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RADIO CONSTRUCTOR

for the Radio and Television Enthusiast

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Radio Constructor

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Edited by C. W. C. OVERLAND, G2ATV

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Editorial

The other day we came across yet another reader who has ceased to listen on the Amateur Bands, on account of "the amount of bilge which is handed out". We've heard some ourselves—and one of the things which is always amusing (or annoying, as the case may be) is the giving of signal reports.

"Your signals coming in here Q5 R9 plus 20 dB" is a typical example. Yet it seldom means anything to the sender, and very, very rarely to the recipient. After all, what *does* it mean?

Assuming that the sender has a receiver fitted with an 'S' meter—and this is not always the case!—then the meter is, usually, calibrated in 'S' points up to S9 (R9) and dB above S9. Here arises the first trouble, for some manufacturers calculate 4 dB per 'S' point, some use 5 dB, and others 6 dB.

But apart from this, what does the meter reading indicate? If the readings can be relied upon—and how many can?—then they are only a reflection of the gain of the receiving system. Such readings enable stations to be grouped according to the strength of their inputs to the receiving system, which conveys little or nothing to the station being received. The standard Report Codes in use are of value, but in our opinion adding dB figures to them is a waste of time. The only justification we can think of is where a station is carrying out tests, and the readings are given, not to mean anything in themselves, but simply as an indication of rise or fall in strength after any particular test.

An interesting article entitled "Dabbling with Decibles" appears on p. 292 of this issue.

G2ATV.

NOTICES

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 Mss must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

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

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 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. 4 All-Wave All-Dry Personal Receiver

This circuit is that of an all-wave four valve superhet, signal pickup being effected on all bands by the use of frame aerials. Where possible, unnecessary components have been eliminated in order to reduce bulk, but this has only been done when their exclusion would cause no falling off in performance.

The Circuit

A pentagrid frequency-changer, V1, is shown in the diagram, the signal-grid tuned circuits being provided by the frame aerials. S2 selects the particular frame aerial for each band, whilst S1 switches in a separate trimmer for the medium-wave band. This slightly unorthodox arrangement enables the medium and long-wave frames to be connected in series to obtain optimum pick-up, whilst, at the same time, eliminating the somewhat complicated parallel trimming circuits often employed in a receiver of this type. It also prevents the use of a parallel trimmer permanently connected across the medium-wave frame. The short-wave frame is switched in separately and consists of a single turn (L3) in series with a loading coil (L4). It is described in detail later.

The oscillator circuit makes the greatest use of the available HT voltage and should function when the HT battery has dropped to 60 volts or less.

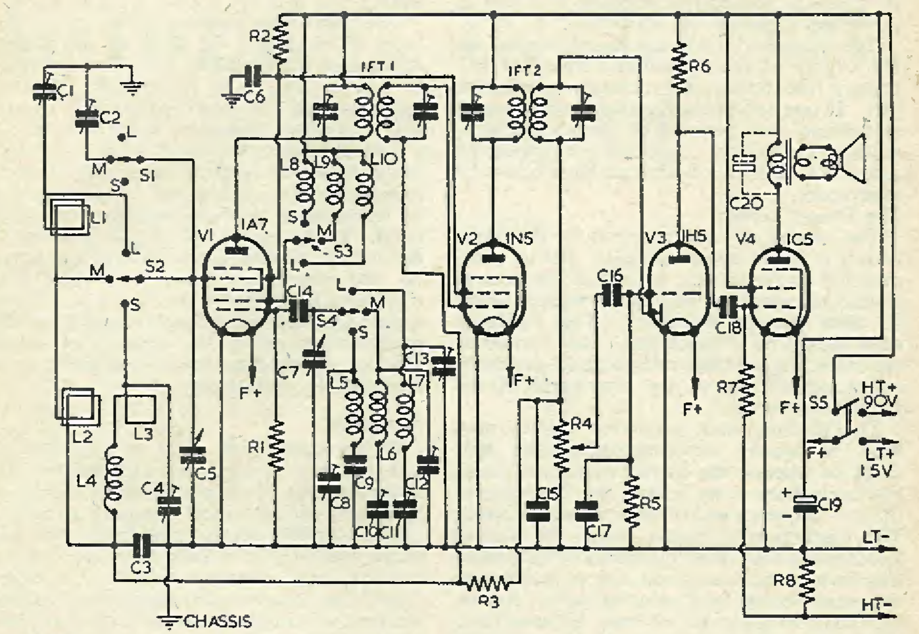
The screen-grids of the frequency changer and IF amplifier are connected together, this being done for several reasons. An obvious saving in components is effected; but the main reason is that the increased stability of the screen-grid voltage on the frequency changer reduces oscillator drift for varying AVC voltage when using the short-wave band. The capacitor C6 should be mounted directly to the frequency changer valveholder tags, a short lead then being taken to the IF amplifier screen-grid tag.

Similarly, the AVC decoupler, C3, should be mounted directly in the frequency changer signal grid circuit, AVC decoupling for the IF stage having the secondary importance. AVC is applied to the frequency changer *via* the frame aerials.

The second detector circuit is conventional, a very small delay (caused by a fraction of the filament voltage) being applied to both signal and AVC circuits. The wiring to the volume control, R4, should be short and direct since this component forms the diode load.

A high value of grid leak, R5, is recommended for the double diode triode. This may provide a small amount of leaky-grid bias on strong (AF) signals, an effect not necessarily detrimental in this case; and it helps to keep the AC and DC diode loads similar in ohmic value.

A tone correction capacitor, (C20), is shown in dotted line connected across the speaker transformer primary. If possible, this capacitor should be omitted since it reduces the limited power available from the output stage. Adjacent channel whistles should not be too troublesome when frame aerials are used, and the slight shrillness which may be apparent when a small speaker is installed can be counterbalanced by having the speaker fairly heavily baffled by the cabinet (i.e. by using an almost completely enclosed cabinet). In addition, if the IF transformers are carefully aligned to a "peak" (it should be remembered that the second IF transformer secondary is only lightly loaded by the diode circuit) sufficient selectivity should be obtained in the



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THEORETICAL CIRCUIT

Components

Resistors (all half-watt)
R1 — 220 kΩ
R2 — 47 kΩ
R3 — 2 Meg.Ω
R4 — 1Meg.Ω
R5 — 5 Meg.Ω
R6 — 160 kΩ
R7 — 470 kΩ
R8 — 420 kΩ

Capacitors
C1, C2 — Trimmers, 60 pF
C3 — 0.01 μF
C4 — Trimmer, 60 pF
C5, C7 — 2-gang, 500 pF
C6 — 0.05 μF
C8 — Trimmer, 60 pF
C9 — 0.005 μF fixed (short-wave pad)
C10 — 500 pF trimmer (medium-wave pad)
C11 — 200 pF trimmer (long-wave pad)
C12, C13 — Trimmers, 60 pF
C14 — 300 pF
C15 — 200 pF
C16 — 0.002 μF
C17 — 300 pF
C18 — 0.005 μF
C19 — 8 μF electrolytic
C20 — 0.002 μF—optional (see text)

Inductors
L1 — Long-wave frame (in series with L2)
L2 — Medium-wave frame
L3 — Single turn short-wave loop
L4 — Short-wave loading coil
L5 — Short-wave oscillator grid
L6 — Medium-wave oscillator grid
L7 — Long-wave oscillator grid
L8 — Short-wave oscillator coupling
L9 — Medium-wave oscillator coupling
L10 — Long-wave oscillator coupling
(L5 to L10 may consist of commercial oscillator coils).

Switches
S1 to S4 — 4-pole, 3-way, wave-change
S5 — 2-pole, on-off (may be part of R4)

Valves
V1 — 1A7
V2 — 1N5
V3 — 1H5
V4 — 1C5
} or English equivalents. (Miniature equivalents may also be used)

IF stages to reduce top response and help in providing apparent AF correction.

The capacitor, C19, connected across the HT supply prevents instability when the HT battery runs down, and increases its effective life. In one or two cases, a slight improvement in volume may perhaps be found if a low-voltage electrolytic capacitor is connected across R8, and this point can be checked by experiment.

The Frame Aerials

The number of turns required for the frame aerials is found experimentally. Before commencing on the frames, the rest of the receiver should be completed and the IF stages aligned to their correct frequency. The oscillator coils should be trimmed and padded to cover the correct frequencies, using a signal generator connected directly to the signal-grid of the frequency changer.

The medium and long-wave frames may then be wound experimentally. The best check of whether the correct number of turns has been fitted is by testing the trimming at the low-frequency end of the appropriate band. The medium-wave frame should be wound and checked first. Both medium and long-wave frames may be wound on the same former, the wires being laid side by side. As an extremely rough guide, it may be said that, if it is larger than a foot square, the medium-wave frame will need about 50 feet of wire, and the long-wave frame about 150 feet. It is emphasised that this is only a rough guide.

The short-wave frame consists of a single loop of wire, (L3), as large as the physical dimensions of the cabinet will allow, completed by a coil, (L4), at its earthy end. To cover approximately the 15-49 metre band this coil will need about half-a-dozen turns of wire on a ¾-inch former, the exact number of turns being found by experiment. This time the inductance of the frame and its coil is checked by trimming at the high-frequency end of the band. Using such an arrangement it will be difficult to eradicate second-channel interference on the short-wave band over the lower (frequency) two-thirds of the range. Nevertheless the short-wave band is capable of good entertainment value, the presence of second-channel interference being considered as an unavoidable detraction.

Squegging

Owing to the high value of oscillator grid leak, R1, it is possible that the oscillator may squeg on part of one or more of the bands. Squegging will be evident as a loud, harsh hiss.

If this trouble occurs on all bands, the value of the oscillator grid leak should be reduced; but if it only occurs on one band a resistor should be connected across the feedback winding of the oscillator coil for that band. This resistor should have as high a value as possible so long as it offers sufficient damping to prevent the circuit from squegging.

"RADIO CONSTRUCTOR" QUIZ

Conducted by W. Groome

(1) When his VCR97 was focused to give thin sharp lines in the raster, Mr. Brain was disappointed to find that the picture showed very poor horizontal definition. When the focus control was re-adjusted, definition improved horizontally but the lines became too broad and vertical definition became poor. Explanation, please!

(2) Which of the following phase-splitter arrangements has the lowest gain—'see-saw', 'concertina', 'paraphrase', 'cathode follower', 'cathode coupled'? Which two of the foregoing popular terms for phase-splitters actually refer to the same thing?

(3) Which two phase-splitters have low distortion due to negative feedback? Which one requires rather critical adjustment from time to time?

(4) Why does ignition interference show as black dots on American TV screens, instead of the white showers of 'snow' with which we are familiar?

(5) If rain, snow, soot, dirt, or any other substance becomes deposited on a TV dipole so as to bridge the centre gap with an effective resistance of 7,500 Ω, what would be the effect upon reception?

(6) The output resistance of a cathode follower is much lower than that of an ordinary amplifier valve. What change occurs to the input impedance when a valve is used as a cathode follower? *Answers on P. 274*

VHF Contest

The Second Annual "Short Wave News" VHF Contest will take place on the week-end of April 21st/22nd. In addition to Certificates of Merit and yearly subscriptions to "Short Wave News", offered by the sponsers, E.M.I. Sales and Service Ltd., through the courtesy of the Managing Director, are offering a Dual Range Power Output Meter to the winner. Full details will be published in the March issue of "Short Wave News". The Contest is open to both Transmitters and Listeners.

MODERN RECEIVER ALIGNMENT

Part 4 *By W. G. Morley*

UP to now we have considered the more common methods of aligning and tracking modern receivers. In this, the concluding article of the series, we shall discuss the treatment of sets with fixed padders and iron cored RF coils; passing on to the alignment of more complicated receivers.

Fixed Padders

It will be found that many modern receivers use fixed padding capacitors for the oscillator tuned circuits. This considerably helps the serviceman as it is then only necessary to trim the receiver at the high frequency end of each band. However, the use of fixed padders has the attendant disadvantage that, unless the IF's are adjusted to the correct frequency, accurate tracking is impossible.

If, after having aligned the IF's of a receiver fitted with fixed padding, it is found that the set cannot be tracked, a good idea of the inaccuracy of the IF frequency may be obtained by examining the state of the signal frequency trimming at the low frequency end of the band. Usually, it is preferable to use the medium wave range for this operation.

An example will help to illustrate this point. Let us presume that the tuning scale of a receiver is mechanically sound and that we have trimmed the oscillator and signal frequency tuned circuits to dial calibration at the high frequency end of the band. However, on checking at the low frequency end, we find that the signal frequency trimmer needs more capacitance to reach its optimum position.

This means that, to keep in step with the oscillator, the signal frequency needs to be lowered. Owing to the inclusion of the fixed padder, we know that the oscillator frequency must be right, and so the incorrect factor can only be the *difference* frequency, that of the IF. As the signal frequency needs to be lowered, and as it is already below that of the oscillator, it follows that the difference frequency required by the IF stages is higher than that to which they are trimmed.

We may therefore, from the above, formulate a rule for receivers with fixed padding. If, after the trimming is completed, the signal frequency circuit needs more capacitance, the IF is too high. On the other hand, should the signal trimmer need less capacitance, then the IF is too low.

It is possible that some slight experimenting may be required before the correct IF can be finally ascertained. However, it will be found in practice that the proper frequency will nearly always be one of the conventional figures mentioned in the second article of this series. Thus, for instance, if it is found that an experimentally-set IF of 465 kcs is too high, then it may be assumed that the receiver has been misguidedly set to this frequency at some previous time; and that re-alignment to, say, 456 kcs (another common frequency) will very probably clear the trouble.

Iron-cored RF coils

Iron-cored coils in the oscillator and signal tuned circuits are used fairly commonly in domestic receivers. When the coils are well designed it is extremely improbable that the cores will need adjustment, since they usually hold their position over very considerable lengths of time.

Unfortunately, as with all the other adjustable screws which stick out of wireless sets, they offer a very great temptation to the dabbler; and so it may be necessary, in many cases, to re-adjust the cores after they have been tampered with.

When a set with iron-cored coils is fitted with fixed padding capacitors the procedure of adjusting the cores is fairly simple. Usually it will be found best to adjust the cores at the low frequency end of each band, having primarily set all the trimmers to approximately half-capacitance. The dial calibration can mostly be relied upon to give the correct frequency at which the coils should resonate. First of all, therefore, the cores should be aligned at the low frequency end. The receiver should then be returned to the high frequency end. If it is possible to select the correct frequency here within the range of the trimmers, all is well; and all that is further necessitated will be to return to the low frequency end again and slightly re-adjust the cores until all circuits are at full resonance on the correct frequency. It may prove necessary to slightly trim the high frequency end again after this.

If the preliminary adjustment of the cores does not yield the required result at the high frequency end it will be necessary to slightly adjust them here as well; moving continually from top to bottom of the band until either the correct setting of the cores is obtained, or a setting is reached which sacrifices, at worst, only a little of the accuracy of the tuning scale.

