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NEW VOLUME

WITH this issue we begin our twentieth volume. It's a far cry to the summer of 1925 when a group of keen members of the old Transmitter and Relay Section launched the first issue of THE BULLETIN. Few present readers will be able to recollect the state of the radio art in those days, fewer still will believe that even in 1925 members of this Society were conducting organised tests on 5 Metres. Yet perusal of the second issue (August, 1925) shows that this was indeed the case. The newer generation of experimenters possibly imagines that V.H.F. technique is a development dating back to only a few years prior to the present war.

Early issues of the T. & R. BULLETIN also provide evidence, if such is needed, of the part played by members in developing the technique of piezo electric control of R.F. oscillations. Experiments in frequency stability and with frequency measuring equipment played an important rôle in the pre-war activities of the Society, but it is gratifying to read that as far back as 1925 and 1926 members were directing their attention to these problems. Who remembers Kenyon Secretan (" Sec. Seldom Sleeps ") and his advertising campaign in the winter of 1925 ? Twenty years ago " Sec." was writing " no transmitter to-day can be considered entirely efficient or to conform to modern practices unless crystal controlled." In the same volume appeared a description by the late Mr. E. D. Simmonds, G2OD, of his first crystal-controlled transmitter. Ever since those distant days this Journal has endeavoured to live up to the aspirations of its first Editor who wrote in Volume 1, Number 1, " Mutual exchange of ideas has always proved the greatest incentive in research among men working along similar lines." The mutual exchange of ideas has, throughout the past 20 years, been practiced by men and women members of all ages. Newer adherents to our cause may raise an eyebrow at the mention of the gentle sex but reference to pre-war and even early war-time issues will show that two of our lady members were among the leaders in the more recent development of the 28 and 56 Mc/s. bands for amateur communication purposes.

Turning to the present time, we find that the volume which has just closed contained many contributions of high technical merit. Mr. Shankland's articles on centimetre waves are still in great demand from members who have joined the Society since they first appeared. Alas their requests must, for the time being, remain unanswered, because few recent back issues are now available. " The Synthescope " described by Mr. R. H. Hammans earned warm praise for its designer, from a multitude of members, as did the classic contribution by Mr. W. A. Scarrentitled " Radio and its Relationship to Kindred Sciences." Strangely enough—yet perhaps it is not so strange after all—the greatest volume of appreciation for that " high light " of Volume XIX has come from members serving abroad. The knowledge that so many of our younger members are thinking deeply about the more abstract aspects of the radio art is something we " old timers " must not forget in the days to come. The inquiring mind needs encouragement. Let us see to it that our own Journal neither falters nor fails in providing them with much food for thought.

Which reminds us that our highly esteemed Honorary Secretary has the honour of being the ace contributor to this, the first issue of a new volume. Those who were fortunate enough to be present at the Institution of Electrical Engineers when Mr. H. A. M. Clark delivered his lecture on the subject of Negative Feedback, need no reminding of the excellence of the fare he provided for their enjoyment that afternoon. Unfortunately his demonstrations cannot be described in a written paper but we assure the 7,000 odd members who missed them, that every one worked—and worked well !

Possibly the progress made by the Society during the past three years can be attributed in no small measure to the quality of the technical material published in this Journal. A commercial publication might be accused of self-praise if it made such a statement but THE BULLETIN is different, for its contributors are unpaid and all are members. This willingness on the part of those who know, to pass on their knowledge to others, has been the subject of much favourable comment from high places. An outstanding example occurs in the Society's Handbook and Supplement—publications which have proved of considerable value to members and non-members alike during the last few years.

When the war clouds pass and the last " doodle bug " has been exterminated, we shall aspire as a Society to build up an even bigger and better BULLETIN than has been offered in the past.

The new Volume now commencing will, we believe, provide evidence of the desire of the Council to pursue its policy of maintaining a high technical level.

London Meetings at the I.E.E.

Only *eight* members out of the many hundreds who live in the London area, responded to the invitation contained in our last issue to state a preference for Friday evening or Saturday afternoon meetings. Are we to assume that these eight members are the only ones interested in future meetings at the I.E.E. ?

J. C.

NEGATIVE FEEDBACK IN TRANSMITTERS AND RECEIVERS *

By H. A. M. Clark, B.Sc.(Eng.), A.M.I.E.E.

PART I — THEORY

Introduction

THE basic principles of feedback circuits have been discussed in numerous contributions to the technical press. Before proceeding to the applications of negative feedback, which form the main subject of this paper, it may be helpful to recapitulate the relevant theory.

The introduction into the input circuit of an amplifier of signals derived from its output has been practised in one form or another for a very long while, but a complete understanding of the effects thus obtained was probably shown for the first time in a classical paper by H. Nyquist in the *Bell System Technical Journal* dated July, 1932. (1) Since then several authors (see Bibliography) have treated the general theory according to their own requirements.

The treatment which follows is far from complete, but will suffice to explain the main reasons for the various effects which are to be observed in feedback circuits.

Fundamental Relationships in Feedback Amplifiers

Fig. 1 is a block diagram of an amplifying system with a feedback circuit. The details of the amplifier circuit and the exact manner in which the feedback is

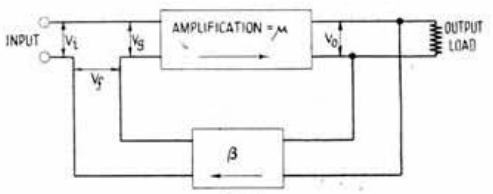


Fig. 1.

Block diagram of an amplifier with effective amplification μ and a feedback ratio of β.

applied need not be considered at this point. The upper block represents an amplifier with a voltage magnification between its input and output terminals equal to μ. The input impedance is considered to be infinite and there is a resistance load on the output. If the voltage applied to the amplifier itself is equal to V_g and the output voltage across the load equals V_o then,

$$\frac{V_o}{V_g} = \mu \qquad \ldots\ldots \quad (1)$$

Also connected to the output is a circuit represented by the lower block. This is the feedback circuit and again details are omitted. It has, however, a voltage ratio between its input and output circuit equal to β where,

$$\frac{V_f}{V_o} = \beta \qquad \ldots\ldots \quad (2)$$

and V_f is the feedback voltage

The output of the feedback circuit is connected in series with the input to the amplifier proper to the main input terminals of the complete system, to which a voltage equal to V_i is assumed to be applied. Hence V_g must equal the sum of V_f and V_i.

$$\text{i.e.} \quad V_g = V_f + V_i$$

$$\text{or} \quad V_i = V_g - V_f$$

$$\text{but} \quad V_g = \frac{V_o}{\mu} \text{ from equation } (1)$$

$$\text{and} \quad V_f = \beta\, V_o \text{ from equation } (2)$$

$$\therefore \quad V_i = \frac{V_o}{\mu} - \beta\, V_o$$

$$= V_o \left(\frac{1}{\mu} - \beta\right) = V_o \frac{(1 - \mu\beta)}{\mu}$$

$$\therefore \quad \frac{V_o}{V_i} = \frac{\mu}{1 - \mu\beta} \qquad \ldots\ldots \quad (3)$$

This equation gives the overall amplification of the complete system, including the feedback, and its meaning will next be studied for various values assigned to β.

Positive and Negative Feedback

In the preceding remarks no assumptions have been made with regard to the phase of the feedback voltage V_f with respect to the input voltage V_i.

In the first place let it be assumed that there is no phase-shift through the amplifier and feedback circuit. This means that the input to the amplifier will be increased above the real input V_i by the feedback voltage V_f. This state of affairs arises when β is positive in equation (3). If $\mu\beta$ has a positive value less than 1 it will be seen that the value of V_o/V_i is increased, indicating an increase of amplification due to the feedback. Such feedback is said to be *positive*.

Now intentional use of positive feedback is almost as old as the valve amplifier itself. Its uses are manifold but they form no part of the present discussion, and so, with the exception of a later reference to the possibility of positive feedback entering in a circuit unintentionally, this type of feedback will not be considered further.

Suppose that instead of there being no phase shift in the system there is now a phase shift of 180° between the amplifier input voltage and feedback voltage V_f. It is immaterial whether this occurs in the amplifier itself or in the feedback circuit. It can indeed be obtained by simply interchanging the leads introducing the feedback voltage into the input circuit. The effect of a 180° phase is, of course, merely to reverse the polarity of the feedback voltage. Its implications can be seen from equation (3) by letting β have a negative value. In such a case the numerical value of the overall amplication is given by,

$$\frac{V_o}{V_i} = \frac{\mu}{1 + \mu\beta} \qquad \ldots\ldots \quad (4)$$

Such a condition is referred to as one utilising *negative* feedback since any positive input to the system is applied to the amplifier input in series with a negative voltage and *vice versa*. It is clear that since the effective input has thus been reduced, the output, and hence the gain of the system, will have been reduced. Reference to the last equation shows that as β is made larger, the value of $\frac{V_o}{V_i}$ is reduced, *i.e.*

* *A paper read to the membership at a meeting of the Society held on April 29th, 1944, at the Institution of Electrical Engineers, London.*

the more negative feedback is applied the less will become the gain of the system.

An interesting case occurs when the product $\mu\beta$ becomes very great compared with 1. In such a case the equation for the effective amplification becomes approximately :—

$$\frac{V_o}{V_i} = \frac{\mu}{\mu\beta} = \frac{1}{\beta} \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

The meaning of this equation is that when negative feedback is very large, the characteristics of the system are determined by the feedback path alone. It should be noted that the feedback may be made large by making μ or β large, or both. It must be pointed out that the feedback path may itself include amplification, *i.e.* β may be much greater than 1.

Advantage of Negative Feedback

So far the only effect of negative feedback to be shown is the reduction of gain of an amplifying system. Apart from the possibility of use as a means of volume control the device might appear to be of little value.

Effects of Negative Feedback on Variations of Amplifier Gain

Let us examine equation (*4*) again, however. For the moment μ can be assumed to be determined by the characteristics of the valves and components in the amplifier itself, whilst β is determined by the network of components from which the feedback voltage is obtained.

The composition of this network will be considered in detail in a later part of this paper. Now the gain of an amplifier may vary from a number of causes. For example the supply voltage may vary, or possibly valves are replaced by others with somewhat different characteristics. Alternatively the input voltage may consist of a number of frequencies, some of which are not amplified to the same extent as others, *i.e.* frequency distortion is present. Suppose an amplifier has a voltage amplification of 100, and for any of the foregoing reasons the gain becomes increased by 10% to 110. Now suppose that one-tenth of the output voltage had been fed back to the input circuit so as to oppose the applied voltage, *i.e.* negative feedback is applied with a value of $\beta = 0{\cdot}1$. The effect can be ascertained from equation (*4*) by inserting the value of β and μ which is equal to 100.

$$\frac{V_o}{V_i} = \frac{\mu}{1 + \mu\beta} =$$

$$\frac{100}{1 + 100 \times 0{\cdot}1} = \frac{100}{1 + 10} = \frac{100}{11} = 9{\cdot}091.$$

The first observed result is that the gain is reduced by one-eleventh from 100 to 9·09.

Now let the gain of the amplifier become changed to 110.

Then

$$\frac{V_o}{V_i} = \frac{110}{1 + 110 \times 0{\cdot}1} = \frac{110}{1 + 11} = \frac{110}{12} = 9{\cdot}167.$$

The increase in amplification is $9{\cdot}167 - 9{\cdot}091 = {\cdot}076$ or an increase of 0·83% only. Thus although the total gain of the amplifier has been reduced the gain has been made much more constant. In fact the constancy has been improved by the same factor as the gain has been reduced, *i.e.* $(1 + \mu\beta)$.

By means of suitable circuits, negative feedback can therefore be used to reduce the effects of frequency distortion, or to reduce the variations in gain due to supply voltage variations, change of valve characteristics, etc.

