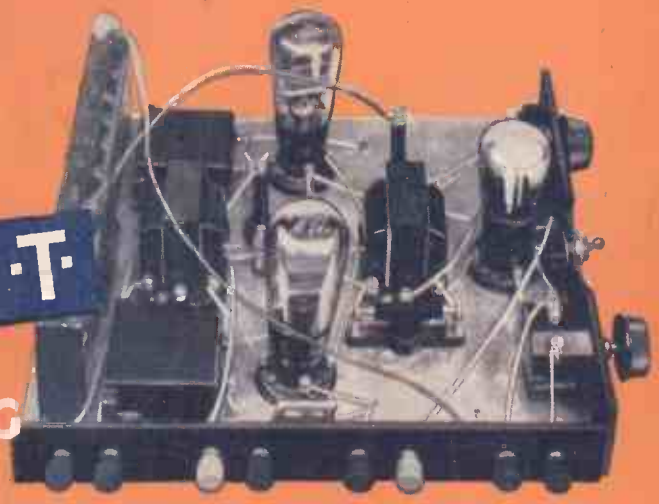
The Wireless Constructor

6d

Vol XV. APRIL, 1933. No. 78.

A Q.P.P. AMPLIFIER SAVES YOUR H.T.

By VICTOR KING



L.H. THOMAS DESCRIBES THE "SPAN-SEAS" TWO

AND MORE EXCLUSIVE ARTICLES by JOHN SCOTT-TAGGART

CONTENTS

As some of the arrangements and specialties described in this Journal may be the subject of Letters Patent the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

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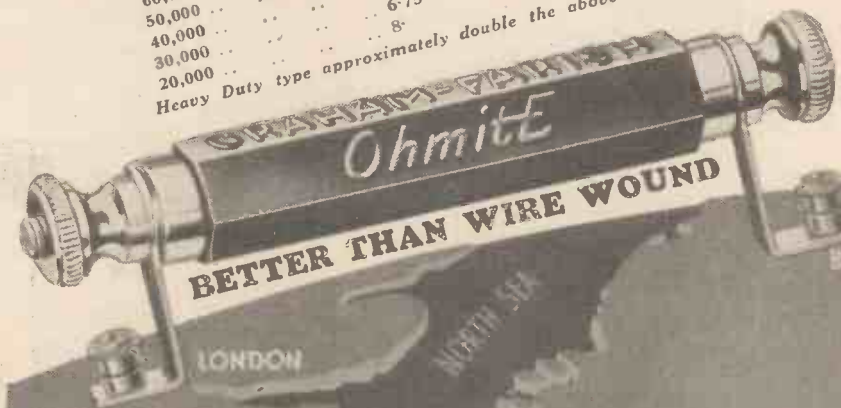

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The WIRELESS CONSTRUCTOR

The EDITOR'S CHAT

This Month's Designs—Unworkable Sets—Look Out for Duds

THE two outstanding constructional features in this month's issue of THE WIRELESS CONSTRUCTOR are a short-wave two-valver, designed by a prominent short-wave transmitter expert, and a Victor King Quiescent Push-Pull Amplifier.

The latter is, of course, for radio or pick-up use, and is based on the new method of amplification which, as every reader knows, is producing quite a stir at the present time because of the economy it provides in battery current; and also because of the large output it can handle.

I particularly draw readers' attention to Victor King's latest design—a design which, it has been proved, will equal mains receivers in volume and quality, and yet will work from H.T. batteries.

The "Span-Seas" Two, the name of the short-waver described by L. H. Thomas, was intended mainly to be a very simple set to make and use; but, as the designer explains, the set turned out to be one of the most efficient short-wavers he had ever tackled. So here, again, is another striking example of how efficiency and simplicity often go hand in hand.

Sets Which Won't Work

As may be gathered from Mr. Scott-Taggart's "Armchair Notes" this month, our distinguished contributor has recently been in Nottingham, and readers will note with relish his caustic description of seeing an "S.T.400" in a window which "was a pretty good imitation using all the components I had carefully excluded from my list."

Now, as S.T. quite rightly points out, someone will probably buy that set and then blame him.

The particular "S.T.400" which Mr. Scott-Taggart saw in a shop in Nottingham was not only built from components which had been deliberately excluded from the designer's list, but the anode and aerial coils had their positions reversed.

Some enthusiastic, and possibly ignorant, amateur will, quite likely, spend his hard-earned money on that set. And he will be puzzled and grieved when, on taking it home, he finds it won't work. And we all know, when suffering from keen disappointment and the feeling that we have been swindled, that the impulse to sit down and write a stinging letter to the designer of a set is almost irresistible.

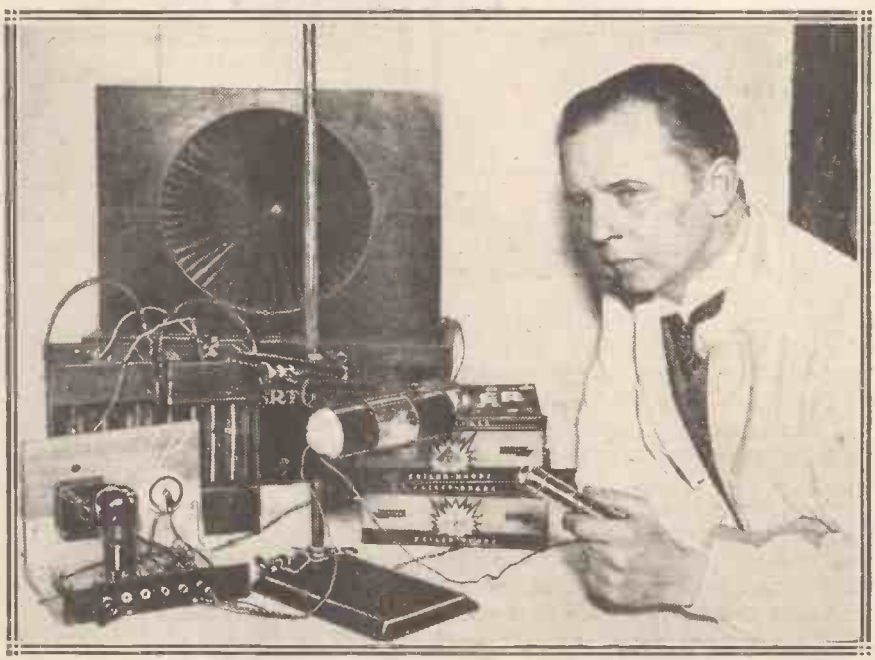
Well, I am going to do all I can to protect readers from this sort of nonsense, because it is nonsense, and nonsense which does a terrific amount of harm to radio as a hobby.

Have You Seen One?

So keep your eyes skinned when passing by a wireless shop, or any type of shop which is offering for sale an "S.T." or other WIRELESS CONSTRUCTOR receiver, and in which, with your eagle eye, dear reader, you detect some obvious fault which you know will prevent the receiver from working properly.

When you have got your evidence, send it to me at Tallis House, Tallis Street, London, E.C.4. I need hardly say that any such letter will be treated in the strictest confidence.

MUSIC FROM THE "JOWIPHON"



Joachim Winckelmann, with his remarkably interesting instrument, the "Jowiphon." It uses a photo-electric cell, through which is passed a continuous current producing a musical note. By varying the light falling on the cell, corresponding variations of tone are obtained, and thus the apparatus can be "played" by light control.

THE MONTH ON SHORT-WAVES

All the latest news about this interesting band.

THIS is "beginners'" month! For the last few weeks I have been conducting an investigation into the causes of failure with newcomers to this great game of short-wave ether probing.

The results are illuminating, to say the very least of them.

So Very Different

Apart from the usual small percentage of failures due to faulty components (almost an insignificant number), my inquiries have brought to light the fact that "no signals" in the case of most newcomers signifies one of two things.

Short-wave reception is so very different from ordinary broadcast work that the tendency is to manipulate the dials much too rapidly, or else—and this was the real surprise—reception of a particular station is attempted when it doesn't happen to be transmitting!

Concerning point number one, there is, I am afraid, little that I can do, for it is so much a case of practice making perfect. But to afford some guidance in the second respect *is* definitely within my province, and so I have prepared a half-hourly tuning table which is correct to the time of going to press. The times are reduced to G.M.T., and in all other respects the table will be self-explanatory.

It will be noticed that two very famous short-wave stations—Nairobi, Kenya, and Sydney, Australia—do not appear in the guide given below. That is because they are only on during the daytime and early evening.

Nairobi, on 49·5 metres, can be heard daily between 4.30 and 7.30 p.m.; but Sydney, on 31·28 metres, is only available on Sundays. The transmission times are 6–8 a.m., 9.30 a.m.–1.30 p.m., and 2–4 p.m.

G. T. K.

HALF-HOURLY TUNING GUIDE

METRES	8.0—8.30 P.M.
16·87	Bound Brook, N.J. (W 3 X A L). Daily.
19·56	Schenectady, N.Y. (W 2 X A D). Daily except Tues., Thur., Sat.
19·72	Pittsburg, Pa. (W 8 X K). Daily.
25·5	Chapultepec (X D A). Daily.
25·6	Winnipeg (V E 9 J R). Daily except Sat.
25·63	Radio Coloniale (Paris). Daily.
30·43	Madrid (E A Q). Sat.
31·35	Poznan, Poland (S R 1). Tues., Thur.
31·38	Zeesen (D J A). Daily.
31·51	Skamlebaek, Denmark (O X Y). Daily.
32·26	Rabat (Radio Maroc). Sun.
48·0	Casablanca (C N 8 M C). Mon., Tues.
49·0	Johannesburg (Z T J). Daily.
49·43	Vancouver (V E 9 C S). Sun.
49·5	Cincinnati (W 8 X A L). Daily.
50·0	Barcelona (E A J 25). Sat.

METRES	8.30—9.0 P.M.
16·87	Bound Brook, N.J. (W 3 X A L). Daily.
19·56	Schenectady (W 2 X A D). Sun.
19·72	Pittsburg (W 8 X K). Daily.
25·5	Chapultepec (X D A). Daily
25·6	Winnipeg (V E 9 J R). Daily except Sat.
25·63	Radio Coloniale (Paris). Daily.
28·98	Buenos Aires (L S X). Daily.
30·43	Madrid (E A Q). Sat.
31·3	Daventry (G S C). Daily.
31·35	Poznan, Poland (S R 1). Tues.
31·51	Skamlebaek, Denmark (O X Y). Daily.
32·26	Rabat (Radio Maroc). Sun.
48·0	Casablanca (C N 8 M C). Mon., Tues.
49·43	Vancouver (V E 9 C S). Sun.
49·5	Cincinnati (W 8 X A L). Daily.
49·18	Chicago (W 9 X F). Daily.
50.0	Barcelona (E A J 2 5). Sat.

(*Please turn to page* 448)

"ON THE GRID"

The airman's distress call—Warm your motor—Radio-set fashions—"Q.P.P."

