of the radio/gram switch. The switch employed originally was of the single-pole two-way type, and it is possible by the addition of a further pole to earth the lead carrying the radio signal when the gramophone is in use. The diagram shown in Fig. 1 indicates the method of connecting the additional switch contacts in order to achieve the required results.

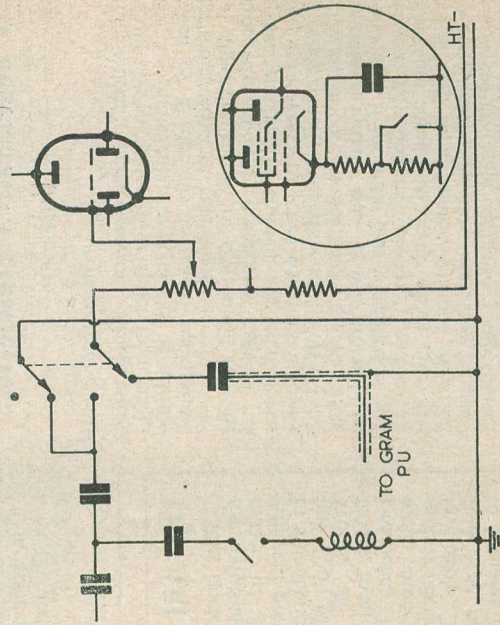


FIG. 1: DOUBLE-POLE TWO-WAY SWITCH FITTED TO R1155 TO MUTE RADIO WHEN GRAMOPHONE PICK-UP IS IN USE.

c 237

QUERY CORNER

“Rules”

- (1) A nominal fee of 2/- will be made for each query.
- (2) Responses on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.
- (3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.
- (4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.
- (5) Correspondence to be addressed to “Query Corner,” Radio Constructor, 57, Maida Vale, Paddington, London, W.9.
- (6) A selection of those queries with a more general interest will be reproduced in these pages each month.

A second, and possibly better, method of muting the radio is to switch an additional bias resistor into the cathode circuit of the frequency changer. A suitable value for the resistor is 27 kΩ and the additional switch contacts are arranged to short circuit it when the radio is in use. The position of the extra bias resistor in the cathode of the frequency changer may be seen from the inset of Fig. 1.

A Regenerative Preselector Unit

Continued from P. 303

ations indeed in signal strength. Regeneration should not be “ploppy” or suffer from backlash; and the oscillation point can be distinguished by a suddenly increased background and the presence of heterodynes.

A final adjustment of C9 should then be made, whereupon the preselector is set up. If further searching is required, any small deviations in frequency may be carried out by using C2 alone, finally “touching up” with C4.

The resistor R2 should not be touched after it has been initially set. It will probably be found that, if too little bias is applied to V2, reaction may become “ploppy”; and so an adjustment should be made which gives the greatest RF amplification without incurring this condition. (The same effect may be given by a screen-grid gain control). Large adjustments of C9 will also have a slight effect upon the reaction setting.

“RADIO CONSTRUCTOR” QUIZ

Conducted by W. Groome

- (1) Our stooge, finding that he had no cored solder left, did a rush job with tinman's solder and ‘killed spirits’. What kind of trouble awaits the clot?
- (2) What happens if valves with mixed heater current ratings are used together in (a) AC/DC sets, and (b) AC-only sets?
- (3) A slight knowledge of acoustics can be useful in understanding the problems of sound reproduction, and the answer to this question will give an indication of what to listen for when judging the merits of AF equipment.

If two instruments, say a violin and a flute, play in turn the same note, what is it that makes the character or timbre so different that we know by ear alone that both sets of notes are not made by the same instrument? For that matter, why should the same note sound different again in timbre when delivered by a sine-wave oscillator?

- (4) Do you know any simple ways of checking interlace by observing a synchronised raster?
- (5) The sawtooth input to a TV magnetic line-scan amplifier should be positive-going. Right or wrong?
- (6) Disregarding special protection circuits, there is one form of EHT generator which will not result in a single, destructive vertical line on the screen if the line timebase fails. Which is it?

Answers on P.313

Op Aid

This booklet is crammed full of all the information the amateur transmitter or SWL is always needing. Amateur prefixes, both by country and in alphabetical order, Zone Boundaries and Call Areas, QSL Bureau of the World; the Q and Z and reporting Codes, local time conversion, Standard Frequency Transmissions, Maps, and much other information set out in orderly fashion for ready reference. An invaluable aid to good operating. Price 1/8d. post paid. Remittance, etc., to Business Manager, S.W. Press Ltd., 57 Maida Vale, London, W.9.

HT SUPPLY for remote apparatus

by W. E. Thompson

The writer once wanted to run a microphone pre-amp. at some distance from the main amplifier, and the question of power supply arose. There was no mains power point near the place where the pre-amp. was to be situated, thus ruling out running it from its own mains transformer. On the other hand, it was not considered desirable to run out an HT feed from the main amplifier, since it is not usually good practice to trail hot HT leads around the floor. Such a course would also involve running out still another wire. The method adopted, and described here, was first of all tried out in the “den” and it proved satisfactory in practice. Since it was necessary to run a screened feed from the pre-amp. to the main amplifier plus a 6.3 volt feed for the valve heater, it occurred to me that it might be possible to step up the 6.3 volts AC and rectify it to provide sufficient anode current for the HF pentode used in the pre-amp. A few calculations showed that this could be done by using a transformer with a step-up of about 1:40. Current being small, in any case not more than 10 mA, it was realized that a suitable transformer would be a small pentode output transformer. The speech coil winding was therefore used as a primary connected to the 6.3 volt feed, the nominal primary then becoming the secondary.

A simple rectifying circuit consisting of a 300 volt selenium rectifier, 32 plus 32 μF electrolytic capacitor, and smoothing choke was made up, the choke again being a pentode output transformer, the speech coil winding being left is and the primary only used. These

transformers have the advantage of being small and light. No troubles from hum induction were experienced, the “power pack” being enclosed in a tin-plate screening box as a precaution, the components in the pre-amp. being carefully screened in the usual way as a matter of course.

The HT load of the pre-amp. being so small, the load reflected in the primary of the transformer amounted to less than 0.5 A, so a load of 0.75—1.0 A for both HT and valve heater was well within the tolerance of the heater winding on the main amplifier power pack. Ordinary lighting flex was used for the 6.3 volt feed between units.

The method would appear to have a further application in feeding an energised extension speaker. We commonly use PM type movements because to use an energised type would involve (here it comes again!) having HT leads wandering around the premises. A small power pack in the speaker cabinet running off a 6.3 volt feed would seem feasible, and although I have not got around to trying it out, it seems likely that a smoothing choke could be dispensed with by using the speaker energising coil as the smoother, as is done in the radio set itself.

The simplified diagram of the pre-amp. appended shows how the small power pack is wired. Perhaps the most attractive feature is the fact that the cost of the “mains transformer” is so small, a suitable component costing only about 3/- to 4/-.

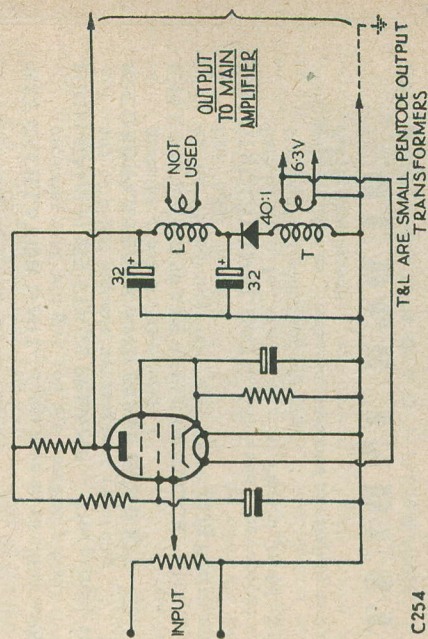
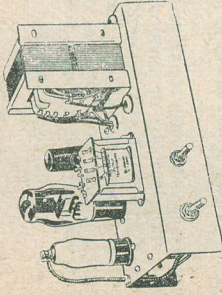


FIG. 1: CIRCUIT OF THE POWER SUPPLY FOR THE PRE-AMPLIFIER.

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MAGNETIC Sound Recording

Magnetic sound recording is enjoying increasing popularity, and the fact that a number of firms are now supplying kits of parts, components, wire, tape, recording heads, etc., enables the radio constructor to build all or much of the gear himself at reasonable cost. Our contributor has had considerable practical experience of home constructed recording equipment.

The fifth of a series of articles by E. KALEVELD, PAØXE

A Simple Drive Mechanism for Tape

WE have now considered three processes—recording, playback, and erasure—both from the theoretical and practical aspect. A further requirement is some method of pulling the recording material past the magnetic heads. In this instalment, we shall consider the construction of a drive mechanism for tape. The unit described herewith is one of the simplest solutions to the problem, but it is by no means the only way in which such a mechanism can be constructed, and readers will no doubt like to carry out modifications to suit their own particular needs. The one important point to note is that the tape must be pulled across the head with an *absolutely constant* speed.

Fig. 1 shows a suitable arrangement, in which an ordinary gramophone motor and turntable are used. There is no need to fear that the strength of the motor will not be sufficient. The writer's first model, built along these lines, used a spring driven gramophone motor which, incidentally, provided a very hum-free drive mechanism. It was with some dismay that the writer, eventually replacing the spring motor by an electric one, found that nothing but an AC hum was audible. But more about that later.

It is important to ensure that the motor spindle has no side play, as this will show up as a "wow" in the recordings.

The general layout, as depicted in Fig. 1, is clear enough. On top of the gramophone turntable a capstan is fastened, which pulls the tape at a constant speed. A jockey wheel, rigged up as shown, prevents the tape slipping. The erase head, if used, and record/playback head are mounted as shown, and the tape made to pass across their faces by means of tape

guides arranged as illustrated. A spring belt, similar to that used on amateur ciné projectors, is used to drive a take-up spool, and should be adjusted to such a tension that it winds up the tape tightly. The spring action of the belt, of course, provides for the change in speed as more tape becomes wound on the take-up spool.

It is not necessary, in using a gramophone motor for this purpose, to impair its use as a record player. The capstan can be made detachable; the jockey wheel can be arranged to swing sideways. Bear in mind, however, that if you have a 10" turntable and you want to play 12" records, you must keep your heads and tape guides well out of the way.

With this unit, re-winding will have to be done by hand, which is a slow process. The quickest way to do this is to fix a demountable handle on the lefthand spool and re-wind by hand after first having unthreaded the tape off the capstan.

The dimensions of the various parts are shown in Fig. 2. The capstan is best turned up on a lathe from a piece of 2" round brass rod. If turned to the dimensions shown, a speed of 7½" per second will be imparted to the tape. This is the recommended speed for good overall reproduction. A round, heavy brass plate, as per dimensions shown, should be fastened to the lower end of the capstan, and exactly in the centre a hole is made which is a tight push fit on the gramophone spindle. This must be really accurately done, so that the capstan, with its flywheel, fits the gramophone spindle perfectly and is quite central. This cannot be too strongly stressed, as the slightest discrepancy will result in uneven tape speed, and a very unpleasant "wow" on playback. The lower groove on the capstan is for the tape, and

Care should be taken to see that the height of both spools is such that the tape moves smoothly from one spool over the capstan to the other.

On top of the take-up reel, a small wheel is mounted to take the spring belt. It can be turned up from brass, or a suitable one may be obtained from advertisers. This wheel is shown in detail in Fig. 3. A pin, shown at 'a', is driven into a hole drilled into the underside of this wheel, and engages in a suitably placed hole drilled in the tape spool, thus ensuring that the latter is turned as the wheel is rotated by the spring belt.

The last items needed are two tape guides, to the dimensions shown in Fig. 4. They can be turned up from brass, if suitable ones cannot be obtained elsewhere. They are fixed to the deck with bolts and nuts, and are padded up with washers until the grooves are the same height as that on the capstan, so that the tape runs smoothly from one spool to the other.