Effects of Negative Feedback on Amplitude Distortion

Not only can the effects of frequency distortion be reduced by the use of negative feedback but the introduction of harmonics and intermodulation products can be reduced to a considerable extent. Suppose that the amplifier depicted in Fig. 1 to have in its output some distortion represented by a voltage d of some frequency which was not present in the input waveform.

Whereas for a non-distorting amplifier, equation (*1*) gives,

$$V_o = \mu\, V_g$$

the output from the distorted amplifier will be,

$$V_o = \mu\, V_g + d. \quad . \quad . \quad . \quad . \quad (6)$$

If the feedback ratio is still β then

$$V_f = V_o\beta = \mu\beta V_g + \beta d$$

$$\therefore\ V_i = V_g - V_f = V_g - \mu\beta V_g - \beta d$$

$$= V_g\,(1 - \mu\beta) - \beta d$$

$$\therefore\ V_g = \frac{V_i + \beta d}{1 - \mu\beta}$$

But $V_o = \mu V_g + d$ from equation (*6*)

$$\therefore\ V_o = \frac{\mu V_i + \mu\beta d}{1 - \mu\beta} + d$$

$$= \frac{\mu V_i}{1 - \mu\beta} + \frac{d}{1 - \mu\beta} \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

From equation (7) it is seen that the amplification of V_i has been changed from μ to $\frac{\mu}{1 - \mu\beta}$ as in the simple case with no distortion and further that the distortion voltage in the output has also been changed from d to $\frac{d}{1 - \mu\beta}$ *i.e.* in the same ratio.

In the presence of negative feedback the distortion and the gain will therefore be reduced in the same ratio. Voltages of a type not present in the input, such as hum from H.T. supplies, etc., will be reduced in the same way as those due to harmonics and intermodulation products caused by the non-linearity of valve characteristics.

It should be noticed that throughout the preceding analysis the voltage amplification has been assumed to be constant, and equal to μ. If the amplifier is distorting very heavily, due to anode current cut-off, or to grid current, the value of μ is no longer constant. Under these circumstances the formulæ no longer hold and the expected reduction in distortion may not be obtained. Negative feedback has its limitations, one of which is that it cannot correct for large distortions due to discontinuous flow of current in the circuits.

The reduction of distortion and improvement in stability of gain, which can be achieved by the use of negative feedback, is frequently well worth the price paid in the form of the loss in amplification. Particularly is this so in many circuits when the gain can be made up in early stages of the amplifying system where the power levels are low. It may indeed be said that the circuit designer has utilised the increase in gain which the valve designer has given him in recent years, to reduce the frequency and amplitude distortion which would have otherwise remained. Negative feedback has been his answer to the problem.

Derivation of the Feedback Voltage

In Fig. 1 the output circuit was shown connected through an unspecified circuit to the input circuit where a feedback voltage of V_f was injected in series with the main input voltage V_i.

Three methods of developing the feedback voltage are shown in Fig. 2.

Voltage Feedback

In Fig. 2 (a) two resistances r_1 and r_2 are connected to series across the load resistance R. These two resistances are made large compared with R and may be considered as a potential divider used to tap a fraction of the voltage V_o across R to obtain the feedback voltage V_f. Thus,

$$V_f = V_o \frac{r_1}{r_1 + r_2}$$

$$i.e.\ \beta = \frac{r_1}{r_1 + r_2} \quad . \ . \ . \ . \ . \ . \ (8)$$

V_f therefore is proportional to the voltage across R rather than the current through it. For this reason such a circuit may be referred to as a *voltage feedback circuit*. The general equations derived from Fig. 1 apply directly to such an arrangement.

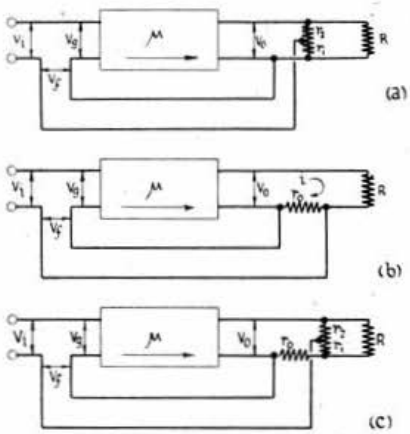


Fig. 2.

Block diagram illustrating: (a) Voltage feedback; (b) Current feedback; (c) Combined Voltage and Current feedback.

Current Feedback

Fig. 2 (*b*) shows a somewhat different type of circuit. Here a resistance r_o, which may be considered as small compared with R, is connected in series with the load. If the load current is i then the feedback voltage is given by

$$V_f = i \,.\, r_o$$

i.e. the feedback voltage is proportional to the current passing through the load. Such a circuit is referred to as a *current feedback* circuit.

In order to apply the general equations, β may be calculated by noting that

$$V_o = i\,(R + r_o)$$

$$\text{But } V_f = i \,.\, r_o$$

$$\therefore \beta = \frac{V_f}{V_o} = \frac{r_o}{R + r_o} = \frac{r_o}{R} \text{ approximately} \quad . \ . \ (9)$$

$$\text{if } r_o << R$$

Thus the feedback voltage can be made to depend chiefly either upon the output voltage or the output current, and circuits based on either principle are used according to which of these quantities is of most interest in any particular application.

Combined Current and Voltage Feedback

There are occasions when it is desirable that the feedback voltage should be dependent upon both the output voltage and output current, in which case the arrangement shown in Fig. 2 (c) may be used.

$$\text{Here } V = i \,.\, r_o + V_o \,.\, \frac{r_1}{r_1 + r_2}$$

If it is assumed that

$$r_c << R$$

$$\text{and } r_1 + r_2 >> R$$

$$V_f = V_o \,.\, \frac{r_o}{R} + V_o \,.\, \frac{r_1}{r_1 + r}$$

$$\therefore \beta = \frac{V_f}{V_o} = \frac{r_o}{R} + \frac{r_1}{r_1 + r_2} \quad . \ . \ . \ . \ . \ (10)$$

This form of feedback is sometimes referred to as *bridge feedback*.

Series and Parallel Feedback Circuits

There is a further general way in which the feedback circuit may be varied. In all the arrangements discussed so far the feedback voltage has been connected *in series* with the input voltage. It is quite possible to connect the input source of voltage directly across the amplifier input terminals and to connect the feedback leads also to the amplifier input, *i.e.* in parallel with the input.

In such circuits it is frequently more easy to calculate the current which the feedback circuit puts into the input circuit, although the same results can be obtained as for series feedback circuits, *i.e.* a reduction in distortion and gain variation at the expense of a reduction in gain.

The choice of a particular feedback arrangement will be determined by the nature of the circuit into which it is to be introduced. Practical arrangements of several of the foregoing types will be discussed in Part II of this paper, but before proceeding to these, there is another property of feedback circuits, the theory of which will be discussed briefly.

Effect of Negative Feedback on Output Impedance

In Fig. 2 (a) let the output impedance of the amplifier before any feedback is applied be equal to R_o. R_o will be the anode impedance of the output valve modified in the usual way by the output transformer, if any. Let the output current from the amplifier be equal to i. To ascertain the value of the output impedance when the feedback is applied (say R'_o) consider the current in the output circuit when a voltage of V is applied to the output terminals. This current will be equal to the sum of the e.m.f.'s acting in the circuit divided by the internal impedance, R_o.

$$\therefore i = \frac{V + \mu V_f}{R_o}$$

$$= \frac{V + \mu\beta V}{R_o}$$

$$\therefore R'_o = \frac{V}{i} = \frac{R_o}{1 + \mu\beta.} \quad . \ . \ . \ . \ (11)$$

Thus the output impedance is reduced, when feedback is in use, by a factor $\frac{1}{1 + \mu\beta.}$

The same procedure can be applied to Fig. 2 (b). In this case,

$$i = \frac{V - \mu i r_o}{R_o}$$

$$R_o = \frac{V}{i} - \mu r_o$$

$$\therefore R'_o = \frac{V}{i} = R_o + \mu r_o = R_o\,(1 + \mu\beta).$$

If the total impedance facing the load R is taken as the output impedance, then

$$R'_o = R_o + r_o + \mu r_o$$
$$= R_o + (1 + \mu)\, r_o \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

In the case of current feedback, therefore, the output impedance is increased by an amount equal to $(1 + \mu)\, r_o$.

Negative feedback is frequently used for the sole purpose of changing the output impedance of an amplifier in this manner.

It sometimes happens that this change of impedance may be an embarrassment when the feedback has been applied to some other purpose, such as the reduction of distortion. In such cases the arrangement of Fig. 2 (c) can be employed with advantage.

Since voltage feedback reduces the output, impedance and current feedback increases it, the combination of the two can be used to obtain the required feedback without any change in output impedance, or with any modification which may be required.

Two values of β must be considered, one for each feedback circuit.

$$\text{Let } \beta_1 = \frac{r_o}{R + r_o} \text{ from equation (9)}$$

$$\text{and } \beta_2 = \frac{r_1}{r_1 + r_2} \text{ from equation (8)}$$

$$\text{Then } R'_o = R_o \frac{(1 + \mu\beta_1)}{(1 + \mu\beta_2)}$$

$$\text{Obviously if } \beta_1 = \beta_2$$

$$i.e. \text{ if } \frac{r_o}{R + r_o} = \frac{r_1}{r_1 + r_2}$$
$$\text{then } R'_o = R_o.$$

i.e. no change in anode impedance will have occurred, but the feedback will be given from equation (10) by

$$\beta_{12} = \frac{r_o}{R + r_o} + \frac{r_1}{r_1 + r_2} \quad . \quad . \quad . \quad . \quad . \quad (14)$$

Effect of Negative Feedback on Input Impedance

Referring to Fig. 1 again, let it be assumed that the input impedance to the amplifier proper is equal to R_i and that this is large compared with the impedance of the feedback circuit across which the feedback voltage V_f appears. This will normally be the case in most practical amplifiers.

Then if the impedance "seen" across the input terminals, of the complete system is equal to R'_i, the change in input impedance due to the feedback can readily be calculated.

Let I be the current flowing into the input terminals.

$$\text{Then } R'_i = \frac{V_i}{I} = \frac{V_g + V_f}{I}$$

$$\text{But } V_f = \beta\, V_o \text{ from equation (2)}$$
$$V_o = \mu\, V_g \text{ from equation (1)}$$
$$\therefore V_f = \mu\beta\, V_g$$
$$V_g = I\, R_i$$
$$\therefore R'_i = \frac{V_g + \mu\beta V_g}{I}$$
$$= \frac{V_g}{I}\,(1 + \mu\beta)$$
$$\therefore R'_i = R_i\,(1 + \mu\beta) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

Thus the input impedance is raised by the factor $(1 + \mu\beta)$. This property can sometimes be made great use. (See later references to the Cathode Follower.)

In the case of parallel feedback circuits of the type referred to in a preceding paragraph the input impedance is reduced by the presence of negative feedback.

An example of this is the Miller effect. In a triode the interelectrode capacity lag between grid and anode causes a negative feedback through the reactance of this capacity from anode to grid. It is well known that the input capacity is increased by an additional amount equal to

$$C_{ag}\,(1 + \mu)$$

where μ is the effective amplification of the stage. This increase in capacity corresponds to a decrease in the input reactance. The change in input is of the nature of an increased capacity, since the feedback circuit consists of capacity elements. A reduction of input resistance would occur, had a resistance feedback been used.

The Influence of the Phase Angle of the Feedback

In all the preceding discussion it has been tacitly assumed that there is no phase-shift either in the amplifier itself or in the feedback network, and that the polarity of the feedback voltage is such as to oppose the input voltage. The feedback voltage may therefore be regarded as being 180° out of phase with the input voltage. Under such conditions pure negative feedback is achieved, and the formulæ already developed are strictly applicable.