"MAY DAY"—what pleasant memories of spring flowers and blue skies are usually conjured up by the words. But they have another association, and a far from pleasant one, too, for "May Day" has the same sinister meaning to the airman as the distress signal S O S holds for the sailor.

I felt contrained to mention this term in passing, because it may have puzzled some to know just why it came to signify an aircraft in danger. The explanation lies in a similarity of pronunciation.

The term has its origin in the French "*m'aidez*," meaning "help me," and which is pronounced "may day."

It is an international call, but is used in radio telephony communication only.

Thinning the Oil

Here's a tip for the cold weather we are experiencing just now (although I bet we shall be having a foretaste of summer by the time you read these notes!).

The oil in your gramo motor will get thick if you keep it in an unwarmed room, and a little sojourn before a fire will be advisable prior to putting on a record. Otherwise, you'll be bothered with a slowing up on loud passages for quite a long time, until the use of the motor thins down the oil.

The Next Fashion?

Selectivity has the biggest influence on radio receiver fashion. During the last few years the need for sharper tuning has produced a tremendous change in the most popular receiver.

Previous to this change the det. and 2 L.F. receiver was without any doubt the most popular design.

The necessity of separating more and more stations caused its downfall as favourite. It could not keep pace with modern developments. That is the reason for the rise to fame of the S.G., det., L.F. (with pentode output valve in the case of all-mains models), the most popular receiver of to-day.

What will the next fashion be? I do not think I am risking much in prophesying the superhet, although it has many, many improvements to come first.

Push-Pull Transformers

Those who have push-pull transformers of the "old," or ordinary type, may have wondered why they are unsuitable for quiescent push-pull amplification. In practice they *would* work after a fashion, the differences between the two types being quite small.

A higher ratio constitutes the difference in the input transformers. The idea is to provide a bigger voltage step-up so that full advantage is taken of the bigger grid voltage handling properties of the output valves.

With the output transformers or chokes, impedance is the critical factor. And the reason: the more negative bias on a valve the higher its internal impedance. This results in a higher anode-circuit impedance being required to give correct matching of output circuit and valve.

A. S. C.

THE TRUTH ABOUT THE COLD VALVE

Recent reports and rumours about the cold valve have produced quite a stir amongst home-constructors, who have been asking: "What is it?" "What will it do?" "How does it work?" In this article the mysteries of the new invention are cleared up.

By JOHN SCOTT-TAGGART, A.M.I.E.E., F.Inst.P.

WE have not had a real slap-up, honest-to-goodness, epoch-making revolution in radio for at least three months.

It must, therefore, have been refreshing to read about the new "cold valve" in the daily press.

NO BATTERIES FOR THE DETECTOR

A saving of both high-tension and low tension is effected when a metal rectifier is used in the detector stage.

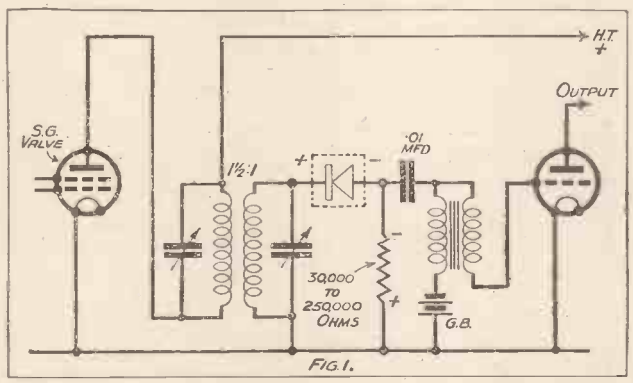


FIG. 1.

Unfortunately, this kind of excitement never lasts; because sooner or later you will buy a radio journal which will give you the low-down on the matter—and the will-o'-the-wisp flits farther away.

"Not So Hot"

In any case, I consider a cold valve as "not so hot," even if developed. You would still need a battery for "H.T.", of course. The L.T. accumulator would go, and would not be missed, but no new *effect* would presumably be obtainable with the valve.

Meanwhile, a real cold *two-electrode* valve has been developed by the Westinghouse rectifier people, who were in no way responsible for the newspaper exaggerations. Everyone knows of the metal sandwich (with a film of copper oxide as the jam) which provides so many commercial and amateur sets with their H.T. (Details were given by me in the issue dated July, 1932.)

An Obvious Possibility

This sandwich has been used for rectifying A.C. of the order of 50 cycles per second. It has been pretty obvious to all of us that such a device *might* be adapted for rectifying wireless H.F. signals, which—on the medium waveband—have a frequency of the order of 1,000,000 per second.

But it was still more obvious to the man who was developing the Westinghouse rectifier. The present cold valve is really a metal sandwich having a cathode surface which is equivalent to the electron-emitting filament or cathode of a diode "hot" valve, and an anode surface pressing against it.

This arrangement, as a matter of fact, is not new as a wireless device. It is not a development of the metal rectifier so as to make it responsive to very high-frequency currents.

The inventor of the metal rectifier proved so far back as 1925 that the device was not only suitable for power rectification of "L.F." currents, but would rectify H.F. of the order of 3,000,000 cycles per second.

This ability to respond without time lag has proved of very great value, and the Westinghouse people have been perfecting the device since 1925 or 1926 until to-day they have just begun to market a rectifier which possesses great potentialities as a device for replacing two-electrode valves in wireless circuits.

Reducing Capacity

The problem to solve before a satisfactory rectifier for H.F. could be marketed was to reduce the capacity of the rectifier, thereby preventing the undesirable shunting of the radio-frequency currents; also, it was desirable to raise the impedance because radio H.F. circuits are of relatively high impedance.

I doubt whether this Westinghouse detector can be regarded as "better" than a thermionic valve diode. It does, however, possess the advantages of cheapness, permanence, reliability, quiet operation, and other merits likely to prove its value in many circuits where "diodes" are now used.

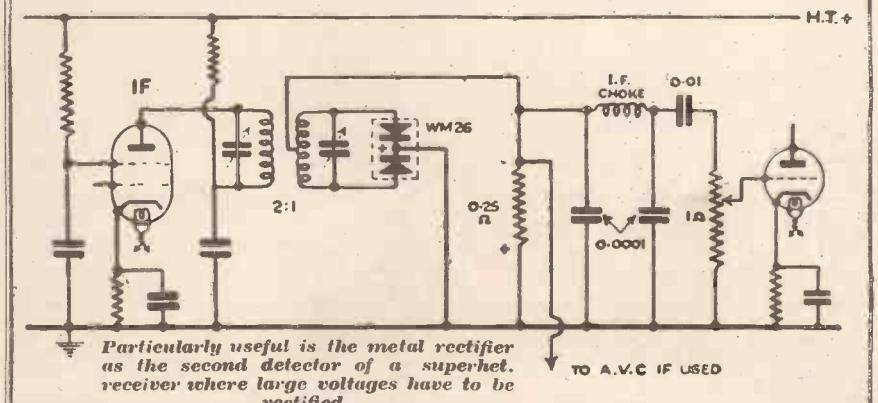
For Mains Superhets

The home-constructor is not as immediately interested as the manufacturer of, say, a mains superhet. There is a definite tendency for the more ambitious set to use diode or double-diode rectification, partly in order to handle the power and very largely to obtain linear rectification.

The average valve detector gives, say, from 8 per cent to 20 per cent

FULL-WAVE RECTIFICATION FOR H.F.

FIG. 2.



Particularly useful is the metal rectifier as the second detector of a superhet. receiver where large voltages have to be rectified.

The Truth About the Cold Valve—*continued*

second harmonic distortion—due to the slope of the "curve" of the rectifier. The diode type of thermionic valve can be designed to give purer rectification, and the Westinghouse "cold valve" can handle 20 volts of H.F. input when four sandwiches are connected in series, or 30 to 40 volts when a six-sandwich rectifier is employed. A single sandwich will rectify without appreciable distortion from ¼ volt to 6 volts. The standard rectifiers are of the 4- and 6-unit types.

As Second Detector

A particularly useful place for the Westector (as this metal rectifier is being called) is as the second detector in a superheterodyne receiver. The H.F. swings may easily reach 20 volts in this position, and I have personally substituted the Westector for a double valve diode without making any changes whatever in the circuit and yet getting just as good results.

But the Westector is not going to replace all valve detectors. In fact its use in home-constructors' sets will not, in the first place, at any rate, be extensive. It will not, of course, amplify, but on the other hand it releases one valve which can probably be put to better use as an H.F. amplifier.

The damping of the Westector is very considerable on, say, medium waveband signals, thus impairing selectivity. This means that we will not have to regard the input H.F. circuit as an important contributor to the selectivity of the set. (In the "S.T.400" the detector input circuit serves an exactly opposite purpose; it is extremely selective, there being no grid circuit damping due to the detector.)

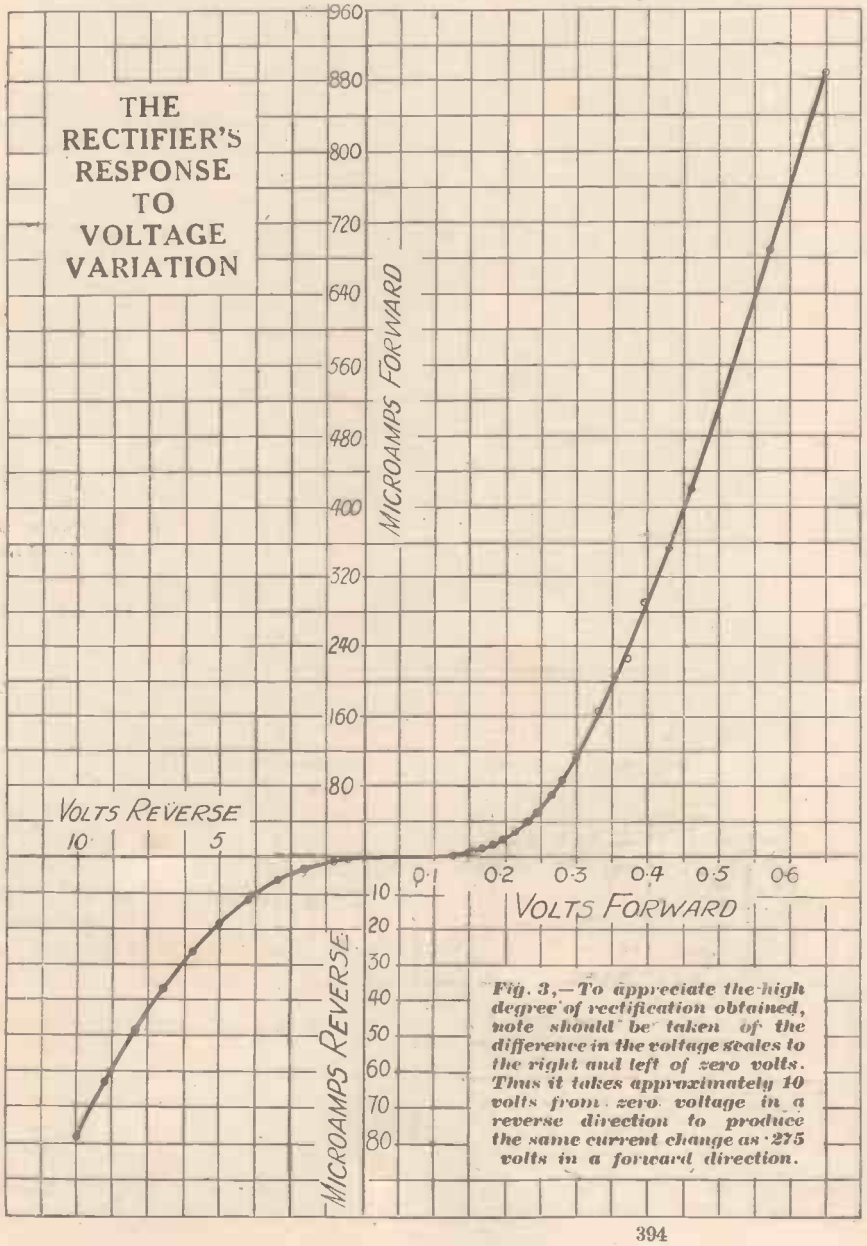


Fig. 3.—To appreciate the high degree of rectification obtained, note should be taken of the difference in the voltage scales to the right and left of zero volts. Thus it takes approximately 10 volts from zero voltage in a reverse direction to produce the same current change as 275 volts in a forward direction.