The above description should prove sufficient to enable the constructor to visualise the arrangement, and he can use his ingenuity to devise suitable parts if he cannot get them turned up just as indicated. (Our advertisers should be able to supply suitable components—Ed.) It must be stressed once again that

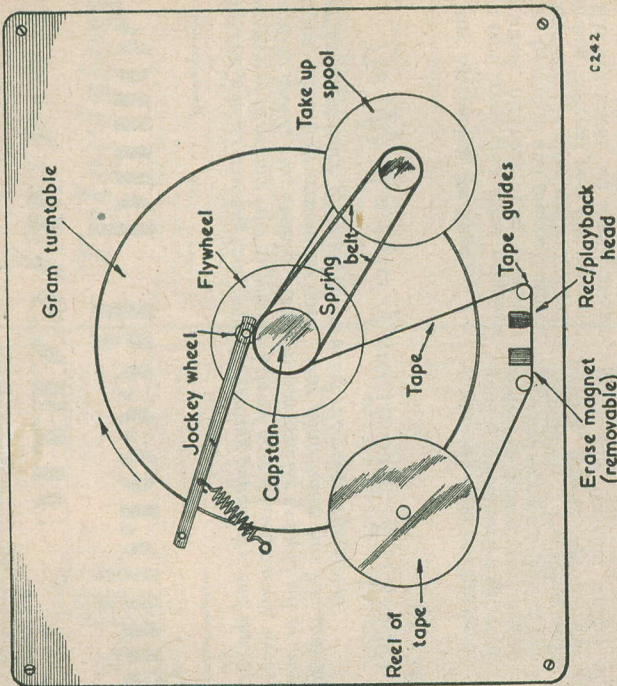


FIG. 1.

the top groove for the spring belt which drives the take-up spool. Both grooves are $\frac{3}{8}$ " deep. That for the tape is $\frac{1}{4}$ " wide, i.e., the width of standard tape. The width of the top groove depends upon the type of belt. Spring belting can be purchased quite cheaply at any shop dealing in home movie equipment.

The capstan could, of course, be given any other diameter, provided the tape speed is

then sufficient for the type of recording envisaged. For instance, when only speech is to be recorded, the diameter could well be halved, thus doubling the playing time.

To prevent the tape from slipping against the capstan, a jockey wheel is so arranged as to keep the tape tight against the capstan. To ensure a better grip, this metal jockey wheel is covered with a piece of adhesive tape. It is fastened to a movable arm of brass strip, and is kept against the capstan by a suitable spring.

The two reels for the tape run on spindles. The left reel, i.e., the one which contains the main supply of tape, should move under some friction, so a fixed spindle can be used for it. The spindle for the take-up reel can be made from the spindle and bush of an old potentiometer or variable capacitor.

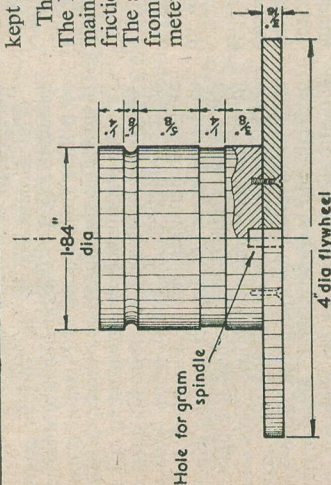


FIG. 2.

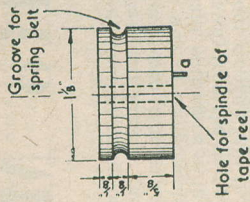


FIG. 3.

FIG. 4.

neither tape nor wire recording is tied down by hard and fast rules. Considerable latitude is possible, provided the basic principles are followed. The design described above is given as an example or rather as a starting point from which a more elaborate model can be evolved. Next month, we shall compare the merits of tape and wire, and describe a simple wire recorder head and drive mechanism.

ANSWERS TO QUIZ

(1) Joints will deteriorate through the corrosive action of the flux. Unlike the tinman, the radio man cannot immerse his work in water and, unless washed away, spirit flux retains much of its destructive nature even when dry. Crackles and background noise are certain to appear eventually, and also the exasperating intermittent fault which disappears whilst you are examining the set, and returns ten minutes or so after you've put the darned thing back into the cabinet.

Good non-corrosive liquid flux is available commercially, but is not so convenient in use as cored solder.

(2) (a) Disaster to the valve with the lowest current rating, for its heater will have to carry the heavier current drawn by the other valves in the heater chain.

(b) Nothing, provided the heater voltage rating of all valves matches the transformer winding supplying them.

(3) Although the fundamental frequency, which establishes pitch, is the same, the instruments generate their own characteristic combinations of harmonics, or multiples of the fundamental. The 'brassy' blare of the

trumpet, for example, is due to the presence of odd harmonics. In the case of the weird and reedy oboe, the harmonics predominate so greatly that the fundamental is the smallest component of its output.

Other factors having a large influence on the sound are transient components, such as the explosive little puff in the trumpet note and rate of 'attack' and 'decay'.

These are a few of the things that demand wide frequency response and good loudspeaker damping in AF gear.

The sine-wave generator emits a pure note with no harmonics, and the sound is most uninteresting musically.

(4) Look for the half-lines at top and bottom. Note whether lines are equally spaced or paired, or whether they 'weave' (lift up or down into one another from time to time). If the raster is perfectly interlaced, steady and bright, the lines should appear to be crawling upwards slowly.

(5) Right.

(6) Fly-back EHT. It will, of course, disappear upon line timebase failure, for that is its source of power.

Radio Miscellany

READERS often deplore the uniformity of present day receivers and lament the passing of the good old days when there was a far greater variety in the way of components and design. They complain, with some truth, that it is impossible to get away from the eternal 4-plus-one superhet without running into the headache of communications receiver design.

Letters in this vein are frequent from readers who do not like theory and formula, and feel they should still, as in bygone years, be able to get plenty of pleasure out of the hobby as a recreational pastime rather than as an intensive study. Their pleasure is in the construction and carrying out of simple, inexpensive personal experiment. Even quality amplifiers are becoming more or less stereotyped nowadays.

If you feel this way, why not try your hand at magnetic recording? The amplifier need only be a simple two-valve affair, both recording and playback, and the parts can usually be conjured up from the junk-box, while a further oscillatory circuit at superperson frequency can be similarly contrived for erasing.

The only item which normally need be specially purchased is the drive motor, but there are still plenty of cheap AC motors on the market as well as spools of wire or tape. The tiny recording head required provides enormous scope for experiment, and a number can be quickly made for the cost of a few coppers. Bent nails, strips of mu-metal or old transformer laminations can all be pressed into service. Surprisingly good results can be obtained with the simplest apparatus, while the recordings can be played back many thousands of times without loss of volume or quality.

The idea is well worth the consideration of readers who no longer feel the same interest as before in normal receiver and amplifier construction, and you can get hours of fun for the smallest outlay.

The Other Fellow

It is odd how often the phrase "average reader" occurs whenever readers discuss or write about Radio Constructor. Yet when we reduce it to cold logic we find there is no such person as an average reader. If, for instance, we find that most readers like Radio Miscellany, we might still find that the reader who is most nearly average in all other respects will tell you that it gives him a pain in the neck.

Perhaps it is because we all like to think of ourselves as being ordinary sorts of blokes

clubs. Anyway, there is none in my district that suits my needs.

"I first took an interest in radio when I was about sixteen; that was in 1932. After building a successful kit set, I began to re-build it in varying forms. They all worked about the same. I then tried to build a super-het, using some ready-wound screened coils. I did not understand the circuit or the principles of super-het reception properly. The set never worked satisfactorily. It suffered from weak reception and no life. Eventually, I gave it up as a bad job. I remember it used a separate triode oscillator and a Westector as a "second detector", although I probably did not think of them as such in those days. They were just parts that did something mysterious.

"I finally re-wound the coils and made a straight set with two RF stages. It was, I suppose, pretty good, but not equal to the contemporary factory-built super-het receiver which I bought. I then lost interest in radio as a hobby. I had bought some of the magazines that were popular in those days, but every issue contained articles on the construction of the same sort of sets, and each had a fancy name. I can see now, there was not much difference in any of them.

"I again became interested in radio in about 1942. I was medically unfit for the Forces, and in the black-out evenings I tried my hand at repairing a badly blitzed receiver. After "wasting" a number of pleasantly enjoyable evenings I had to give it up as hopeless. My knowledge was unequal to it.

"During the War one or two quite useful books were published, and I was also learning as I went along. My test meter and oscillator (IF only) were home-built.

"By the end of the War I was beginning to deal with trouble-shooting along professional lines. Not that I expected that with the return of it, as I realised that with the return of normal supplies of new receivers and the availability of qualified servicemen there would be little demand for spare timers. I still do occasional repairs for friends or satisfied war-time customers.

"Since then I have specialised in the modernisation of ancient receivers for my own amusement. There is a lot of fun in planning a modern lay-out on an old-fashioned chassis. It invariably means a complete re-build, fitting a modern coil pack, switching and valves. I am surprised that so little attention is given to this aspect of the hobby in radio journals, although we have had an overdose on converting ex-WD equipment. I am not keen on communications receivers or on short wave listening."

De-Luxe Models

Perhaps this would be a good point to interrupt to mention this reader's latest conversion. This had been a complete strip-down job, and he had polished the steel chassis with fine emery until it shone like an Exhibition model.

A Mullard EM34 (magic eye) had been fitted, and seven-way push-button tuning

CENTRE TAP talks about The "Average" Reader

"Owing to the call-up it became virtually impossible to get radio servicing done in this district, and I had a look at a neighbour's radio—at their own risk! As it happened I soon got it going, and the news spread up and down the road that I was an expert. As a consequence, there was no end of a demand for me to have a look at broken down sets.

"I did not know anything about systematic servicing, but by persistence and trial-and-error methods I managed to sort most of them out, finding the bits and pieces from the first blitzed receiver very useful. It was as well I did not make a charge for my labour, as I often took five or six hours finding a fruit that should have been located more or less straightforwardly.

added as the original gang-condenser tuning was big and awkwardly shaped as well as being of the "tracked" type. Manual tuning was omitted, and consequently there was no tuning dial to bother about. The bakelite cabinet, which had been cracked on the front, had only a tiny tuning scale hole. It was, therefore, cut away whole and a plywood front overlaid with a coarse weave fabric put in its place. The edges were turned over and glued at the back, thus no screw-holes were visible. The top and sides of the cabinet had been re-polished and the whole thing gave a pleasing and modern effect.

The only workshop facilities available are a garden shed (too cold for winter use) and a

Continued on P. 331

IN YOUR WORKSHOP

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

READERS may remember that last month's article concerned itself mainly about one subject, that of stripping down ex-Government and similar gear. The month before, we discussed the various types of drill and methods of drilling. It would therefore make a change if we devoted our space in this issue to a miscellany of different topics, all of which are sufficiently interesting to merit space here, but which do not in themselves require a great amount of detail.

Tuning Wands

A useful little accessory for constructional and servicing work which has found its way into many workshops is what is known as a tuning wand. This is a very simple device consisting of a length of insulated rod or tubing on which is affixed a round slug of brass at one end, and an iron-dust core (as used in RF coils) at the other. The primary function of the wand is to check the state of the trimming in a tuned circuit. For instance, if a super-het is tuned to a station or to the output of a signal generator, and it is found that placing the iron-dust end of the wand into the RF coil increases the strength of the signal, it then follows that the coil needs more inductance to be accurately tuned; or, in other words, that the frequency of the tuned circuit is too high. To remedy this, the trimmer connected to that particular coil needs to be adjusted to give greater capacitance. On the other hand, should it be found that the signal increases when the brass slug end is inserted into the coil, then that

particular trimmer must be adjusted for less capacitance. (The brass slug has the effect of reducing the inductance of the coil). It will often be found that it is not necessary to insert the wand right into the coil, it being quite sufficient, in many cases, simply to hold it near to it.

The tuning wand also has other uses. It may be employed, for instance, to locate certain coils in a complicated layout. Should a signal be apparently "tuned out" when the wand is held near a particular coil, then that coil will obviously be the oscillator coil for the band to which the receiver is switched. The subsequent behaviour of other inductors on the approach of the wand will then enable the user to accurately map out the complete coil layout.