In passing it should be noted that all orthodox impedance coupled amplifier stages have a phase-shift of 180° within the valve itself so that only amplifiers with an even number of stages can be considered as having strictly no phase-shift. Amplifiers employing an odd number of stages can be used equally well by using a feedback circuit in which the voltage is not reversed in polarity. This will maintain a feedback which still opposes the input voltage.

Most amplifiers, however, contain reactive elements in their circuits which cause a phase-shift at frequencies near the upper and lower limits of the frequency band over which the amplifier is intended to work. These are the portions of the circuit which also cause the gain to fall at each end of the frequency band. Examples are :—

(1) The series reactance of grid coupling condensers.
(2) The shunt reactance of stray capacities from anode to earth, including the input capacity of the following stage.
(3) The leakage inductance of input and output transformers.
(4) The core inductance of such transformers which appears in shunt with the input and output circuits.

Items (1) and (4) above cause a phase-advance which increases as the frequency falls whilst items (2) and (3) cause a phase-lag which increases as the frequency rises.

It has been stated that as long as the total phase-shift round the complete amplifier and feedback loop is 180°, the feedback is wholly negative. Any phase-advance or lag will cause the feedback voltage to become this much less or more than 180° and will reduce the effective *negative* feedback. When the phase-shift becomes 90°, so that the feedback is at 90° or 270° to the input, the feedback neither aids nor opposes the input since it is at zero value when the input is at its maximum. In such a case the feedback will have become reduced to zero. Any further lag or advance of phase will cause a positive feedback which will increase until it becomes a maximum when the phase-shift round the complete amplifier and feedback loop becomes 0° or 360° (which amounts to the same thing).

It follows from the above that whilst a feedback amplifier may function as expected at frequencies near the middle of the frequency band the reduction of negative feedback at high and low frequencies may

cause peaks in the gain curve to occur in these regions.

Further, if the amount of feedback is sufficient, enough positive feedback may occur to cause oscillation at a frequency near the upper or lower frequency cut-off.

Conditions for the Prevention of Oscillation

The exact conditions required to cause oscillation to start, form the subject of the well-known paper by Nyquist referred to earlier. The subject is too complex to be dealt with here but a statement which is adequate for most practical purposes can be made as follows. (1) (3) (5)

To prevent oscillation, the total amplification through the feedback loop must not exceed unity at frequencies where the phase-shift in the loop reaches ± 180°. (6)

Referring back to equation (3) it was shown that the effective amplification in the presence of feedback is equal to

$$\frac{\mu}{1 - \mu\beta}$$

The term $\mu\beta$ is the loop amplification. If the amplification contains a phase-shift of 180°, the total feedback together with the intentional 180° intended to provide negative feedback will be zero, *i.e.* β is positive. If $\mu\beta = 1$, then the amplification with feedback will be equal to

$$\frac{\mu}{1 - 1} = \frac{\mu}{0} = \textit{infinity.}$$

This means that the output signal would build up continuously until overloading of one form or another limits the value of μ, and a steady output voltage is maintained with no externally applied input voltage. This constitutes a state of oscillation.

In order to prevent such oscillation in feedback amplifiers it is necessary to ensure that the gain in the feedback path is reduced to less than unity at frequencies at which a phase-shift of ± 180° has occurred.

A single stage of resistance-coupled amplifier can never cause a phase-shift of more than 90° and so is generally immune from instability troubles.

When the feedback is applied over two or more stages, however, instability may occur at very low or very high frequencies. It is also possible with large amounts of feedback in single stages if some additional source of phase-shift is present, such as an input transformer.

A useful rule to apply in multistage feedback amplifiers is to design one stage so that it has the maximum permissible attenuation at the high and low frequency cut-offs and to keep the losses in the other stages at these frequencies at the lowest possible figure. In this way feedback can be used with 3 or 4 stages of amplification.

In D.C. coupled amplifiers the phase shift at the low frequency end can be eliminated, but there will always be stray capacities present to cause trouble at high frequencies unless suitable precautions are taken.

(*To be continued*)

POST-WAR DREAMS

The author of this article needs no introduction to his many friends of the ether. His dreams may only be dreams, but they are worthy of careful consideration by all who aspire to make their post-war station a thing of beauty and a joy for ever. We hope to attend the Inauguration Ceremony!

By G. S. WOOLLATT (G3ZI).

DURING two and a half years' service overseas, I have had a good deal of time—too much apparently—in which to reflect upon the delights of returning once again to the old game. Although I have been unable to practise radio as a hobby, I have been continuously employed on radio work and in the course of my duties have collected many new ideas, which I hope to include in my post-war schemes.

My thoughts and reflections take many forms. For instance, I think with deep pleasure of the renewing of contacts with old friends, the picking up of the threads we dropped in 1939, of the delightful visits to amateur friends. I think, too, of the many hours spent tinkering with bits of gear carefully put together and of the time spent getting as much R.F. as possible "up the spout," of head scratching and pencil sucking—a sure indication of a problem to evaluate!

Then my thoughts turn to the new G3ZI, that nebulous, changing theme centred around super-efficiency, versatility and professional appearance. At the time of writing, the 194– version of G3ZI takes the form, on paper, of a super outfit comprising four full-size racks and an operating desk. Two separate transmitters, one for 7 Mc/s. and 14 Mc/s. and one for 28 Mc/s. and 56 Mc/s., all remote controlled, motor tuning, automatic frequency- and wave-change controls, voice operated relays, automatic routing of speech frequencies for Duplex work, harmonic suppression and peak-limiting amplifiers. All the audio gear; both modulating and receiver, is contained in a third rack and will be completely automatic in operation. All controls are grouped on the control desk and incorporated in a super receiver-cum-control unit. This last effort contains two complete (four stages each) R.F. units, one for 56 Mc/s. and the other a three band affair; five I.F. stages with A.F.C. variable band width, A.V.C., noise suppression, audio limiters and crystal gate. Band switching on the receiver controls the operation of the transmitters and selects a suitable aerial. Thus, every and any operation will be controlled by one button or switch from one position and in addition alternative devices will be incorporated so that, if for example, the V.O.R. system fails, the outfit may be controlled by a manual switch.

This all sounds very elaborate and complicated, but has been designed so that each section can be built as a workable entity—this had to be, as the work involved (and the cost) is rather a tall order. The fourth rack will house a complete simple three-band transmitter with no frills and no connection with the rest of the set up. This may be controlled either separately or from the main control unit.

The object behind this rather grandiose scheme is to enable G3ZI to be always available for communications and operations, whatever experiments may be in hand. In the past when a modification to a piece of gear was devised, the transmitter would be put off the air and a hurried alteration made, probably hooked up and operations recommenced. If it did not work very well, the urge to get back on the air with full power output was usually too strong, and out would come the modification and back on the air we would go, with the transmitter just slightly more haywire than before. And were we not all like this?

(*Continued on page* 16)

SERVICING COMMUNICATIONS RECEIVERS

By H. W. Miles (G2NK)

PART—I

Fault Finding

IN this article and the one to follow, an attempt will be made to outline a method of checking the performance of superheterodyne receivers, particularly those of the Communications type. Fault finding will be dealt with in detail for the benefit of readers who have not had much experience in the overhaul and maintenance of modern receivers.

It is realised that test equipment is difficult to obtain to-day, but a multi-range meter, such as the "Avominor," is an absolute necessity for circuit checking. whilst if alignment of the tuned circuits is to be considered some form of signal generator will be required. If the circuit diagram of the receiver is available trouble tracing will be simplified but as the majority of communications receivers follow a general arrangement the method of checking described below can be used in most cases.

When a receiver fails to operate correctly it will display one or more of the following symptoms :—

(1) Complete absence of signals.
(2) Signals below normal standard.
(3) Signals distorted.
(4) Signals accompanied by cracking or high hum level.
(5) Signals received only on certain wavebands.
(6) Signals received over part of any waveband.
(7) Signals at normal level but intermittent.
(8) Excessive heating of certain components, such as transformers, etc.

The primary task is to discover in which part of the circuit the fault is situated and for this purpose it is generally best to work backwards through the instrument, starting at the power supply circuit. As the majority of commercial communications type receivers are A.C. operated superhets this type will be assumed in the following discussion.

With the receiver disconnected from the mains supply, remove the rectifier valve and measure the resistance between chassis and one rectifier filament socket. A kick, due to the charging of the filter condensers, followed by a steady reading around the 10,000 ohms mark suggests normality. This resistance is due to the potential divider network usually fitted to feed the screens of the R.F. and I.F. valves. A zero resistance reading generally indicates a short circuited reservoir condenser whilst a reading equal to the resistance of the speaker field, or smoothing choke, suggests a short circuited filter condenser located on the " receiver " side of the power pack.

Should there be an abnormally low resistance in the H.T. line the rectifier valve is likely to be destroyed or seriously damaged if the receiver is connected to the mains. It is advisable at this stage to make a few tests on the speaker circuit as a fault here can cause complete absence of signals. The resistance between the positive terminals of the filter and the reservoir condensers will give the value of the field winding in the case of an energised speaker, or the smoothing choke when a permanent magnet speaker is fitted. Test also between the output valve anode and the H.T. feed line. This will give the output transformer primary resistance—usually around 400 ohms—and should produce a slight click in the speaker if of the energised type and a louder one if a permanent magnet type is used.

Resistance measurements should also be made between chassis and screening grids of all R.F. and I.F. valves. It is not uncommon to find faulty by-pass condensers giving a steady reading of a few thousand ohms, so the figure obtained should be compared with the nominal value of that part of the screen potential divider between screen and chassis.

The checking of filter and by-pass condensers is most important, as a high percentage of failures are due to faulty components of this type. While the ohmmeter is on hand it is advisable to check the various anode circuits. With one lead clipped to the H.T. feed line touch the other on to the anode pins of each I.F. valve in turn, including the mixer valve. This will give the resistance of each I.F. transformer primary and will of course vary with different makes but can be assumed to be in order if values of between 20 and 200 ohms are obtained. Sometimes a decoupling resistance of a few thousand ohms is fitted in series with the transformer and this should be allowed for if it occurs. A zero reading may indicate a faulty trimmer condenser whilst an infinity reading will suggest an open winding. An erratic pointer reading, by no means uncommon, denotes either a faulty winding or condenser, usually the former, and it will then be necessary to open up the transformer for examination. The secondary windings can be checked in like manner, remembering that the A.V.C. line is in circuit, and tests must be made between grid-cap and the appropriate I.F. transformer lead—usually the black one if colour-coded.

The anode circuits of the R.F. stages can be checked by connecting the ohmmeter between H.T. feed-line and the appropriate plate pin. Readings are taken at each position of the wave-range switch and in general the resistance will decrease with increase of frequency range, dropping from between say 10 and 100 ohms on the broadcast band to a fraction of an ohm on the highest frequency. Failure to operate on any particular waveband is often due to open-circuit windings on the R.F. transformers and the writer has encountered literally dozens of sets with this fault. It appears that, due to the steady anode current flowing through the winding, an electrolytic action is set up if conditions are favourable; these conditions apparently being acid in the coil former or impregnating wax. This fact seems verified because the aerial primary coils, although of similar construction, rarely break down owing to the fact that no anode current passes through them. R.F. secondary coils do not often give trouble but they can be checked by clipping the ohmmeter between the appropriate stator of the tuning condenser and chassis with the A.V.C. shorted down to chassis, varying the wave range switch as before.

The oscillator circuits can be checked in like manner but as the circuits vary in different receivers it is generally necessary to refer to the circuit to choose suitable checking points. Wave range switches of the ganged wafer type are likely sources of trouble and if open circuit or intermittent resistance readings are obtained, when making the above tests, the particular section of the switch should be examined and the contact lightly prodded with a stick or trimming tool. As it is difficult to increase the tension of the wiping contact, owing to the method of construction, it is generally necessary to remove the whole wafer by disconnecting the leads and withdrawing the driving bar. The outer contacts can now be reshaped with a small pair of round nosed pliers. This, quite frankly, is no easy task but it can be done with care although any attempt to press the contacts together when in

position invariably results in springing them further apart. Very often faulty contact is caused by dirt and grease and this can be removed by washing the wafer with carbon tetrachloride or "Thawpit."