Should the receiver be fitted with adjustable padding, the signal frequency cores should first be adjusted, being tested as above to resonate at the appropriate dial settings. The oscillator core may then be set primarily by adjusting it at the high frequency end with the oscillator trimmer at approximately half-capacitance. If, at the low frequency end the correct setting is outside the capacitance range of the padder, the iron core will have to be re-adjusted. (Should the padder apparently not have enough capacitance the core should be screwed further into the coil; and *vice versa*). After several attempts it should be possible to obtain a position that holds for all dial settings.

Receivers with an RF Stage

Up to now we have dealt with receivers without RF stages, such as are exemplified by the usual "four-plus-one" domestic receivers. The process of aligning a receiver with an RF stage is only slightly more difficult than for one without; all that is necessary being to adjust two sets of trimmers for the signal frequency circuits instead of one. It will sometimes be found that the tuned circuit fed by the anode of the RF valve trims more "sharply" and is easier to track than is the aerial tuned circuit. If the discrepancies between the two tuned circuits are only small, the oscillator should be padded against the *anode* tuned circuit, as the aerial circuit will suffer heavier damping while the receiver is in use.

Communications Receivers

The alignment of a multi-valve communications receiver should never be attempted unless one is sure of the frequencies used in the set. It is also very advisable to be acquainted with the procedure recommended by the manufacturer. With "surplus" receivers it is not always possible to do the latter, although one may occasionally obtain copies of the relevant instructions from some postal dealers.

However, if the serviceman should feel himself sufficiently competent there is no reason why he should not carry out the alignment without the instructions, etc., and make a very good job of it.

The IF Stages

As with the domestic receiver, the first thing that needs to be ascertained when lining up a communications receiver is the frequency of the IF's. Nearly all these receivers use fixed padding, it then being doubly necessary to ensure that no mistakes are made. Many American sets use the "conventional" IF frequencies which lie between 450 and 470 kcs; although, of course, this does not always hold true. The frequency at which the IF stages happen to respond when the receiver is first encountered may be checked for accuracy, by ascertaining whether the tracking on two or three of the lowest frequency bands is correct. In many receivers it will probably be found that the frequency is marked, either on the IF transformers themselves or in a prominent position on the chassis.

If the set is fitted with a crystal filter, (assuming in the case of surplus receivers, that some gentleman has not removed it!) then the frequency of the IF's will be obvious, as the crystal will have its frequency engraved on its case.

In nearly all receivers of the communications type it will be found that the IF transformers are of the loosely-coupled variety and should be aligned for a "peak". Alignment should always be carried out with the receiver set to maximum selectivity.

The RF Tuned Circuits.

The RF and oscillator tuned circuits of the receiver should be treated in just the same manner as for the domestic type of receiver mentioned earlier. Although a greater degree of accuracy is called for in this process, it will prove easier in many ways owing to the fact that such faults as "pulling" and poor tracking will never be found in a well-designed communications receiver.

Should the receiver be fitted with a tuning indicator or "S"-meter, this may be employed for trimming, instead of using the separate meter previously recommended to read changes in the AVC voltage.

Conclusion

We have now reached the end of this short series devoted to the alignment of modern receivers. The writer would like to state here that he hopes that he has cleared up any doubts or misconceptions which may have existed on this interesting subject, and also that he may perhaps have been instrumental in enabling receivers which have previously been allowed to fall out of adjustment to be given a new lease of life.

QUERY CORNER

A "Radio Constructor" Service for Readers

Push-Pull Amplifier

I have followed with interest the articles which have appeared in the Radio Constructor describing mains powered gramophone amplifiers. Unfortunately we are not on the mains supply here, and I am thus compelled to content myself with battery powered amplifiers, but so far I have been disappointed with the relatively low output which has been obtained. Can you therefore recommend a circuit of an amplifier which will provide about 1 watt of audio power, whilst keeping the HT and LT consumption to a minimum?

L. JAMES, Nr. Clovelly.

From correspondence which we have received from time to time there would appear to be an appreciable demand for a battery powered amplifier capable of providing an output which is above the average for equipment of this type. It is certainly true that an output of a quarter watt, which is normally obtained, does not permit the realistic reproduction of the louder passages of a piece of music when the gain control is set to provide comfortable listening at the average volume level. It is not proposed to comment upon what is probably one of the quality enthusiasts' favourite topic for discussion, namely the range of power output which is required if

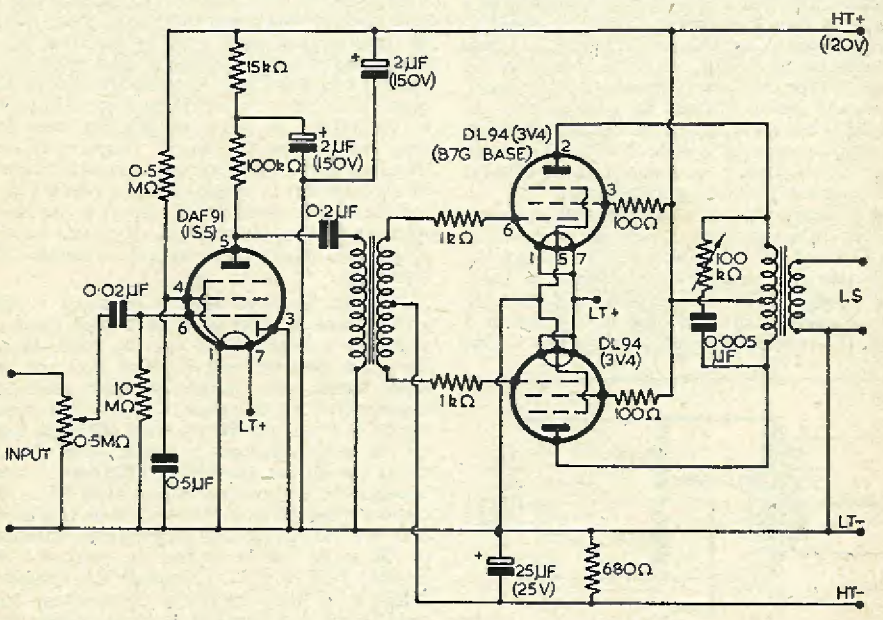

Fig. 1: Complete circuit diagram of the amplifier. The anode to anode load of the output stage is 14,000 Ω

QUERY CORNER

"Rules"

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

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

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

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

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

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

volume compression is to be avoided, whilst still retaining a satisfactory average listening level. It can, however, be stated most emphatically that it is well over a quarter of a watt and thus the amplifier which is about to be described is capable of providing a degree of accoustical fidelity, unobtainable with the smaller type of battery powered equipment. It should be mentioned in passing that an amplifier of this type may, in conjunction with an elliptical speaker, a pick up and a clockwork gramophone motor be made into an efficient yet compact portable gramophone.

With battery powered equipment, the main factor which limits the audio output power is the HT and LT consumption. To reduce the high tension current to a minimum, the push pull output stage is operated in class AB, and is capable of providing 0.75 watts at a total HT consumption of 20 milliamps. This

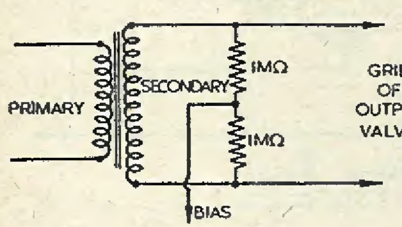

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Fig. 2: The method of using an intervalve transformer without a centre-tapped secondary.

current reduces to 5 milliamps under "no signal" conditions, but during operation the consumption will vary between these two values according to the signal amplitude. Valves from the miniature 1.4v. range have been used, and the total LT consumption is 0.25A at this voltage.

The first valve, a voltage amplifying pentode, is arranged to parallel-feed an intervalve transformer, which in turn feeds the signal in opposite phases to the control grids of the output pentodes. The coupling transformer should have a turns ratio of 1: 2 + 2, or to put it in another way, a ratio of 1: 4 with a centre tapped secondary. Should a transformer be available which has this ratio, but lacks a centre tap, it may be employed by connecting a resistive potentiometer across the secondary winding. This potentiometer consists of two equal value resistors, the combined value of which is limited on the low side by their shunting effect upon the anode load of the previous valve, and on the high side by the maximum permissible grid resistance of the output valve. The valve manufacturer normally quotes in his published data a maximum value for the resistance which may be placed between the grid and filament of the valve. This value he determines from the amount of grid current which the valve may pass; it will be appreciated that even a fraction of a microamp flowing through a grid resistor of several megohms will appreciably change the bias and hence the general operating conditions of the valve. A good compromise value for the two secondary shunt resistors is one megohm each. The complete circuit diagram of the amplifier is shown in Fig. 1 whilst Fig. 2 indicates the method of using a standard intervalve transformer in place of one of the push pull input type having a centre tap secondary.

Bias for the first valve is obtained by the grid current method in which a high value of grid leak is used. Grid current flows during the most positive part of each cycle of the input signal and charges the grid capacitor negatively. As the peak value of the input signal is small compared with the grid base of the valve, changes in signal level cannot cause any serious alteration in the bias. Also, because the grid resistor is of a high value, the current which flows through it will be very small and will not cause any appreciable damping of the input circuit during the peaks of the positive half cycles. To ensure the complete stability of the amplifier, even when constructed on the smallest possible chassis, the anode circuit of the first valve is decoupled and stopper resistors are included in the grid and screen circuits of the output valves. Tone

control is effected by means of a series resistance-capacitance combination connected across the primary winding of the output transformer. The amplifier is suitable for use with most types of pick-up, and requires an input signal voltage of 0.15V for full output power.

Finally, a 90V HT battery may be used if it is desired to economise in space, and at this voltage an output power of 0.5 watts can be obtained.

AF Mixers

I wish to mix different signals at the input to my amplifier in such a manner that it is possible to fade from one to the other, or to superimpose one upon the other. The simple method which I have tried to date, of connecting two potentiometers in parallel across the input to the amplifier, is not entirely satisfactory as the two controls do not operate independently of one another. Can you suggest a better solution?

W. BURT, Braintree.

It is sometimes necessary, as for example when titles are announced whilst records are being played, to mix in the correct proportion the outputs from two separate signal sources at the input of an amplifier. As our correspondent points out, this may be simply achieved by the use of two potentiometers to control the signal levels of the two channels, but such a

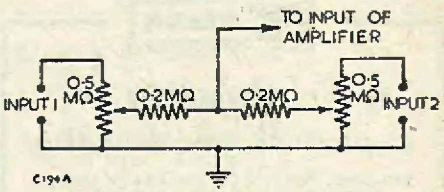


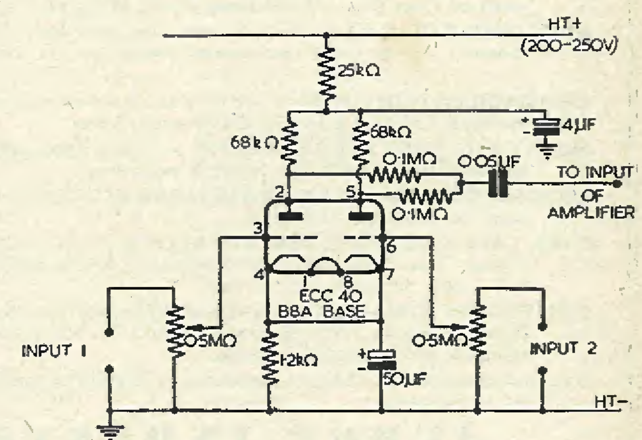
Fig. 3: A simple method of mixing two inputs to an amplifier.

system suffers the disadvantage that when one of the potentiometers is adjusted it alters the gain of the other channel, because of the shunting effect which one control has upon the other. This effect may be considerably reduced by the inclusion of two resistors in the slider circuits of the potentiometer as shown in Fig. 3.

A more ambitious method, and one which is to be recommended where some degree of pre-amplification is required, is shown in Fig. 4. In this case, the two input channels are fed into the separate sections of a double triode, and the mixing is effected in the common anode circuit of the valve. By this means, the gain level of the two channels may be adjusted entirely independently of one another, and the amplification which is obtained from one section of the valve may usefully be employed in the microphone circuit. In order to reduce the

Continued on Page 276

Fig. 4: A combined mixer and pre-amplifier circuit. The heater voltage of the ECC40 is 6.3V.



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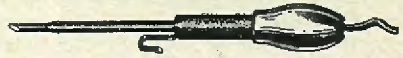

MAGNETIC Sound Recording

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 fourth of a series of articles by E. KALEVELD,
PAØXE

Erasure

As we have mentioned before, one of the many attractive features of magnetic sound recording is that a recording can be wiped out and a new one made on the same material without any wear taking place in the material, and without affecting subsequent recordings in any way.

This wiping out process, or erasure as it is more commonly called, can be achieved in one of two ways. The tape or wire may be passed through a strong RF field, or through the field of a permanent magnet.

The latter method is, of course, the most simple. The tape is passed across the poles of the magnet, with the result that the magnetic particles, which as a consequence of the previous recording are lying in a pattern, are pulled round into one position as they attain a uniform polarity from the magnet.

This method of erasure, though simple, is entirely satisfactory. The magnet need not be very strong, and in the case of tape is best placed so that it is in contact with the back of it. Any roughness on its faces will then not scrape off the magnetic material. The strength of the magnet should be tested by its ability to erase the loudest passages of the recording. In the writer's case, the magnet from the earpiece from which the bobbin was taken proved entirely satisfactory.

There is one snag about permanent magnet erasure. The remaining background noise is rather higher than that from RF erasure because, when re-recording, the tape is already premagnetised. However, if the erasure magnetisation is not too strong, it will in actual fact almost disappear, because of the influence of the RF bias during the recording process. If the erasure magnet is too strong, on the other hand, there will be a high residual background noise. Moral—do not erase with a stronger magnet than is necessary and, consequently, do not record at a higher level than necessary.

Erasing by RF does not have this disadvantage. All that is required is another head made up like the one already described, but this time with about 100 turns 20 swg wire on the bobbin and an air gap of some 0.003-in., or the thickness of three cigarette papers. (Erasure heads may be bought ready-made from advertisers in this magazine—Ed.).

Referring to Fig. 5 in Part I of this series, we see readily that, if the RF bias was increased considerably in amplitude, each individual particle of the magnetic material would be taken up into the region of saturation, down through zero and further down in the other direction, and this process would be repeated several times before the particle left the RF field, i.e. the gap in the erase head, as this gap is substantially larger than that in the recording head, and the frequency substantially higher than the audio frequencies. The net remainder of any recorded sound after this process is, of course, zero and the magnetic material, taken as a whole, is neutral.

From the foregoing, it will readily be seen that an RF bias during recording, which is too high, will decrease the signal, until it finally obliterates the signal if its amplitude becomes too great.