It will probably also be found in practice that the iron-dust core causes greater variations in inductance than does the brass slug. This is no great disadvantage, but it is a point worth bearing in mind when the wand is being used.

Fig. 1 shows the dimensions of a typical tuning wand which has been made by the writer from an odd piece of paxolin tubing, (origin, before being found in the junk-box, unknown). Any type of insulated rod—ebonite, glass, or even, at a pinch, wood—will cope providing it is sufficiently strong. The iron-dust core was obtained from a permeability-trimmed IF transformer and had the advantage that a short length of threaded rod was fixed to it, thus allowing it to be easily mounted to the rod. The brass slug was filed out from a heavy brass bolt, and is fixed by a pin which passes through a small hole drilled in the tubing and the brass. The pin is rivetted over and filed flush with the paxolin. It may be noticed that, in this particular case, the brass slug has its end filed so that it may also be used as a screw-driver: this enables quick adjustments to be made to trimmers which are "on the surface" and can be easily reached.

Quick Padding

Whilst on the subject of trimming, many busy servicemen may find it helpful to have an odd buzzer or de-gonging bell on hand in order to help them make quick padding adjustments.

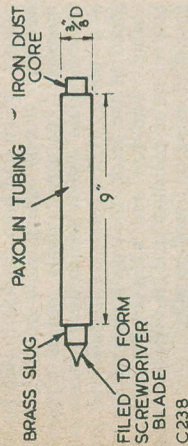


Fig. 1 A suggested tuning wand. The dimensions shown need not be followed accurately.

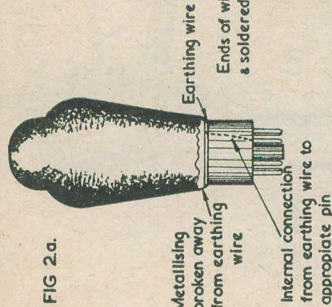
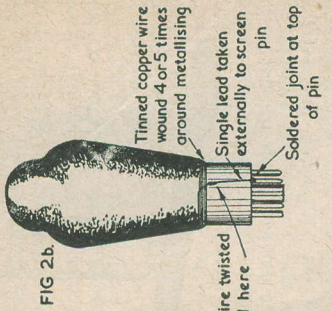


Fig. 2 Showing how a valve whose metallising has become disconnected may be repaired. (a) illustrates the fault and (b) the repair.



If connected by a few feet of flex to a battery, the buzzer will create sufficient noise on medium and long waves to enable quite accurate padding to be carried out on these bands without the necessity of rocking the tuning capacitor. Hardly a laboratory instrument, but nevertheless quite useful for "rush" work. The buzzer also helps in finally touching up those portables whose frame aerials go "off-trim" when external connections are made to the aerial terminal provided.

De-based Valves

There are few things so irritating as finding that, after pulling out a valve, the glass has come loose in its base. Admittedly one should always remove a valve by holding onto its base and not the glass, but the layout of some receivers render this impossible. The writer's experience has been that some British valves seem to be very prone to this fault. This is a pity, and one hopes that attention is being paid to this detail in our post-war designs.

It is rather difficult to find an adhesive which will stick a loose valve to its base with reliability. Perhaps the best solution is given by the use of carpenter's Scotch glue, but this has the disadvantage of necessitating the use of a glue-pot. There are several well-known brands of "tube-glu" which give good results in this respect provided that they are given a good twenty-four hours to set after application. Celluloid or cellulose glues and "cements" can often be employed and they have the advantage of setting very quickly. Nail varnish, incidentally, offers an easily obtained and quite serviceable glue of the cellulose type.

("Tiluma" Tile Cement is the favourite of your Editor, particularly for top caps of output valves, as it is unaffected by heat).

When the glass of a metallised valve becomes loose, the metallising often breaks away from its earthing wire. This is a well-known fault

with some of the older receivers, the result consisting of crackles in the output or intermittent instability. There is no necessity to condemn a valve suffering from this fault, the cure consisting simply of fitting an extra and more reliable earth connection to the metallising. Fig. 2 illustrates the steps needed to repair the valve, but it should be pointed out that the glass should first of all be re-stuck to its base before the additional connections are made. It may be found possible to solder the additional wire to the original earthing wire at the bottom of the glass, (see Fig. 2(a)) instead of running an external lead to the pin at the

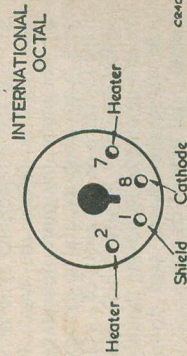
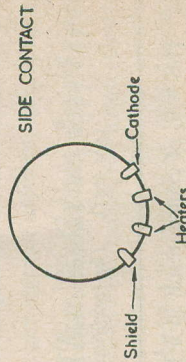


Fig. 3 The differences in contact layout between the side-contact and the average International octal valve. The view is looking at the bottom of the valve.

for the average octal and side-contact valve base.

The task of fitting the new base is commenced by preparing the pins of the octal valve for soldering. This is done as shown in Fig. 4 (a), where a small file is used to remove the plating on the outside edge of the pins. Tinned copper wire (24-28 swg) is then wrapped around each pin as shown in Fig. 4 (b). The joint is then soldered, a good joint being obtained particularly at the surface where the pins were filed. The top end of the wire is then cut off as near to the pin as possible. "Dummy" pins should, of course, be left blank. A piece of rubber sleeving about half an inch long is then slipped over the wires soldered to pins Nos. 2, 7 and 8, and, should the valve be screened, No. 1. The rubber sleeving may be obtained by stripping the insulation from "push-back" wire or from some types of rubber-covered mains wire.

A side-contact base should now be prepared. This may be obtained from the original faulty valve, or from spares which the constructor may already have on hand. The glass is removed from this base, which should then be cleaned free of debris and of the cement which originally stuck it to the glass. The contact holes are next made free of the original wires and of solder, this being done either by shaking or tapping them free, or by running a clean piece of wire backwards and forwards through the hole; either operation being carried out with the soldering iron applied to the contact.

The wires soldered to the octal valve pins are now passed through the appropriate holes in the side-contact base, as shown in Fig. 4 (c). This diagram also shows how, after each wire has been inserted, it is prevented from slipping back by bending over the end quarter inch or so.

When all the wires have been passed through, each wire is then carefully pulled in turn by hand until the octal valve pins have passed into the side-contact base as far as the pieces of rubber sleeving will allow. Each wire, starting with those insulated by the sleeving, is then pulled in turn carefully but firmly with a pair of pliers (holding the side-contact base with the other hand) until it comes to a definite stop, whereupon the wire is anchored to its contact as shown in detail in Fig. 4 (d). The definite stop is occasioned by the bottom of the octal valve base reaching the top of the side-contact base. Each wire is then soldered to its contact as shown in Fig. 4 (d), the excess wire being cut off.

The valve will now present the very neat appearance shown in Fig. 4 (e). It will be appreciated that the rubber sleeving fitted to the heater and cathode leads, etc., will have become compressed internally. If the job has

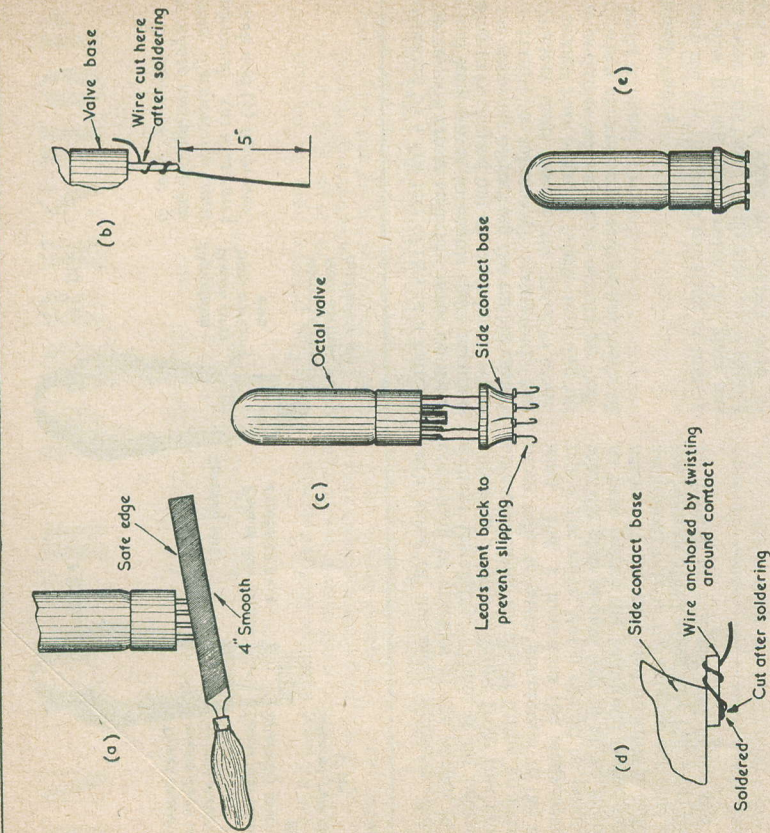


FIG 4 Successive steps in modifying an octal valve to fit a side-contact valveholder (see text). The modified valve is shown at (e).

base. This will, of course, result in a neater repair.

Side-Contact Valves

There are many receivers in this country which still use the side-contact type of valve which was popular before the war. These valves are not made any more nowadays, or, at least, not in any quantity, and so the replacement of such a valve on the event of its failure is somewhat difficult. Many radio repairers overcome this trouble by removing the original valveholder from the chassis and fitting an International octal type in its place.

This is not always an easy task, especially if the tags of the particular valveholder are hidden under a lot of components; and a simpler repair can often be made by connecting a side-contact base (removed from an old valve) to the pins

been properly carried out, the connecting wires will themselves hold the two parts together very firmly and no adhesive will be needed at all.

Although the above procedure may appear a little startling and unconventional to some readers, it is really quite simple to carry out. Several years ago the writer had the task of repairing a somewhat large number of receivers each of which had one or more unserviceable side-contact valves. As, in many cases, it would have taken at least an hour to change each valveholder and, in one or two others, such a change was impossible without having to remove a very complicated permeability-tuned multi-range bandspread coil switching assembly the writer fell back very gladly upon the method of modifying octal valves described above, in which the usual time taken in carrying it out was around fifteen to twenty minutes. Although a check for short-circuits between contacts is obviously necessary before a valve altered in this way can be used, the layout of the pins is such that, in the writer's experience, these never occur.

It will be appreciated, of course, that this method of modifying valves in order to effect a replacement of types which are difficult to obtain does not confine itself necessarily to side-contact types alone. It can also be used for replacing obsolete UX or British types, etc.; or, indeed, for repairing any equipment whose valves cannot be easily found in present-day lists.

The Editor Invites

articles from readers, of a nature suitable for inclusion in this magazine. Articles submitted for publication should preferably be typewritten, but ordinary writing is acceptable if clearly legible. In any case, double spacing should be used, to allow room for any necessary corrections. Drawings need not be elaborately finished, as they will usually be redrawn by our draughtsmen, but details should be clear. Photographs should preferably be large (half-plate) but in any case the focus must be good. Much useful advice to prospective writers is given in our "Hints for Article Writers", which will be sent free on request.

Universal . . . SUPPLY UNIT

By A. F. GAISFORD

EVERY radio experimenter or service engineer finds the need of power supplies other than AC mains only, such as LT AC to heat valves on a hook-up, to test speakers for rattle etc. AC at a greater or lower voltage than the mains supply is very useful, one example being to operate 110V receivers from 200V mains. Again, an LT DC voltage may be required to operate vibrator equipment such as a car radio, or to charge an accumulator; also, an HT DC source is a necessity.

The apparatus described will meet almost any requirement as outlined, and provides the following facilities:—AC voltages of 110, 200, 230, 250, up to 250 watts. This range is controlled by a Santon type rotary switch S4, the output appearing at the 5A two-pin socket; a 300V meter is provided to give definite indication of this, and can be of the rectifier or moving iron type.