Testing the Receiver in Operation

It will be realised that the foregoing describes static tests that can be made before the receiver is switched on and which, with a little experience, can be carried out in a few minutes. They are of value particularly when the receiver shows signs of faults 1, 4, 5, or 7. If these checks fail to bring to light the cause of the trouble the next procedure is to switch on the receiver and test under working conditions. A slight residual hum will show that current is flowing in the speaker circuit, and touching the grid of the first audio valve (often a double diode-triode top cap) should produce a very loud hum. Absence of hum locates the trouble beyond this point. Anode and screen voltage measurements can now be made with the voltmeter connected between chassis (negative) and the electrode in question. Unless the voltmeter is of exceptionally high internal resistance the screen voltage readings are likely to be low, due to the meter loading the circuit and for this reason the use of an electronic voltmeter is recommended. However the normal type of multi-range meter likely to be used by the amateur will give useful results providing allowance is made for the loading effects.

If a signal generator is available a modulated signal of the correct intermediate frequency may now be fed into the control-grid of the frequency-changer valve. If a crystal filter is fitted, this should be switched out and the A.V.C. switch placed in the "off" position. We are not concerned with the accurate alignment of the receiver at this stage, but the presence of a strong audio output when an I.F. signal is fed into the frequency changer, will indicate that any failure to operate on normal signals is due to a fault in the oscillator or R.F. circuits. Up till now no attempt has been made to measure the current flowing in the various circuits, for the reason that the insertion of a milliammeter involves breaking the leads or fitting an adaptor plug. Instability is likely to be experienced when using a split-anode adaptor plug and for this reason it is generally advisable to test these valves away from the receiver, although the A.F. and output valves may be checked for anode current by means of an adaptor.

Turning now to the high-frequency oscillator circuits, these are fortunately not the erratic things they were a few years ago and it is rarely that serious trouble is encountered with them. If the oscillator fails to function no signals at all will be heard, while low emission will cause weak signals accompanied by high background noise or patchy reception. By referring to the valve maker's lists the R.F. voltage generated may be checked by inserting a 0–1 milliampere meter in the grid return lead. The reading obtained, expressed in amperes and multiplied by 1·11 times the grid leak value in ohms, will give a close indication of the peak R.F. voltage developed by the oscillator.

Distorted Signals

We have now traced our way through the receiver and should by now have located the position of the trouble if not the actual faulty component. However there are a number of other causes for indifferent reception and some will now be dealt with in detail. Distortion in the audio output is often caused by a leaky coupling condenser or a soft valve. In either case the distortion may be permanent or may develop some while after the set is switched on. An output valve may be checked for softness by disconnecting the grid coupling condenser at the grid terminal and leaving it "on soak" for about half an hour with an anode current meter in circuit. If the anode current remains normal, even when the grid is shorted down to chassis, it can be assumed that the valve is hard. On the other hand if the current creeps up to an excessive figure and fluctuates on shorting the grid to chassis, the valve is probably soft. If the valve checks satisfactorily, reconnect the coupling condenser. An increase in anode current, either immediately or after a short time, indicates that the coupling condenser is leaky and is putting a positive bias from the preceding plate on to the grid and thereby opposing the normal negative grid bias. Distortion can also be caused by a leaky A.V.C. line. This can be determined by operating the R.F. and I.F. gain controls. If distortion occurs at even low audio levels when the R.F. gain is increased on a strong signal, it is probable that leakage of the A.V.C. filter condensers is taking place. Where a tuning eye or meter is fitted, faulty A.V.C. action is shown by low or erratic readings.

Distortion due to microphonic action is well known and can be traced by tapping softly the valves and components with a pencil wrapped with a few rubber bands. An often unsuspected source of microphony, particularly with sets having a built-in speaker, is due to vibration of the vanes of the oscillator tuning condenser. Distortion of a severe fluttering nature on strong signals is often due to poor regulation of the power supply and can usually be overcome by fitting a neon regulator tube across the oscillator H.T. feed. This fault is rare now but was prevalent some years ago on some of the lower priced communications receivers. Signals accompanied by crackles or are intermittent may be due to mechanical faults. If signals cut in and out on moving the chassis the insulated end of a trimmer tool should be poked around the various components, gently lifting resistors and condensers. Loose earthing tags, corroded connections, shorts between components and chassis and between components themselves are all known to give rise to intermittent reception. Be careful of screened leads, making sure that they are well earthed and that the insulation to the core is satisfactory. Valves should be "wobbled" in their holders, and if British types with split pins be sure that the wires leading to the electrodes are not broken in the pins. Faulty spot-welding within the valve often causes crackling and intermittent reception.

Excessive Heating and Hum Level

Excessive heating of the mains transformer may be due to shorted turns in one of the windings and if this is suspected it is advisable to remove all valves from the set and leave the mains connected. The transformer should run cool but considerable heat will be developed if there are shorted turns in any of the windings. The only remedy is to rewind the transformer. Abnormal hum level in a receiver can be due to a variety of causes. Neglecting those due to faulty design, which should not be evident in a commercial receiver, the most common cause is due to ageing of the filter condensers. This can be overcome by fitting new condensers across each existing unit, 8 μF units being generally used. A valve with abnormally low leakage resistance between heater and cathode will cause high hum level and short of replacing the valve, improvement may sometimes be effected by increasing the value of the by-pass condenser. Modulation hum is a form which occurs only when a carrier is tuned in and can often be cured by connecting a pair of 0·1 μF condensers in series, with their outers joined to the outers of the mains transformer H.T. secondary winding, and the centre tap to the rectifier filament centre tap of H.T. positive feed line.

(To be continued.)

H.T. SUPPLY FROM AUDIO TRANSFORMERS

By W. H. WALKER (2DXS)

HAVING used an audio transformer with success, as mains transformer, to provide anode voltages for a cathode ray tube, it was thought that an indication of the outputs to be expected under reasonable load conditions would be of assistance to others, since high voltage transformers are now difficult to obtain.

Owing to the high voltages developed, when the primary of the usual audio transformer is connected to the mains, all transformers are not equally suitable. The Ferranti AF5, on which these notes are based, employs separate bobbins for primary and secondary, and each of these is sectionalised, so that the risk of breakdown is minimised. The risk could be reduced still further, only by layer winding.

Measuring Circuit Arrangements

As the only measuring instrument of first grade accuracy available, was a Model 7 "Avo," and as the current taken by this meter, even when on its highest voltage range of 1,000 is in excess of that taken by a cathode ray tube and its associated resistance network, it was decided to disconnect the supply and to incorporate it in a separate test circuit (see Fig. 1). The 0–1 milliameter was used for both current and voltage indications. Current readings were corrected by

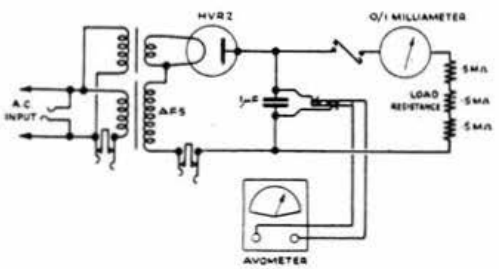


Fig. 1.
Circuit used for examining the operating conditions of a Ferranti AF5 audio transformer used to provide high voltages.

subsequent comparison with the "Avo," whilst voltage indications were based on a comparison of the readings on the two instruments when both were connected in parallel across the supply, as shown in Fig. 1. This allows the meter to be inserted elsewhere in the circuit by means of the plug to which it is connected, an arrangement that reduces the possibility of measurements being protracted sufficiently long for the mains voltage to change. During the process of measurement it was found that the mains voltage remained constant, otherwise the results would have been to some extent invalidated. Readings which were misleading have been omitted; for instance the secondary voltage across the transformer was measured as 690, but the milliameter reading dropped from ·56 to ·5 when the "Avo" was connected across the secondary. The secondary voltage off load—arrived at by extrapolation—agreed closely with the calculated voltage, based on the transformer ratio. This is shown in the graph (Fig. 2)—relating voltage output with current—from which it appears that the D.C. voltage at zero current would be in the vicinity of 1,100 volts. At zero current the D.C. voltage would be equal to the peak A.C. voltage only with a perfect condenser. Leakage current sets a minimum beyond which current cannot be further reduced.

Examination of the graph shows that if the transformer is to be allowed to provide the high voltages required (1,000 volts in the case of the ECR30), all losses must be reduced to a minimum. This rules out the possibility of using series-connected electrolytic condensers for smoothing, a method which is very convenient when a drain of a few milliamperes can be tolerated.

After the measurements had been concluded, using a "Peak" 1μF condenser rated at 800 volts D.C. working, it was decided to conduct tests with two separate paper dielectric condensers. The first condenser (capacity 0·1μF) showed that the D.C. voltage was maintained at the same value, whilst the second condenser (capacity 4 μF) reduced the voltage by nearly 200, proving that the power factor, even of a paper dielectric condenser, must be watched when losses are of importance.

When the tube is finally incorporated into an oscilloscope a pair of 1μF 800 volts D.C.-working condensers will be used in series.

Tabulated Results

The load consisted of three 0·5 megohm (rated value) resistors in series. The total value was measured as 1,600,000 ohms but as the actual value would appear, from the results, to be somewhat higher than this figure, the load values shown in the first column of the table are possibly in error by a few per cent. The other figures quoted are, as previously explained, either readings obtained directly from the "Avo" (at open parts of the scale) or readings based on comparison with the "Avo." Readings obtained directly are marked with an asterisk. Those not so marked, are likely to be little greater in error than would be expected from a first-grade instrument.

Load.	Current in Milliamperes.				Voltage.	Power (Watts).
	Milliameter reading.	Corrected reading.	Avo current.	Total current.		
Avo and 1·6 megohms in parallel (381,000 ohms)	·39	·38	1·26	1·64	630*	1·03
Avo only (500,000 ohms)	—	—	1·38	1·38	688*	·94
1·6 megohms only	·56	·54	—	·54	905	·48

* Readings obtained directly.

A.C. conditions for the figures in the third line were :—

Primary current 3·4 mA. Primary voltage 240 at 50 c.p.s. Secondary current ·7 mA.

Comparison between AF3 and AF5 Transformers

In order to ascertain whether the lower resistance of the windings used in the AF3 transformer gave an appreciable increase in D.C. voltage a transformer of this type was substituted for the AF5.

Measurements taken with the "Avo" showed the resistances to be approximately :—

AF3 : Primary 1,800 ohms, secondary 27,000 ohms.

AF5 : Primary 2,500 ohms, secondary 33,000 ohms.

With the load adjusted so that the corrected current reading was ·54 mA. it was found that the D.C. voltage was now 930, whilst the secondary current was the same as before at ·7 MA., but the

primary current had increased to 4·5 mA. When these figures were taken the mains voltage had dropped, slightly, to 235 volts.