The practical arrangement of this erasure method is that the erase head is connected to the same RF generator as that providing the RF bias during recording, and by means of a

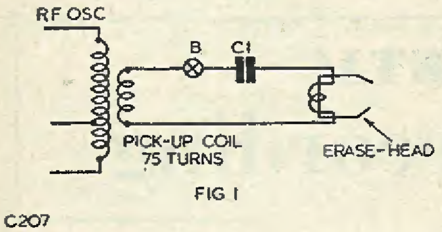

FIG 1

switching system is brought into circuit for erasure. The head must be brought into resonance by changing C1 (see Fig. 1), which has a value of between 0.01 and 1 μF, depending upon the construction of the head. Resonance is indicated by the most brilliant glow of the small 0.5A 6V bulb B, which must be removed after the value for C1 has been determined.

The writer feels justified in recommending permanent magnet erasure, rather than the RF method, for when properly applied the small background noise does not justify the much more complicated installation needed for the latter. Only when no signal is on the tape is it possible to distinguish one method of erasure from the other.

One hint may be given here, applying to both magnetised tape and wire. It cannot be brought back to a magnetically-free condition by RF erasure alone. The proper way is to demagnetise it by a strong permanent magnet (or several, if necessary, stacked in the correct polarity). The resulting high noise component left is then removed by suitable RF treatment.

Next month, we shall describe the construction of a simple drive mechanism for tape.

Correction:

In the amplifier circuit Fig. 2 in last month's article, the grid of V2B should be connected to the junction of the 500kΩ and 250 kΩ resistors just below.

To be continued

Construction of Heads for Wire and Tape Recording

by L. F. SINFIELD

General

The Heads can be either high or low impedance, the latter requiring a matching transformer.

Erasing can be achieved by a permanent magnet, but improvement in background noise results from supersonic AC erasure. Some of this supersonic supply may be utilised as bias for the recording head to improve the fidelity, and to reduce the recording power required (or increase the output).

The heads to be described are of balanced construction, designed to virtually cancel out external magnetic fields, but the associated input transformer must be mumetal shielded and suitably positioned for best results.

Construction, for wire

(*a*) Cut two pieces of mumetal, thickness 0.01″, as in Fig. 1.

(*b*) Wrap four turns of cellophane tape around the centre, and cement thin paxolin cheeks in place to form coil bobbins.

(*c*) Grind or file the edges forming the gaps so that they are dead flat, and check by putting pairs of poles together and seeing that no light is visible between them.

(*d*) Wind on coils of 34 swg enamelled copper wire. See Fig. 2A.

(*e*) Soft-solder copper shims in place in gaps A and B. Ensure that the shims are of correct thickness, and that the pole pieces are tight against the shims. Solder while held in a vice or clamp, and do not apply the iron for too long, to avoid overheating of the coils.

(*f*) Trim away excess solder to bring back the thickness of the pole pieces to that of the stampings (0.01″).

(*g*) Grind or file the front edges AA (the rear edges are unimportant).

(*h*) Clamp between phosphor bronze side cheeks, with 0.01″ spacing washers.

(*i*) Give the coils a coat of wax or polystyrene lacquer.

(*j*) With a thin, sharp tool, mark the groove on the front surface of the pole pieces AA to provide a better magnetic contact for the wire.

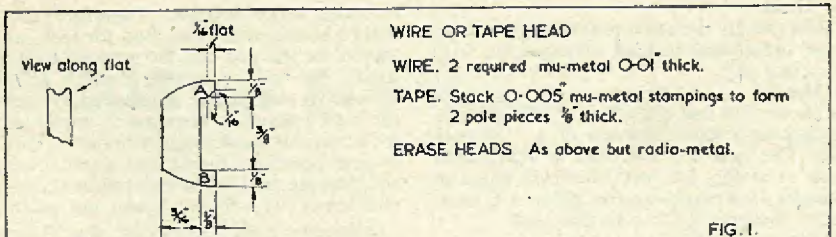

FIG. 1.

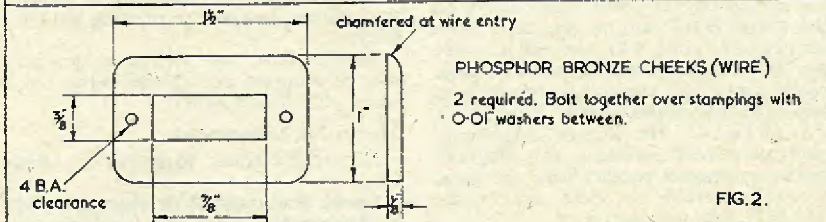

FIG. 2.

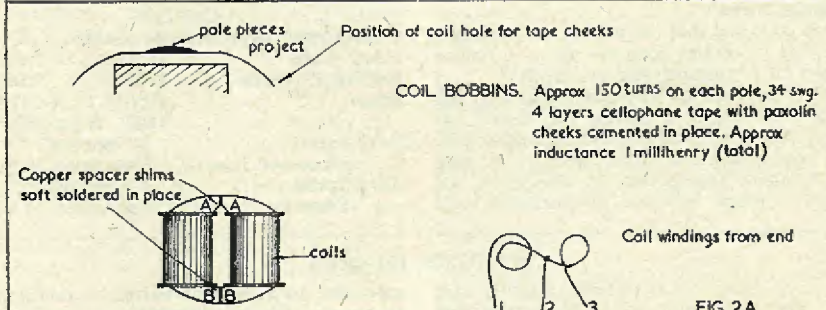

FIG. 2A.

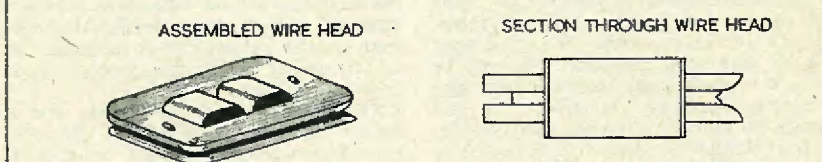

FIG. 3.

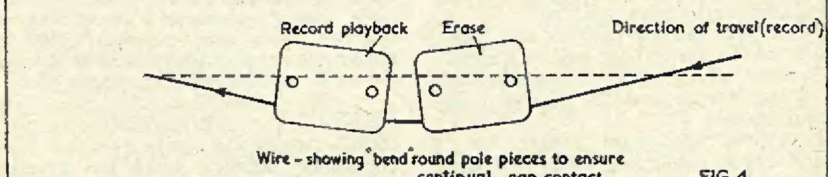

FIG. 4.

Erase Head

Follow exactly the same procedure as above, but use radiometal instead of mumetal, with appropriate gap.

Tape Heads

As above, but use a stack of 0.005″ laminations making a total thickness of ⅛″, for both heads. The hole for the coils in the cheeks is made as at Fig. 2A, with the front edges of the cheeks filed back, as the poles AA must project. No groove (*j*) to be provided.

Housing

When completed, the record/playback head and the erase head can be mounted close together in one housing, which should be made of heavy iron or steel for magnetic shielding. The heads should be correctly aligned, with the erase head first in the 'record' direction of travel, as in Fig. 4. The wire or tape should be 'bent' round the heads, as in this diagram, to provide continuous contact with the gaps, and should preferably be held against the gaps by light felt pressure pads.

Additional Notes

It will be noted that the rear of the front gap of the pole pieces has been cut away to reduce the amount of parallel gap or 'depth'.

Due to the wear of wire passing at 2-ft. per second over the pole pieces, the depth has been left still considerably more than optimum.

For tape heads, the surface area of the pole pieces is much larger, also the velocity of the medium is much less and the medium itself of much softer texture. Therefore, the wear will be considerably less than for wire, and the 'depth' of the gap can be reduced to approx. 0.010″ by further cutting away. The effect of wear is that as the parallel gap is reduced, the high frequency response is improved, and the sensitivity made slightly higher. However, as wear continues further the 'width' of the gap will increase, and so the high frequency response and sensitivity will fall again, but rapidly.

It is considered, personally, that it is better to allow the 'depth' of the gap to be not below these figures in order to prolong the life of the heads.

Rather more high frequency compensation will be required during the initial use of the heads, for this reason.

Metals for Laminations

Record/Playback: Mumetal* or Permalloy C†.

Erase: Radiometal* or Permalloy B†.

* *Telegraph Construction and Maintenance Co., Ltd.*

† *Standard Telephones and Cables, Ltd.*

Head Gaps	Front-A	Rear-B
Record/Playback ..	0.0005″	0.001″
Erase	0.005″ Tape	0.005″
„	0.02″ Wire	0.02″
Wire Speed	24″ per sec.	
„ Erase and Bias ..	Frequency 30 kcs.	
Tape Speed	7½″ per sec.	
„ Erase and Bias ..	Frequency 45 kcs.	

ANSWERS TO QUIZ

(1) For once, it was not Mr. Brain's own fault. The spot produced on his screen was in the form of a narrow oval, due to the influence of the deflector plates. The fault, known as astigmatism, is inherent in some electrostatic—and magnetic—CR tubes. Adjustment of focus merely turns the spot around, so that good definition can only be obtained in the direction to which the spot presents its narrowest dimension. It can sometimes be cured by having variable bias on all four deflectors, instead of only one of each pair, as is most usual.

(2) (*a*) The cathode-follower.

(*b*) The "concertina" is another description for the cathode-follower, but only in its application to phase-splitting.

(3) (*a*) The cathode-follower has heavy feedback due to the cathode half of the load. The 'see-saw' circuit also has negative feedback, a fact which produces its useful self-balancing action.

(*b*) The paraphase circuit has a potentiometer as anode load to the first valve, so that the correct input for the other valve can be obtained from it. Any change in the gain due to ageing of valves or components or supply voltage necessitates a readjustment of the potentiometer. Other circuits are putting the paraphase 'out of business'. The 'see-saw' has a self-balancing action which requires neither close-tolerance resistors nor even similar valves, and is probably the best of all, having useful gain, low distortion and constant balance.

(4) In the American system, the modulation is the reverse of the British. Full modulation represents black instead of peak white, and low modulation produces white instead of black. Ignition pulses, therefore, instead of driving the CRT white, drive it to cut-off and produce black dots.

(5) The impedance of a dipole at the centre is about 75 Ω, and a shunt of 7,500 Ω will reduce it to approximately 74.25 Ω—a reduction too slight to have any undesirable effect.

(6) The input resistance of a cathode-follower is very high, hence the rather inaccurate description given to the 'infinite impedance' detector, which has a very high input impedance, although it is not by any means infinite.

FOCUS on 144 Mcs. . . .

Part 2

OPERATING
LOGGING
Dx CONDITIONS

by H. E. SMITH, G6UH

Operating On 144 Mcs

When you begin your very first listening period on 144 Mcs, you may experience some disappointment, as it is more than probable that you will hear nothing! There are, invariably, several other stations "on the band" especially during the early evening, but like yourself they are just listening. So always put out frequent calls, and your chances of a QSO will increase greatly. Many stations have appeared on 144 Mcs, but after a few months or even weeks have vanished from the band. The reason they give is almost always the same: "there is not enough activity", or,"once you have worked a station he never wants another QSO with you". This last expression is one which is often heard regarding 144 Mcs. It is a long way from the truth, and is most disheartening for the newcomer to hear. The facts are, that, once two stations have had a QSO, each waits for the other to call, on the next occasion. So they go on for months, hearing each other, but neither liking to call because of the "once worked" bogey. The writer has contacted many stations up to a dozen times, and has never yet encountered an operator who "didn't want" another QSO.

If then you QSO a station, call him again, even if it is only the following evening. It all helps to promote activity. When conditions are good and DX is coming through, the other fellows are not very interested in local calls, so it is good policy to refrain from calling them at these times, and listen for the DX yourself.

DX hunting on 144 Mcs can become annoying and "temper fraying", especially when you hear a local station having a solid QSO and giving a 579 report to a station 100 miles away, and you cannot even hear the latter's carrier. This, of course, may be due to local screening, insufficient height of aerial, or many other reasons, and you get used to it.

In any case, having once ascertained the normal limitations of your QTH, you do not expect to work DX in some directions.

If you are fortunate enough to live several hundred feet above sea level you will, of course, do much better than the fellows at the lower levels, but it is doubtful whether you will get so much fun out of it. A great deal of the pleasure and interest in working on these frequencies is, in the writer's opinion, living in a poor to medium QTH, and experimenting with aerials in an effort to get better signals in and out. A very small percentage of 144 Mcs operators live in exceptionally good spots; about six per cent. would probably be the answer.

On the other hand, there are a great number who live in an exceptionally bad QTH, and it is difficult for operators on the LF Bands to understand how some of these still manage to find the determination and spirit to carry on. There is one particular West London operator who virtually works from an aerial in the bathroom, owing to QTH difficulties, and yet he gets a good signal round the country in some directions, if not all, and has worked many DX stations. So do not become disheartened if you happen to live in an unfavourable spot. Remember there are many worse off than yourself, and keep plugging away. Above all, experiment and keep on experimenting.

Contests

The fact that only a comparative few have the great advantage over the majority is evidenced by the results of most of the 144 Mcs contests, which use the "points" system of scoring. These contests usually terminate in the same six or seven stations struggling for top position, the organisers of such contests paying no regard to the contestants' height above sea level etc., so if you do enter a 144 Mcs contest the scoring of which is by "points", go in with the facts in mind, and unless you live at least 300 feet above sea level, don't expect to come in the first three! Consider the conditions under which you operate and be your own judge as to whether you have done well or not. Above all, retain your sense of humour.

Logging

Keep an accurate log of everything you hear, as well as everything you work. If you make a Schedule, keep it right on the minute, and make an entry in the log of the exact time you called. (Don't forget that your signals *may* be being logged somewhere, and it may be real DX).

Enter as many details as possible in your log, including, if possible, temperature and barometer readings existing at the time. These may be extremely useful for checking at some later date.

Frequency Drift

The crystal controlled converter is about the only type which has negligible "warm-up" drift. Most other types, however, take quite an appreciable time to stabilise. It is, therefore, wise to switch on fully half-an-hour before you intend to listen, otherwise your calibration will be in error. A 1 Mcs crystal connected in a tritet circuit, using a button-based valve, will produce useful harmonics on 144, 145 and 146 and makes an extremely useful band-edge marker. You can thus always check your calibration, and any slight error may be compensated by adjustment of the IF tuning. A few hours spent in calibrating your dial will save lots of trouble when searching for a station whose frequency is known.

While on the subject of drift, it must also be remembered that the receiver you are using as the IF will have its own "warm-up" period, the time of wich will depend upon the make and type of receiver.

Calling Procedure

Never make long calls. When sending CQ, sign frequently and deliberately. Remember that if conditions for DX are fair, but QSB is bad, the other station may be waiting impatiently for you to sign before you fade out altogether. So make your calls nice and short and, if the conditions are as stated, don't waste time describing your gear on the first change-over. You will probably fade out and the QSO will not be completed.