Two H.F. Stages

It seems highly likely, therefore, that two H.F. stages will be necessary in a straight set using the Westector. In a superhet, however, the "damping" introduced by the device is very, very much less, as the frequency of the currents applied to the detector are of intermediate frequency (commonly 127 kcs.).

In a straight set the Westector, I should imagine, will operate best if worked from an H.F. pentode. I doubt if the best results can be obtained from an ordinary S.G. valve. It must be remembered that the Westector is a power-operated device, and the preceding apparatus must be of a kind designed with that fact in mind. An anode-bend detector (as in the "S.T.400") is purely a potential-operated detector.

The Westector may be used either to rectify on the half-wave or full-wave principle. The latter arrangement, of course, will require two of the rectifiers. The full-wave scheme will introduce greater damping, but more rectified carrier-wave is obtainable, and this is useful on sets using automatic volume control where large voltages are required to control the variable-mu H.F. stage. The alternative to obtaining these large voltages direct is to use an amplifying valve which, of course, is really a wasted valve.

Characteristic Curve

In Fig. 3 is reproduced a characteristic curve of a *single* Westector disc—not the 4- or 6-disc assembly such as will be sold to the public. But it shows very strikingly the rectifying properties of this permanent device. It should be specially noted that the reverse current (which is not wanted) is drawn on a different scale to the main curve. Likewise, the reverse volts are drawn on a different scale.

(*Please turn to page 444.*)

The "SPAN-SEAS" TWO

A highly efficient receiver for use on short-waves, especially designed to provide the utmost simplicity in construction and operation.

By L. H. THOMAS (G6QB)

THE simple short-wave receiver about to be described is rather a curiosity. When I started work on it, the idea behind it was really to design a completely fool-proof short-waver for the novice; one that anyone could build "in the dark" with the certainty of obtaining exactly the same results as those given by the original set.

For this reason everything in the nature of a complication was omitted from the circuit, and at the same time anything that was in the least likely to cause trouble was looked after.

For Novice and Expert

I had expected the result to be a short-wave set that, while being thoroughly reliable and simple, might possibly fall short of the average "two" so far as results were concerned.

This would have been perfectly satisfactory, since a set for the novice *must* be completely "snag-free," even if the designer has to sacrifice results slightly.

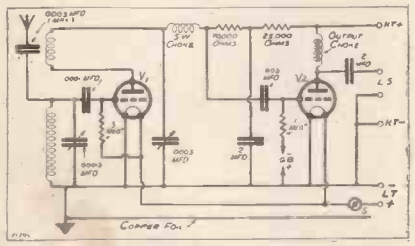
This was all right in theory, but it did not work out in practice. Rather to my own surprise, the set turned out to be so good that it has, for the present, ousted my own receiver from the test-bench! I have not the least hesitation in saying that this set is the best short-wave two-valver that I have ever made, and that it is, at the same time, eminently suitable as a "first set" for those who have never touched short waves before.

Possibilities of R.C.

For some reason or other, we all seem to have overlooked, to a great extent, the possibilities of resistance-coupling for the L.F. amplifier in a short-waver. Sets have been made with two L.F. stages, the second being resistance-coupled, but very few have used "R.C." immediately after the detector.

The use of this form of coupling provides, at once, a complete cure for that bugbear of short-wave work —"threshold howl." This fault has driven many good men to distraction, since it can be caused in a variety of ways, and about twenty different cures have to be tried before it can be got rid of with any certainty.

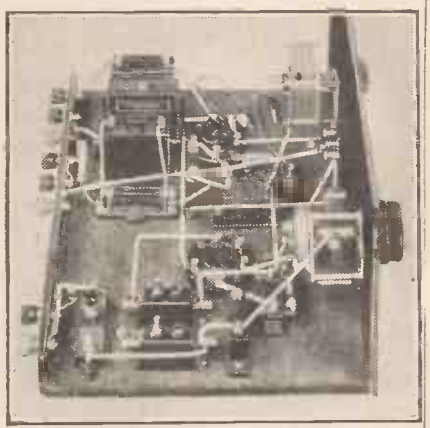
The whole thing, however, is tied up with the use of transformer-coupling; and presumably the only reason why more sets using resistance-coupling have not been designed is that the designers were afraid that the amplification obtainable would not be great enough.



NO THRESHOLD HOWL

The main feature of the circuit is the use of resistance-capacity coupling between the two valves. Not only does this produce smooth reaction, but it also provides a quiet background.

HAND-CAPACITY AVOIDED



The baseboard is covered with foil on the underside, an arrangement which is conducive to safety and absence of hand-capacity troubles.

The Limiting Factor

The point that has been overlooked is this—that by the time a transformer-coupled set has been "tamed" and "damped" to get rid of the threshold-howl trouble, the amplification has often been reduced so much that R.C. would be even *better* in this respect.

All this applies only to sets in the "novice" class, for it is possible, by somewhat elaborate means, to make any set "threshold-howl-proof" without losing amplification in the process.

But there is yet another point to watch. The limiting factor on short waves is usually not the weakness of the stations to be received, but rather the amount of "background noise" through which they have to be found. For this reason we often find that the man using a detector only will receive more stations than his neighbour with one or two note-mags.

The reason for this is simply that, although the man with the big set is *receiving* the stations—and receiving them at much greater strength than the single-valve man, as one would expect—he is losing them in the perfect welter of "mush," hissing and frying noises that are all being amplified out of proportion to the stations that he is trying to get.

An Unfortunate Habit

The average L.F. amplifier, through no fault of the designer, has an unfortunate habit of magnifying the weak station by perhaps 400 per cent,

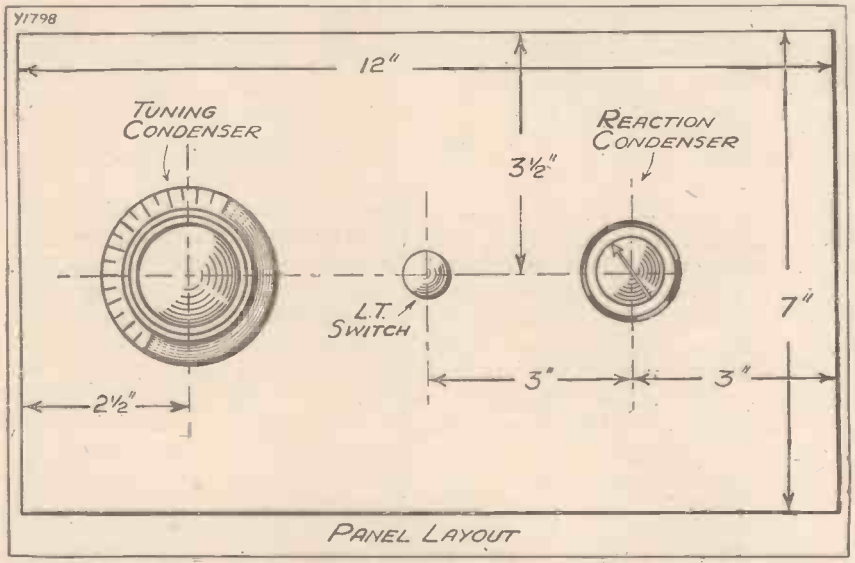
The "Span-Seas" Two—*continued*

and the mushy background by 600 per cent or more. The result is that for really weak stations we become worse and worse off as we add valves!

Some of this extra mush is undoubtedly due to the reception of long-wave, high-powered commercial stations on the primary of the L.F. transformer. This has been proved again and again by laboratory experiments. Also, the best transformer made cannot help giving us more amplification of "mush," which is a highly complex mixture of all the audible frequencies and several others as well, than of "station."

Resistance-coupling is another story, and, in practice, it works excellently. And with this somewhat long-winded preamble we had better proceed to the description of the receiver itself.

TYPICAL OF THE SET'S GENERAL SIMPLICITY



Only three holes have to be drilled in the panel, except, of course, for those along the bottom edge to take the fixing screws.

The theoretical circuit is so perfectly straightforward that there is not much that *can* be said about it. The detector uses the normal series-fed, throttle-controlled reaction circuit. Two plug-in short-wave coils are employed, and the grid coil is tuned by a ·00013 condenser with a good slow-motion drive. The grid condenser is on the small side (·0001) and the grid-leak used has a value of 3 megohms.

Circuit Details

The latter value is not critical, and the grid leak should really be chosen to suit the particular valve in use. Smoother reaction is sometimes achieved by using a leak with a value of 5, 7, or even 10 megohms. The leak, incidentally, is taken to the positive leg of the detector filament, and there appears to be not the slightest necessity for using a "potentiometer return" scheme.

Reaction is controlled by a ·0003 condenser, and the H.T. is fed to the valve through a 25,000-ohm decoupler, a 70,000-ohm anode resistance, and a short-wave H.F. choke, finally passing through the reaction coil, as series-feed is used. This arrangement is usually preferable to parallel-feed for short-wave sets, since one is not so entirely at the mercy of the H.F. choke.

The detector is coupled to the next valve through a ·002-grid condenser, and bias is supplied to that valve through a leak of 1 megohm. An output choke is used, and a 2-mfd. condenser couples the loudspeaker or 'phones to the anode.

Smooth Reaction

The other 2-mfd. condenser is the "by-pass" section of the decoupler, which is, I believe, largely responsible for the stability and the smoothness of reaction control.