Suitability of Other Types of Transformer

It is impossible to make a comprehensive statement regarding the suitability of all audio transformers for the purposes referred to in this article, since the designs vary so widely, but the essential requirement is that the insulation must be able to withstand the voltages developed. This refers not only to the insulation between the two windings, but also to the insulation between turns at different potential in the same winding. The inter-winding insulation resistance in the case of the AF5 was measured as 14 megohms but as the transformer is many years old, minute particles of dust may have entered inside the shrouding. This resistance is however sufficiently high to prevent inter-winding A.C. currents rising to a value likely to damage

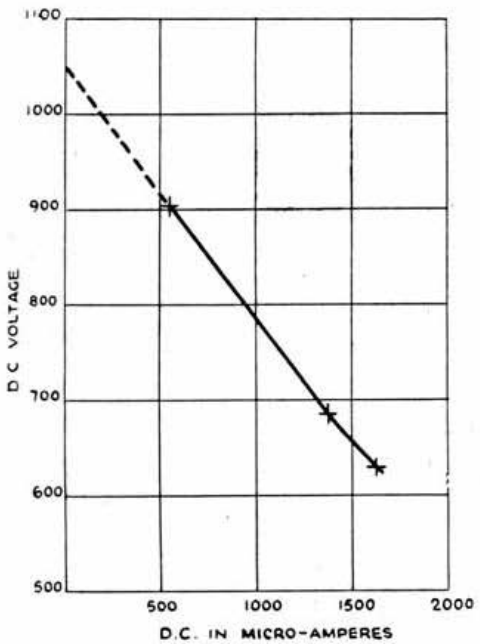


Fig. 2.
Curve relating D.C. current with D.C. voltage to illustrate voltage regulation with AF5 transformer.

the insulation. Since both primary and secondary windings are usually earthed at some point in most power circuits, the inter-winding current cannot be ignored. The gauge of wire used will limit the maximum current which may be drawn from the transformer. The primary current is likely in most cases to set the limit, especially if primary and secondary are both wound with the same gauge of wire. In the case of the AF5 the wire used for the primary is No. 47 gauge, so that under the conditions applicable to line three in the Table, the wire is worked at a density of about 1,200 amperes to the square inch.

The cross sectional area of the core is never likely to be too small, nor is the total weight of iron. In the case of midget transformers small lightweight cores are liable to be accompanied by too small a number of turns for the purpose; this then will be the deciding factor. In the case of the AF5 the cross-sectional area of the core is 1·05 square inches, with a primary winding of 7,600 turns. Although this winding on such a core gives the AF5 its excellent frequency-response the number of turns is far greater than is necessary for power purposes, a fact largely responsible for the limit which is placed on power output if the voltage is to be maintained at a high value.

As a rough test of the suitability of any particular transformer, connect its primary to the mains, and measure the current consumption with the secondary on open circuit. If this agrees closely with the value to be expected from the inductance of the primary, it can be assumed that the transformer is withstanding the voltages developed, since short-circuited turns anywhere would be manifest by an increase in current. The measured primary current of the AF5 with the secondary open-circuited was 600 micro-amperes, comparing with a calculated value of about 750 micro-amperes for an inductance of 100 Henrys. (Resistance is negligible in comparison with reactance in this case.) Even if the inductance of the transformer is low, and the current consequently high (since there is a phase difference of nearly 90 degrees) there need be no doubts regarding the ability of the wire to carry the out-of-phase component.

No allowance has been made for smoothing in the figures given, but if the conventional high resistance is used, the voltage drop can be calculated quite easily. A small smoothing choke from a battery eliminator has been found to provide sufficient inductance, and its use minimises voltage drop. Alternatively, a second audio transformer can be used for the purpose. For this function the insulation resistance is comparatively unimportant, but it is necessary to earth the core. Assuming the positive side of the supply is earthed, as is usual with cathode ray supply units, the potential between windings and core is consequently small. If the chassis should be connected to H.T. negative, it would be safer to connect the choke in the negative line.

Mr. E. W. Fair (BRS4095) is thanked for his co-operation in the course of this enquiry.

Cash Sales Department

The following items are now in stock at Headquarters :—

Members' Notepaper (new style), 100 sheets	3s. 6d.
Car Plaque of Emblem	3s. 6d.
Rubber Stamp of Emblem	3s. 0d.

The above items will be sent post free to any address in Great Britain on receipt of remittance. Orders for Northern Ireland and all neutral countries are despatched *via* the Censorship authorities.

OUR FRONT COVER

The cover illustration records two notable milestones in valve development as typified by the Mullard EF39 and EF50. The former is the highly efficient R.F. pentode so widely known and used just prior to the war ; the latter embodies the new technique of the " pinch-less " all-glass construction which opens up new possibilities in radio design.

Silent Keys

With deep regret we record the death of Mr. George Curran, **G2KY**, whose home was in Manchester. Mr. Curran had been a member of the Society since 1933 and his call was well known in many parts of the world. Our sympathies are extended to his son, Sergeant G. Curran, and other relatives.

• • •

It is also with deep regret we record the names of the following members who have made the Supreme Sacrifice.

Flight-Lieutenant D. A. Ashton, R.A.F., **BRS4519,** of Billericay, Essex.

Sergeant F. P. Bramley, R.A.F., **2FMX,** of Moira, near Burton-on-Trent, Staffs.

Sergeant H. Maxey, R.A.F., **BRS7498,** of Grantham.

Sergeant F. W. Porteous, R.A.F., **BRS5286,** of Poplar, London.

Flying Officer T. D. Reilly, **BRS5325,** of Newport, Mon.

Pilot-Officer William O. Simpson, **BRS6000,** of Carlisle.

DIODE DETECTION AND AUTOMATIC VOLUME CONTROL

By W. G. Johnson (2BJY)

THIS article will attempt to present in a simplified form the fundamental principles underlying diode detection and automatic volume control. The latter depends mainly upon the provision of R.F. amplification, using variable-mu valves, whilst diode detection must be preceded by a reasonable amount of R.F. amplification, since there is no voltage amplification in the valve itself.

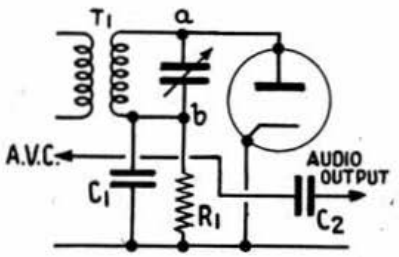


Fig. 1.
Illustrates a diode valve connected as a detector. The circuit is not suitable for practical purposes as instability occurs due to R.F. feedback. R1 ·5 megohm. C1 ·0001 μF. C2 ·01 μF.

Diode Detection

Fig. 1 depicts a diode valve connected as a detector, T1 is an intermediate frequency transformer, R1 a diode load resistance connected between I.F. transformer and earth, C1 a by-pass condenser for R.F., and C2 an audio coupling condenser. An alternating current at radio frequency, the amplitude of which will depend upon the signal voltage in the aerial plus the effective amplification of the previous stages in the receiver, will flow in the I.F. transformer, and when the I.F. transformer secondary at " a " becomes positive with respect to " b," current will flow through the valve and R1 will become negative at " a " with respect to R1b. This process of rectification causes an audio frequency voltage to be developed across R1 which can be fed into an audio amplifier *via* the coupling condenser C2. The voltage may also be fed to the grid circuits of the mixer stage and the R.F. and I.F. amplifiers. If these stages employ variable-mu valves, then their effective amplification will be reduced in proportion to the increase in voltage developed across R1. This circuit is unsuitable however for practical purposes since some radio frequency will be fed back into the R.F. and audio stages of the receiver thereby causing serious instability.

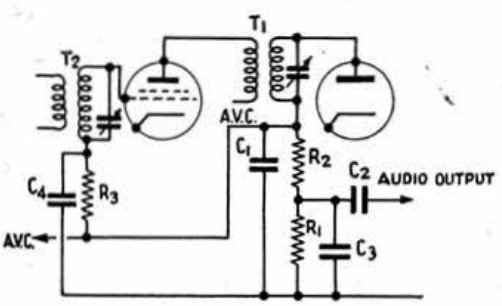


Fig. 2.
An improved arrangement using stopper resistances.

R1, 3	·5 megohm.	C1, 3, 4	·0001 μF.
R2	50,000 ohms.	C2	·01 μF.
	T1, 2 I.F. transformers.		

The circuit of Fig. 2 illustrates an improved design. In this case R2 is the diode load resistance and R1 an R.F. stopper used to prevent radio frequencies getting through into the audio stages. R3 is a stopper resistance in the A.V.C. line to the I.F. grid circuit. Similar resistances must be connected in the A.V.C. line to any controlled stages. This circuit is not completely satisfactory, since the A.V.C. voltage will still be developed on weak signals with the result that they will be to all intents inaudible.

Double Diode-Triode for Detection and A.V.C.

In Fig. 3, a double diode-triode is connected in a circuit in such a manner as to overcome this difficulty. In this arrangement one diode is employed as a detector whilst the other provides A.V.C. The triode section amplifies the rectified audio output of the detector diode. R1 is the load resistance for the detector diode and R2 a separate A.V.C. load resistance for the

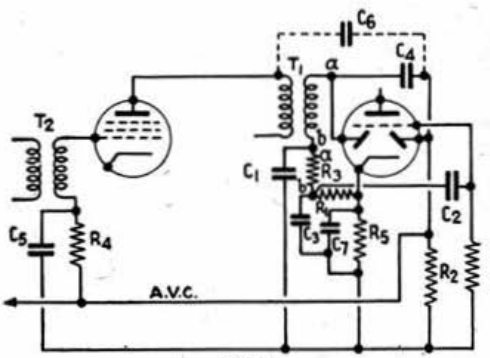


Fig. 3.
A practical circuit employing a double-diode triode.

R1, 2, 4	·5 megohm.	C1, 3, 4, 5, 6	·0001 μF.
R3	50,000 ohms.	C2	·01 μF.
R5	1,000 ohms.	C7	25 μF.
	T1, 2 I.F. transformers.		

A.V.C. diode. R3 is a R.F. stopper in the line to R1, and R4 a R.F. stopper in the A.V.C. line to the I.F. stage. If other stages in the receiver are controlled they must include similar R.F. stopper resistances. The remaining components will be familiar, R5 is the cathode bias resistance; C1, 3 and 5 are R.F. filter condensers and C7 the cathode by-pass condenser.

Alternative methods of connecting the A.V.C. diode are shown at C4 and C6. The connection shown dotted is more often used, since the receiver is less selective in this position, resulting in better A.V.C. action on the extreme sidebands. C2 is the audio coupling condenser to the triode section of the valve. It will be appreciated that, since R1 is connected directly to cathode, the detector anode will not receive a negative bias. Consequently the A.V.C. load resistance is connected to earth to provide the A.V.C. anode with a negative bias in proportion to the voltage drop across R5.

With the valves commonly available the negative bias developed is about 2 volts, hence the delay bias will ensure that no A.V.C. is developed until the

signal amplitude exceeds this negative bias. As a result weak stations are fully amplified. If a battery valve with a directly heated filament is used then the detector anode load resistance is connected to the earth line and the A.V.C. load resistance is battery biased to between —1½ and —3 volts. In the more ambitious types of communications receiver it may be desirable to apply different values of negative bias to individual valves, in order to improve the signal-to-noise ratio. This may be done by splitting the load resistance R1 (Fig. 3) into two or more separate resistances and by connecting the junction to those stages which do not require the full A.V.C. voltage.

A number of variations are possible with A.V.C. and diode detector circuits, and after study of the fundamental principles outlined above, the beginner will find that he has before him a wide field for interesting and instructive experiment.

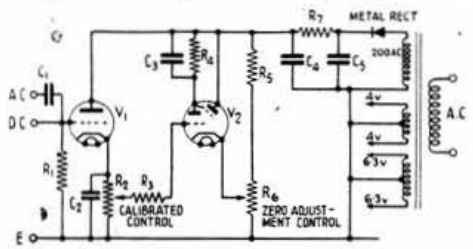
MAGIC-EYE VALVE VOLTMETER

By C. A. MACKAY, 2BMZ*

THE instrument to be described differs from the usual Magic-Eye voltmeter in that no voltmeter or slide-back control are employed. Further, the supply required is only 200 volts D.C. The input voltage to the instrument is read directly from a calibrated potentiometer. The voltage range is from 0·5 to 200 volts A.C. or D.C. and is accurate at all frequencies between 50 c/s. and 12 Mc/s.