Tuning and QSB

On certain occasions, a peculiar type of QSB is evident on DX and semi-DX stations. This takes the form of a quick flutter, and when these conditions exist, it is much easier to miss a station calling you. A good maxim, when listening for DX, is to tune slowly through the band thus:- Six degrees slowly forward,
Three degrees slowly back
and so on, until you have covered the band, or the portion of the band that you are searching. Tuning the 2 metre band is a tricky business, and the writer fully agrees with a comment passed by a well-known 2 metre operator, that it was "barely possible to search more than 200 kcs of the band after each CQ call". That is a pointer to the care that must be taken in searching. A weak station calling you may easily pop up out of the noise level just as you pass over him, and it is really surprising how relatively strong these kind of signals are, once you have them tuned in. It sometimes seems hardly possible that you nearly missed him!

DX Conditions

As a general rule, DX Stations (i.e. Stations over 100 miles distant) should be audible under the following conditions:-

(1) Warm and fair, no wind, barometer steady.

or

(2) Foggy conditions generally

or

(3) Sudden rise or fall in temperature, irrespective of other conditions

or

(4) During prolonged spells of dry warm weather.

DX Stations will *not* normally be audible:-

(1) During continuous rainy weather

or

(2) High winds and cloudy weather

or

(3) Very cold weather generally.

or

(4) A difference in barometic pressure between your QTH and the DX area.

The foregoing are only rough general rules, and there are a great many factors yet to be investigated. Some 144 Mcs operators may not even agree with the above, but they are compiled from experience over a long period at the writer's QTH, and they will, it is hoped, serve as a guide. *To be continued.*

AF MIXERS Continued from page 269

shunting effect of one triode upon the other, which would seriously reduce the gain of both sections, resistors are included in the output leads to the common coupling capacitor.

A valve which we have found to be particularly suitable for use in circuits of this type is the Mullard ECC40, a double triode having a low hum, low microphony characteristic. However, where the mixer unit is not followed by a very high gain amplifier a valve of the 6SN7 class will prove to be quite satisfactory.

PRACTICAL AERIALS

by "AETHERIUM"

VHF Aerials
The Dipole
3-Element Yagi
The Stacked Yagi

Part 7

VHF Aerials

The simplest form of VHF aerial is the dipole. Besides being the simplest, it is reckoned to be the worst type, most of the radiation being at high angles. While some high angle radiation is useful under certain conditions, the dipole radiates a large amount of its energy in a purely vertical direction which is wasted under any conditions.

The simple dipole is, however, a very useful part of the VHF operator's equipment, one of its main uses being for the alignment of multi-element beams. The dipole is connected to the transmitter and the aerial to be adjusted is erected several wavelengths away. With an RF indicator connected to the feeder of the beam to be adjusted, it is only necessary to watch this while adjustments are carried out, all tuning up being for maximum reading.

A rotating dipole is also useful for the listener and will assist in assessing the "gain over a dipole" of various kinds of beams on received signals.

Fig. 1 shows "A" a simple dipole and "B" a folded dipole.

The object in folding a dipole, as explained in preceding chapters, is to increase the impedance at the feed point and not, as some people imagine, to increase its efficiency as a radiator. A simple method of overcoming the natural disadvantages of a dipole for VHF working is to add a reflector (Fig. 2). The phase change produced by the reflector causes most of the vertical radiation to disappear and more of the energy is concentrated at the useful angles. Another method is to mount another dipole above the existing one as shown in Fig. 3. One could go on adding dipoles in this manner, but the feed impedance becomes very complicated after a maximum of four. With this latter system a bi-directional beam is obtained, which means a rotation of 180

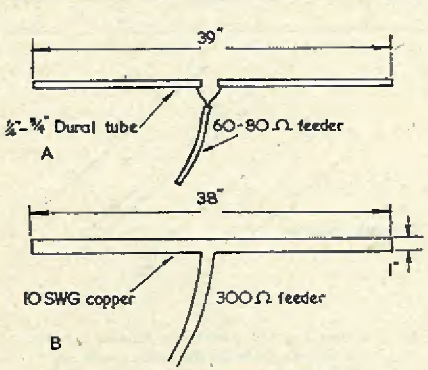

FIG 1. Simple dipole & folded dipole for 144 Mcs.

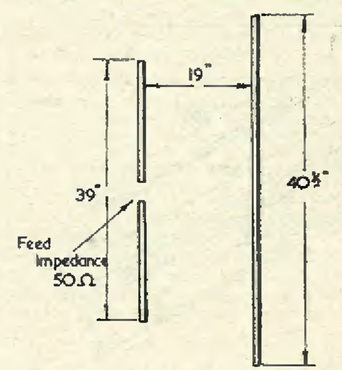

FIG 2. Dipole with reflector. Dimensions for optimum forward gain.

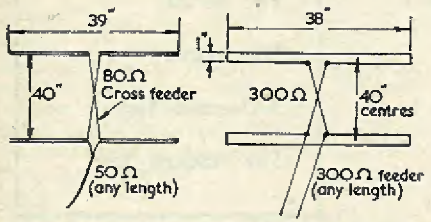

FIG 3. Two simple examples of the "stacked" dipole aerial. Dimensions are for optimum performance

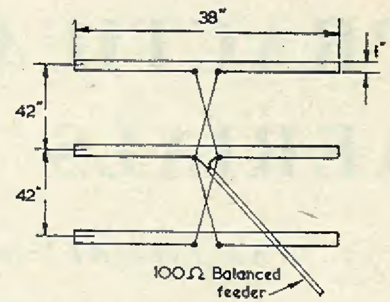

FIG 4. 3-element stacked dipole array. Cross feeders = 300Ω ribbon. Elements of 8 or 10 S.W.G copper.

degrees instead of 360 with the reflector method.

A 3-element rotary stacked dipole array which will give a good account of itself on 144 Mcs is shown in Fig. 4. If made exactly to the dimensions given it will require no further adjustment. A point to remember regarding this and all other VHF aerials is that they should be installed at the maximum height it is possible to obtain. An increase of a few feet can make an unbelievable difference in results. The aerial just described, as with other stacked array types, gives a low angle radiation with a broad front and will not have the forward gain or sharpness of a Yagi type beam.

The 3-Element Yagi

This is a favourite aerial among VHF operators. It takes up little room and has a forward gain of about 7 dB over a dipole.

A typical example with dimensions is given in Fig. 5. These dimensions are the result of practical experiment and, once again, no further adjustment will be necessary if built as shown. Dural is recommended for the elements because of its lightness, but there is no reason why copper tubing should not be used.

Do not use steel conduit for beam elements. It *will* work, but its RF resistance is high and results may be disappointing. Before erection and when completely finished and tested, give the whole beam a coat or two of good outside paint (dip corks or wooden dowelling in paint and plug the ends of the tubing). Dural tube oxidises rapidly out of doors and, unless painted, the whole beam may fall to pieces within a few months.

Adding a fourth element to the 3-element Yagi often pays dividends. Although theoretically a gain of only 1 dB is effected by adding a further director, the angle is lowered still further and in actual practice results often exceed this figure. For optimum results the spacing of this fourth element is fairly critical (Fig. 6). Although the impedance (or radiation resistance) of the beam is lowered by adding this element, the change is so small that it does not warrant any alteration to the feeder point. (NOTE: A correctly adjusted 3-element beam was fitted with an additional director and the measured change in SWR did not exceed .1).

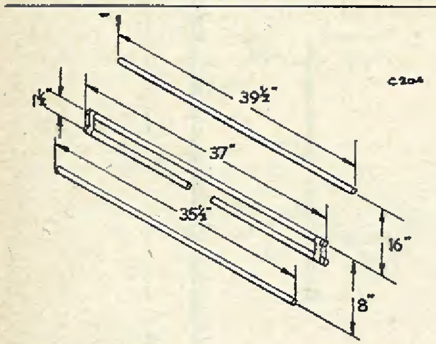

FIG 5. 3-element close spaced beam for 144 Mcs. All elements of ½" dural tube. Spacing at feed point 1". Feed with 50Ω feeder.

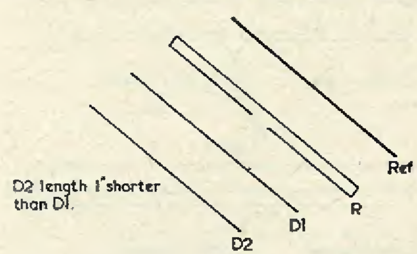

FIG 6 Adding a second director. If spacing between R & D1 = ·1λ, D1 to D2 should be made ·15λ. If spacing between R & D1 = ·2λ, D1 to D2 should be ·1λ.

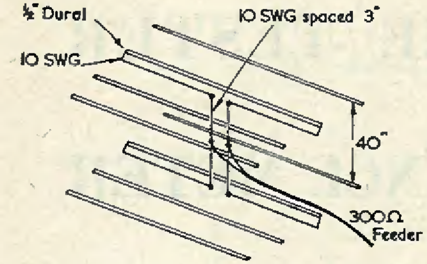

FIG 7. Feed method for 4-over-4 yagi. Folded elements are ½" dural. Fed elements 10 SWG spaced 2" to centres. Element lengths as FIGS 5 & 6.

Stacked Yagis

If a second 3 or 4-element beam is mounted above the first (spaced ½ wave) two things happen. Firstly the angle is lowered still further, secondly the "nose" of the beam becomes wider. The overall gain goes up, but not to twice the value of a single beam. The feeder system must be revised for the stacked Yagis, and Fig. 7 shows a good method of feeding such an array.

The importance of keeping the elements aligned cannot be stressed too strongly. Remember you are dealing with 8 elements, two only of which are fed, the rest are relying on phase changing for their operation, which is brought about by accurate and constant spacing. Some stations use up to four 4-element Yagis in this manner and these are known as "4 over 4 over 4 over 4". Feeding an array such as this is a fearsome undertaking, and the beginner is not recommended to attempt this until he has had experience with the simple beams.

CAPACITANCE TESTER *and* HIGH RESISTANCE METER

by NOEL Ta'BOIS

THIS apparatus can be used for testing non-electrolytic capacitors at their working voltage over a range of 150 to 1000 volts. The principle consists in applying a known DC potential to a capacitor through a neon lamp. If the lamp glows, the capacitor is passing a current and is faulty. The apparatus was originally designed for testing capacitors only, but by the addition of a DPDT switch it is possible to measure, at a pressure of 1000 volts, the insulation resistance of capacitors and the value of resistors from 100kΩ to 50MegΩ, with quite accurate readings over the range from 250kΩ to 10MegΩ. There should be no difficulty in obtaining the comparatively few components used, either from the junk box or on the surplus market.

Fig. 1 shows the theoretical circuit. The transformer is an EHT transformer having an input of 230V 50 cycles and an output of 800V at 3mA. By making VR1 large to keep the load across the secondary of the transformer small, it is possible to obtain an EMF across the reservoir capacitor C2 of just over 1000V. Reducing VR1 to 500kΩ drops the voltage to about 950. C2 is a 2.0µF oil filled capacitor rated at 1000V working. 0.1µF 2.5kV working capacitors are fairly plentiful on the surplus market and if available one of these, or better still two in parallel, may be used. It may, however, be found that the voltage indicated by the meter is less than the peak value, and a full scale deflection of the meter is unobtainable. As will be seen later this is a slight disadvantage when measuring resistance, since calibration of the meter is made more complicated.

The LT windings on the transformer presented a problem as they had to be added. There was just room between the core and the original windings to add the new windings, which consist of 30 turns of 26 swg enamelled copper wire for the rectifier heater, and a further 10 turns (making a total of 40 turns) for the 2.5V pilot lamp. The wire is rather thinner than that ideally required, and there is therefore a considerable voltage drop on load. This is no disadvantage providing due allowance is made. The correct number of turns was found by experiment by adding a few turns at a time, until a current of 1A was obtained as shown by an AC ammeter and 2.0V across the valve heater pins on an AC voltmeter. There was no need to remove the core to add the windings, but there was only just room for one layer of thick brown paper to insulate the LT windings from the core of the transformer. As this insulation could not be expected to withstand the peak inverse voltage (about 2.0kV), one side of the LT windings is connected to the chassis; hence the unorthodox position of the rectifier. It should be noted that the positive HT is connected to the chassis, so that the point C is negative, and D and E positive. Care should be taken in connecting the meter.

Suggested alternatives for overcoming this difficulty of the LT windings are:—

1. To use a separate filament transformer giving an output 4.0V 3.0A centre-tapped. One half of the windings is used for the rectifier heater, and the whole for the pilot bulb which should then have a 3.5V rating. (Fig. 2). Note change in HT polarity.

2. To substitute two J50 metal rectifiers in series for the valve rectifier. A second neon lamp (230V) can take the place of the pilot bulb. (Fig. 3). If metal rectifiers are used it will not be possible to obtain quite as high a voltage (850 to 900V can be expected) owing to the metal rectifiers having a higher resistance than the valve rectifier. Again note polarity.

3. To use a transformer having an output of 350—0—350V and 4.0V centre-tapped. The whole HT windings are used, giving 700V RMS, or nearly 1000V peak, while the LT is connected as in Fig. 2.

The meter, which cost 7/6d. has a full scale deflection of 1.0mA. By connecting a 1.0 MegΩ resistor R3 in series with the meter, the latter then reads directly in kilovolts. For example, a reading of 0.7mA indicates an EMF of 0.7kV or 700V across CE (Fig. 1). The value of R3 is critical. Perhaps the easiest way to determine the correct value is to connect a reliable voltmeter to the points C and E, and try a series of 1.0 MegΩ resistors in turn until one is found which gives the same reading on both meters. If it is not possible to find such a resistor, select one which is slightly less than 1.0 MegΩ (gives too high a reading on the meter being calibrated) and connect a small resistor (the correct value to be found by experiment) or a variable resistor in series. Actually, the total resistance across CE should be 1.0 MegΩ, but as the meter specified has an internal resistance of only 500Ω it is negligible compared with R3. It is not essential that a meter be incorporated in the apparatus. The points C and D can be taken to insulated terminals on the chassis and a milliammeter having a full scale deflection of 1.0mA connected to them. Alternatively points C and E can be taken to insulated terminals and connected to an external meter reading up to 1.0kV, in which case R3 is omitted. If an external meter is used, be careful to observe polarity and switch off before connecting the meter.

The values of R1 and R2 are not critical. R1 discharges the capacitor after it has been tested, and should not be omitted. R2 limits the current in the event of the capacitor under test having a short circuit.