AC voltages of 4, 8, 12, 16, 20, up to 10A. Controlled by another Santon switch S5, the output of this range can be obtained from a pair of insulated type terminals, the actual voltage again being shown on a 20V meter. The output of this range can also be applied to a rectifier unit by means of a heavy duty switch S3, the rectified current now being available at a pair of heavy duty brass terminals on the right hand of front panel. A pair of meters show conditions here, the fine control being adjusted by the rheostat R3 of 1Ω. Associated with this section is a smoothing circuit consisting of a 1 henry choke and 1,000 μF capacitor. This is very useful whilst operating vibrator type equipment direct, but of course entails some loss of output, so is arranged to be omitted when charging an accumulator, for instance DC HT on two channels is provided, and is controlled by separate rheostats.

Construction

The complete assembly being rather heavy, it is advisable to use an aquarium-type angle-iron frame with five additional bars as shown in the

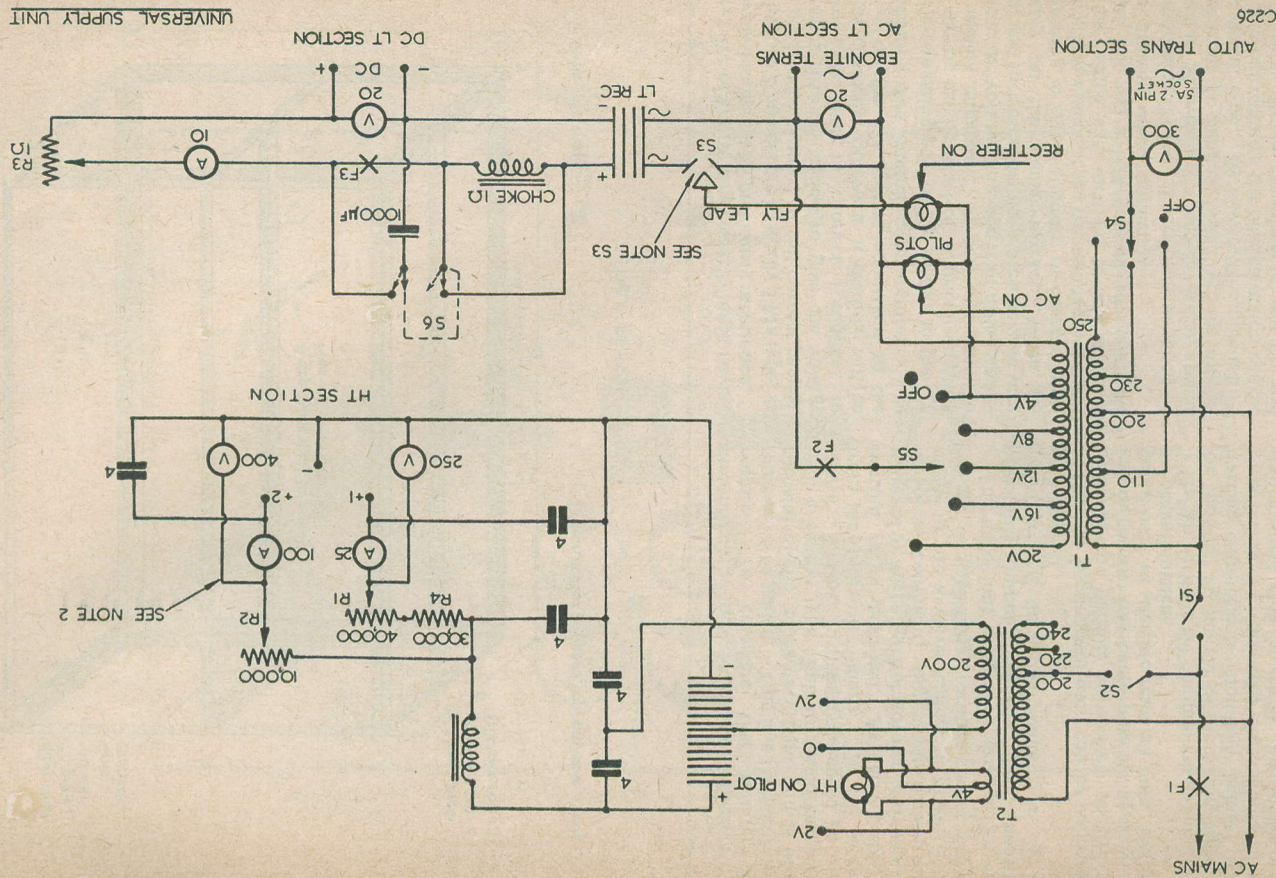
diagram. The edges of this can be drilled and tapped and cover plates attached, enabling easy examination of any part of the interior. The front panel can be of aluminium, which is easily worked. Apart from using "tank" cutters for circle cutting, it is possible to cut up to No 12 gauge on a fretworker's machine, using only wood cutting blades of the finest size.

Transformer T1 will have to be a heavy duty type of 250 watts rating, and the extra secondary winding will need to be put on. Before dismantling, it is as well to test for turns-per-volt ratio by passing a few turns around the core, say ten, and measuring the result on a meter. Of course, there will have to be room for this additional winding, and assuming five turns-per-volt is needed, then 200 additional turns are required. The gauge should not be thinner than No 16.

The LT choke should be rated at about 1 henry, and No 14 wire on a large core should provide the answer here. Be sure not to make the internal resistance greater than 1Ω, otherwise the maximum output will be restricted by reason of this DC resistance. Large LT chokes of this type can be obtained from ex-Govt surplus stores; also all the switching which is dismantled from the charging boards offered for sale, the four 2" meters being fitted to same. Constructors are advised to include complete metering, as not only does it enhance the appearance of the unit, but it has a very definite purpose in avoiding guesswork and the need for external meter hook-ups to find out if the volts are right, etc.

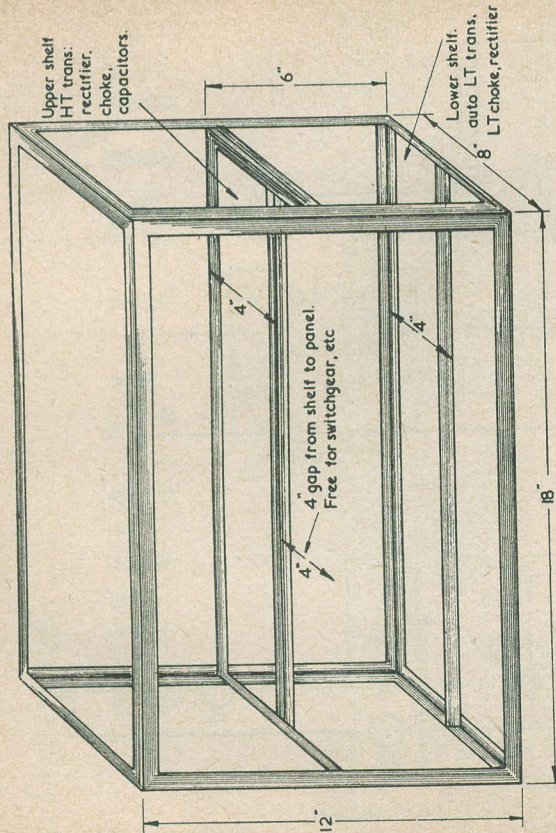
Note should be taken of switch S3, which on the theoretical diagram appears as a three point switch. The type used from the charging board as mentioned has an insulated blade contacting two separate poles and, although of the single-pole type, allows the use of a flexible lead to the blade to get 3-point action in order to operate the pilot lamp in this section.

Switches S1 and S2 as shown on the panel



C222

UNIVERSAL SUPPLY UNIT



Angle iron frame

Frame drilled & tapped for removable panels

DETAILS OF FRAMEWORK

c224

layout are of course unnecessarily large, having been used to match S3 previously mentioned. The four 2" meters are basically 5 Ma type, so will need to be shunted to suit current ranges, or series resistors added to give the voltage ranges. Be sure to connect voltmeters in circuit correctly, otherwise a reading will be shown on the mA meters equivalent to the voltmeter's own internal consumption.

The remaining pair of 2 1/4" meters in the LT DC section can be relatively high consumption mA meters converted. A few milliamps to operate the volt reading side is of little importance, and such excellent types are available very cheaply on the surplus market. When recalibrating, a small quantity of carbon tetrachloride on a piece of rag will remove unwanted figures, which can then be re-written using indian ink and a ball pointed nib (available from drawing office suppliers).

Smoothing for the LT section is switched by means of S6, which is a Santon switch, and as taken from the charging board is of the double-pole on-off type. By altering the position of the internal contacts the desired action can be obtained as shown, double-pole, one on and one off, thus shorting out the LT choke and

disconnecting the electrolytic capacitor as required. To complete this section, R3 remains to be added. This is a 1Ω heavy duty rheostat of the semi-rotary type, and is fitted with a Santon type knob to match the panel layout; however, a slider type could be used from the dismantled board. The HT section remains to be described. As shown, this is powered by a separate transformer, and requires no special comment. Some constructors may prefer to use a valve rectifier in place of the voltage doubler metal rectifier circuit shown.

The important thing is to arrange for two adjustable output channels. The rheostats shown are of the double-bank type, 20 kΩ each bank.

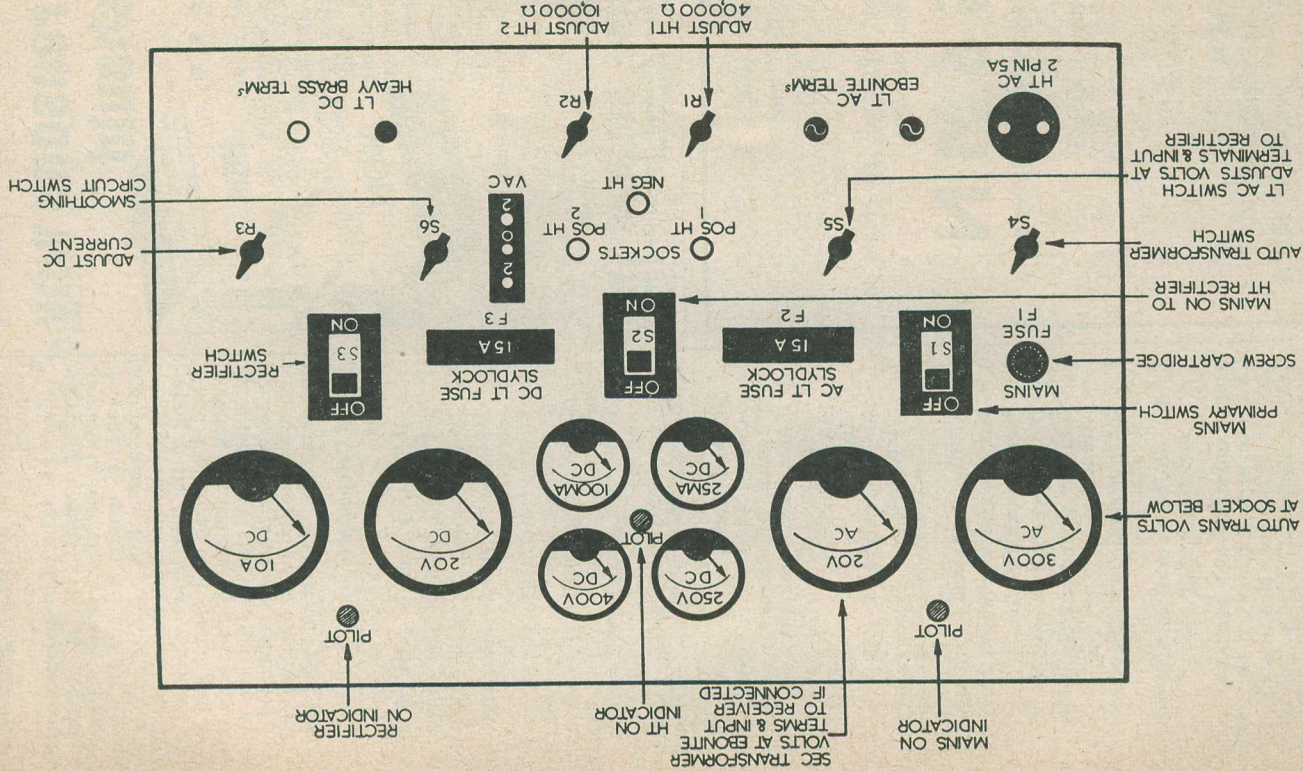
The two windings of each can be connected in series and parallel respectively to give the values shown, this being possible as they are being used as variable resistors only, and not as potentiometers.