Circuit Description

The anode current of V1 is maintained at approximately cut-off, due to the fixed bias developed across R2. An input voltage applied to the grid causes an increase in anode current and an increased voltage drop across R2. If the slider of the potentiometer is set at the cathode end, the positive voltage across R2 will be applied to the grid of the Magic-Eye *via* R3.



Circuit of Magic-Eye Valve Voltmeter.

C1	·01 μF.	R1	6 megohms.
C2	·5 μF (non-inductive).	R2	50,000 ohms (wire wound).
C3	·1 μF.	R3, 4	1 megohm.
C4	8 μF.	R5	50,000 ohms.
C5	4 μF.	R6	20,000 ohms.
V1	AC/HL.	R7	2,000 ohms.
V2	6G5.		

Calibration

Before taking a reading the edges of the shadow of the Magic-Eye must be made to just touch by adjusting the bias control (R6). During this operation the input terminals (D.C. and E.) must be shorted and the slider of R2 placed at the cathode end. If now the short-circuit is removed and a voltage applied to the input, the shadow of the eye will open by a certain amount. The calibrated potentiometer (R2) is then adjusted until the "eye" just closes again and the voltage read directly from the scale.

The potentiometer can be calibrated at a frequency of 50 c/s by feeding standard voltages into the input from a mains transformer. An accurate voltmeter must be placed across the input terminals and a variable resistance connected in series with the output from the mains transformer.

It was found that the value of the condenser C2 is rather critical, a higher or lower value than the one specified producing a discrepancy between A.C. and D.C. readings.

* 96 Winsor Road, Cambridge.

Letters to the Editor

Amateurs or Experimenters

DEAR SIR,—The term "Amateur" is of late being increasingly used in editorials, articles and letters in the Society Journal.

By far the greater number of R.S.G.B. members are seriously engaged on radio experimental work. While radio and allied subjects are our hobbies we are not interested as amateurs in the commonly accepted sense.

The R.S.G.B. is a scientific Society, and the continued growing use of the term "amateur" is in this way a retrograde step—much to be deplored.

I suggest that the Society make an official statement regarding this matter.

Yours sincerely,
HARDY D. H. SMITH (G6YN).

WWV Standard Frequency Transmissions

DEAR SIR,—Early in June it was noticed that the telephony announcement was being read somewhat faster than previously. This was because another sentence had been added but the whole announcement had still to be completed in one minute.

The new sentence is as follows: "The 4,000 cycle modulation is omitted at night from the 2½ and the 5 megacycle broadcasts." This sentence should be inserted immediately after the sentence ending "59th second of each minute." (See June BULLETIN, page 184.)

Yours faithfully,
W. N. CRAIG (GM6JJ).

Congrats.

● To L.A.C. G. K. Adams, **2BOU**, of Porth, Glamorgan, whose wife recently presented him with a daughter, Ann Margaret.

● To Mr. and Mrs. W. N. Follis, **G3AY**, of Birmingham, now proud parents of a son, Peter John, born May 28th, 1944.

● To Mr. and Mrs. L. R. Crawley, **G3DT**, late of Winchmore Hill, London and now resident in Bath, on the birth of a son—Gardner Savill—on May 17, 1944.

● To Mr. G. W. Parker, **BRS5210**, and his wife, of Nuneaton, Warwicks, on the birth of a third son, Stewart Terrance.

Hospitality Offered

Mr. H. Lefebure, **BRS4093**, 8 Berwood Road, Sutton Coldfield, Warwicks, will be pleased to extend hospitality to visiting American amateurs. Telephone Erdington 3293.

Can you help?

Mr. J. B. Roscoe, **2FJM**, Springdale, Woburn Sands, Bletchley, Bucks, seeks information on D.C. amplifiers. He finds that most of the standard textbooks treat this subject sketchily.

Cpl. Profaze, **BRS6942**, 106 The Mall, London, N.14, seeks information on the remote control of model aircraft by means of radio.

New Book

RADIO WAVES AND THE IONOSPHERE. By T. W. Bennington. Published by Iliffe & Sons, Ltd. Price 6s., by post 6s. 3d.

This is not a textbook in the accepted sense of the word. It contains no mathematics yet it succeeds in providing the reader with a clear and concise account of phenomena which, up to but a few years ago, was little understood outside advanced scientific circles.

The author introduces the subject with a simple description of ground and sky wave theory. Chapter II deals effectively with the Sun and the Ionosphere. Chapter III describes how the Ionosphere is sounded. Ionosphere Variations, and Long-Distance Transmission form the subjects of Chapters IV and V, whilst the last chapter is devoted to a description of Ionosphere Disturbances and other Abnormalities.

The text is illustrated with numerous line diagrams and sketches.

Radio amateurs will find within the covers of this new book much that will interest them. J. C.

BRITISH ISLES NOTES AND NEWS

DISTRICT 2 (North Eastern)

D.R.: C. A. Sharp (G6KU), 50 Moore Avenue, Wibsey, Bradford. Bfd. 10772. *Scribe: H. Beadle (G8UO), 13 Chandos Street, Keighley.*

Members are asked to note the D.R.'s change of address.

Morley.—A meeting of the Morley and District Radio and Television Society was held on June 11th, when Mr. J. H. Bateman G6BX, gave a lecture-demonstration on the "Cathode Ray Oscillograph." Among those present were G5YV, 6BX, NP, PL, QO, 8UO, WP, 2CGR, HHV, BRS1151, 5893, 6709, 6730, and Messrs. Brocholme, Green and Hunter.

G6BX and 8UO were recently given a demonstration by 5YV of his home-built 10-valve Communication receiver and were greatly impressed by its appearance and performance. Mrs. Beaumont is thanked for providing tea. BRS5893 is building a multi-range test meter covering A.C., D.C., and resistance. He requires three I.F. transformers; any offers? (Try a small ad. ED.)

Halifax and Sowerby Bridge.—A meeting is to be held on Sunday, July 23rd, at 3 p.m., at the home of Capt. Richards, BRS6642, 3 Heath Park Avenue, Halifax. Will those intending to be present please send a p.c. to BRS6642 at the above address or to the T.R. 6807 has heard Singapore on 9·448 Mc/s., and would like to hear from anyone else who has logged this station.

General.—Capt. Platt, G2VO, was married on June 14th to Miss W. M. Bailey (W.A.A.F.). Congratulations. 4412 sends 73 to 2BJO, who is now F./Lt. R.A.F. 6XL has traced 6AZ, who is also F./Lt., and is happy on radio work. 6XL, Signals Officer in the local H.G., says they have built most of their gear themselves. 3HA reports that 8RY is still with him but 3UP and Sgt. West are back in G. He sends 73 to 2DM and would like to hear from 3KF. G8UO.

DISTRICT 3 (West Midlands)

D.R.: V. M. Desmond (G5VM), "The Chestnuts," Hanley Castle, Worcester. Scribe: E. J. Wilson (2FDR), 48 Westbourne Road, Olton, Birmingham.

Birmingham.—Thirty-five members and visitors were present at a meeting of M.A.R.S. held on Tuesday, June 13th, at the Chamber of Commerce, New Street. At this meeting Mr. George Brown gave a very interesting talk on Broadcasting and Science, dealing in broad outline with his own ideas of the future possible trend of broadcasting and U.H.F. services.

A letter has been received from A.C.1 W Moorwood, now serving in India. He wishes to be remembered to all old friends and to members whom he met in District 7.

Coventry.—It is learnt from G5GR that in response to his request for names for a "get-together," at least one reply has been received! 2FDR.

DISTRICT 4 (East Midlands)

Deputy D.R.: Albert E. Clipstone (G8DZ), 14 Epperstone Road, West Bridgford, Notts.

Derby.—A meeting is to be held on July 30 at 3 p.m. at G2OU, 43 Kenilworth Avenue, Derby, when Mr. H. Murfitt, BRS4071, will give a talk on insulating materials. If possible a works visit will also be arranged. (*via* G2OU).

Leicester.—Although the attendance was low, interest was exceedingly high at the June meeting held at BRS5329. Many useful pieces of apparatus were demonstrated by our host, including an ingenuous home-made Morse recorder of which any amateur might be proud. The workshop too, which had been well-equipped, came in for a lot of attention, especially on the part of G8CZ. After an excellent tea (thanks to Mrs. Pretty), a debate on last month's Editorial ensued, with the result, it is rumoured, that 6VD's R.M.E. 99, will be "hung, drawn and quartered" at the next meeting!

Congrats. to 2HBG (R.A.F.) on his recent marriage. He has just returned home after three years in the M.E. Congrats. also to our D.R., G2RI, on his promotion to S./Ldr. Best of luck to our T.R. who at the time of writing is passing (we hope) an examination. (G6VD for BRS5605).

Nottingham.—An interesting Radio Quiz took place at the June meeting, followed by tea (thanks to Mr. Charles B. Williams). Later a demonstration and talk on his home-built Signal Generators, Valve Volt Meters, and Universal Meters, was given by BRS5514.

In July local members are to join the Derby Group at their monthly meeting.

It is hoped to visit the Nottingham Rediffusion Centre in August. G8DZ would like to hear from members who are likely to be present on that occasion.

Peterborough.—The T.R. reports an increase in activity in this area. BRS5727 is working on an amplifier with two PX25's; BRS7410 and T.R. are on 'scopes; Mr. D. W. Wheele on a portable H.F. receiver with tuned H.F. and D.E.T. anodes, which increases sensitivity considerably. (*via* 2FQV).

G8DZ.

DISTRICT 5 (Western)

D.R.: R. A. Bartlett (G6RB), 31 King's Drive, Bishopston, Bristol. Bristol 46960.

Bristol.—The attendance at the usual monthly meeting was much below the average we have had in recent months. Two members from Bath again managed to come across, and we were very pleased to see them. Next meeting, Sunday, July 23rd. Bath meetings have again been suggested by several members now in that locality. Will all those who could attend such meetings, if arranged, please get in touch with Mr. A. S. Williams, BRS7383, 7 Uplands Road, Saltford?

The D.R. was pleased to receive a letter from 8140, of Cinderford, now serving with the R.E. He hopes to attend meetings in Gloucester or Cheltenham in the not too distant future.

G6RB.

DISTRICT 7 (Southern)

D.R.: W. E. Russell (G5WP), "Milestones," Mayford, Woking, Surrey. Woking 1589.

The Southern P.D.M., more fully reported elsewhere in this issue, was a great success in spite of considerable difficulties experienced by the organisers, G2DP, 3ST and BRS3003. Certain objects flying past the windows provided a counter attraction to Clarry's talk, but he rapidly overcame the competition and held the gathering with his engrossing account of Society activities and plans.

Bournemouth.—Following the note in the last issue regarding the possibility of a meeting in Bournemouth the response has been sufficient to bring the proposal into being. Details will be found under "Forthcoming Events" and if there is a worthwhile attendance it is hoped to arrange regular meetings.

(*via* 2HNO.)

Croydon.—The main feature of the June meeting at the Croydon Y.M.C.A., was a talk on "Carrier Telephony," by Lt. E. Illott, 2JK. A most interesting subject with a large scope for experiment and much enjoyed by the 14 members present among whom were 2HP, 2JK, 2UA, 3ST, 5BT, 2HHD, 1545, 3003, 4324, 4584, 5317, 7043, 2DP and a visitor. We were sorry to hear of 3ST's and 4324's bad luck in a recent raid. Congrats to 6RF, M.E.F., on his promotion to Major. He says all the Radio Handbooks are on sale in Cairo including the R.S.G.B.'s. See "Forthcoming Events" for details of the next meeting.

(*via* G2DP.)