YOU MAY HAVE MANY OF THE NECESSARY PARTS ON HAND

1 Panel, 12 in. × 7 in. (Goltone, Permcol, Wearite, Becol, Peto-Scott, Lissen, Direct Radio).
1 Baseboard, 12 in. × 10 in.
1 Cabinet for 12 in. × 7 in. panel and 12 in. × 10 in. baseboard (Gilbert, Cameo, Lock, Morco, Peto-Scott, Osborne, Direct Radio, Pickett).
1 ·00013-mfd. or ·00015-mfd. tuning condenser (Ormond type R491A, Polar, J.B.).
1 ·0003-mfd. max. preset condenser (Formo, Goltone, Sovereign, Polar, Telsen, Ormond, Colvern).
1 ·0003-mfd.–·00035-mfd. air dielectric reaction condenser (Utility, J.B., Polar, Telsen W.131, Cyldon, Lotus, Igranic).
1 ·0001-mfd. fixed condenser (Dubilier type 620, Ready Radio, Telsen, T.C.C., Lissen, Ferranti, Igranic, Watmel, Graham Farish, Peto-Scott, Goltone, Sovereign).
1 ·002-mfd. fixed condenser (T.C.C. upright type, or see above).
2 2-mfd. fixed condensers (Telsen type W.226, T.C.C., Dubilier, Lissen, Igranic, Sovereign, Ferranti, Formo, Peto-Scott).
1 Set of short-wave plug-in coils (Atlas, Igranic). See text.
1 Short-wave H.F. choke (Bulgin type H.F.3, Peto-Scott, Wearite).
1 Output choke (R.I. Audirad).
1 3-meg. grid leak and holder (Dubilier, Lissen, Telsen, Ferranti, Watmel, Graham Farish, Igranic, Ready Radio, Bulgin, Goltone, Tunewell).
1 1-meg. grid-leak and holder (Ready Radio Thermium, or see above).
1 70,000-ohm resistance and holder if required (Graham Farish "Ohmite," Dubilier, Watmel, Wearite, Ferranti, Colvern, Sovereign, Varley).
1 25,000-ohm resistance, with wire ends or terminals (Dubilier 1-watt type, Graham Farish "Ohmite").
2 5-pin valve holders (W.B. large type, Benjamin, Telsen, Bulgin, Lotus, Peto-Scott, Wearite, Lissen, Clix, Ready Radio, Tunewell).
1 Two-point on-off switch (Ready Radio, Goltone, Lissen, Lotus, Igranic, Benjamin, Bulgin, W.B., Keystone, Wearite, Ormond, Telsen, Tunewell, Colvern).
2 Two-pin coil holders (Igranic type Adcol, Lotus, Wearite).
1 Terminal strip, 11½ in. × 1½ in. (Goltone).
8 Indicating terminals (Bulgin, Clix, Igranic, Belling & Lee, Eelex, Goltone).
4 Plugs (Clix, Igranic, Belling & Lee, Eelex, Goltone, Bulgin).
2 Accumulator spade terminals (Belling & Lee, Clix, etc.).
2 yds. of sleeving, and 3 yds. of 18-gauge tinned copper wire (Goltone, Wearite).
1 Piece of ·004-in. copper foil, 12 in. × 10 in.
Screws, flex, bolts and nuts, etc.

The "Span-Seas" Two—*continued*

Of the constructional side of the set there is a little more to be said. You will note that the underside of the baseboard is covered with foil, and that all "earth-return" wires are taken straight through to this by means of short bolts through the baseboard.

EQUIPMENT NEEDED

L.T. 2-volt Accumulator.—Ediswan, Lissen, G.E.C., Exide, Oldham, Pertrix, Block.

H.T. Battery.—(This should be of ample size to deal with the requirements of the valves chosen.) Pertrix, Siemens, Lissen, Magnet, Ediswan, Ever Ready, Drydex, Marconiphone.

G.B. Battery, 9-volt.—See above list.

Recommended Aerial and Earth Equipment. Electron "Superial," Graham Farish "Filt" earthing device.

This appears to be a sure and certain means of doing away with hand-capacity effects, which, next to the aforementioned "threshold-howl," do more to make the short-wave man's life a misery than anything else. The old dodge of backing the panel with copper foil has no effect whatever unless the baseboard is treated in the same way, and it is usually found that if the baseboard is "lined" the panel may be left alone. That has been done in this case with perfectly satisfactory results.

If one treats the panel and not the baseboard, it is usually found that the entire sheet of foil behind the panel becomes "live"—no part of it can be touched, or even approached, without causing a change in wavelength. Fortunately, the "lined baseboard" provides a simple remedy for this effect.

Sharp Tuning

Of course, it is necessary to arrange for the moving sets of vanes of both the tuning and reaction condensers are at earth potential, and this is another reason for the use of a series-fed circuit. In this case they are both at earth potential, not only as regards H.F., but D.C. as well. Taking this in conjunction with the fact that the capacity of the tuning condenser is ·00013, it is understandable that the operation of the set should be quite easy and straightforward.

The frequency band covered—with the average short-wave coils—by a condenser of this size is such that tuning is about five times as sharp as it is on the average medium-wave broadcast receiver. This is just about as good a state of affairs as we *can* arrange at present, considering that the short-wave listener wants to cover a range of 18 to 60 metres at the very least.

Coil Details

This requirement—for a short-waver—is quite modest, but it entails the covering of a band over 10,000 kilocycles wide. Reflect that the width of the medium broadcast band, if we put it generously at 200 to 600 metres, is only 1,000 kilocycles, and you will see that "medium-wave tuning" with "short-wave band-covering" is not yet a possibility.

Igranic coils (if you use them) are marked with their wavelength ranges when used in conjunction with a ·0005 condenser. Both the tops and bottoms of these ranges may be disregarded, since the condenser used has a smaller minimum than the average ·0005; while the maximum is, of course, just over one-quarter!

The 4-turn coil, for instance, will be found to be marked "22–70 metres with ·0005," but the range covered with it in this set is 18 to 32 metres.

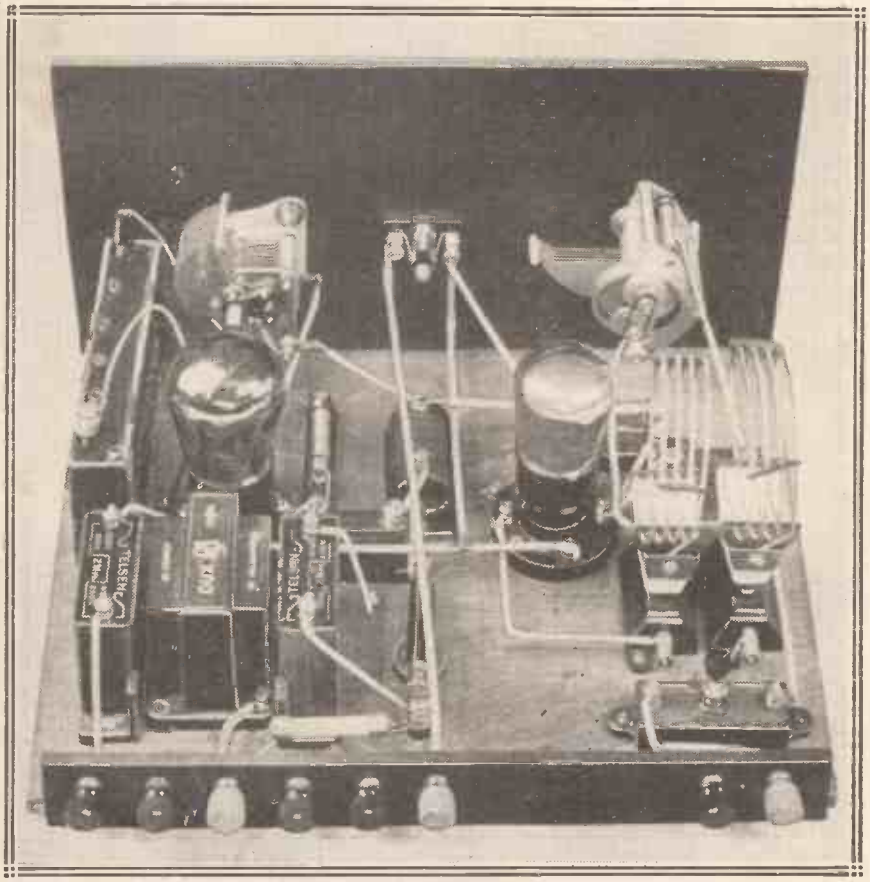
Atlas coils are designated by size numbers. A size 4 Atlas coil being roughly equivalent to an Igranic 4-turn coil. I used the Atlas coils, and since the wiring of set is so simple and short, the dial readings which follow should be approximately correct for any set using Atlas coils and not far out with the Igranic.

An Outstanding Feature

So far nothing has been said about the performance of the set. As a matter of fact, one cannot say much more than that it does, with ease, just what one would expect any good short-wave two-valver to do.

Smooth reaction may certainly be claimed as an outstanding feature, and the set oscillates so readily that a small reaction coil may be used at

THE FOIL IS UNDERNEATH THE BASEBOARD



A number of points are wired to the copper foil by means of nuts and bolts which pass right through the baseboard. To allow for the nuts, the baseboard should be fixed to the panel and terminal strip so that it is raised a little.

The "Span-Seas" Two—*continued*

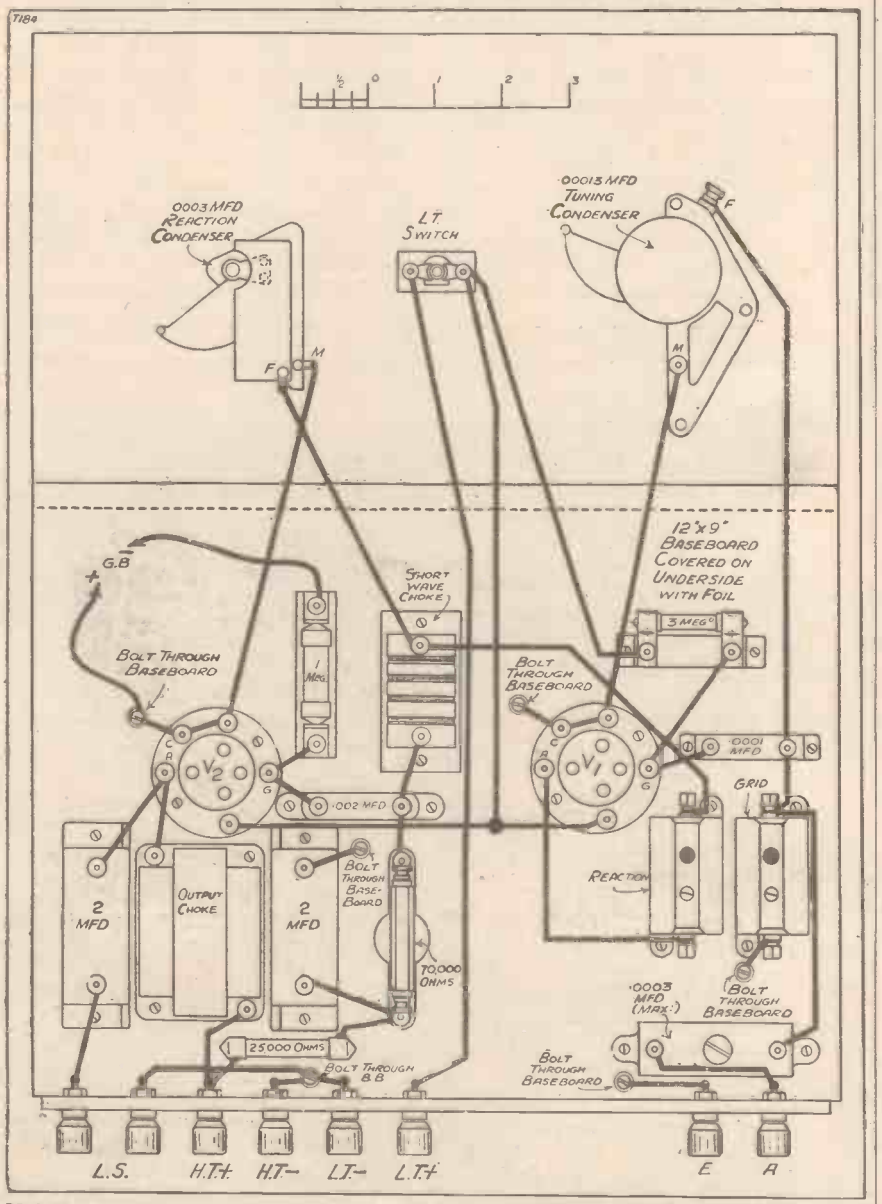
all times. I found that the size 4 coil served as reaction coil, whether the 6-, 9-, or 2-size grid coil was in use. When using the size 4 coil in the grid circuit, however, the "6" was needed for reaction, simply because no other "4" was available.