The whole of the HT components are mounted on the shelf at the rear of the frame, with the heavier components mounted below these. Four inches of clearance is allowed between the transformers and the panel, thus giving good clearance for wiring up to the panel components.

PANEL 18X12 1/4G ALI
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FRONT PANEL

c225



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Fuses are included at various points to give complete protection; F1 is included in the primary of both transformers; F2 and F3 protect the low tension AC and DC circuits and can be rated at 10A. A fuse bulb is included in the negative HT lead; this can be of the same rating as the pilot lamps which are 6V 0.3A. The HT pilot can be lit from a four or six volt winding on the transformer; the other two pilot lamps will operate from the 4V tapping on T1, with the proviso as mentioned previously concerning switch 3 and the three point action to operate the "rectifier on" pilot lamp.

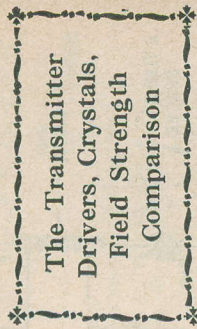
**List of Components
 Meters**

- 1, 2½" Moving iron, 0—300V to read AC.
- 1, 2½" Moving iron, 0—20V to read AC.
- 1, 2½" Moving iron, or coil 0—20V to read DC
- 1, 2½" Moving coil, 0—10A, to read DC.
- 4, 2" Moving coil. — All these (converted mA meters.) — components obtained from
- Switches**
- S1, S2, S3. Single-pole — from Ex-Govt Charging Board.
- S4, single-pole 4-way — rotary, Santon.
- S5, single-pole 6-way — rotary, Santon.
- S6, double-pole change-over, Santon. (see note concerning S6) concerning S6
- 2, 15A Slydlock fuse carriers. —
- 1, pair heavy duty brass terminals. —

- 1, pair Ebonite shrouded terminals.
- 1, Cartridge type fuse holder, 2A.
- 1, 2-pin 5A outlet socket.
- 1, 30kΩ wire-wound resistor. R4.
- 1, 10kΩ wire-wound variable resistor. R2. See text.
- 1, 40kΩ wire-wound variable resistor. R1. See text.
- 1, 1Ω, 10A wire-wound variable resistor. (Santon type knob to fit).

Auto transformer with additional secondary. L.T choke, approx 1 henry at 6A, Ex-Govt. 1,000 μF electrolytic Capacitor, 15V working. Components for the HT DC section as required. L.T Rectifier, 15V 6A. (Standard Telephones.)

FOCUS on 144 Mcs. . . . Part 3



by H. E. SMITH, G6UH

The Transmitter

Not much difficulty should be experienced in getting a transmitter to operate on 144 Mcs, providing the same rules are observed as for the receiver regarding the use of valves specially designed to operate on this frequency. It is a well-known fact that when activity commenced on this band, there were far more transmitters working efficiently than receivers! (It may be as well to note at this stage, that the term "144 Mcs" as used in these articles refers, of course, to the whole 2 metre band, i.e., 144 to 146 Mcs.) Valves for the crystal oscillator stage and trebler stages do not, of course, need to be of any specialised type, as the frequency in the early stages is reasonably low. Even the good old 807 may be pressed into service as a doubler or trebler up to 72 Mcs. However, let us start from the right end of the transmitter and have a few words on the crystal oscillator.

Crystals

Always use a reliable crystal, and be sure of its frequency. If you are uncertain, send it to a reputable firm such as Q.C.C. They will, for a nominal fee, check its frequency, and you will then know your exact frequency on the 2 metre band. This is assuming, of course, that you do not own a "Bendix" frequency meter, or similar device. Now what about the Crystal? There are, of course, several ways of multiplying up to 144 Mcs. Some use 4 Mcs crystal, and some use the harmonic type, which virtually start off at 24 Mcs or so. The more usual method, however, is to use either an 8 Mcs or 6 Mcs crystal and work on x18 or x24. Taking the 8 Mcs crystal first, we can treble to 24 Mcs, treble again to 72 Mcs, and double up to 144 Mcs. In several cases, however, it has been found that the 24 Mcs output from the first trebler has also a fairly large 48 Mcs harmonic, which will, unless this stage is well

and truly screened, produce quite a noticeable pattern on neighbouring television screens by direct radiation from the trebler anode coil. The other consideration is that the 8 Mcs crystal is not so strong mechanically as the 6 Mcs type, and is more liable to fracture if accidentally over-heated. By using a 6 Mcs band crystal in this order: — oscillator, quadruple to 24, treble to 72 and double to 144 — the harmonic radiation at 48 Mcs is negligible and there is still ample RF drive for the trebler stage. This, in fact, is the system used by the writer, the valves being VR53 oscillator, VR53 quadrupler and VT501 (TT11) trebler to 72 Mcs.

Drivers

There are two surplus units which can easily be adapted for use on 144 Mcs. These are the SCR522 and the transmitter unit from the TR1143 equipment. Both of these units make excellent drivers and, as in many cases, may be used as complete transmitters. Regarding

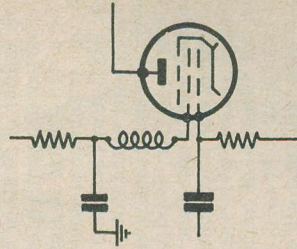


FIG.1
 RF CHOKE IN SERIES WITH SCREEN
 OF TT1 TO IMPROVE PERFORMANCE
 AS DOUBLER TO 144 Mcs

C245

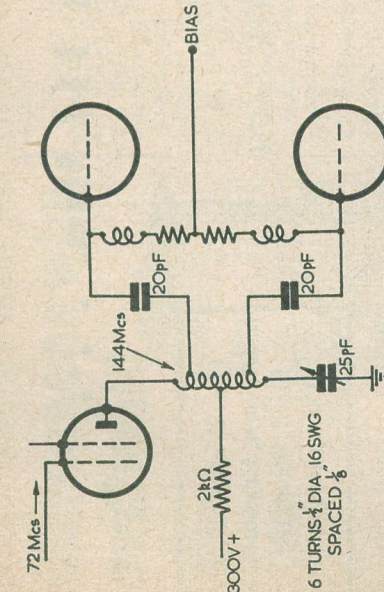


FIG. 2
TTI11 DOUBLER DRIVING A PAIR OF TTI11s
AS BUFFER OR FINAL STAGE

C246

the SCR522, the writer has heard of several cases where difficulty is encountered in keying the unit, as it was originally designed for telephony and constant carrier MCW only. These complaints are difficult to understand, as it is quite a simple matter to break the cathode lead of the trebler or the output valve (832) and insert the key leads as described later.

Up to 25 watts of RF can be obtained from the SCR522, and up to approximately 10 watts from the 1143. The VT501 valves used in the latter unit are equivalent to the MOV TTI11, and give an excellent account of themselves on 144 Mcs. The performance of a TTI11 can usually be improved still further if, when it is used as a doubler to 144 Mcs, a choke is fitted in series with the screen (Fig. 1). This choke consists of 40 inches of 30 DSC wound on a ceramic resistor of 50 kΩ or more. A greater RF output may sometimes be obtained by reducing the screen voltage to approximately 100. While on the subject of doubling to 144 Mcs with a TTI11, it will be found that, due to the internal capacity of the valve, and stray circuit capacity, the anode coil assumes very small proportions. A very good method of overcoming this is to "Series Tune" the anode coil. This, together with a recommended method of coupling to a pair of TTI11's as buffers, is shown in Fig. 2. This will, of course, allow a much larger inductance to be used, and the resulting increase in L-to-C ratio will provide a corresponding increase in RF voltage.

Before leaving the subject of drivers, do not be misled by valve drive requirements as stated in the Handbooks. Taking the 829 as an example, the grid drive required, according to

as a 144 Mcs buffer stage, it is most important to neutralise, and great care should be taken over it. If any instability exists in this stage you will most probably have a little family of carriers each side of the main one, and you will be quite unpopular. The doubler and trebler stages, as the grid and anode work on different frequencies, do not, of course, require neutralising.

Tuning the PA Stage

There are some important points to remember regarding the tuning of the PA anode circuit. On the lower frequency bands, it is usual to tune the anode to resonance, indicated by "maximum dip" on the meter, then to insert the aerial coupling coil until the anode current is drawn up to the rating of the valve. This procedure is not normally possible on 144 Mcs, as owing to the unavoidable reactance introduced by the proximity of the aerial coupling loop, the anode tuning is affected, and a slight re-tuning is necessary to bring the anode circuit back into optimum resonance.

Another important point is the position of the anode tuning capacitor, if one is used. This should be fitted as close to the anode connections of the valve as possible. It is far better, of course, to use the hair-pin type of inductance, which is tuned by sliding a shorting bar along from the "cold" end, carrying the HT + feed.

Keying

A few words on keying the transmitter may be helpful at this point. Keying chirp must be entirely eliminated on 144 Mcs (it's not very nice on any other band either). Never key the crystal oscillator. In the writer's experience, the best place is either in the cathode of one of the doubler/treiber stages or in the cathode of the final. A method of cathode keying is shown in Fig. 3.

An 829 final has been keyed in this manner for over a year at G6UJH, and there is not a vestige of a spark at the key contacts, and clicks and thumps are at a minimum.

Field Strength Comparison

On the lower frequency bands, reliance is usually placed in a thermo-ammeter in the feeder for indicating maximum FR output. This is not so simple on 144 Mcs, especially if a co-axial feeder is used, as the fitting of a meter in series will upset the impedance at

C247

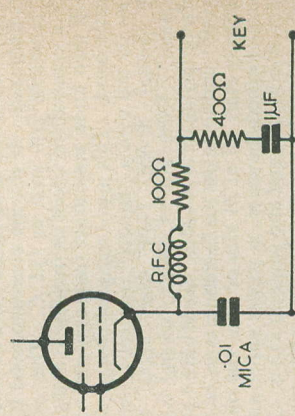


FIG. 3
THUMPLESS CATHODE KEYING CIRCUIT
FOR TTI11 VALVE-ALSO SUITABLE FOR
832 OF 829 FINAL

C247

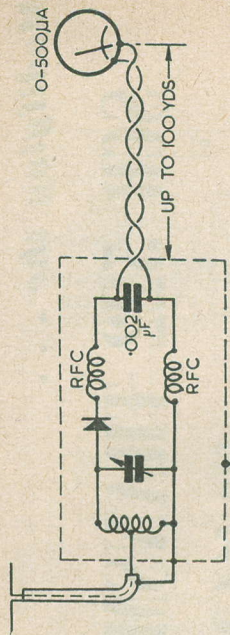


FIG. 4
REMOTE FIELD STRENGTH COMPARATOR
RFC=20 OF 30 DSC WOUND ON A
1 MEGOHM CERAMIC RESISTOR

C248

that point, and so cause a mis-match. The answer to this problem is to build a field strength comparator.

Reference to Fig. 4 will show how simple this is to construct. The crystal may be either a germanium type, or one of the surplus ex-radar crystals. The whole should be built into a metal box, and the meter lead, which is brought into the shack from the remote point, may be of ordinary twisted flex. Having tuned in the comparator to produce a reading on the meter, it is now only necessary to watch this meter when carrying out tuning adjustments on the PA and aerial link, always tuning for maximum reading.

Approximation of back to front ratio of your beam may be made by this means. If your beam is in the roof space, it will be better to erect the di-pole for the comparator outdoors, as reflections from walls etc., can cause false readings.

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Modifying the . . .

SCR 522 TRANSMITTER

. . . for 144 Mcs Operation

By J. BRAMHILL, G2BMI

Introduction

This very fine piece of ex-government equipment is generally available at very reasonable prices and can be modified very easily for two-metre operation. It was realised from the outset that if the necessary information was not forthcoming re the circuit diagram and general lay-out etc. it would be very difficult to identify the unwanted wiring from the essential.