Coulsdon.—G2UA has recently been discharged from the R.A.F. on medical grounds after serving for two years in VU as Ft./Sgt. During his stay he met several Dominion amateurs. Our sympathies are extended to 2KU and his parents upon the loss of his sister. 2780, R.C. of S., has been awarded his first stripe.

(*via* 3003.)

Reading.—F. A. Ruddle, 2DIO, addressed the June meeting upon VHF Equipment. Discussion ranged over valves, circuits, and aerials. Thanks are due to 2DIO for the pains he took to clear up many points. After a spell in sick-bay we were glad to hear that 4716, M.E.F., is back in harness once more. Among those present at the meeting were 2IT, 2YI, 5IV, 8KJ, 2BTY, 2BYZ, 2DIO, 2HIY, 4030, 7578, 6957 and the T.R., 4573. G2YI, our Treasurer, again "raked in" some cash for the P.O.W. Fund by means of a raffle. Members in the Services will be very welcome at our next meeting (see "Forthcoming Events") at which 6957 will demonstrate some equipment. Morse practice is to the front again so dig out and polish up your brass. (*via* 4573.)

Southampton.—The June meeting was spent discussing U.H.F. topics. Two receivers, tuning down to 224 Mc/s. employing standard valves, were on view. An attendance of 18 was recorded and although this is a good figure for a war-time meeting we hope to soar higher. Details of the next meeting under "Forthcoming Events."

(*via* G8QW.)

General.—7904, at present a Radio Instructor at an R.A.F. station in the Midlands, sends greetings to 3NQ and would appreciate a line from him. G5WP.

DISTRICT 8 (Home Counties)

Deputy D.R.: L. W. Jones (G5JO), 16, Leys Road, Cambridge. Telephone: Cambridge 3406.

There is little to report this month. A few regulars have written, and there seems to be a tendency for some of them to be planning future amateur activities. Public address amplifiers are attracting attention from one or two members, whilst another local has been brushing up his technical knowledge by servicing a few broadcast sets.

The writer will be pleased to hear from any member who is in the District. G5JO.

DISTRICT 11 (North Wales)

Deputy D.R.: C. Spillane (BRS1060), "Woodside," Meliden Road, Prestatyn.

Airgraphs are to hand this month from G6FK, GW8WJ, 4027, 4728 and 5770. The first-named suggests the formation of "Prestatyn Radio Club Overseas," in which all members who at various times met at Prestatyn might correspond and possibly meet. The writer can forward addresses to those interested.

GW8WJ has met nine French North African amateurs to date. 4728 (R.E.M.E.), now a corporal in Italy, finds a full-time job keeping dust out of his equipment. 5770 (India) is assisting in the operation of the station cinema. He can receive the "All India" radio programme on cinema equipment by shining his torch on the P.E. cell in the sound head! G2GZ, after a spell in hospital, is back on the job again. He has recently enrolled two

new members from his unit, BRS8152, from the Orkneys, and BRS8265, North London, to whom we extend a hearty welcome. BRS7529 (Caernarvon) has been provisionally accepted for R.A.F. air crew. He is working with a local radio engineer pending call up. BRS3789 (R.A.F.), now in District 11, is building a P.P. 6L6 amplifier. BRS1060.

DISTRICT 12 (London North and Herts)

D.R.: S. Buckingham (G5QF), 41 Brunswick Park Road, New Southgate, N.11. Enterprise 3112.

North London.—Our annual outing to the home of G6LL at Cuffley has been arranged for Sunday, July 23rd, when it is hoped, weather permitting, to have the usual fun and games. It is necessary during these times that everyone bring their own food, but tea will be provided. To assist matters members are asked to let the D.R. know if they are coming. The District 15 dinner was attended by five members from No. 12, and a most enjoyable evening spent.

The D.R. acknowledges the receipt of letters from BRS935, 7162, 7634, 7823, 8086, most of whom are enthusiastic for "District Workshops."

St. Albans.—G5QF, 8FJ, 2HAB, BRS4502, 4659, 7097, and 7238 took part in a spirited debate at the last meeting at BRS3412 concerning the best way of improving amateur status. (The suggestions put forward have been sent to Council by 2CNC, who has been advised that in order to carry them out the Society's Articles of Association would require considerable change.—Ed.) Owing to the small attendance no conclusive result was obtained and no vote taken, but the subject is guaranteed to produce much argument and some "heat"! All were in favour of a technical standard, but it was agreed that 12 W.P.M. is a sufficient morse speed and any attempt to raise it would be resisted. The establishment of experimental workshops was considered an excellent idea but too costly for a small local membership. To give the scheme a start in St. Albans the T.R. offers the use of his garage, workshop and tools and 7238 the use of his many drills and metal-working tools by arrangement only. Thanks for the tea are due to 3412's parents and to his lady. G5QF.

Forthcoming Events

July 22	District 4. 2.30 p.m. at 2FQV, 32 Lime Tree Avenue, Peterborough.
July 23	District 1 (Ashton-under-Lyne Section). 2.30 p.m. at A.T.C. Headquarters, Astral House, Stalybridge.
July 23	District 4. 2.30 p.m. at G6VD, 9 Cecilia Road, Clarendon Park, Leicester.
July 23	District 7. 3 p.m. at 2HNO, 45 Parkwood Road, Boscombe.
July 23	District 5. 3 p.m. at 17 Colston Avenue, Centre, Bristol.
July 23	District 12. 3 p.m. at G6LL, "Woodlands," 90 Tolmers Road, Cuffley. (Train to Cuffley Station, then 10 mins. walk.)
July 29	District 7. 6.30 p.m. at The Comrades Club (first floor), 42 Oxford Street, Reading. Talk and demonstration by J. Dee, BRS6957.
July 30	District 4 (Derby and Nottingham section). 3 p.m. at G2OU, 43 Kenilworth Avenue, Derby.
July 30	Districts 7 and 13. Combined Meeting. 3 p.m. at Y.M.C.A., North End, West Croydon.
Aug. 13	District 7. 3 p.m. at Pirelli General Sports Club, Lodge Road, Southampton.

DISTRICT 15 (London West, Middlesex and Buckinghamshire)

D.R.: H. V. Wilkins (G6WN), 539 Oldfield Lane, Sudbury Hill, Greenford, Middlesex. Byron 3369.

The highlight of the month was the District Dinner and Dance, which is reported elsewhere in this issue. (Not received up to the time we closed for Press.—Ed.)

Three reports only have reached the D.R. From F./O. Fletcher comes news that he is now stationed in Norfolk, while 2BMY sends further greetings from India. BRS8136 writes again from Buckinghamshire. G6WN.

DISTRICT 17 (Mid East)

D.R.: A. C. Simons (G5BD), Admiralty Road, Mablethorpe. Phone 69.

Last month's hope of more notes has not materialised. The Louth meeting is still "in the air" for want of information from those who may be able to attend it. So far 1060 and G4BY are the only probables. G2FT has been home on leave, taking back bits and pieces to make up a pre-selector. The D.R. has just finished one which works beautifully, thanks to an excellent circuit supplied by G6LI. G5LL has at last left Sicily for another island nearer. 4160, home on sick leave, called for a yarn. G5BD.

DISTRICT 18 (East Yorkshire)

District Scribe: S. Davidson (G6SO), 10 Sidney Street, Scarborough.

Sgt. G. L. Fish, 7345 (R.E.M.E.) reports conducting a drive for new members although service duties take priority at the present time. Sgt. H. Mills, 5796 (R.A.F.) who now finds himself in Ross-shire, Scotland, after his brief spell in Iceland, mentions a lack of radio activity at his new QRA. Mr. H. L. Rayner, 8270, whom we welcome as a new member is anxious to meet other members especially any in the Hornsea area. His address is "Field Cott," Carrington Avenue, Hornsea. 6SO was pleased to receive a visit from G3FP (R.A.F.) at present stationed in the district. He sends 73 to his many friends in Districts 7 and 13. G6SO.

Northern Ireland

D.R.: J. N. Smith (GI5QX), 19 Hawthornden Drive, Belmont, Belfast. Phone Bel. 63323.

Belfast.—Our sympathies are extended to GI6TK on the sudden illness of his wife. We sincerely hope that she will soon be quite fit and well. GI5HU records a visit from Bill Johnston, 7937, who is busy with amplifier work.

Congratulations are offered to the Notting-Ham Ray Barnes, G6DS, on his promotion to C.Q.M.S. Jerry Dickson, 7936, is awaiting the result of his "C and G" examination. Harold Mills, 5796, is in Scotland after serving for a few months in Iceland. Bill McIlwaine, EI9F, has returned to Eire. At GI6YM (Y.M.C.A. Radio Society) a start is being made with the construction of a code oscillator. The secretary, however, complains of lack of attendance at Committee meetings. This is a poor show remembering the good resolutions made at the A.G.M. Members should keep in mind that GI6YM is one of the very few radio clubs which have managed to keep going during the war and further that it has been one of the chief means of keeping the "ham-spirit" alive in Belfast during this trying period. GI5QX.

Scotland

Scottish Records Officer: J. Hunter (GM6ZV), 51 Camphill Avenue, Glasgow, S.1. Langside 237.

"A" District.—At the June meeting, which was held as usual in The Royal Technical College, Mr. Sey, GM8MJ, gave a very interesting talk on B.E.R.U., A.R.R.L., and N.F.D. contests. His collection of contest Q.S.L. cards gave witness to the results obtained during competitions; they also showed how useful contests are for finding out the propagation qualities of equipment in a short period. The ensuing remarks centred on aerials, and this subject is earmarked for a future lecture. Mr. A. C. Kerr, Radio Officer M.N., paid his first call to the meetings since joining the Society in 1943. He sailed on the same ship as GM2KP, and remarked that George is enthusiastically active building gear despite a long period stationed in the M.E. on board ship.

How about some news, "A"? If you cannot come to the meetings, send it in to the D.O. We know that you aren't all inactive. What results are you getting from those superhets, pre-selectors and oscilloscopes you are building? Owing to the holiday season there will *not* be a meeting in July. GM6ZV.

Southern Provincial District Meeting

There was an attendance of 38 at the Southern Provincial District Meeting held at the Savoy Studios, Broad Green, West Croydon, on Saturday, June 17th, when Mr. E. L. Gardiner, G6GR (President) and Mr. John Clarricoats, G6CL (General Secretary) represented Headquarters. Mr. W. E. Russell, G5WP (District Representative) opened the meeting by introducing the President, who gave a brief outline of current Society activities.

The General Secretary, who followed (complete with his black book!), gave interesting details of war-time progress and told how the Society is keeping in touch with the G.P.O. He also stated that steps were being taken to solicit the aid of Radio Manufacturers in preparing for the post-war amateur market. The good work of the R.S.G.B. P.O.W. Fund was also brought to the notice of members, and reference made to the fact that a separate account had been opened for the benefit of members now in Japanese hands. After tea had been served the Secretary conducted a Dutch auction for six packets of special headed notepaper donated by Mr. De Leeuw, and a crackle finished steel cabinet. The sum of £14 was thereby raised for the P.O.W. Fund.

Photographs were taken at the conclusion of the meeting but they were unfortunately a failure.

The following is a complete list of those present:—G2DP, HP, JK (& YF), MR, NH, UA, VB, YL, 3ST, 4FB, NI (& YF), 5BT, (& YF), WP, 6CL, GR, NF, 8RN, 2ADL, 2DBK, 2HCZ, 2HMV, 1545, 2780, 3003, 4324, 4584, 5301, 5317, 5332, 7943, 8141, VE3ASJ and three visitors.

★ **IS YOUR SUBSCRIPTION DUE? PROMPT PAYMENT ASSISTS HEADQUARTERS**

COUNCIL 1944

President:
ERNEST LETT GARDINER, B.Sc., G6GR.