Here are some specimen readings: Grid coil, size 4; reaction, size 6. W 2 X A D (19·56 metres) was found at 30 degrees; W K U (just above 20 metres), 40 degrees; transatlantic 'phone on about 20·8 metres, 44 degrees; amateur band, 20·8–21·4 metres, 45 to 57 degrees; G S E (Daventry), 25·3 metres, 80 degrees.

Actual Dial Readings

These readings refer to a 180-degree dial. The 30–32 metre broadcast stations occupy the top twenty degrees of the dial, and are found again on the size 6 coil between 20 and 40 degrees, this time using the "4" for reaction. Sydney was heard twice at good strength on about 25 degrees with this coil.

INDIRECTLY-HEATED VALVES CAN BE TRIED



Note how the 5-pin valve holders are used, their cathode terminals being joined to the negative filament terminals. This is to enable indirectly-heated valves of mains variety to be tried with accumulator L.T. This is a scheme which often produces remarkable results on short waves.

For the interesting group of stations between 46 and 50 metres the reaction coil remains a "4," and the grid coil is a "9." Under these conditions the amateur band (41·2–42·8 metres) spreads roughly between 48 and 62 degrees, and the 50-metre Moscow station comes at 100 degrees. The other broadcast stations spread down from Moscow's reading to about 85 degrees. It was here, by the way, that the ease of tuning showed up particularly well, a station on 49·02 metres being separated from one on 48·86 by a full degree.

With the slow-motion drive provided, tuning to one-tenth of a degree was perfectly simple and straightforward. The size 2 coil (with 4 as reaction) covers a range of roughly 10–21 metres.

Adjusting Aerial Coupling

The aerial coupling is effected by means of the usual "preset" condenser, which may be varied in value to give more or less selectivity, as desired from time to time. Generally speaking, though, if it is set to such a value that there is no difficulty in making the set oscillate smoothly over the whole of each waveband, there will not be much point in altering it. Greater signal strength may be obtained, naturally, by screwing it hard down; but this brings its disadvantages—particularly if a large aerial is used—by increasing background noise, by reducing selectivity appreciably, and by causing "dead spots" over which oscillation will not occur.

Mixing Valves

Readers will have noted by now that 5-pin valve holders have been used, and that the "cathode" terminals have been connected to L.T. negative and earth. This was done for the benefit of readers who may be placed like myself, having a large 4-volt battery crying out to be used. In such a case it is well worth while to use indirectly-heated valves. Two amperes seem a lot of current, but when charging facilities and an accumulator of suitable size are available it is well worth while on account of the greater efficiency obtainable with I.H.C. valves.

One can strike the happy medium and use an indirectly-heated valve as detector with a note-mag. of the ordinary type, giving a consumption

The "Span-Seas" Two—*continued*

of about 1·2 amps. altogether, but do not construe this to mean that the set does not work well with ordinary dull emitters. All the tests of the set were carried out with ordinary 2-volt valves, and all that need be said about

THE "SPAN-SEAS" TWO VALVES

	Detector.	Output.
Mullard ..	P.M.1H.L.	P.M.2A.
Cossor ..	210H.L.	220P.A.
Mazda ..	H.L.2	P.220
Marconi ..	H.L.2	L.P.2
Osram ..	H.L.2	L.P.2
Tungsram ..	H.210	P.220
Lissen ..	H.L.210	P.220
Eta ..	B.Y.1815	B.W.604
Six-Sixty ..	210H.L.	220P.A.
Clarion ..	H.2	P.2
Micromesh ..	H.L.B.1	P.B.1

valves is that the detector should be one of the "H.L." class and the L.F. any good power valve.

An Economy Tip

The set, as it stands, is not suitable for the use of indirectly-heated valves with *A.C.* on the filaments, and was never intended for that. There is, however, not the slightest objection to the use of a mains unit for H.T., provided that the voltage does not exceed that for which the valves are rated. On test a single 120-volt battery was used, and the consumption was of the order of 5 or 6 m.a.

Grid bias should naturally be arranged to comply with the valve makers' recommendations. With the average 2-volt power valve and the H.T. mentioned, 7½ or 9 volts is suitable. Over-biassing will produce an economy in H.T. current, naturally, and may be indulged in with very little loss of signal strength.

Furthermore, it will not show up—as it does on the medium and long broadcast bands—by the introduction of distortion, since short-wave signals are seldom comparable in strength with those from the local station on the medium band.

Loudspeaker Results

As a matter of fact, three or four transatlantic stations were received quite well on the loudspeaker, during a week in which conditions were not particularly good. W M A, a commercial telephone station on 23 or 24 metres, was particularly good, and strong enough to be heard outside the room, every word being distinguished clearly with the door shut! I am not claiming that this—or any other two-valve short-waver—is a loudspeaker set, but on headphones it is possible to hear any station that is available to the owner of a short-wave receiver.

There is so much to be heard nowadays on the short waves that it is no mean problem to "spot" every station!

Finding Americans

Before concluding, however, it may be as well to deal with one or two difficulties which *may* confront those who have never before tried their hand at short-wave work. Short-wave conditions just at present being somewhat unreliable, it is never worth one's while to worry if nothing much is heard on any particular day.

The more powerful stations like Moscow, Rome, the Vatican and Zeesen should, of course, come in at respectable strength, however bad conditions may be. The Americans, however, are variable. One stands the best chance of getting them in the region of 49 metres late at night.

Once Moscow and the other "pointers" in this region have been found, it is sufficient to keep a close watch on the ten degrees or so just round them, and if the Americans are coming over, they will be found. Midnight is generally the best time, but on a good night they come in quite well at 10 p.m. or earlier.

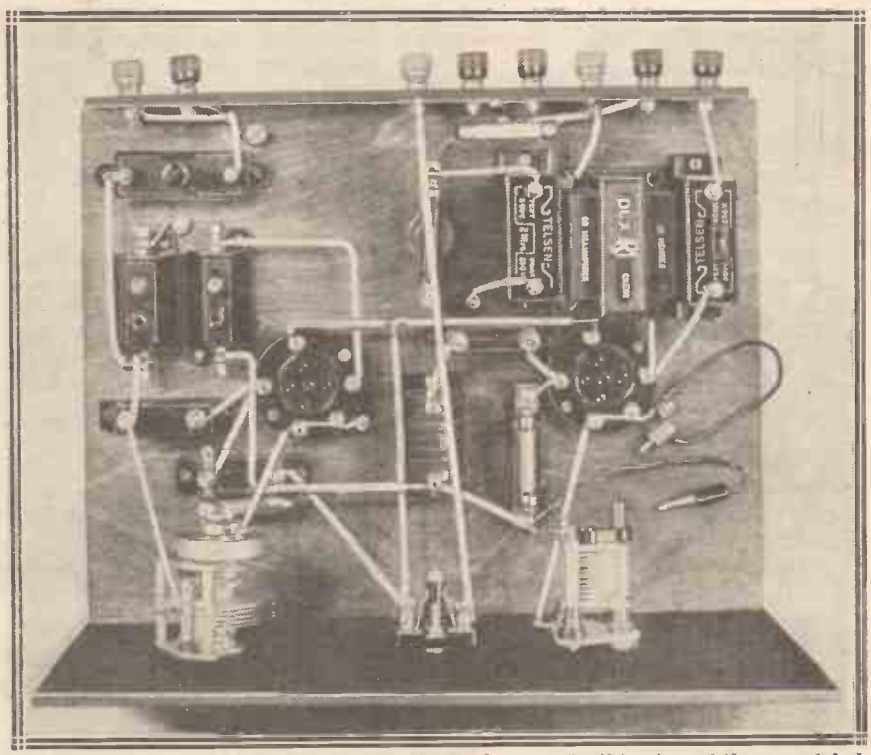
Next, don't worry if the short waves seem to be "all Morse." The broadcast stations are all "huddled together," so to speak, in groups, and in between them there *is* very little but a series of high-power commercials working on Morse. Don't be too vigorous with the tuning control, and stop and investigate every little thing that you hear. It *may* be interesting—but it certainly won't if you go swishing past it.

Listen for the background of "mush," and keep your set *just* oscillating on the very edge of this mush. Then, if there's anything there, you'll hear it.

The mush itself varies in intensity for different localities, but it should always be clearly audible, so that it follows that any signals loud enough to come through it will also be audible.

Patience, and lots of it, is the greatest asset you can have.

THIS PHOTO SHOWS MOST OF THE WIRING



Almost every wire in the receiver can clearly be seen in this view of the completed set, which makes it particularly helpful in conjunction with the wiring diagram.

WITH PICK-UP AND SPEAKER

Conducted by
A. JOHNSON-RANDALL

WITHOUT a doubt, the man who is most interested in obtaining volume economically is the radiogram enthusiast who has to use battery H.T. because he has not access to mains. And with his radiogram in mind, he is naturally greatly interested in quiescent push-pull amplification which has suddenly jumped into prominence.

It is not intended to deal with the theoretical side here, nor to weigh the pros and cons of the system against one another, but to tell you something about results obtained during tests of a quiescent push-pull amplifier for pick-up work. The reader should get a good idea of whether it is worth his while to go in for this type of push-pull amplification. An amplifier designed along similar lines is fully described elsewhere in this number by Victor King.

First of all a few details about the amplifier that was used. The two quiescent valves were tried by themselves at first, the input from the pick-up being fed into the primary of their input transformer, but it was not possible with most pick-ups to come anywhere near loading up the output valves by this scheme.