Hence the reason for this article. The transmitter condition as sold varies considerably, but in the main the usual components which have been removed by the MOS are the modulation transformer and choke, the meter switch and the relays. Sometimes however other components are removed at random, e.g. of the two SCR522's purchased one was in mint condition, plus modulation transformer and choke but minus all inductors and resistors whilst the other had corroded metal work, plus all resistors and inductors but minus modulation transformer and choke.

General Description of Transmitter

The transmitter employs a crystal-controlled oscillator, a 6G6 in a modified Pierce circuit, whose plate is tuned to the second harmonic of the crystal. Two frequency tripler stages, a 12A6 and an 832, follow the oscillator, thus making the final output frequency 18 times the crystal fundamental frequency. The output from the second tripler drives the second 832 as the Power Amplifier. This radio frequency energy is plate and screen modulated by a push-pull modulator stage of two 12A6 tubes driven by a 6SS7 speech amplifier.

Modifications

For the benefit of readers, all components are denoted by their part-number and not by the component value; this makes it easier

to follow on the circuit diagram and all components are identified with their own particular reference numbers. The part-numbers can be decoded from the separate table.

Relays 161 and 131 have usually been removed from the chassis and therefore this leaves a number of loose wires; these are traced back to the Jones plugs and removed. 123-1 pins 3, 6 and 7 and 123-2 pin 2.

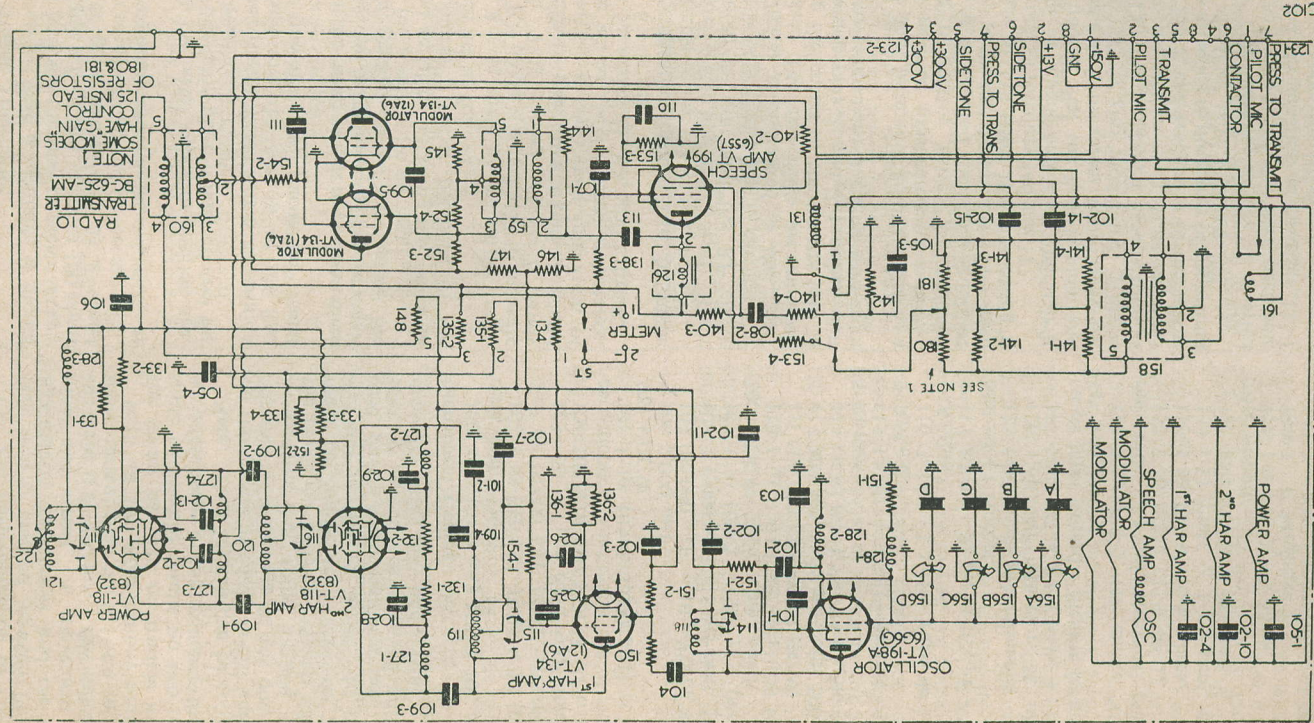
The next to remove are the side tone components and the pilots intercom network, and are resistors 141-1, 141-2, 141-3, 141-4, and capacitors 102-1A and 102-15. This leaves the gain control to be altered; some models have a fixed control, 181-180 and others a variable resistor 125. As it is better to have means of gain control during modulation it is suggested that 180-181 are removed and replaced by 125. The variable arm is connected direct to resistors 153-A. Other components not necessary are resistors 140-2, 140-3, 140-4, 142 and capacitors 108-2 and 105-3.

Last but not least is the meter switch. The recommended type is a "6 position, 1 pole, 2 deck switch with non shorting rotor controls"—this is substituted in the place of the one removed. From the circuit diagram the part numbers of the shunts can be ascertained and the coloured leads from these resistors traced back to where they were cut and reconnected to the new switch.

No other modification needs to be done i the transmitter is to be operated from the following power supplies.

- HT voltage:—300 volts at 260 mA.
- Heaters:—13 volts at 5 amps,
- Grid bias:—150 volts at 10 mA.

other than supplying a carbon microphone plus 1.5 volts energizing voltage and connecting either to pins 1 and 2 or 1 and 4 of Jones plug 123-1.



Method of Tuning Transmitter

If a test set 1-139-A is available it should be inserted into the transmitter meter socket, if not available a 0-1 mA meter of 100 ohms resistance is quite satisfactory as a visual indicator.

The transmitter should be adjusted as follows:—

(1) With the meter switch in position one, adjust the oscillator plate tuning control for maximum reading.

(2) Repeat using meter switch in position two and adjusting the control of the first harmonic amplifier for maximum meter reading.

(3) With the meter switch in position three adjust the second harmonic amplifier for maximum meter reading and *at once* adjust the PA anode for a minimum current.

(4) Load aerial by adjusting the "antenna coupling control". Other positions of the meter switch are as follows:—

Position A:—in some of the earlier transmitters an RF diode was included to measure RF output. This reading however is purely relative, without quantitative significance, and is equivalent to a neon bulb indication of RF voltage across the PA tank inductance.

Position 5:—indicates PA grid current.

Position 6:—is off.

Further modifications which can be made if it is desirable to use 6.3 valves and CW.

(1) Heaters—6G6 and 6SS7 valves. Their heaters should be split and the RF choke removed, the 6G6 heater pin is earthed and the 6SS7 heater is connected to the "live" 6.3 volt line. The two 832's are modified by earthing the centre of the heaters (pin 5) and connecting pins 1 and 7 together—not forgetting to remove the earthing wire from pin 1.

(2) The first harmonic amplifier valve, a 12A6, can now be substituted by a 6F6.

(3) The modulator valves are replaced by a pair of 6V6's, and their bias should be adjusted by removing the resistor 152-3 from the full bias of 150 volts and connecting it to the junction of resistors 146 and 147.

It should be stated here that although it has been quoted that the final is plate and screen modulated, in actual fact the screen of the first 832 is also modulated. This is fatal for TVI. A suggested modification is to remove the yellow wire from resistors 133-1 and 133-2, and resolder it to the yellow wire that is attached to the centre of the second harmonic amplifier tank inductor.

(4) For CW working a jack is inserted between the cathode of the first harmonic amplifier and the junction of resistors 136-1 and 136-2 and capacitor 102-6.

(5) For easy indication of PA current a jack is also inserted between Pin 5 of the modulation transformer and the final 832's plate and screen. A convenient range for the meter is 0-100 mA—this indicates slightly more current than the 0-1 mA meter $\times 100$.

With all the modifications outlined above, the writer has had no trouble in obtaining quite worthwhile results on two metres with a modest output of approximately three pounds.

Note. Four crystals can be accommodated on the crystal assembly board and the slides adjusted for pretuning on any one of the four frequencies, but some method of holding the particular slide in position whilst in use must be constructed, otherwise the crystal will not remain in circuit. In the writer's case, purely for convenience only, the crystal selector switch was removed and provision made for using only one crystal.

Component Coding

100, 101, 101-1 and 101-2—10 $\mu\mu\text{F} \pm 5$ per cent. 500 VDCW.

102-1 to 102-15.—Fixed 4700 $\mu\mu\text{F}$ or 6800 $\mu\mu\text{F}$ or 10,000 $\mu\mu\text{F}$ paper, ceramic or mica.

103—50 ± 1 per cent. $\mu\mu\text{F}$ mica.

104—100 $\mu\mu\text{F}$ 500 VDCW Zero temp. coeff ceramicon.

105-1 to 105-4. 1,000 $\mu\mu\text{F} \pm 5$ per cent. 500 VDCW.

106 2,000 $\mu\mu\text{F}$.

107 100,000 $\mu\mu\text{F} \pm 10$ per cent. 400 VDCW.

108-2 1,000 $\mu\mu\text{F} \pm 5$ per cent. 500 VDCW.

109-1 to 109-5 —20 ± 1 per cent. $\mu\mu\text{F}$ 500 VDCW Zero temp. coeff.

110 1 $\mu\text{F} \pm 10$ per cent. 100 VDCW.

111 500,000 $\mu\mu\text{F}$ 400 VDCW.

113 300 $\mu\mu\text{F} \pm 5$ per cent. 500 VDCW.

114 11-65.6 ± 1.5 $\mu\mu\text{F}$ variable—8 statohms—5 Rotors.

115 3.5-27 ± 1 $\mu\mu\text{F}$ variable—12 statohms—7 Rotors.

116 3-16.5 ± 1 $\mu\mu\text{F}$ —Variable—8 statohms—5 Rotors.

117 2.8-11 ± 10 per cent. $\mu\mu\text{F}$ —Variable—6 Statohms—3 Rotors.

125 1 Megohm potentiometer—audio gain.

126 Coil—AF. Reactor. 5k ohms DC.

127-1 to 127-4 RF Choke 9.19 ohms DC, single layer wound. Steatite former $\frac{1}{4}$ " Diam. 1 $\frac{1}{2}$ " long.

128-1 to 128-3. RF choke 50 ohms DC resistance. 2.5 microhenries, pie wound.

132-1 to 132-2 25 k ohms.

133-1 to 133-4 40 k ohms.

134 1.53 ohms ± 1 per cent. wire wound.

135 and 135-2. 0.76 ohms ± 1 per cent. wire wound.

136-1 to 136-2. 4 k ohms.

138-3. 1 Megohm.

140-2 to 140-4 500 k ohms or 50 k ohms

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141-1 to 141-4 1 Megohm.
142 5 k ohms.
143-1 and 143-2 82 ohms, deleted on later models.

144 250 k ohms.

145 15 k ohms.

146 6 k ohms.

147 18 k ohms.

148 75 ohms.

150 50 ohms.

151-1 to 151-2 50 k ohms.

152-1 to 152-4 50 k ohms.

153-1 -3 to -4 2 k ohms, replaced by 135-6 and 136-2, on some models.

154-1 and 154-2 5 k ohms.

158 Microphone transformer, centre tapped

5.2 ohms DC resistance, secondary 4,000 ohms.

159 Interstage transformer, centre tapped

secondary-primary 1,050 ohms DC resistance,

secondary 2,750 ohms DC resistance.

160 Modulation transformer, centre tapped

primary. Primary 690 ohms DC resistance.

Secondary 170 ohms DC resistance.

160-1 and 160-2 RF chokes—single layer of

38 turns of 28 avg on 1 megohm former.

RADIO MISCELLANY

Continued from P. 315

corner table in the kitchenette when it is not otherwise used for culinary preparation or ironing.

Further Questions

The final questions that I put were "What about building a TV receiver?", "How would you improve RC" and "Which item do you think manufacturers might best develop to meet constructors' requirements?".

To the first he said "I have managed to get along without TV for an awful long time. I am not all that interested in building one, and I would rather spend my spare time in doing something—not merely watching. Perhaps later."