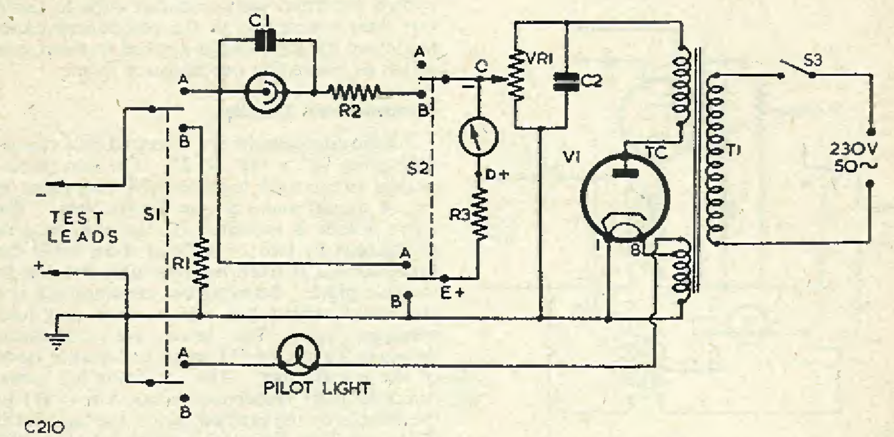

Fig. 1: Circuit diagram of the C/R Tester.

LIST OF COMPONENTS

C1 0.1µF 1000 VDC.
C2 2.0µF 1000 VDC Oil Filled.
R1 10kΩ 2W.
R2 20kΩ 2W.
R3 1MegΩ 2W.
VR1 2MegΩ potentiometer.
V1 U22 Mazda or U16 Osram.
T1 EHT Transformer. Input 230V 50cps. Output 800V Premier.
S1, S2 Toggle switch DPDT.
S3 Toggle switch SPST.
1 meter, 0—1mA, 500Ω.
1 pilot lamp 2.5V, 0.3A.
1 red pilot lamp holder.
1 Osglim neon lamp 230V, 5W, and holder.
1 Mazda octal or BR4 valve holder.
1 Aluminium chassis 9½" × 4½" × 2". Premier.
2 Crocodile clips.
1 Knob.
1 ½" rubber grommet.
5 ⅜" rubber grommets.
1 tag board.
1 capacitor clip.
6ft. flex and adaptor.
Wire, nuts and bolts.

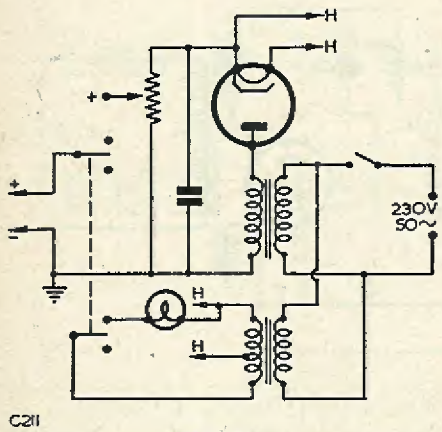

Fig. 2.

The neon lamp is a 230V 5W commerical type. The capacitor C1 connected across it is not essential, but is advantageous. Without it, a capacitor under test having a slight leakage results in the neon lamp glowing very dimly. When the capacitor C1 is in circuit it is charged until a certain voltage is reached which is sufficient to flash the neon lamp and discharge C1. The process is then repeated. Thus instead of a faint discharge through the neon lamp there is an intermittent flashing which is much more easily seen. Needless to say, C1 should be a good component having a high insulation resistance.

The pilot lamp is mounted behind a red window and lights up when the test leads (which are fitted with crocodile clips to facilitate their connection to the component under test) have the test voltage applied to them, and serves as a warning not to touch them.

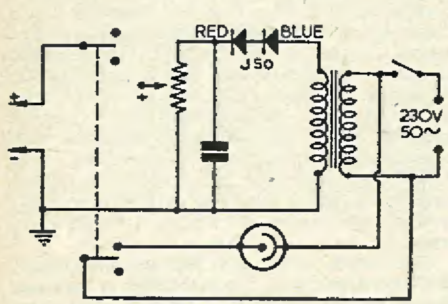

Fig. 3.

Constructional Details

All the components are mounted on a chassis measuring 9½" × 4½" × 2". The two photographs (see cover) together with the plans in Fig. 4 should make all the details clear. The valve holder is mounted on the end plate of the chassis by two 1" screwed rods, while the capacitor C2 is fixed by a suitable bracket to the side plate. Between the valve and C2 is a tag board which has one earthed and four insulated tags. The latter are convenient points to attach the HT input and output leads of the transformer. The LT leads are taken direct to their respective points, viz:— (1) to the chassis by the earthed tag on the tag board, (2) to pin 8 on the valve holder and (3) to the pilot lamp. The last lead should be left long enough when the LT windings are added to the transformer. All leads pass through rubber grommets mounted on the chassis. Two earthing tags are bolted to the chassis by the nuts and bolts holding the meter in place. These facilitate the earth connections of R1 and the positive test lead and the earth connections of S1, S2, VR1 and C2 respectively. R2, R3 and C1 are supported by the components to which they are connected.

Instructions for use

To test capacitors. Set S1 and S2 to position B (Fig. 1). Connect capacitor to crocodile clips, and adjust VR1 to working voltage (or test voltage if marked) of capacitor. Switch S1 to position A. The neon lamp will glow as the capacitor charges, the length of glow depending upon its capacitance. If the glow persists, the capacitor either has a short-circuit or a low insulation resistance. If the glow is intermittent, the capacitor has a fairly high insulation resistance the less frequent the flashes the higher the resistance. Theoretically, a good capacitor should cause no flashing, but it is found that the neon lamp is very sensitive to leakages in the apparatus itself. Providing, therefore, that there is no more flashing than is evident when no capacitor is connected to the test leads, the capacitor can be considered to be perfectly satisfactory.

To measure resistance. Set S1 and S2 to B and adjust VR1 to give a reading of 1.0mA on the meter. Connect the unknown resistor or capacitor to the crocodile clips, switch S1 and S2 to A and take the reading of the meter in mA. The table then shows the value of the resistor or the insulation resistance of the capacitor.

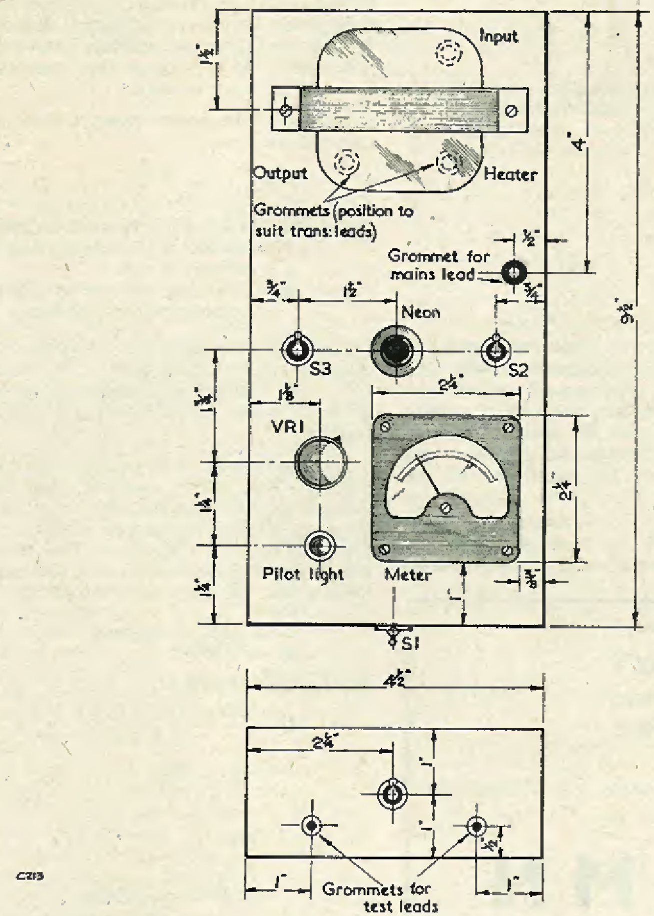

FIG 4

RESISTANCE TABLE

Meter reading	Resistance	Meter reading	Resistance	Meter reading	Resistance
0.99	10kΩ	0.56	750kΩ	0.20	4MegΩ
0.95	50kΩ	0.50	1MegΩ	0.17	5MegΩ
0.91	100kΩ	0.40	1.5MegΩ	0.09	10MegΩ
0.80	250kΩ	0.33	2.2MegΩ	0.05	20MegΩ
0.66	500kΩ	0.25	3MegΩ	0.02	50MegΩ

The table can be augmented by calculating the resistance for any meter reading by applying the formula:—

$$Rx = \frac{1-C}{C} \quad . \quad . \quad (1)$$

where Rx = unknown resistance in Megohms
C = reading of meter in mA.

Example. An unknown resistor gives a reading of 0.54mA. What is its value?

Applying formula (1)

$$Rx = \frac{1-0.54}{0.54}$$

$$= \frac{0.46}{0.54}$$

$$= 0.85 \text{ Megohms or } 850k\Omega.$$

It should be noted that when measuring the insulation resistance of a capacitor 1000 volts are applied to it, so only capacitors having a rating of 1kV or more can be so tested, unless the meter is recalibrated for test voltages of 750 or 500. See formula (2) below. This will, however, reduce the sensitivity of the instrument.

If metal rectifiers or a transformer giving less than 1000V peak are used, it will not be possible to zero the meter on 1kV (1mA on the meter). The next convenient reading must be taken as the zero setting and the meter recalibrated. If an external voltmeter is used (connected to CE as suggested above) whose internal resistance is one Megohm, formula (1) will apply. If it is other than one Megohm, formula (2) must be used.

In any of the above cases, the formula for calibration is:—

$$Rx = \frac{E-CR}{C} \quad . \quad . \quad (2)$$

where Rx = unknown resistance in kilohms
E = voltage in volts applied to Rx
C = current in mA
R = resistance of meter plus R3 (if connected) in kilohms.

Example. An external voltmeter with an internal resistance of 500kΩ is connected to CE. The maximum deflection obtainable is about 775 volts. Find the value of an unknown resistor.

First switch S2 to B and set the voltage to exactly 750. Now connect the unknown resistor to the crocodile clips. Set S1 and S2 to A and take the meter reading. This is found to be, say, 150 volts. The meter has a resistance of 500kΩ and reads 150 volts. By Ohm's law, the current it is passing is

$$\frac{E}{R} = \frac{150}{500{,}000} = 0.3\text{mA.}$$

Now apply formula (2).

$$Rx = \frac{750 - (0.3 \times 500)}{0.3}$$

$$= \frac{750 - 150}{0.3}$$

$$= \frac{600}{0.3}$$

$$= 2000k\Omega \text{ or } 2Meg\Omega.$$

It is by no means essential to build the apparatus exactly as described. Once the principle has been understood, the reader should have no difficulty in building up a tester from components available.

Care should be taken when using the apparatus as the voltages are high. It is a good plan to get into the habit of handling the test leads with one hand only, the other being kept in the pocket. This is easily done if the component to be tested is placed on the bench and the two crocodile clips connected one at a time. If this is done, and one is always careful to see that the red pilot light is out before touching the clips, there is no risk of receiving a shock.

Nuts to you, too!

by **H. DUDLEY STILTON**

There is a limit to the endurance, at which point one either loses physical health, or the brain is affected and the individual becomes insane.

I have very nearly reached the second stage!

The reason, strange as it may seem, is silence. Yes. Just common or golden silence. Now however, I must for sanity's sake confess my error. For by what was at that particular time, nothing but a simple experiment, I have thrown the world into a chaotic upheaval, and laid the finest brains of two continents in the dust; caused rumour to run rife through a fear-filled world, and may, should I hold my silence, cause untold misery to millions of intelligent forms of life throughout the galaxy.

I am, I must confess, a keen student of the occult. As you will probably be aware, man has throughout the ages tried to transform the elements. To turn lead into gold; carbon to diamond; age to eternal youth. It can, as the atomic plant has shown, be done. My method was far simpler, and as events turned out, far more drastic! Let me then begin at the beginning and explain.

Knowing, as every radio enthusiast does, the formation of the atom; and knowing, as every mystic does, the phenomena of vibrations, I was struck by their similarity. A similarity which I could perhaps explain better by drawing a simple comparison: If you could, by some means, reduce yourself in size sufficiently to be able to live on an electron in much the same manner as you now inhabit the earth, you would find a planetary system, depending of course to what element the electron belonged, and remarkably similar to our own universe, with the proton as the sun and the other electrons as the planets.

Now if, by some devilish bit of bad luck on your part, some person on the world changed the formation of your universe by blending it with another element, in other words he lit the match that your own little electron was part of, then you and your whole galaxy would. . . ., well, that doesn't need much working out, does it?

If, on the other hand, he introduced a body of neutrons to your galaxy, the chances are that they would pass between your worlds *without upsetting the balance at all*! You see what I am driving at? In other words, to pass one solid body *through another* without damaging either,—*And I did it* ! ! !

It took me about three months to build the apparatus. Three very expensive months, but at last it was finished. I inveigled the wife into letting me experiment with a couple of saucepan lids and the top of her pressure cooker thrown in for good measure. Then the fun started. I beamed the projector out of the open window and flung the lids into the ray; EACH ONE IMMEDIATELY VANISHED.

For a moment I couldn't believe it; then, shrieking with joy, I spun round in a frenzy of excitement, but in so doing I inadvertently knocked the projector over. Luckily, I managed to catch it before it disintegrated the house, but it certainly dug me a nice pit in the garden before I managed to switch it off. Sweating, yet shivering, from the reaction, I turned to the wife.

She was standing arms akimbo, glaring at me with a gaze that sent a shiver of foreboding down my spine.

"And where," she ground out, "are my pan lids?"

That certainly *was* a poser. Where the devil could they be?—I flicked a glance at the hole in the garden, and kept my suspicions to myself.

"Oh-ho," I forced myself to cackle, rather inanely I must admit, "they'll appear again; you see they are in a time lag, or a space warp, or,—or. . . ."

"Well, sonny boy," she retorted, "they'd better be in my kitchen by tomorrow dinner time, or else. . . . . . ! ! ! !"

I breathed again; if the worst came to the worst I could buy some new ones by then.

You can imagine my dismay, however, on reading the next morning's papers, can't you? —Remember?

FLYING SAUCERS REPORTED OVER AMERICA!

TELEVISION
Picture Faults

Part twelve of a series.

Part 12 – Rejector Circuits

Rejector Circuits

THE addition of rejector circuits to vision or sound units to reject an interfering signal is easily made. They can be coupled to existing coils inductively (direct or by a link) or capacitively. The method to adopt depends a great deal on the existing circuit, it being obviously better to interfere as little as possible with the original design. The inclusion of additional tuned circuits will modify considerably the original response curve; re-alignment will therefore be necessary, particularly if the rejectors are to tune near to the original band pass.