Increasing Volume

So an ordinary amplifying valve was used before the push-pull valves, the pick-up being fed direct to its grid and filament via a potentiometer volume control.

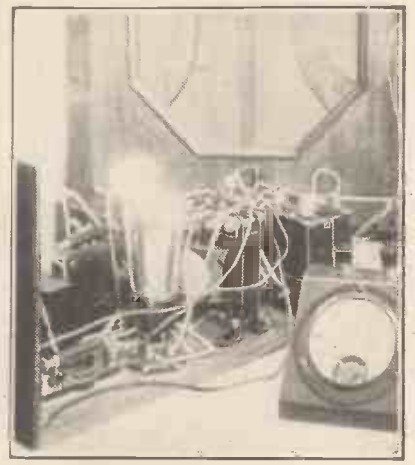
The valves used in the output were two steep-slope pentodes of the Pen. 220A type. Smaller pentodes were tried, but the very slight saving in H.T. did not warrant the difference in output that could be handled, especially where such a small H.T. current was concerned.

The total current taken with 120 volts H.T. was below 10 milliamps., that is, within the powers of a standard H.T. battery to supply, but the output was well up to that obtainable from a fairly powerful mains outfit! Theoretically, the power is around 2 watts with 150 volts, each valve having an undistorted output of 1,000 milliwatts, but the average consumption is about half that of ONE valve used normally, so in effect we get much more volume with less current consumption.

Easy on the Battery

Since the scheme uses the valves working on their anode bends, the current naturally rises when reproduction is taking place, but the rise is considerable only on loud passages, so that the extra load is merely occasional, a type of loading that a dry battery can well stand, it being the constant drain of a heavy current that ruins them.

IT INDICATES FEED-BACK



The needle kicks of an anode circuit milliammeter do not indicate distortion with push-pull valves, but the meter shows when feed-back is taking place.

In connection with this increase of current with volume, it is interesting that this type of amplifier is the first which is more economical the quieter the results. With a normal amplifier there is not (at least there *should* not be) any change in average consumption when reproducing.

Another point that this increase with volume brings forward is that a milliammeter cannot be used to indicate overloading by its kicks up or down. This is not a real drawback, since if the G.B. is adjusted by ear, audible distortion can be allowed for. Distortion that one cannot hear is not of much importance from a reproduction point of view.

A noticeable feature of the quiescent push-pull, and one which those who have a fixed dislike for pentodes should note, is that the characteristic tone of the pentode is gone, and the reproduction is indistinguishable from ordinary triodes. Of course, ordinary triodes can be used with the scheme, but there is little point as the maximum power available with them is so much smaller, while no greater saving in current is effected.

Adjusting Grid Bias

The question of overloading is very unlikely to crop up, so powerful is the amplifier on its 8 or so milliamps. and the method of adjusting grid bias is simply to increase it as far as possible until quality seems to be affected and notes tend to break up, after which it is reduced, say, 1½ volts.

The outcome of quiescent push-pull is that no longer can the mains man sneer at the battery user because of the small volume the latter used to get. What is more, the battery man can now often get a dig back at the mains user because of the silent background he is able to get in spite of big volume!

QUESTIONS I Am Asked

by JOHN SCOTT-TAGGART

Q. 13. I find I cannot get enough selectivity on my receiver. I live two miles from the Daventry station. What do you advise?

A. (a) Change your receiver, or (b) move away from Daventry, or (c) wait till Daventry moves away from you.

Q. 14. My "S.T.400" will not work. Neither did my "S.T.300." Father says you must be a pretty rotten designer. What shall I do?

A. Send Father to me.

Q. 15. I have used my "S.T.300" parts in converting it to "S.T.400," but the results are no better. What do you think is wrong?

A. You, chiefly, for imagining that a radically wrong set can be converted into a success. Whatever it was that stopped the "S.T.300" working will prevent the "S.T.400" from doing its stuff. Thoroughly overhaul your components. Sometimes a constructor will build several dud set designs in succession and then suddenly achieve good results. He praises the set. It is simply that the design does not use the particular component that has been giving the trouble.

Q. 16. Is it too late to build the "S.T.400" now? Or have you anything else up your sleeve?

A. Both sleeves are full, but contain nothing in the "S.T.400" category. You get a wonderfully long run on my sets. There has been nothing from me, for example, on three-valve sets since the "S.T.300" for the very simple reason that I know of nothing better in its class.

This reader also hopes I shall be able to keep on using the same parts in different sets, simply adding one or two parts. This, I am afraid, is too much to expect to be continued indefinitely. The "S.T.400" was a very unusual case.

I have no intention of producing new sets merely because they're new. They have to be *better*. And this may mean a clean start as regards part of the set.

Q. 17. Can a variable-mu valve be used on the "S.T.400"?

A. Yes, but you will have another knob! Also, it would not act as a true volume control. In the first place, you are bound to vary the reaction conditions of the set. By increasing the bias on the grid of S.G. valve, you will reduce the anode circuit damping on the intervalve "tuned-anode" circuit. This will *increase* the effect of any direct reaction on that circuit, but simultaneously you will (since the amplification of the S.G. valve has been reduced) *decrease* that vague amount of reaction which is known as "inherent reaction."

In this new feature our contributor places at your disposal the experience and ability which have made him famous as a radio consultant on both sides of the Atlantic.

Every reader will enjoy his characteristic and uncompromising directness, and intending constructors will find his lucid comments on radio of the greatest interest and assistance.

Right on top of all this you will get the greatest change of all if double-channel reaction is employed. The reaction on both circuits would be reduced, since "chain reaction" is taking place when reaction is applied to the aerial circuit (see last month's article). The total effect of all these forces at work is that increasing bias reduces reaction.

This is not desirable in all cases, and on a set such as the "S.T.400" I emphatically would prefer a volume control on the L.F. side to avoid alterations elsewhere. Too many readjustments are obviously undesirable and a variable-mu valve is of no advantage on this set. Of course, if you have one you can use it—even as an ordinary S.G. valve.

Q. 18. I wish to turn the "S.T.400" into a single-control receiver with ganged condensers (drum-drive), and fit it with plug-in coils, a radiogram switch and preferably an extra H.F. stage which can be switched on or off or alternatively be adapted to tune down to 7 metres. Will you please give full details in your next issue how to do this.

A. No.

Q. 19. What is your opinion of the superheterodyne? If favourable, why haven't you designed one for CONSTRUCTOR readers?

A. The superheterodyne in its modern guise is an excellent set, simple to tune, sensitive, capable (if properly designed) of giving excellent quality. It is highly selective but involves the use of more valves than a straight set.

The time is not ripe to design a superhet for the CONSTRUCTOR, although work is continually proceeding with such sets in my laboratories. The "S.T.400" undoubtedly gives in most zones a degree of selectivity as high as that of a superhet. Readers who want even more selectivity will probably require a special four tuned circuit receiver with a single tuning control or else a special superhet.

Some such step will be essential sooner or later.

I can give no clue as to my next big set, because there is much work to be done before deciding whether to offer a superhet or a special "straight." I also am working on a more modest receiver which should establish a new standard in its class.

Practical notes on what stations to look for and how the various foreign programmes are coming over.

RECEPTION from the Continental stations continues to be full of interest, and nearer home we have had the new Athlone station getting into its stride on 413 metres, relaying the Dublin programme.

Athlone happens to sit on a very interesting section of the dial, with Katowice, the popular Polish transmitter, on the wavelength immediately beneath him, and the Sottens programme (Radio Suisse Romande) between that and Midland Regional.

* * *

Rabat, the Moroccan station which is immediately above Athlone in wavelength (416 metres) and about one degree up on the dial has been doing well of late, while above that we have old favourites like Berlin, Madrid, Stockholm, and Rome all within a few degrees of each other.

* * *

In spite of brighter weather, even the distant stations seem determined to keep friendly with this country. Many of the low-powered programmes are still receivable at remarkably good strength, considering that the winter is theoretically behind us. And as our own West Regional is soon to be regularly active, there is plenty of interest, especially for those who are wondering just how much "summer" benefit we shall receive from the higher power now being generally used for broadcasting.

It looks as though even in midsummer there will always be plenty of alternatives for a powerful set to choose from.

* * *

On the long waves the situation has undergone little change, though the excellent reception from some of the Soviet stations has been noteworthy, particularly round about 1,000 metres.

Oslo has been more erratic than the other stations, and Motala and Kalundborg perhaps not quite so steady as their colleagues a little higher up the waveband. But on the whole long-wave reception has certainly been very satisfactory. We should soon be hearing something from the new Kalundborg, but so strong is the present station going, as these words are written, that it seems almost a pity it is to be supplanted.

* * *

There still seems to be a curious long-range effect obtainable in the early mornings, when low-powered European relays can be heard at strengths seldom achievable from those same stations after dark. If you happen to have an idle moment before breakfast some morning, switch on and see what you can get. The results are often quite phenomenally interesting.

POINTS FOR PURCHASERS

Interesting details from manufacturers about recent trade activities.

Ready Service

EVER ready to serve the needs of their wide public, the Ever Ready Company (Gt. Britain), Ltd., has developed a system of designing batteries specifically for use with certain popular sets, so that the set-owner is left in no doubt as to the battery's suitability for the work in hand.

The range of sets so catered for is now a wide one, and is frequently added to, so readers should not fail to take advantage of this excellent idea when contemplating the purchase of an Ever Ready battery. It places the firm's own experience behind the choice, and makes the selection of a suitable battery a certainty.

A Wide Range

The complete Graham Farish catalogue, recently received, is a reminder of the many and varied lines in which this popular concern has made its mark. The catalogue is well illustrated, with brief details of all the components, and with all prices clearly marked.

It is an excellent production, and as those who have benefitted by a "Filt," or have proved the excellence of "Ohmites," may be wondering what else this firm offers in the way of efficient radio components, it will be sent free to any reader who makes application to Graham Farish, Ltd., Masons Hill, Bromley, Kent.

Box Baffles

The use of the box baffle for loudspeakers, in place of the larger and unsightly flat baffle, has increased apace since the B.B.C. gave the method its blessing.

Readers will be interested to know that the famous Howe Box Baffle is now available in kit form, for home construction, suitable for insertion into an existing cabinet, or for use as a separate loudspeaker unit.

Full details can be obtained from F. McNeil & Co., Ltd., 52, Russell Square, London, W.C.1.

Over One-and-a-Half Millions!

Rola loudspeakers to the enormous number of over 1,500,000 are in use to-day, in this country, according to figures recently supplied. The firm is well known in connection with its dual-matched models, and is now issuing a list of all its loudspeakers which any reader can obtain on application to the British Rola Co., Ltd., 179, High Road, Kilburn, London, N.W.6.

H.T. for Q.P.P.

Another sign that the radio industry is anything but quiescent in regard to quiescent push-pull amplification is provided by H. Clarke and Co. (M/cr.) Ltd., of "Atlas" fame.