On improving RC he told me "I would like to see more of Query Corner, Readers' ideas, and technical descriptions and servicing notes for popular sets. The things I would cut out, or reduce, would be everything to do with transmitters, and theory articles which do not keep to a practical level."

To the third question he replied "I would like to see the seven inch 33 $\frac{1}{2}$ rev. per minute gramophone records introduced over here. They are very popular in America, and they play as long as the standard 78 rpm 12" record."

I should, in fairness, point out that all the answers and information resulted from discussion, not from on-the-spur-of-the-moment replies. Perhaps one day I will try the whole thing out again on another reader.

A TWO-CIRCUIT MIXER UNIT

By J. GARSIDE

I was recently asked to "fix a microphone" to a radio-gram. Some of my fellow-dabblers (if they will excuse the term) may be interested in the results of this request.

Connecting a microphone to a radio-gram or ordinary receiver is, of course, a simple enough job, but the entertainment value of the gadget is greatly enhanced if it is possible to use the microphone simultaneously with the gramophone. This arrangement gives the budding crooners, etc., their chance to sing (or otherwise!) with full orchestral accompaniment. A two-circuit mixer stage suggested itself, therefore, and this was built quite cheaply to the circuit shown in Fig. 1.

The operation of the unit is quite simple. The two different audio signals are fed one to each section of the double triode valve, and the combined signal is developed across the common anode load resistor R3. From here, it is fed via C1 to the audio stages of the receiver. VR1 and VR2 are potentiometers which provide a means of controlling the volume level of each input signal independently, and the output volume is adjusted by the usual volume control on the receiver. Note that although VR1 is

shown as having a value of 500 kΩ in this circuit, the actual value should be according to the type of pick-up used, or the same as that used for the volume control in the receiver itself. It will be seen that no bias resistor bypass capacitors have been included. Very little amplification is required, or overloading of the later stages may occur, so some degree of negative feedback is obtained by omitting these capacitors, and there is also a saving of components.

The HT current drawn by the unit is quite low, and is obtained from the receiver. It was originally intended to supply the heater current also from the receiver, but the valves proved to be of the 0.1A heater variety, and were connected in series (as in an AC/DC circuit).

A suitable valve with an 0.1A heater rating was not to hand at the time of building, so the alternative of using a separate heater transformer was adopted. A bell transformer was actually used, and was found to be quite capable of supplying the heater current (0.15A at 12.6V for 12AH7 valve) continuously. Other double triode valves could be used, of course, to suit the available heater supply.

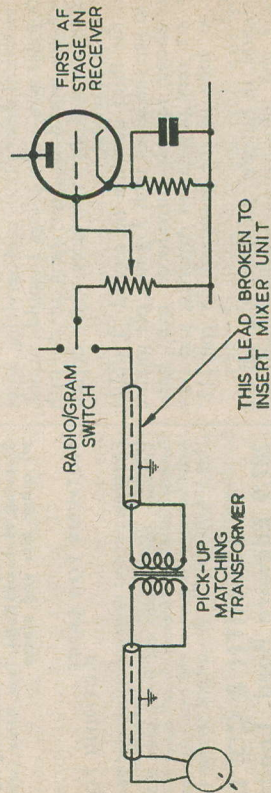
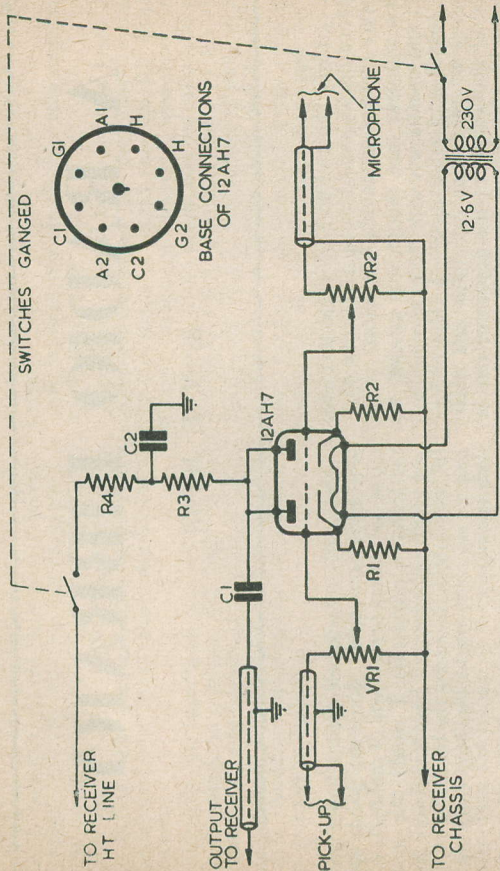


FIG. 2 ORIGINAL PICK-UP ARRANGEMENT

C257



C256

FIG. 1: CIRCUIT OF MIXER UNIT

Component Values

- VR1, 500 kΩ pot.
- VR2, 500 kΩ pot.
- R1, 1 kΩ ½W
- R2, 1 kΩ ½W
- R3, 20 kΩ 1W
- R4, 10 kΩ 1W
- C1, 0.1 μF 350 V wkg.
- C2, 8 μF 350V wkg.

The only point to watch when wiring and making connections to the set is that the leads from the microphone and pick-up to the mixer unit, and between C1 and the receiver input, should be screened.

The whole unit, including heater and microphone transformers, was accommodated on a chassis 6" x 4" x 1 3/4".

A word about microphones might be appropriate at this point. Two types may be bought in the shops for about 7s. 6d. These are usually carbon or magnetic, and it should be remembered that the former type needs an energising battery. Such cheap microphones do not provide anything like faithful reproduction, however. Moving coil models are available, at reasonable prices, which give much better results. A fact which is not always realised is that a loudspeaker will work quite well as a moving coil microphone. A transformer is required for both carbon and moving coil models.

PANEL TRANSFERS

Following on our plea, some time ago, for panel transfers, and the publication recently of our Panel Sheets, we are now pleased to learn that someone has had the courage to market a sheet of Pukka Panel Transfers.

These are of the water-slide type, and are printed with silver lettering on a black background. They can be applied to either plain or painted panels, including those with a crackle finish.

The range covers all the markings encountered in the usual 'den', having been designed by an Amateur for Amateurs. Samples have been submitted to us, and these we have found to be easily applied, with a resulting professional finish.

The sheets cost 2s. 6d. inclusive of postage, and may be obtained from K. Norvall, c/o H. Norvall and Sons, Ltd., 5 Torrens Street, City Road, London, E.C.1.

A RADIO LIBRARY

By N. F. WEBB

A carefully chosen library of radio text and reference books should form a valuable part of every radio constructor's workshop.

Few will deny that, though it is possible to build and operate sets with the bare minimum of knowledge of radio theory, a clear understanding of the basic principles and their practical application in the apparatus one is building enables one to get much more satisfaction and much better results from our hobby.

There are literally hundreds of books on radio. They vary from weighty tomes in three or four volumes, stuffed with advanced maths, down to simple little pamphlets of a mere 40 or so pages that do little more than give a bird's eye glance at the subject.

Unfortunately, it is not until you have read through a book that you can tell whether it explains all you want to know in a way that you can understand.

A beginner might plough his way through a text book, making heavy weather of it, and blaming himself for not being very bright; later, when he has learned more about the subject he will realise that the book was at fault. The author, who doubtless understands the subject himself, has not the ability to put his ideas across in a manner that the beginner can grasp.

Again, some books do not succeed in doing what they claim. One much-advertised treatise on the superhet, for instance, ends a chapter on "General Design" with 19 lines on "Aligning the oscillator," and dismisses padding and trimming with the following words:

In order, therefore, that a ganged condenser may be used to tune both oscillator and input circuits, it is necessary to "pad" the oscillator circuit in order to bring it up to the same ratio as the other circuits.

True; but with no illustrations, and no further explanation, what use is such a book to the radio constructor embarking on his first superhet?

The writer's bookshelf groans under about fifty books on radio. Some are good; some are so-so; others are a waste of money. With the Editor's permission, I would like to tell you about some books I have found very helpful, not only in mastering the basic theory, but also as reference books that one can turn to with confidence.

Perhaps the most famous radio book in the world is the Radio Amateur's Handbook, published by the American Radio Relay League, and available in this country for £1 at time of writing.

The Handbook is now in its 27th edition. Well over two million copies have been sold. There must be a dog-eared copy in every radio shack in the world.

For the beginner, Chapter II and III, entitled respectively "Electrical Laws and Circuits" and "Vacuum Tube Principles," form a very useful introduction to radio theory. These two chapters have needed little revision in the last few editions of the handbook, and this suggests that the treatment of the subject, the explanations and circuit diagrams have been made sufficiently clear and detailed to meet successfully the needs of succeeding groups of newcomers to the hobby.

During the late war, the Handbook was the standard instruction manual in U.S. Army and Navy signal schools, which is eloquent testimony in itself.

The rest of the book—22 chapters—deals with all aspects of amateur radio. The newcomer will derive much practical help in building communication receivers and amateur transmitters. But he will look in vain for details of ordinary broadcast receivers and quality amplifiers; and there are one or two small but surprising omissions—there is nothing about metal rectifiers, for instance.

But the Handbook's great virtue is that it is invaluable to beginner and old-timer alike.

The beginner can feel that it's all there if only he will make an effort to master it. He will especially benefit from the chapter on "Workshop Practice." The old-timer will always find himself turning to it for data and circuitry. He will find Chapter XXV—Vacuum Tube Data—listing the characteristics and base connections of over 1,000 valves, alone worth the money.

Admittedly, the Handbook is a rather hefty job with which to confront the beginner in radio, who might be frightened by photographs and diagrams of kilowatt rigs, and be puzzled by such American terminology as binding posts and tickler coils.

So, from the sublime to the ridiculously cheap—a little book by G6CL—John Clarricoats, secretary of the Radio Society of Great Britain. Its title is "Radio Simply Explained" and it does just that. There are 44 pages in this book, and into them G6CL has crammed a surprising amount of information. He starts by describing the nature of the electromagnetic waves we spend so much of our time in capturing; he clears up the relationship between wavelength and frequency; and gives an elementary description of the signal's progress from microphone to loudspeaker. The basic principles of electricity and magnetism, and their application in radio components are dealt with very crisply. The book ends with a description of a crystal set and an 0-v-1 (the very circuit I started my radio career with!) and a brief note about the superhet.

For the newcomer who wants a simple introduction to the subject, this book—which costs ninepence—is ideal. An hour or two with it will give him a broad picture of what has to be learnt. Other books he might read would deal with little that is not mentioned here. They would only go into more detail.

If you cannot get this little book, see if your bookseller has "Radio Simplified." This is also written by Mr. Clarricoats, and is really an enlarged version of "Radio Simply Explained." New material is chiefly concerned with measuring current, voltage and resistance.

If you prefer a text book that goes deeper into basic theory, and has a more academic approach, Mr. M. G. Scroggie's "Foundations of Wireless" is a classic in its way. It deals with the subject very thoroughly, and there is even—brace yourself!—a little maths to be studied. My only quarrel with Mr. Scroggie's comprehensive book is that component values are not indicated in the text or the diagrams. Mr. Scroggie might argue that he is dealing with the theory, not practice; to which I would stubbornly reply that I still think component values should be given!

A book with a more practical outlook is "Radio Receiver Circuits Handbook," by E. M. Squire.

Mr. Squire splits the receiver into stages and describes each in turn.

Chapter I starts by describing how the aerial is connected to the input circuit, and the signal is traced through RF amplification, frequency changing, detection, AF and power output stages, and the various forms of power supply are described. In the last chapter the circuits of a number of well-known commercial receivers are given and discussed.

Mr. Squire is an admirable writer. He has a real gift for clear explanation, and he is very thorough in his treatment.

Finally, a reference book on valves. The R.C.A. Valve Manual lists all American valves, and has in addition a very comprehensive treatise on valve theory, especially written for the lay-man. But perhaps you use British as well as American valves; in which case, you cannot do better than buy "Radio Valve Data," published by Iliffe and Sons for 3s. 6d. This book gives full characteristics and valve bases of over 1,600 British and American valves. There can't be many more!