A rejector circuit should have as high a "Q" as possible; not only should the coil be efficient, but the tuning capacitor should be of high quality and very stable. Inductive or capacitive tuning may be used with the other element fixed, the inductance preferably being similar to the existing one in the receiver when inductive coupling is used. At 45 Mcs and above it is probably better to have a fixed capacitor and to adjust the coil with an iron

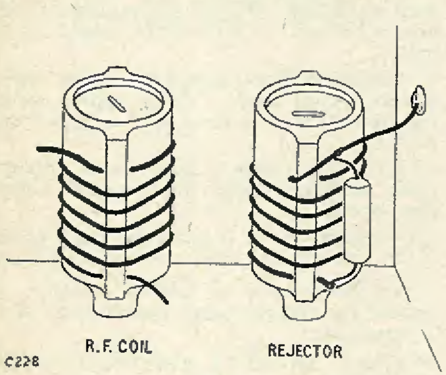

Fig. 1.

slug. A design which will cover sound and vision frequencies of the Alexandra Palace transmission consists of 7 turns of 18 gauge wire wound on a threaded former approximately 7/16" in diameter (G.E.C. or Neosid) with suitable iron core. The turns are spaced to lay in every other groove, giving slightly more than one wire diameter spacing, and being anchored above and below the winding. This coil is shunted with a 22 pF capacitor, preferably of low temperature co-efficient, with as short leads as possible. It can be mounted parallel with an existing coil, and as close as possible if high attenuation is required; the end from which trimming is to be carried out should be connected to chassis with as short a lead as is possible. This reduces "hand capacity" effects when adjustment is made.

Fig. 1 shows the appearance of the tuning coil and rejector when mounted in the chassis; the spacing may be made much closer than the drawing might suggest, the coils not being drawn to scale. Fig. 2 shows the most likely way of indicating an inductively coupled rejector in a circuit diagram.

For higher frequencies, reduce the number of turns; remember when trimming that the complete traverse of the slug may only be equivalent to half a turn on the coil. All reductions of coil turns should be carried out half a turn at a time, or the correct tuning range may be missed.

At lower frequencies, a similar procedure can be adopted, but the tuning may be accomplished with a variable capacitor. The important point is that the coil should be of as high quality as possible.

Link coupling is carried out by adding a single or half turn coupling winding to the rejector and coil which are to be coupled. The coupling windings can consist of the same piece of wire passed round the coils, and both ends joined.

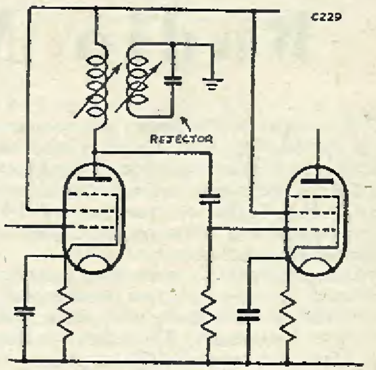

Fig. 2.

Capacitive coupling may be obtained by connecting the rejector to the circuit through a small capacitor; something of the order of 2 pF is quite common. Its effect on the circuit may be complex and difficult to predict without studying the problem mathematically; it is advised therefore that inductive coupling is used.

Another method of including rejectors, commonly used in commerical receivers and easily adapted to homebuilt sets, consists of a tuned circuit inserted in the cathode lead of one of the RF valves. In the interest of impedance matching and low damping, the cathode is usually connected to a tap on the coil. The shunt capacity due to the cathode therefore only appears across a small portion of the inductance. The circuit arrangement is drawn in figure 3, and a practical arrangement will be quite obvious. The inductance should be positioned so that the magnetic coupling between it and other circuits is at a minimum. The principle involved is to provide a high impedance at the unwanted frequency and thus to reduce the gain of the circuit by selective feedback. The rejector should have a reasonably low impedance to those frequencies which are to be amplified. The capacitor may therefore have to be proportionately larger than that in other types of rejector circuits.

Rejectors have the effect of cutting a valley in the response curve of the receiver when tuned within the pass band, or to steepen the fall in gain when tuned to the end of the curve. It may be necessary to use two rejectors coupled to separate circuits to obtain rejection of the order of 30 to 50 dB. This is the generally required standard for rejection of sound interference on a vision signal, and assumes special significance where there is a possibility of interference from the sound transmission of the adjacent channel. As an example of this, a vision receiver tuned to the upper side band of the London transmission and located on the North Western fringe and working at high gain may have interference from the Holme Moss sound channel on 48.25 Mcs. A rejector similar to the one described above should be quite suitable to eliminate the sound breakthrough. This is given as an example and may not occur in those areas where the transmission from Holme Moss starts. In some circuits where there is coupling between the tuned circuits of vision and sound to provide the input for the sound section of the receiver, the first sound coil may act to some extent as a sound rejector on the vision channel and can be usefully used to reduce sound breakthrough on vision.

Another important job for which rejector circuits may be employed is as a sideband attenuator. As all the transmissions apart from that radiated from London use single sideband, some difficulty may occur in obtaining the correct level at the vision frequency. Ideally, the response curve of the vision receiver should be flat to within approximately three quarters of a megacycle of the vision frequency. From this point the gain should fall at a steady rate so that at the vision frequency itself the gain should be half of that at the flat section, that is 6 dB down. On the other side, the gain continues to fall at the same steady rate. It is very easy to achieve this even fall in gain if rejectors are tuned to 1.5 Mcs on the opposite side of the vision frequency. For example, a receiver for use in the Birmingham area will have rejectors tuned to the vision frequency plus 1.5 Mcs i.e. 63.25 Mcs, which incidentally is the sound frequency of the next channel "up". The rejectors will therefore serve the double purpose of adjacent channel sound rejector and set the gain of the vision receiver down by 6 dB at the vision frequency and ensure good low frequency video response.

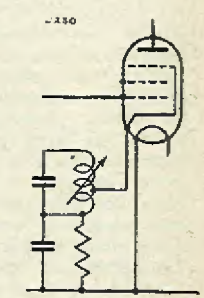

Fig. 3.

Radio Miscellany

SO the number of TV pirates is now estimated to be 80,000. This figure is said to be computed by subtracting the number of licences issued from the number of sets manufactured, guessing that 55,000 of them are still in the shops unsold, and allowing for 25,000 unlicensed home made sets.

If there are 25,000 TV home constructors who have failed to pass their two pounds over the Post Office counter, there must be a total of far more home-built TV receivers than I would have been rash enough to guess.

Commenting on the extensiveness of such piracy, a daily newspaper describes the constructors of these home-built receivers as "kitchen craftsmen". This title may be smart journalese, but non-pirate TV constructors are likely to feel they ought to qualify for a worthier nick-name. TV construction has not yet been quite reduced to the level of being possible for anyone possessing a penknife and a screwdriver, even if that was all that was required (according to the advertisements) to build many a three-valve Special in bygone years.

Quarter Century

To be called Kitchen Craftsmen is enough to make every TV old-timer shudder. Despite what many of our younger readers might think, there are plenty of TV old-timers who first felt the urge over a quarter of a century ago. Unlike the transmitting fraternity, they have never started a club to mark their long association with the hobby.

Turning out some half-forgotten papers a few weeks back, I came across an old licence permitting the use of the Baird patents for experimental and personal use only. It was dated 1926! Just in case anyone should get the wrong impression that I am claiming any very special distinction, licences were granted to almost anyone who applied. I mention it only because of its interest and to establish, for the incredulous, the antiquity of TV construction as a hobby.

There must surely be quite a number of readers who shared with me the making (and still harder, keeping) of a disc scanning receiver to work properly for more than a few seconds at a time. Using old suction cleaner motors, it was a tricky business. When successful, one had a tiny, crude orange-tinted picture of less than a couple of square inches, made up partly of shadow and largely of imagination. Then, almost as soon as you had made up your mind that it really was a picture, the motor driving the disc would either slow up or accelerate slightly. Your picture then divided itself into two transposed halves, or more likely dissolved itself into a streaky smudge.

The old-time "kitchen craftsmen" had to have a taste for mechanics, too. A great problem was to find material for a non-whip disc. Then one had to cut correctly-spaced square holes of just the right size—only to find it whipped and juddered when you revved it up. To help in adjusting it to the right speed a stroboscope design would be painted on the face. Later it became fashionable to cut the disc itself to form spokes for this purpose. The single-handed amateur, like the cook in the song who kept one eye on the pot and the other up the chimney, gave himself many a headache keeping one eye on the stroboscope and one eye on the picture.

Spreading Northwards

Looking back it seems strange, despite our expectations, that the development of TV has been so slow even since the resumption of the Service after the War. Only in the last couple of years has it leapt to real popularity. We seem to be now nearing the stage where it will threaten to eclipse sound broadcasting, especially when the Holme Moss transmitter scheduled to open this summer, and Kirk O'Shotts (in the Autumn), make TV available to 32,000,000 people. In increasing numbers people will be lured away from ordinary listening, change their habits and form new likes and dislikes.

Despite the fact that viewing is not really necessary for many of the programmes, sound-only broadcasting becomes remarkably tame after you have enjoyed a few good TV programmes. Sports commentaries, in particular, seem downright old-fashioned without a view of the event.

Few listeners, I imagine, place much faith in boxing commentaries and summaries after being caught once or twice by being led to believe that one of the fighters is a mile ahead on points, only to learn that the decision is given to the other chap. If the fellow you have been led to believe is winning hands down suddenly gets on to the receiving end of a few terrific wallops and finishes on the canvas stone cold, it can always be passed off as a dramatic turn of the tide. But on quite a number of occasions points verdicts have left the innocent listener gasping.

CENTRE TAP *talks about*

TV PIRATES & PROGRAMMES – BEVERIDGE REPORT

With TV, commentators can only draw your attention to details—from that point you can form your own conclusions.

Have you, by the way, ever taken a portable receiver and listened to a commentary while actually seeing the event? I did once, to check for myself on a sports commentator who was said to frequently describe a whole lot of dramatic incidents which neither he, nor anyone else present, ever saw.

Fashion Cycle

Most viewers are agreed that TV programmes are on the up-grade, with the possible exception of the comedy element. Comedians, generally speaking, have not yet been able to adapt themselves to the medium. Maybe we shall see a return to the traditional comic of the oddly assorted clothes and funny grimaces who has been out of fashion for many years. With TV, the slick gag-cracking comedian in his turn may pass into the twilight. Most of the top name broadcast comics have fallen flat when they have tackled TV.

In all other respects the TV programme builders and artistes have done a good job. The more you know of the difficulties under which they have worked, the more unstinted becomes your praise. Let us hope that now it is becoming "important" the B.B.C. do not overload it with pompous officials.

It was, by the way, very pleasant to see a programme in which TV had a good laugh at itself in "Here's Television"—a thing the rest of the B.B.C. became much too self-important to do donkey's years back.

910 Pages plus Oral Evidence

Interested readers will by this time have had opportunity to digest and consider the findings of the Beveridge Broadcasting Committee's Report. Those who have studied only the Press extracts will have gathered from their comments that each seems to have found a widely varying significance in its recommendations. From a few of the Dailies one might be almost led to wonder whether they were reporting on the findings of quite different Committees.

Taking into account the composition of the Committee, I think the result runs true to form. Mildly progressive, and extremely cautious.

The recommended greater use of VHF stations to obviate further confusion in the congested broadcast bands was pretty obvious but, with the majority view that our broadcasting must remain a monopoly, the extension of wired relay services in the thickly populated areas would, to my mind, be a still better solution.

The most depressing part of the Report is the number of further Committees and Sub-Committees proposed or suggested in addition to Regional Committees. But that is not the end of it. They also recommend that the Governors shall be free to appoint even more Committees! How on earth one can expect to get the sadly needed vigour and enterprise under the numbing influence of a labyrinth of Committees and Sub-Committees, completely baffles me. There is far too much deadwood in the Broadcasting hierarchy already, without adding to it.

Upon the question I consider to be the fundamental issue—whether controlled competitive broadcasting should be introduced—the Committee failed to reach unanimity. The majority favoured the continuance of the monopoly, but seven of them were of opinion that no case had been made out for barring sponsored programmes completely. Even the majority favoured decentralisation, and sees a danger in the "Londonisation" and sense of mission which, combined with the desire for security of office, animates the BBC.

As one might have expected, a lot of time was taken up with comparative trivialities such as puritanical objections to allegedly frequent references to drink in radio drama and variety. Scottish Nationalists, too, sternly condemned the emasculated voices of the announcers. The Listeners' Association alleged that the Corporation advocated and advertised Communism, while the Labour Party accused them of social bias and were offended at Producers occasionally allowing working-people characters to appear incapable of using the King's English.

Those who have long hoped to see important reforms in British broadcasting (had they rested much hope in the Beveridge Committee) will, of course, be disappointed. To my mind the only improvements likely to result are in detail, other than the changes which must inevitably be forced upon us, such as those arising from difficulties brought about by overcrowded wavebands, a more liberal policy in the matter of controversial issues, and so on.

TONE CORRECTOR CIRCUIT

for Crystal Pick-ups

By W. E. Thompson.

The circuit to be described is a simple means of providing tone compensation and gain control between a crystal pick-up and audio amplifier. It has been in use for some time on the author's record reproducer and, although perhaps not as perfect as one would wish, it does seem to be suitable for all but the most exacting requirements. As it stands, this corrector enables a Rothermel crystal pick-up to fully load a Williamson amplifier (15 watts undistorted output for 1.9 volts peak input.)

There is some inter-dependence between the bass and treble controls, although only a little adjustment to one has to be made if the other is altered. It has, in fact, proved so satisfactory over a period that the design of a better corrector has been, at various times, put off until more opportunity for experiment is available.

Referring to the circuit, Fig. 1, R1 is a 5-megohm load resistor across the pick-up output, and it is necessary since the impedance of the crystal is mainly capacitive. Omission of this resistor results in "screech", whilst a lower value will give woolly reproduction. A mica capacitor for C1 is necessary, 300 pF being an average value. Increasing this to, say, 500 pF will effect some top cut and the final choice perhaps depends on one's particular taste for "top" and attack, and to some extent upon the characteristics of the amplifier used.

The variable resistor R4 is the gain control, and should for preference be graded to a log law. If the pick-up should overload the input stage of the amplifier, insertion of a resistor of 0.5-megohm upwards at the point marked "X" will effect necessary attenuation. The precise value will, of course, need to be found by trial.

A paper capacitor is quite satisfactory for C2 since this component is not at all critical.

The bass control is R2 whilst R3 controls the treble. By adjusting these, a pleasing wide-range response can be obtained with only perceptible needle scratch. The functions of R2 and R3 can be summarized as follows:—

To reduce bass:	Increase R2
To increase bass:	Decrease R2
To reduce treble:	Increase R3
To increase treble:	Decrease R3

If some reduction of the middle register is required, it can be obtained by increasing the value of C2. Since this tends also to cut bass response, some correction by reducing R2 may be needed.

Earthed screened leads each side of the network are essential and, to ensure complete freedom from hum induction, enclosure of the components in an earthed screening compartment may be desirable. The author has not found this to be absolutely necessary with his equipment, because the filter is mounted remote from the amplifier. The point is given mention just in case others meet with some difficulty in this respect. It should not be forgotten, also, that the gram motor frame should be bonded to earth. Failure to do this can result in a mysterious increase of hum when the pick-up is placed over the turntable.