This go-ahead concern is now marketing H.T. units for A.C. and D.C. mains, especially suitable for the man who is taking to this newly-popular system of amplification. Three different models are already available, each capable of an average output of 150 volts at 12 milliamps. —which fulfils Q.P.P. requirements— and peak outputs of up to 20 milliamps. are passed without appreciable voltage drop.

One model incorporates an L.T. trickle charger—a very valuable feature—and all are available on easy payment terms.

Fulls details are obtainable from the above-named firm (at George Street, Patricroft, Manchester) upon application by any reader of THE WIRELESS CONSTRUCTOR.

VICTOR KING DESCRIBES A Q.P.P. AMPLIFIER

QUIESCENT PUSH-PULL

is a method of amplification in which the current drawn from the H.T. battery varies according to the strength of the programme. Read all about it in this extremely interesting description of a really first-class amplifier.

LOWER running costs; greater power. That is the proposition offered battery-set users with quiescent push-pull.

Employing the "new" system of output valve coupling (it is not really new, but an old scheme brought up to date), and a couple of steep slope pentodes, one can get an output power of some 1¼ watts with only 120 volts H.T. With 150 volts H.T. the power goes up to some 2 watts (2,000 milliwatts).

Battery Supplies Power

Naturally this power cannot be obtained for nothing—it is taken from the H.T. battery, but it is only taken when needed, and you all realise that the full output of a valve is but rarely used if the operation is to be free from overloading. More like 50 per cent of the full power is the usual average. And on soft passages of a record or broadcast the percentage drops to a very much lower value than this.

But let us take the case of the amplifier we are about to discuss. Presume it is used for gramophone record reproduction with a pick-up. For two-thirds of the time the set is switched on (often less, as a matter of fact) the record is actually playing. The remaining third is taken up with looking for the next record, changing records, changing needles, and winding up the motor.

Now then. With an ordinary amplifier capable of giving about 1,000 milliwatts output (using one of the pentodes such as we use) we should require 150 volts H.T. and an anode current of some 18 or so milliamps—to say nothing of the current taken by the screen of the valve, another 3 or more milliamps.

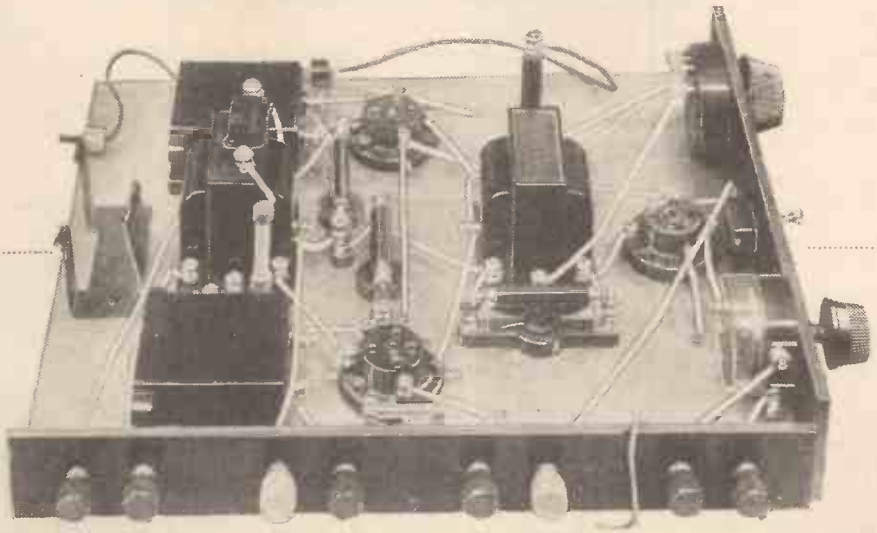
Cutting Down Costs

The set is beyond the capabilities of an ordinary H.T. dry battery, and so to keep it within such limits we have to reduce the output power by using a "smaller" valve.

But whatever we do to cut down the cost of running (we are not concerned with the man who has mains and can use a mains unit), the current is being drawn steadily from the battery *the whole time the set is switched on.* Nothing happens in the way of music during one-third of the time, however. So the horrible fact dawns on us that during that time the power we are taking from the batteries is being wasted—one-third of the available power!

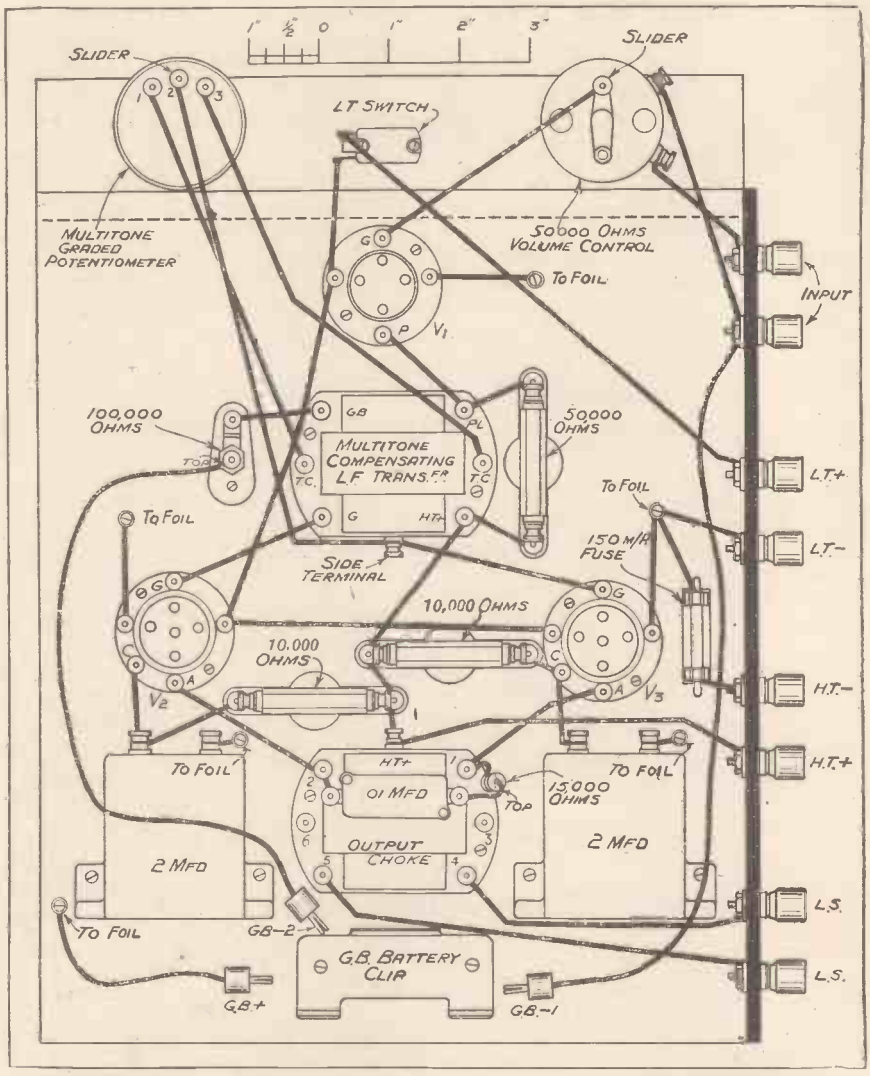
There is a remedy—to switch the set off every time; but who is going to bother to do that? While if the

THE PARTS—AND THEIR POSITIONS



1 Baseboard, 12 in. × 10 in.
1 Terminal strip, 12 in. × 1½ in.
1 Terminal strip, 10 in. × 2 in.
1 4-pin valve holder (Telsen W.224).
2 5-pin valve holders (Lissen L.N.593).
1 Quiescent push-pull input transformer (Multitone Compensated "Puco")
1 Quiescent push-pull output choke or transformer (Multitone "Puchoke," R.I., Varley, Sound Sales, Ferranti).
2 2-mfd. fixed condensers (T.C.C., Telsen, Dubilier, Lissen).
1 ·01-mfd. fixed condenser (Dubilier type 670, T.C.C., Telsen, Lissen, Graham Farish "Ohmite").
2 10,000-ohm resistances with holders if desired (Graham Farish "Ohmite," Telsen, Dubilier, Wearite, Colvern).
1 50,000-ohm resistance with holder (Graham Farish "Ohmite," or see above).
1 100,000-ohm resistance and holder (Graham Farish "Ohmite," or see above).
1 15,000-ohm resistance with wire ends or terminals (Dubilier 1-watt, Graham Farish "Ohmite").
1 Snap-action on-off switch (Bulgin type S.102, Radiophone, Claude Lyons).
1 Multitone graded tone-control potentiometer.
1 50,000-ohm potentiometer (Lewcos, Wearite, Colvern, Telsen, Ready Radio, Watmel, Radiophone, Tunewell, Bulgin).
1 Small fuseholder and 150-milliamp. fuse (Belling-Lee, Bulgin, Telsen, Goltone).
5 Battery plugs and 2 accumulator spades (Clix, Belling-Lee, Bulgin, etc.).
8 Indicating terminals (Belling-Lee, Bulgin, Igranic, Eelex, Clix).
1 Bias battery clip (Bulgin, Goltone).
1 Sheet copper foil, 12 in. × 10 in. Screws, flex, tinned copper wire, etc.

A Q.P.P. Amplifier—*continued*



The switch and other controls are on a strip at right angles to the terminal strip, as shown above. The amplifier can be suitably covered by a wooden box, or placed inside the radiogram cabinet.

amplifier were used for radio it would not be possible to switch off for each interval or pause in the programme, and those pauses account for quite a lot of the time.

Cutting Down Waste

The quiescent push-pull amplifier, on the contrary, does not waste all that current. It takes a mere 5 to 7 milliamps. total (anodes, screens, and all) from the H.T. battery when no record is being played, and the current from the battery is only increased when sound is required.

Then the current goes up—but it does so in proportion to the volume of sound required. Unlike the ordinary type of amplifier, which takes a constant current regardless of the volume being taken from it, the quiescent push-pull amplifier takes its power in proportion to the volume. So on soft passages the current drawn from the H.T. battery is very much less than when a loud passage is played.

So we pay for what we get, and save for the 5 to 7 milliamps. when no music is being played, the set is quiet (quiescent) and lifeless during the intervals.