That's my basic radio library. With these books on the shelf of your shack, and with Radio Constructor every month, it will be a pretty tough problem that will stump you!

The Radio Library

The books I suggest for starting a radio library are:

The Radio Amateur's Handbook (The American Radio Relay League) £1.

Radio Simplified by John Clarricoats, (Sir Isaac Pitman and Sons, 4s. 6d.)

Foundations of Wireless by M. G. Scroggie, (Iliffe & Sons, 7s. 6d.)

Radio Receiver Circuits Handbook by E. M. Squire (Sir Isaac Pitman and Sons, Ltd.), 6s.

Radio Valve Data (Iliffe and Sons). 3s. 6d.

DESPITE THE FACT

that we are now printing and distributing many more copies of this magazine, we are still receiving letters from readers informing us that they have difficulty in obtaining regular copies. If details are sent to us, then we can take up the matter with the people concerned. Should this prove ineffective, then we shall be glad to supply copies direct, on either 6 or 12 month subscriptions.

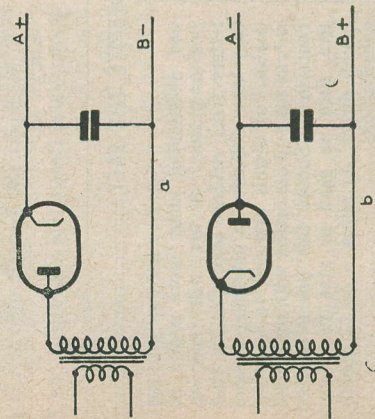
POWER SUPPLY NOTES

BY ERIC LOWDON

WHEN designing a piece of equipment the power pack should be the last part of the circuit to receive attention. This may seem so obvious as to be hardly worth mentioning, yet I have often seen beginners reverse the procedure by considering the power pack first, without any clear idea of what will be required from it in the way of current, voltage, degree of smoothing, regulation, etc.

The way to approach this question is, of course, to decide on what is required from the circuit as a whole. When this has been satisfactorily settled it will be quite clear what performance is required from the power unit, and the type of rectification, the type of smoothing filter, and the degree of smoothing which will give the desired results can be chosen.

It is not proposed to discuss here the somewhat complex calculations involved in power pack design. Most amateurs (and professionals for that matter) prefer to work to the well-tried formula of 'Try it and see' and the following notes and practical hints are intended to form a basis on which to work.



C164

FIG 1

Half-wave Rectification.

Fig. 1a shows the connections for a typical half wave rectifier, so called because only one half of each complete cycle is used to provide the output, the remaining half being suppressed. If it is wished to reverse the polarity of the output, that is to say to make point A negative to point B, the rectifier must be connected as in Fig. 1b. It is easy to see which way the polarities will work out if you remember that when the cathode is negative to the anode—which is, of course, the same thing as saying that the anode is positive to the cathode—a stream of negatively charged electrons flows from the cathode to the anode and into the top plate of the capacitor (Fig. 1b) thus making it negative. When the rectifier connections are reversed, as in Fig. 1a, so also is the electron flow, and the negative electrons are drawn from the top plate so making it positive.

The principal limitation of this circuit is that unidirectional pulses of current are flowing in the transformer secondary which tends to saturate the core. It can be used therefore, only when the current required from it is quite small—the EHT for a cathode ray tube, for example. Further, the regulation, that is the way in which the output volts vary with change in load, is also poor and so the circuit is most useful when the load is fixed.

A point to note, for those who make their own mains transformers, is that on non-conducting periods the voltage across the rectifier is very much greater than either the secondary transformer voltage or the DC output voltage. It is, in fact, made up of both these voltages in series, and therefore the insulation between the HT winding and the heater winding should be sufficient to withstand this pressure.

Full-wave Rectification

Two rectifiers are used in this circuit shown in Fig. 2 (or a double rectifier contained in a single envelope) and are connected so that each conducts on alternate half cycles, so making use of the full wave. In this case,

however, the pulse of current from each valve flows through its respective half of the secondary winding in opposite directions, thus giving rise to an alternating flux in the core. The saturating effect of DC as obtained in half wave rectification is thus avoided.

Full wave rectification is therefore suitable for application where the current drain is comparatively heavy. The regulation is good. Here also a high voltage appears across each rectifier on non-conducting periods, and in this case it is approximately three times greater than the DC voltage output and the transformer insulation must be arranged accordingly.

Smoothing

Smoothing filters are classified according to how the inductors (or resistors) and capacitors which make up the circuit are arranged. For example, Figs. 3 and 4 are for obvious reasons designated capacitor input circuits, while Figs. 5 and 6 are examples of choke and resistor inputs respectively. The circuits shown in Figs. 4 and 6 are effective only when the current drain is very small, and for this reason are most often used in half-wave rectification. Where a fairly heavy current is to be drawn from the pack, the circuit of Fig. 3 gives much more efficient smoothing and this, in fact, is probably the most commonly used filter circuit.

All these circuits suffer from the disadvantage that the regulation is not good. For receivers and test instruments this is of little importance, since the load in such cases is usually fixed. If for any reason the load has to be varied slightly, then the regulation can be improved by increasing the value of the first capacitor, but care must be taken that it is not made too large, otherwise the rectifier may be destroyed by excessive charging current.

Where a heavy variable load is to be applied, such as might be encountered in an amateur

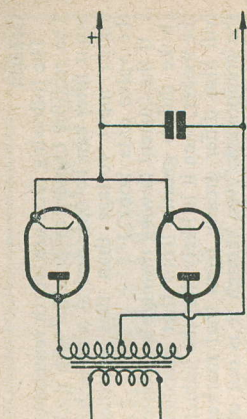


FIG 2

C165

transmitting station, it is usual to employ the choke input arrangement which possesses good regulation. It is necessary, however, to ensure that the inductance of the choke is of the correct value, otherwise the filter will assume the characteristics of a capacitor input circuit and the good regulation will be lost. For efficient operation the inductance of the choke in henries should not be less than the figure obtained by dividing the effective load resistance by 1,000, though in practice it is usual for the choke to have about twice this inductance.

It will be noticed that when the load resistance is small, that is when the current is large, the minimum inductance necessary will be smaller than when the current drain is small. On a variable load, therefore, the inductor is usually a swinging choke, which is a choke designed to vary considerably in inductance with change of current through it. This result is achieved by making the gap in the core of the choke smaller than normal, so that the inductance decreases as the current increases and vice versa.

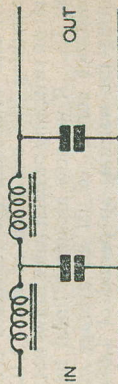


FIG 3

C166

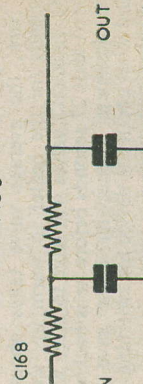


FIG 4

C167

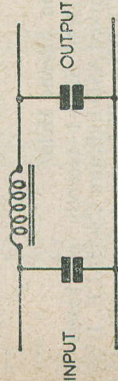


FIG 5

C168



FIG 6

C169

General

The following facts are worth remembering. The rectifier chosen to operate with a choke input filter can be operated at a considerably higher input voltage than that specified in the valve data book.

If the current flowing through an iron-cored choke differs greatly from that specified by the maker, then it is likely that the inductance will also differ greatly from that marked on the component, even though it is not of the swinging variety. In an emergency, therefore, it is often possible to use a low inductance choke with a high current rating in place of a high inductance choke with a low current rating.

It is definitely bad practice to use two low voltage capacitors in series across a DC supply in place of one capacitor of higher voltage rating—for example, two 4.0 µF capacitors of 350 volts working in place of

a single 2.0 µF capacitor of 700 volts working. The reason is that the voltage across each capacitor is not distributed according to the relative capacities, but is proportional rather to the leakage resistance of each. Thus the capacitor with the highest leakage resistance will also have the highest voltage developed across it, which may be great enough to cause breakdown.

Finally, when only a very small current is taken from a power pack the DC voltage output will approach 1.414 times the AC input RMS voltage, and this figure should always be taken as the working voltage for the smoothing capacitors. This fact is also useful when EHT is required for the CRT of an oscilloscope, for the whole secondary winding of, say, a 350-0-350 volt transformer can be used in a half wave rectifying circuit to provide 700 volts input, which will give a little less than 1,000 volts DC output.



from our

Mai bag

Intermittent Heater Supply

Dear Sir,—With regard to the correspondent's query about intermittent valve heaters (P. J. Jackson, February issue).

On the face of it, he has found something really useful, but there is a big snag.

Assuming a normal valve 6.3V 0.3A, Ohm's Law will say that this has a resistance of 21Ω, (E/I). This is only correct when the valve is hot, and when cold the resistance drops to that on switching on each valve draws not 0.3A, but 3A. If we now assume a linear heat-to-resistance curve, we get an average current during the warming-up period of 1.65A, or 5.5 times the normal current.

Now, the average valve takes about five seconds for the heater to warm up, so that Mr. Jackson's valves will have to "free wheel" for at least 27 seconds before he is back where the designers intend, let alone save juice. And what about the device for switching—that will also cost expensive juice.

No, Sir, it just don't work. I suggest Mr. Jackson puts on his volts and leaves the

problem of Watt/hours to the valve designers. Life's complicated enough.—K. Piper (Clapham, S.W.4.)

Inexpensive Televisor

Dear Sir,—I have recently built up your Timebase circuit and find that inserting a 5 kΩ resistor from anode to chassis of potentiometer R17 will improve interlace.—W. H. Dibb (London, N.19.)

Can Anyone Help?

Dear Sir,—I recently purchased a unit marked ASD Indicator CS-55ACE. It contains a CRT No. 5PF7, with its focus coils and focus and brilliance controls. I should like to know whether you or any of your readers could supply me with the base connections or operating conditions for this tube, and whether it can be used for an oscilloscope or TV. I should also like, if possible, the timebase circuit for operating this unit. Thanking you in anticipation, and wishing continued success to your paper.—Wm. A. Finlayson, 17 Ariel Road, West Hampstead, London, N.W.6.

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PRIVATE

112 COPIES of Practical Wireless, 42-50. 80 watt fluorescent choke, condenser, starter bulb. Offers or exchange.—Dixon, 638 Bacup Road, Waterfoot, Rossendale, Lancs.

ATTENTION, DX MEN. The following as new, for sale or exchange. Hammarlund HQ129X, SX28, S27, Sky Challenger, RME70, DB20, BC348.—Box B 148.

THREE VOLUMES plus Data Book "Modern Practical Radio and Television", 50/-. Cost £4.10.0.—Gregory, ISWL/G2116, 24 Caversham Road, Reading, Berks.

PHILCO Table Model all-wave AC Superhet. Practically new, bakelite cabinet. £10.—Box B149.

8 kV RF EHT UNIT, new, perfect, £2 or part exchange signal generator.—Williamson, 75 Ichester Crescent, Bristol 3.

EXPERT PRIVATE TUITION given in Radio and Technical Mathematics (London), terms moderate.—Box B147.

RADIO CONSTRUCTOR. 20 issues 1949 to 1951. Sale or exchange.—Cutler, 38 Torney House, London E.9.

RF UNITS. 24's, 25's, 25 1/2's, 27's 35 1/2's. Post 1/6. Voltmeter 3500V £2. 807, EF36, EF39, EB34, EBC33, 2X2, DH63, 607, SP41, SP61, KT66, 6/6 each.—Moulind, Lower Buckland, Lymington, Hants.

BACK COPIES Radio Constructor wanted. April, May, June, July, August, September 1949. Articles required, Logical Fault Finding.—Box B150.

RADIOGRAM CABINET. Solid oak, 44in. x 38in. x 22in. Weight approx. one cwt. £7.10.0.—King, Cudham Grange Cottage, Grays Road, Westerham Hill, Kent.

FOR SALE. DST 100 Double Superhet Rx. 13 valves. Coverage, 50 kcs to 30 Mcs. continuous. S meter, noise limited, variable selectivity, RF, IF gain, etc., correct tuning. Perfect but slightly scratched. Wanted, 1155N, KC to date. Offers.—Trevor Woods, St. George's Theatre, Kendal.

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TRADE

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