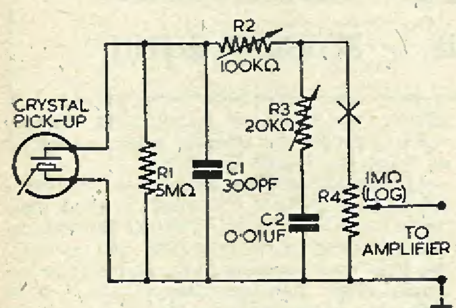

FIG 1
TONE CORRECTOR CIRCUIT

C191

Dabbling with . . . DECIBELS

by R. J. CABORN

THE process of learning any science has at times been likened to the unravelling of a skein of string. After having unravelled the string sufficiently far to reach and master the fundamentals, the student finds that those fundamentals introduce him to more advanced and complicated questions; which, in their turn, induce him to look even deeper into the subject.

Particularly is this true of radio, where it may be said that it would be extremely difficult to thoroughly master the enormous amount of ground now covered by this branch of engineering. Nevertheless, an understanding of the more general aspects is very easily obtained, and is, of course, extremely useful to those who have acquired it.

One of the earlier difficulties which are encountered is that of finding the exact meaning and use of the term *decibel*. It is surprising to find how many people there are who encounter the expression continually and, yet, are very hazy as to what is actually meant by it.

Power Ratio

What *is* a decibel?

First and foremost it must be understood that the decibel is not a quantity: it is a *ratio*. We cannot, for instance, state that a certain circuit gives a power equal to say 10 decibels; but we can state that that power is 10 decibels higher or lower than another power developed elsewhere. If the output power of an amplifier were found to be 10 decibels higher than that of its input, then the amplifier would be spoken of as giving a gain of 10 decibels.

Relative Loudness

However, the decibel is not necessarily intended to differentiate between certain power levels. It was originally intended to offer a means of assessing the strength of different signals, or sounds, in terms of relative loudness as observed by the ear.

Unfortunately, the ear responds to the intensity of sounds in a somewhat awkward manner. To start with, it can only assess the power ratio between two different sounds; and it cannot give any very accurate idea of the *value* of the power of either of them. To take an example, if the output of an amplifier were increased from 100 to 500 milliwatts and a person listening judged that it now sounded twice as loud, he would also say the same if the output were increased from 1 to 5 watts. In the first instance the increase in power was only 400 milliwatts, whereas, in the second case, it was 4 watts, a much larger change. However, so far as the listener was concerned, all he knew was that the sounds in both cases increased by the same amount; that is, they both became "twice as loud".

This peculiarity of the ear is due to the fact that it responds to the power of sounds in a *logarithmic* manner. It then becomes necessary, when referring to the relative loudness of two sounds, to employ a unit equal to the logarithm of their power ratio.

Numerical Value

This is where the decibel originally came into use. To make the unit practicable[1] it is made equal to *ten* times the logarithm of the power ratio, giving us the following formula:—

$$dB = 10 \log \frac{P1}{P2},$$

where P1 and P2 are the two powers under consideration. (dB is, of course, the abbreviated form of decibel). Common logarithms (to the base 10) are used in the formula.

When the ratio between the two powers being compared represents a gain, the value in dB is given as a positive quantity (thus, +6dB); and, when it is a loss, the value is made negative (e.g. —4 dB).

The method of obtaining a value in decibels is easily clarified if we consider one or two practical examples.

For instance, let us suppose that we have an amplifier which delivers an output of 3 watts for an input of 10 milliwatts. The power ratio (output to input) is then $\frac{3000}{10}$ i.e. 300.

1 *A change of* 1 *decibel in sound power can just be detected by the average ear.*

The gain in decibels is therefore equal to:—

$$\begin{aligned} & 10 \log 300 \\ &= 10 \times 2.4771 \text{ (using common log. tables)} \\ &= 24.8 \text{ dB.} \end{aligned}$$

Or again, let us imagine that we have a transmission line which gives rise to certain losses. We find that when we feed 20 watts of power into it we only obtain 15 watts at the output end. (We assume that the line is correctly matched). The power ratio is then $\frac{20}{15}$ i.e. 1.333. This would be expressed in decibels as:—

$$\begin{aligned} & -10 \log 1.333 \\ &= -10 \times 0.1248 \\ &= -1.25 \text{ dB.} \end{aligned}$$

It will be noted that, as this is a loss, the value in dB is represented as a negative quantity.[2]

Voltage and Current Ratios

In practice, it is not always convenient to use power ratios to give us values in dB, and it therefore often proves useful if we are able to obtain such values from voltage or current ratios.

Before we can obtain a figure from such sources, however, it is essential to ensure that the two voltages or currents being observed are connected to the same value of impedance.

Thus, if we had an amplifier which had an input impedance of, say, 100 kΩ, we could not use the voltage given at its output to obtain a value in dB if the output impedance was only 5 kΩ.

Nevertheless, this does not stop us from *calculating* the output voltage which would theoretically be obtained if the output impedance were made equal to 100 kΩ, and using the figure obtained to give us the gain in dB. Carrying on with the values just mentioned, and assuming an output voltage of 8 into the 5 kΩ load, we could safely say that the voltage would be $8 \times \frac{100}{5}$ (= 160 volts) when the output impedance was 100 kΩ. This figure could then be used to evaluate the gain in decibels.

A second point which must be considered lies in the fact that a voltage or current ratio does not incur a similar power ratio. The voltage or current ratio would, in fact, be equal to the square root of the power ratio obtained.

2. *It is interesting to see what happens when we have a "gain of unity" (i.e. output power equals input power). As the logarithm of* 1 *is zero, the "gain", expressed in dB, is also equal to zero.*

FIG. 1

Fig. 1: A simple circuit, used in the text to show the relationship between voltage or current ratios and power ratios.

This point may easily be illustrated if we refer to Fig. 1. Here we have a voltage E1 connected across an impedance of R ohms. The current flowing through the circuit is I1 amps. The power dissipated in the circuit will then be equal to $\frac{E1^2}{R}$ or $I1^2$ R watts.

Let us assume that we alter the applied voltage to E2, thus causing a current of I2 amps to flow through R. The new power will now be $\frac{E2^2}{R}$ or $I2^2$ R watts.

The ratio in power for the change of voltage (or current) is then:—

$$\frac{\frac{E1^2}{R}}{\frac{E2^2}{R}} = \frac{E1^2}{E2^2} = \left(\frac{E1}{E2}\right)^2$$

or

$$\frac{I1^2R}{I2^2R} = \frac{I1^2}{I2^2} = \left(\frac{I1}{I2}\right)^2$$

It may therefore be seen that it is necessary to square a voltage or current ratio in order to convert it to a power ratio.

The next thing to do is to find how we may obtain decibel values from the voltage or current ratios. We already know, by definition, that

$$dB = 10 \log \frac{P1}{P2}$$

and we have just seen that voltages or current ratios have to be squared in order to obtain the requisite power ratio. We may therefore now state that

$$dB = 10 \log \left(\frac{E1}{E2}\right)^2 \text{ or } 10 \log \left(\frac{I1}{I2}\right)^2$$

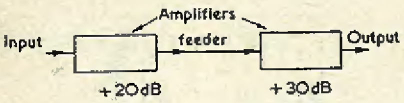

FIG 2(a)

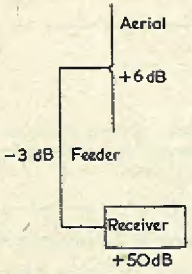

FIG 2(b)

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Fig. 2: Two systems which illustrate the simplicity of calculating overall gain with the aid of dB.

As the square of any number may be found by multiplying its logarithm by 2 we can go a stage further and say:—

$$dB = 10\ 2 \log \frac{E1}{E2}$$

$$= 20 \log \frac{E1}{E2} \text{ (or } 20 \log \frac{I1}{I2}\text{)}$$

This last is the formula used generally for obtaining decibel values from voltage or current ratios.

Other uses of the Decibel

Owing to the fact that the decibel is logarithmic, it proves extremely useful in ascertaining the behaviour of several items of equipment when used together. For instance, if, as is shown in Fig. 2 (a), an amplifier whose gain is equal to 20 dB is connected to another of gain 30 dB, the total gain may be found simply by adding the two values together. Thus, in this case, the overall gain would be 50 dB.

If, however, the amplifiers were some distance apart and were connected together by a feeder which introduced a loss of —5 dB, then the total gain would be 20 + 30 — 5, or 45 dB.

An alternative example is shown in Fig. 2 (b). Here we have a receiving installation in which the aerial gives a gain of 6 dB, the feeder causes a loss of —3 dB, whilst the receiver has a gain in the pre-detector stages of 50 dB. Assuming that matching is correct, the total gain of the system would be 6 — 3 + 50, i.e. 53 dB.

IN YOUR WORKSHOP

This month J.R.D. discusses ways and means of stripping down manufactured or "surplus" equipment, giving also some novel hints on salvaging small components.

ALTHOUGH the pursuit of philosophy necessitates at times a certain amount of belligerence in the presentation of one's views or findings, and the business of professional philosophy (as carried out by certain gentlemen who contribute to the Sunday papers and to women's magazines) is often enhanced by the airing of opinions diametrically opposed to those of other writing gentlemen, it is very interesting to note that almost all these people agree on the fact that young people look forward to the future and that the old dwell mainly on the past.

Your writer, (who is still technically fairly young but who has worn a little in places), often finds himself in the second category. As he has spent so much of his time professionally and, as a hobby, working with radio, his thoughts naturally dwell mainly around that subject. There have, of course, been many changes in the past in the general approach towards wireless as a hobby, but none have been so extensive and so sudden as was occasioned by the release, after the war, of the large stocks of equipment built originally for the Armed Services. Indeed, in the last four years, so much gear has been offered for sale, and so cheaply, that it could be said that the use of surplus equipment by the home-constructor has evolved its own entirely new technique.

Surplus Equipment in the Workshop

What does surplus equipment offer us?

Classified broadly, it may be stated that this gear offers us two things. First of all it gives us complete items, such as receivers, amplifiers, indicators and so on, which usually require only a small amount of modification before they can be converted for our own use. Such examples as the No. 18 Receiver and the R1155 fall very readily into this category. Secondly, there are those units which may be bought simply for their "component value". Of little use as complete items, they are nevertheless full of small parts whose value is often much greater than the price at which the equipment is offered.

It is this second class of equipment which the writer would like to discuss here. Most advertisers offer such gear expressly for stripping down and, with a little care, the constructor can pick up some very good bargains indeed.

The writer has found that the best value for money in this line is obtained from those chassis which contain the greatest number of *small* components. Although some chassis offered for sale may be fitted with a large amount of valves, this does not necessarily mean that they also contain a great number of resistors or capacitors and those other small items which are always useful in *any* circuit. One sometimes finds also that the valves, whilst being perfectly serviceable, are specialised types which do not readily lend themselves to the average circuit envisaged by the constructor.

On the other hand the small things, resistors, capacitors, valveholders, tagboards, trimmers grommets, etc., etc., are all items which can be employed for practically any job and, providing one has the little amount of patience needed to remove them from their chassis, can form a very useful addition indeed to the spares already held in the workshop.[1]

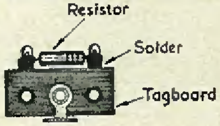
Stripping Down

One of the first things that strikes the would-be-stripper-down is the care with which most Service chassis are made and the precautions which have been taken to prevent anything working loose. For instance, it will very often be found that nuts and bolts, apart from being fitted with shake-proof washers and other devices, are also liberally daubed with shellac varnish. The use of shellac varnish does not seem to apply to some of the American chassis, these employing instead a purple-coloured sealing compound which can usually be easily displaced by a sharp twist on the appropriate nut or bolt.

Shellac varnish, however, is a different and more difficult problem. Where it has only been lightly applied to the top of a nut or bolt a little strength and the use, where applicable, of a box spanner will usually suffice for their removal. If the shellac has worked into the threads it is very possible that the bolt will break before the shellac gives way. The best course then consists of heating the nut and bolt with a soldering iron before commencing to unscrew. Should the application of heat prove ineffective it may next be necessary to apply a little solvent such as methylated spirits (shellac dissolves in meths to give French polish) but this process takes some time. The only other alternative consists of breaking the bolt or of drilling it out.

Another problem which confronts one on stripping down these chassis is the difficulty of removing wire-ended resistors and capacitors from solder tags where the wire-ends have been wrapped several times around the tags before soldering. As these wires have probably also been pushed through a hole in the centre of the tag before the wrapping process the job of removing the component is, at first sight, even more difficult. Nevertheless, it can be done quite quickly and simply.

FIG. 1.



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Wire-ended resistors and capacitors are often mounted in the fashion shown here, making their removal very difficult. This process is discussed in the text.

The way *not* to remove such a component is to apply the soldering iron to the tag and attempt to lever off the wires with the bit. This will only result in too much heat being applied to the component and the possible breaking of the tag. Sometimes the wires can be removed with a small screwdriver whilst the iron is held to the tag but there are still better methods than this.

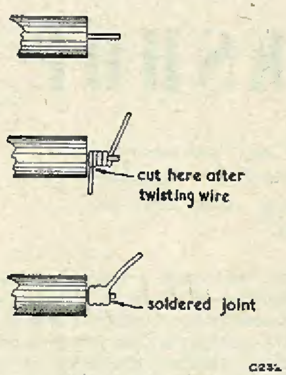
Fig. 1 shows a resistor mounted on a tagboard in a manner often met in surplus equipment. It may be seen that the ends of the resistor body are tight up against the tags, leaving hardly any wire at all free of the solder

1. The writer would like to point out that many of the hints concerning surplus equipment which are given in the following paragraphs will, of course, apply also to the removal of parts from civilian radio equipment and, to a smaller extent, to ordinary workshop and servicing practice as well.

FIG 2(a)

FIG 2(b)

FIG 2(c)



Successive steps in carrying out a fairly reliable repair on a component with a short wire-end.

on the tag. We obviously cannot cut the wire-ends or break them as we would then be left with a Manx resistor. The solution consists of holding a clean hot soldering iron against one of the tags just sufficiently long to melt the solder. If the tagboard is immediately shaken or tapped against the bench nearly all the surplus solder will fall off. It may be necessary to repeat this process once or twice to completely remove all the solder, and a touch of flux on the tag beforehand will usually hasten the operation. If the end of the resistor wire is now caught between the jaws of a pair of pliers it will be found possible, with a rotary movement of the pliers, to *tear* it away from the tag. This method may cause the wire-ends to be slightly kinked and, perhaps, to leave a little of their tin plate on the tag; but the resistor itself is undamaged and is available for immediate use elsewhere.