Executive Vice-President: S. K. Lewer, B.Sc., G6LJ.
Honorary Secretary: H. A. M. Clark, B.Sc., G6OT.
Honorary Treasurer: A. J. H. Watson, A.S.A.A., G2YD.
Honorary Editor: Arthur O. Milne, G2MI.
Immediate Past President: A. D. Gay, G6NF.

* *

Members: F. Charman, G6CJ, D. N. Corfield, D.L.C.(Hons.), G5CD, Group Capt. G. R. Scott Farnie, GW5FI, F. Hoare, G2DP, Wing-Com. J. Hunter, G2ZQ, W. E. Russell, G5WP, H. W. Stacey, G6CX.

General Secretary: John Clarricoats, G6CL.

May Council Meeting

Resume of the Minutes of a Council Meeting held at New Ruskin House, Little Russell Street, W.C.1, at 6 p.m., on Monday, May 22nd, 1944.

Present.—Messrs. E. L. Gardiner (President), S. K. Lewer, H. A. M. Clark, A. J. H. Watson, A. O. Milne, A. D. Gay, A. E. Watts, F. Charman, D. N. Corfield, F. G. Hoare, W. E. Russell, H. W. Stacey, and J. Clarricoats (General Secretary).

An apology was received from G./Capt. G. R. Scott Farnie.

1. It was unanimously resolved to elect 170 Corporate Members (134 proposed by Corporate Members, 36 supported by references) and 12 Associates.

2. The monthly balance sheet and statement of account was presented and adopted.

3. It was resolved to loan a further sum of £1,000 to H.M. Government free of interest.

4. It was agreed to place orders for an 11th printing (30,000 copies) of the Handbook and a 4th printing (20,000 copies) of the Supplement. It was reported that 20,000 copies of the 10th printing of the Handbook and 12,000 copies of the 3rd printing of the Supplement had been sold in four months.

5. In view of the possibility that at some future date it may be found possible to send parcels to members who are held prisoner of war by the Japanese, it was resolved that the Society shall transfer the sum of £270 forthwith from the R.S.G.B. P.O.W. Fund account, to a second account to be known as the " R.S.G.B. Prisoners of War (Far East) Fund " and that the Society's Bankers shall be instructed to transfer from the main Fund further sums of £20 per month until further notice. It was further resolved that the present " R.S.G.B. Prisoners of War Fund " account shall be transferred to a new account to be known as the " R.S.G.B. Prisoners of War (European) Fund."

6. It was agreed to invite members to express a preference for either Friday evening or Saturday afternoon meetings at the Institution of Electrical Engineers, commencing September, 1944.

7. It was resolved that the Society shall open a new account to be known as the " Pilot Officer Norman Keith Adams Trust " account. It was also agreed that the Adams Trust Deed shall be deposited with the Society's Bankers for safe custody.

8. Matters relating to the revision of the licence application forms in use by the G.P.O. prior to the war were discussed. It was agreed to review the proposals made to the G.P.O. by the 1939 Council, and to prepare an up-to-date statement of licence policy.

9. Due to the lateness of the hour it was agreed to defer discussion on a suggested meeting with representatives of the radio trade.

10. It was reported that a successful P.D.M. was held in Leeds on May 14, 1944.

The meeting closed at 9.40 p.m.

R.S.G.B. Prisoners of War Fund

DONATIONS.—The General Secretary acknowledges with thanks, on behalf of Council, receipt of donations from :—District 7 (Reading), £1 2s. 6d. ; J. Bence, 4289, 6s. ; T. Gafner, 6721, 5s. ; District 1 (Liverpool), £1 ; Mrs. O'Hagan, 9s. 6d. ; P. W. Moores, ZE1JA, £2 2s. 6d. ; R. P. Udall, 2HKS, 10s. ; S. J. Geary, G3MO, £1 1s. ; W. A. Scarr, G2WS, 5s. ; A. E. Hockstein, SU1AX, £15 ; F. Elser, W6ANM, £1 ; J. A. Reading, G3RX, 6s. ; E. W. Thompson, G8BG, 5s. ; Students' Union, Southampton (Proceeds of Dance), £3 5s. ; Anon, £10 ; W. Larbey, 2DWV, £1 5s. ; R. L. Hamers and Friends, £2 ; Croydon Meeting, £14 ; District 15 Meeting, £3 10s. ; C. M. Freer, 4781, 3s. ; District 13, Croydon, 11s. ; H. McFadzean, 5349, 5s. ; **Total receipts to date, £1308 14s. 4d. Expenditure to date, £731 6s. 1d. Balance in hand as at June 30th, 1944. European Fund £287 8s. 3d. Far East Fund £290 0s. 0d.**

THANKS U.C.S.—As the result of a dance organised by the University College Southampton Amateur Radio Society, the R.S.G.B. Prisoners of War Fund has benefitted to the extent of £3 5s. 0d. Appreciations are recorded to the Honorary Secretary (Mr. C. D. Pomeroy) and his colleagues.

Difficult Times

We crave the indulgence of members for delays, omissions or errors which may occur in the publication of this issue or in the handling of routine Society business. We are operating under difficult conditions.

Headquarters Address

A considerable amount of official Society correspondence is still being delivered to the General Secretary's private address. This, in spite of frequent requests for all R.S.G.B. correspondence to be sent to New Ruskin House, 28/30 Little Russell Street, London, W.C.1.

Those who act as sponsors to applicants for membership are kindly requested to record the above address on the application form, if the latter bears the temporary war-time address of the Society, *viz.* 16 Ashridge Gardens, Palmers Green, London, N.13.

When communicating with Headquarters the Society's name must *always* preface the address. Embarrassment and delays are often caused because letters intended for the Society are opened by one of the other firms operating from New Ruskin House.

Changes of Address

Members who change their permanent address are asked to note that at least one month must elapse before the change can become effective for BULLETIN despatch purposes.

The Society cannot, under existing conditions, send the BULLETIN direct to a Service address. Members on Active Service should arrange for re-direction from their home address. Provided re-direction is effected promptly, no additional postage is required.

Technical Publications

The attention of members is directed to the fact that no facilities exist at Headquarters for obtaining technical publications other than the American publications listed below. Considerable inconvenience is caused by members who send cheques and postal orders for other publishers' books when forwarding either their subscription or an order for American publications.

American Publications

The Society is in a position to accept orders for the following publications which are ordered individually from America :

" QST " (Official monthly publication of The American Radio Relay League). By subscription, per annum	17s. 6d.
" The Radio Amateur's Handbook " (A.R.R.L.) ..	10s. 6d.
" The Radio Amateur's Handbook "—Special Defence Edition (A.R.R.L.)	8s. 6d.
" The Antenna Handbook " (A.R.R.L.)	4s. 0d.
" A Course in Radio Fundamentals " (A.R.R.L.) ..	3s. 6d.
" The Radio Handbook " (Editors and Engineers Los Angeles)	12s. 0d.

Orders must be accompanied by a remittance made payable to the Society and rates and prices are subject to alteration without previous notice. Delivery can be expected in about 12 weeks from date of order. Service Addresses must not be used. Single copies of text books only may be ordered.

Subscriptions to " Radio "

Until further notice no further subscriptions to the American monthly publication *Radio* can be accepted by the Society.

The Amateur Radio Handbook

The tenth printing (22,500 copies) of the Society's Handbook is now on sale price 4s. post free. Cloth bound copies are also available, price 6s. 6d. Headquarters will be pleased to allow trade terms on orders for 12 or more copies.

The Radio Amateurs Society (South Africa) stand at the World of Models Exhibition held in the City Hall, Johannesburg, last September.

POST-WAR DREAMS—(*continued from page 6*)

Now I shall be able to try out my ideas on one transmitter and always have one ready to go on the air. As a result any modification or experiment I carry out will be fully tested and tried and when incorporated it will be built in as a proper unit.

And what, may one ask, is there to experiment on anyway ? Well, there are so many fields to explore that I cannot name them all—here are a few I am determined to tackle—multi-wire aerials, loop aerials wave guides, frequency modulation, cathode coupling for audio and R.F., carrier suppression, frequency control, low-level modulation, 112 and 224 Mc/s., and television (yes—why not television transmission ?). Enough work here to keep me happy to a ripe old age, I'll be bound. When it comes to aerials, well, my dreams just run riot—super aerials, acres of land, 70 ft. masts—but wait—I shall still have to earn my living and an unsympathetic employer may not see eye to eye with my request to live in the country and up a hill ! So I refuse to dwell on this most delectable subject until I am sure that I can establish my home and my " op's room " in a suitable bit of country.

Finally, my whole station, whether it be a B.B.C. type as described above, or a simple CO.-PA.-T.R.F. is going to be " open house " to any amateur or prospective amateur who cares to come around, and I know that Mrs. 3ZI will co-operate with home-made cream sponges and lashings of tea ! And so with lots of gear and lots of space and lots of friends, I for one, am determined that my post-war amateur activities are going to be beneficial to one and all, and above all, to the advancement of the amateur spirit.

KHAKI and BLUE

● Mr. R. F. Galea, **ZB1E,** sends greetings from Malta G.C., to all members who have met him during the war years. Bob's hospitality has been eulogised by many members who have visited H.Q. on their return to the U.K. For the information of those stationed in Malta and who have not yet met the " good Samaritan," his address is 20 Collegiate Street, Kirkirkara.

● S./Ldr. Frank Adams, **G2YN,** in a letter from S.E.A.C., R.A.F., passes on the news that Ken Jowers, **G5ZJ,** (now a Wing Commander) was recently married. Frank is now a member of the Duration Dx-ers Club and is associated with S./Ldr. Edge, G6GD and S./Ldr. Osmond, who was for some years A.C.I. at Cranwell.

● L.A.C. R. J. Leworthy, **2HGJ,** whose home address is 6 Goldwell Road, Thornton Heath, Surrey, is anxious to meet District 9 members. He is serving with the R.A.F. at a station in Norfolk.

● J. C. Ford, **2DWW,** late of the R.A.F., would like to contact 2DTQ and 2CMN. His home address is 55 John Street, Dunoon.

● Speedy recovery to S./Ldr. Arthur Hibbins, **BRS3887,** who was operated upon recently. " Hibby " is known to several " generations " of war-time members who have served at Cranwell. They will be glad to hear that he is again beginning to take " nourishment " !

● That inseparable pair S./Ldr. Brookes, **G5OI** and F./Lt. F. J. E. Starkey, **GW6KY,** after serving together as " Early Birds " and later in the Middle East, are now at an R.A.F. station in South Wales.

● L.A.C. N. D. Glass, **2FFM,** reports that the first of a new series of ham gatherings was held in Alexandria early in June, when G5BR, 8GG, 2DKX, SU1AX 1MS and 1HT, were in attendance. The question of obtaining a Club Room, with workshop facilities, as suggested in the April BULLETIN, was considered.

● Sgt. G. R. Statham, R.A.F., **BRS4500,** writing from C.M.F., wishes to be remembered to the many friends he met in North Africa. He holds periodical " gen " sessions with others interested in amateur radio.

Radio Amateurs Society

Mr. W. Ensor (Hon. Secretary, Radio Amateurs Society, South Africa) advises that a club for radio amateurs has been opened in Cape Town. Meetings are held on the first Thursday of each month at 7.30 p.m. at 73 Loop Street (2nd Floor, Randall House). The address of the local Secretary is Box 3037, Cape Town. British Isles amateurs are assured of a warm welcome.

Mr. Ensor also reports that a club has been started in Port Elizabeth. Details can be obtained from ZS2Y, 14 Hudson Street, Newton Park, or ZS2X, 120 Upper Valley Road. A Bloemfontein club is in the process of being formed.

Next Cairo Meeting

Members serving in the Middle East are reminded that a United Nations Amateur Radio Meeting will be held at the Bystander, Cairo, on Friday, November 24 next. Full details can be obtained from Mr. W. E. Marsh, SU1WM, 3 Rue Kattini, Tanta, Egypt.

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