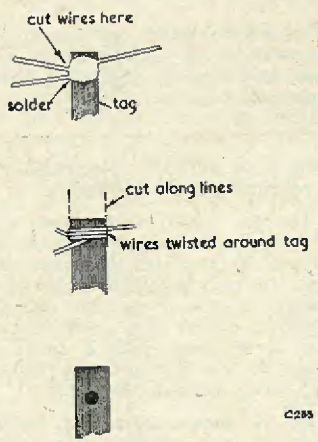
Fortunately, all resistors and capacitors are not so awkwardly mounted as this and it will often be found that quite a useful length of wire-end protrudes from the component before it is anchored to its tag. It is sometimes recommended that the wire between the component and its tag be held by a pair of taper-nosed pliers when the iron is applied; the idea being that the pliers will conduct away the heat from the component and prevent any subsequent damage. As, however, one usually needs a third hand to hold the pliers a better scheme consists of making a clip which will fit onto the wire and stay there by itself. A piece of springy brass strip about five inches long can be bent to form such a clip in a few moments. The writer does not believe, by the way, in *religiously* unsoldering wire-ends from tags (particularly if the tags are awkwardly placed) when a reasonable amount of wire would be left on the component after the use of a pair of nippers. It is hardly worth while going to a lot of trouble to save an extra half inch on a wire-end which would otherwise still be over an inch long.

Mistakes, incidentally, happen in the best-regulated workshops, and one occasionally finds oneself with a sorry-looking component sporting only a stump of wire; such as that shown in Fig. 2 (a). If it is desired to use such a component an extra length of wire can often be soldered to it without incurring any damage. To do this the "stump" should first of all be scraped clean with a razor-blade or pen-knife, and a piece of *thin* tinned copper wire (about 26 swg) wrapped several times around it, as illustrated by Fig. 2 (b). Then, after the application of a little flux, the joint is very quickly soldered, giving the effect of Fig. 2 (c). It is necessary to use thin wire for this repair in order to allow the solder joint to be made quickly and thus reduce possible damage by heat, and also to enable the additional wire to have a good mechanical twisted joint with that protruding from the component. Added to this is the fact that a thin wire will not cause the existing wire to fracture under any subsequent physical strain. It must be pointed out that, although fairly reliable repairs may be made quite often in this manner with resistors and moulded capacitors, such components as paper capacitors, whether wax-covered or not, are very likely to be damaged by the propinquity of the soldering iron.

FIG. 3(a)

FIG 3(b)

FIG 3(c)



Illustrating a method, explained in the text, of removing solder and wires from a previously-used tag.

Cleaning Valveholder Tags, etc.

When one has stripped down a "surplus" chassis to its essentials, one usually finds that one is left with a number of valveholders, tagboards and other odds and ends, all of which are very useful, but which cannot be employed immediately owing to the wires which are wrapped around and soldered to their tags. These tags may be quickly cleaned free of the wires providing one sets about it in the right way.

The first step consists of cutting the wires on each tag back to the solder. Fig. 3 (a) shows the idea. The tag is then heated with the iron and the solder shaken off in the same manner as we used above for removing awkwardly mounted components. The tag will then appear like that illustrated in Fig. 3 (b).

Next, with a pair of side or diagonal cutters (not snips or shears) the wires adhering to the tag are cut along its edge, the position of the cut being shown by the dotted lines in Fig. 3 (b). It will now be found that, if the soldering iron is applied to the tag once more, the pieces of wire will simply fall away or may be easily pushed off, leaving the tag clean, as in Fig. 3 (c). Alternatively, the tag may be "flicked" off the end of the bit, whereupon the springiness of the tag will itself throw the wires away from it. When a valveholder or similar component with several tags is being cleaned in this manner each of the operations just mentioned should be carried out on *all* the tags before proceeding onto the next step: this procedure will save more time than if the tags are tackled individually.

An . . . AUDIO OSCILLATOR

. . . . *for Modulation Checking*

by "Wacco"

Used in conjunction with an oscilloscope, this audio oscillator will save much time and energy in the checking of modulation depth. One usually whistles or talks into the microphone while watching the oscilloscope pattern, and the consequent variation of amplitude makes it difficult to assess the actual modulation peak value.

By connecting this oscillator to the microphone input of the modulator, a constant input at approximately 1 kcs is obtainable, and it will also be found useful for MCW operation. The circuit, as can be seen in Fig. 1, operates on the Transitron principle. There is nothing complicated about it and all the components involved are usually to be found in the junk box.

The HT supply for the unit may be taken

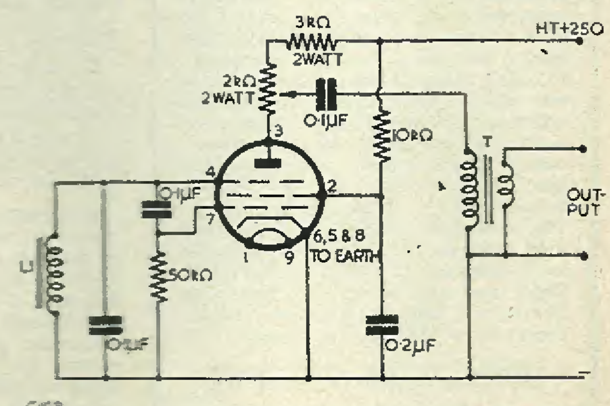


Fig. 1: Circuit of 1 kcs oscillator. Valve EF50. T, Standard output transformer (20—30/1). All resistors 1W. except where otherwise stated.

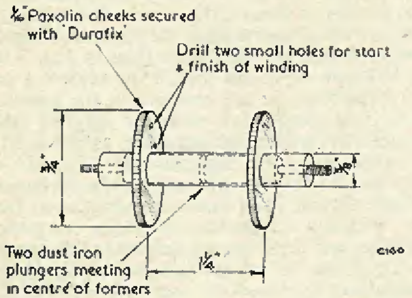


FIG 3 FORMER DETAILS L.1.

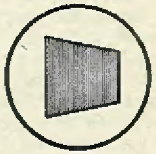


FIG 2
REDUCE MODULATOR INPUT UNTILL A PATTE[RN] SIMILAR TO ABOVE APPEARS ON SCOPE WITH NORMAL SPEAKING VOICE. DISCONNECT MICROPHONE & CONNECT OSCILLATOR. ADJ[UST] OSCILLATOR OUTPUT UNTILL SIMILAR PATTE[RN] APPEARS

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from the normal receiver supply, or from a dry battery. Current consumption is between 4 and 5 milliamps. The oscillator will deliver up to 0.1 of a volt, which is comparable with the best of the moving coil microphones. Care should be taken to ensure that the output control is well insulated from the case.

A simple method of setting the output voltage is to first of all connect the microphone, and speak at normal operating level while watching the oscilloscope. Then disconnect microphone and connect the oscillator output to the microphone sockets. Adjust ou control, until a similar pattern appears tube. This check is best done with the mo lator gain control set at a low level, so the trapezoid appears as in Fig. 2. Ha obtained the correct level from the oscilla the output control should be left set in position, and all adjustments to modula level carried out using the modulation control only.

Construction

The coil L1 is the only item requi special mention. This is wound with appr mately 2,500 turns of No. 42 Enamelled w in ten layers of about 250 turns each. De are given in Fig. 3. The cheeks should firmly fixed with Durofix before windin commenced.

When completed, two standard 1" dust-iron plungers should be given a coa Durofix and inserted into the former, from each end. The completed coil ma fitted into a standard IF screening box. will protect the winding and make for a t job, the presence of a screen making on microscopic difference to the inductance.

A switch should be incorporated in the lead to the unit in order that it may be swit off when not required.

Experiments with the value of the capa across L1 will produce different frequen if required; in fact, a six-position sw could be incorporated, switching in diffe values of C to produce six frequencies in audio range. As an example, the capacit value for an audio frequency of app mately 500 cycles would be about 0.95 while for 5,000 cycles, the value will be app mately 0.01 μF.

OM OUR . . .

Mailbag

pensive Television

ear Sir,—I am writing to thank you for r Inexpensive Television Booklet. I ose a photograph taken of the VCR97 en showing the tuning card, and I should to point out that we are about 100 miles n Sutton Coldfield, there being a hill of ft. only a mile the station side of us, and my aerial is in the attic. The picture is the quality shown 6 days a week, and etimes more.

or the benefit of those who intend to make televisor, I will mention briefly the diffi- ies I encountered. Firstly, the RF Unit. ould advise getting an RF25 for either ion. For Sutton Coldfield, the oscillator should be 2½ turns, tapped at ¾ turn from earthy end, and tuned with a 10 pF trimmer arallel with a 15 pF fixed capacitor. Also, und it better to tap the aerial feeder across end 1½ turns or so of the first coil, instead the loop provided. I have added a pre- plifier of two 6SH7's.

he other major difficulty was in the HT ply to the timebases. G2ATV recommends g a 350—0—350V transformer, which is fectly satisfactory as the load is small and output voltage is nearer 450V. But certain s sell 350—0—350V 160 mA transformers un the R1355 as well. This does not work ; the line non-linearity shown in the tograph is due to this. If it is intended to this, the transformer should be rated at t at 450—0—450V.

ther smaller points include the insertion frequency corrector coil in the anode load he VF stage, the modification of the sync rator, and the use of inverted EHT. he timebases, contrary to expectation, ed hardly any trouble, and in fact the set is to be recommended to all who want to do a little more than make a kit set. I found it very simple to understand, although I am only sixteen. Thanking you again, Yours faithfully, J. S. Reynolds (Devises, Wilts). (The photograph was unfortunately not quite good enough for reproduction, but indicates clearly that excellent results are obtained by our correspondent.—Ed.)

Can Anyone Help?

Dear Sir,—Could any of your readers give me any information regarding a piece of apparatus which I think is an oscillator unit of some kind. The reference number is 10S 7188. It comprises two valves (one a VT20 and one a VR22 which is equivalent to a Cossor 220.P and 220.PA 4-pin battery operated output triodes), and a tuning capacitor to tune (as shown on graduated dial) from 45 to 120 metres. The other components are:—a transformer (IP, OP, IS, OS) and an IC and OC winding on the same transformer, a tuning coil (10 turns on a 4-in. former) phone jack, a TR to CW switch and a coupling coil (1 turn) which leads to 2 knife contacts on the front panel. I would be extremely glad if I could find out what this set is used for, and how used. Yours faithfully, W. J. Temple (Altrincham, Ches.)

EHT for 7/6

Dear Editor,—I should like to take this opportunity to thank H. W. Arundel for his interesting article "EHT for 7/6".

I find that Kershaw's figures are correct for the VCR97 only. I find that the 5CP1 tube requires more current on the EHT supply. The figures given by H. W. Arundel provide the correct voltage for this tube, and the input voltage is still 36V. I find that these transformers will take an input current of 1A quite safely. As a matter of fact, I have used up to 25 μF on one of these transformers, and found that they will stand a much greater load than is required. Yours faithfully, W. T. Martin (Birmingham 6).

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PRIVATE

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EXPERIMENTERS surplus valves, components. Cheap. Several untouched Radar boxes. Testing equipment. Pathescope 9.5mm films. S.A.E. for list.—Tidswell, Fernlea, Barnoldswick.

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HALLICRAFTERS SX23, crystal gate, NL, BFO, S—meter, 540kc-34mc, separate bandspread on ham bands, perfect condition, £25. 0. 0., with S23 speaker £27. 10. 0. Pye communication receiver fitted speaker, 230v £8. 10. 0. Taylor signal generators 65B, little used, £9. 10. 0. Triplett multi-range radio test meter, as new, £10. 10. 0. Ediswan and Phillips intercom systems, both excellent, £9. 0. 0. and £7. 0. 0. Valves five KT66, two KT8, new, £1. Carriage extra please.—Flat 4, 64 Palace Road, East Molesey, Surrey. Telephone: Molesey 3267.

TRADE

"GLOBE-KING" Short Wave Kits and Components. Production fully booked up until new series commence Autumn, 1951. Watch this magazine for later announcements.—Johnsons (Radio) Macclesfield.

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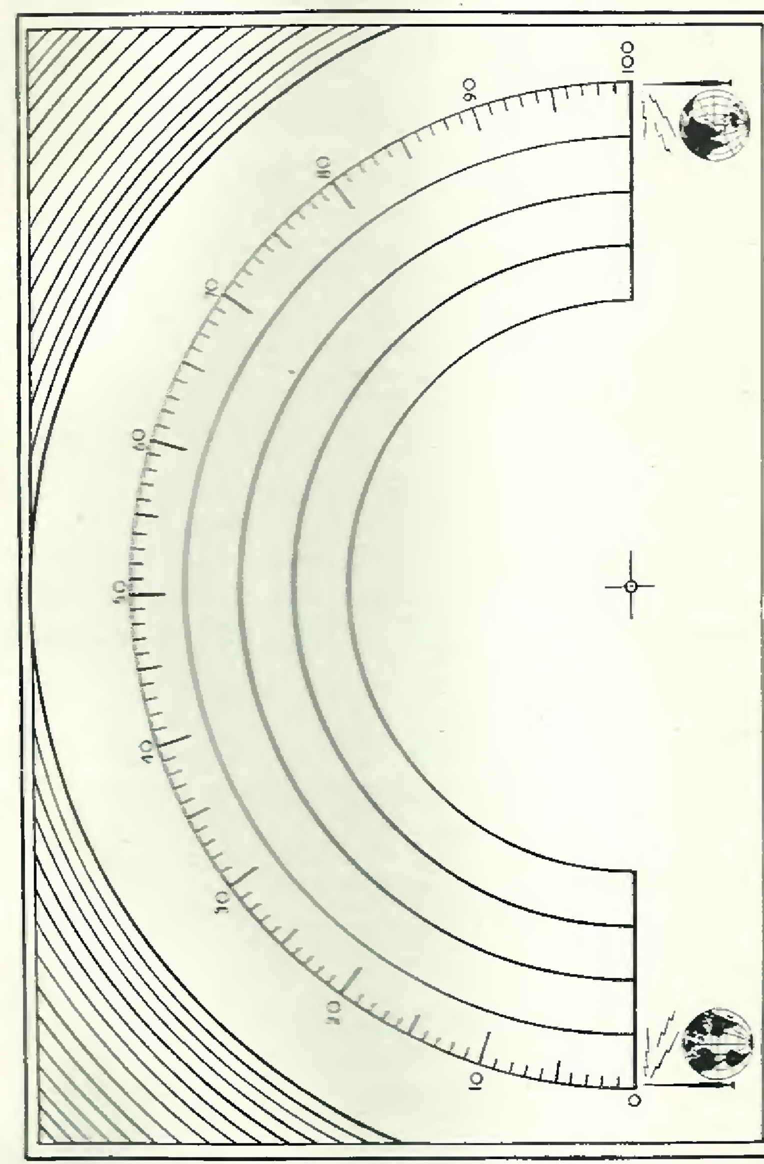
6d. PER WORD
Minimum 6/-



C215

Panel Sheet No. 8

Large Dial
Protect with Sellotape or Clear Nail Varnish