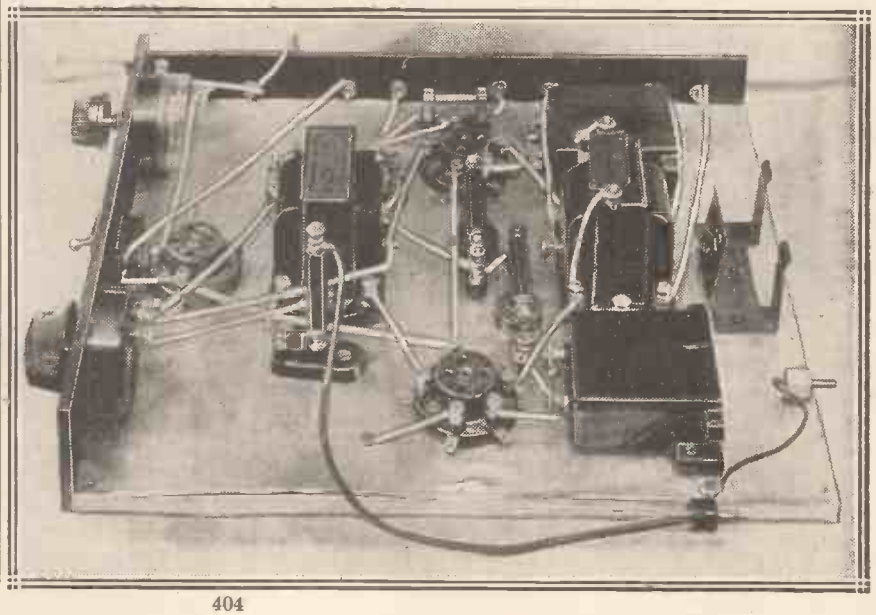
Positive Pulses Used

Obviously, the Q.P.P. method of providing power is more economical than the old system. The *average* anode current of the amplifier is some 12 milliamps. at good strong volume, the fluctuations being above and below that figure, according to the strength of the modulation.

As the two output valves are operating at their anode-bend points, and are utilising only the impulses that make their grids positive (first one valve and then the other), it is easy to see how the anode current change of the system is twice that of one valve, thus providing about twice the output wattage.

Naturally, the lengthened grid swing of the valves requires a greater voltage input to fully load them, but this is automatically provided for by the high ratio intervalve transformer, which instead of being of the

EASY WIRING—NO PANEL—AMPLE SPACING



A Q.P.P. Amplifier—*continued*

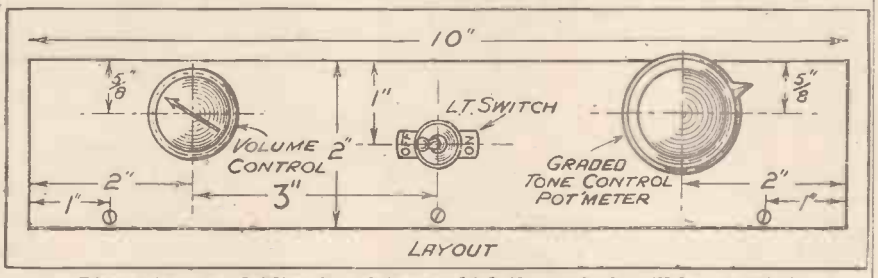
order of 1:3·5 as for ordinary sets is about 1:8 or 1:9, giving a much bigger voltage step-up.

I fear that in some cases the primary inductance is somewhat reduced, resulting in loss of bass, but the characteristics vary with the make employed.

valve is withdrawn from its socket while the set is on, or the H.T. lead to its anode is broken while current is flowing.

Such an event (and the withdrawal of valves while "on" is quite a common practice while sets are being tried out) would tend to induce a very high and sudden voltage on the grids of the pentodes, which impulse might so affect the space charge of the valves as even to blow the filaments.

DRILLING THE STRIP FOR THE CONTROLS



Dimensions for drilling the strip on which the controls will be mounted.

In the Q.P.P. amplifier I have built, I have chosen the Multitone tone-control transformer and its associated output choke so that not only can the volume from the amplifier be varied, but also the tone, enabling recording vagaries to be counteracted, and the output to be balanced between the proportion of high and low notes to suit the individual listener.

Interesting Points

There are one or two interesting points in the circuit that should be explained, so we will have a look at the theoretical diagram first. It will be seen that the amplifier is chiefly designed for pick-up work, and though it could be used, with suitable coupling scheme, for addition to a radio receiver, it was intended for gramophone reproduction, and as such is eminently suitable.

To all intents and purposes the circuit is a perfectly normal push-pull circuit, with choke output and common bias for the pentode valves.

It will be noted, however, that a 50,000-ohm resistance has been placed across the primary of the intervalve transformer. This is for one reason only—in case the first

Preventing Surges

An impedance equaliser is used in this amplifier across the output choke as it serves a purpose apart from the correction of high note prominence. It acts as a safeguard for the pentode valves. Without it the loudspeaker could never be disconnected while the set is in operation, otherwise damage might be done to the pentodes due to the removal of the load. This enables a large A.C. voltage to be generated in the valves, with possibly disastrous results.

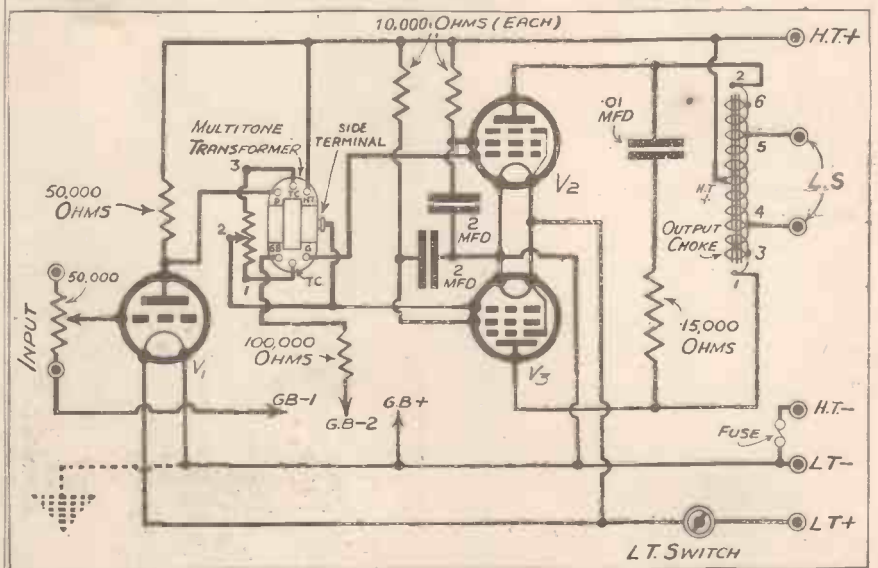
The output can be matched to the loudspeaker by means of the three pairs of terminals on the output choke, and this matching is of the utmost importance.

To simplify the operation of the unit we have not given separate tappings for the two screen grids of the pentodes, but have arranged for a common H.T. tap to be taken to the whole amplifier, the screen volts being broken down through resistances decoupled by two 2-mfd. condensers to earth.

Special Matching

Those who are of an experimental frame of mind and possess a milliammeter, may like to match their valves carefully, taking H.T. taps from the H.T. ends of the two resistances and so arranging the taps that the anode currents of the valves are equal, but it is doubtful if they will notice any difference in the operation of the set under normal conditions, and it would entail the use of either the special quiescent type H.T. batteries now on the market, with close voltage taps on the upper end of the battery, or else the placing in series a small closely-tapped battery at the maximum end of the normal H.T. supply.

AN UNUSUALLY ATTRACTIVE CIRCUIT



This diagram of the circuit can be consulted in conjunction with Victor King's description of the very interesting principles on which quiescent push-pull works.

VALVES

1st Valve.	Output Valves (One pair needed.)
Mazda H.L.2.	Pen.220 or 220A.
Cossor Det.210	230H.P.T. or 230P.T.
Mullard P.M.2DX	P.M.22A or P.M.22
Marconi H.L.2	P.T.2
Osram H.L.2	P.T.2

A Q.P.P. Amplifier—*continued*

The layout of the unit is of the skeleton variety, for it is intended that it be placed in a convenient position in a radiogram cabinet or be provided with a small wooden box.

The ebonite strip that takes the place of the usual panel is only a couple of inches deep, and holds the on-off switch, and the volume control and the tone-control potentiometers.

Copper Foil Covered

Along one side is the terminal strip for the input, output and the batteries, while the bias battery fits into a clip at the back of the baseboard.

The whole of the baseboard is covered with copper foil, to which the various "earthed" points are taken, and which also acts as the L.T. negative connection between the valve holders and other points of the circuit.

Care should be taken when mounting the valve holders and the resistance holders to place strips of thin card, or paper, between them and the foil to prevent any possibility of shorts to the foil between the valve sockets when the valves are pushed right home in the holders, or between the screws of the resistance holders and the foil in the event of the latter being at all raised, or buckled under the holders.

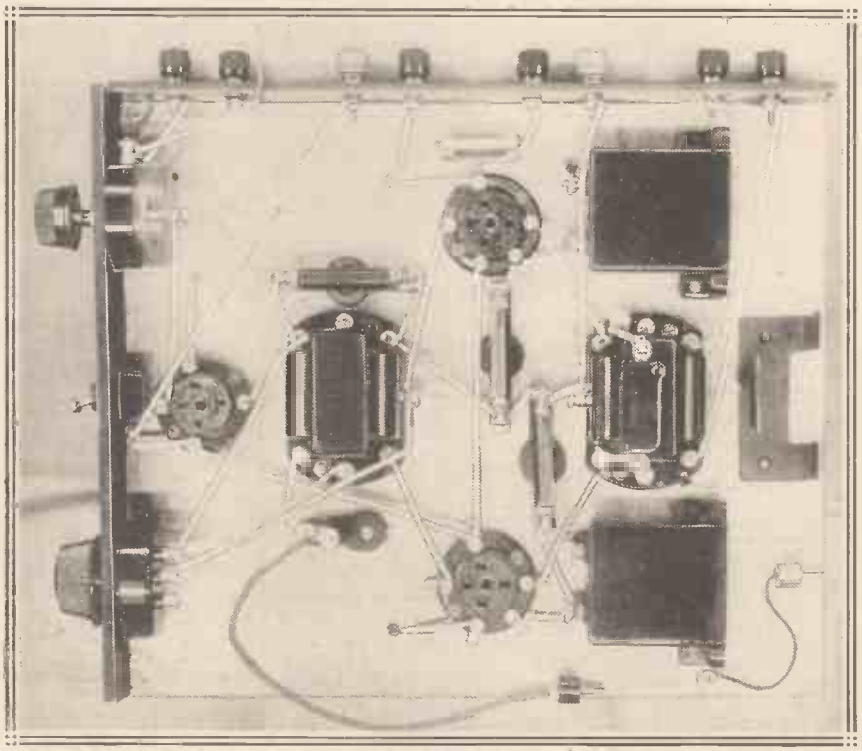
In the photographs the Multitone output choke is shown connected to the output terminals by terminals 4 and 5, but it must not be taken that these are the correct ones for your speaker, and it is a good plan to use flex leads between the output terminals and the choke until the correct ratio has been found.

Various Ratios

Details as to the ratios are given by the manufacturers of the choke, and it will be an easy task to decide from the quality of reproduction.

The operation of the amplifier is very easy. The connections are: pick-up to the two input terminals, L.T. and H.T. to the respective terminals, and loudspeaker to the terminals marked L.S. We are assuming that you will use an ordinary speaker, with, if it is of the moving-coil variety, the usual transformer. If you decide to use a special quiescent transformer on your speaker, for there are some available now, you will not need the output choke in the amplifier, and the connections will have to be altered.

READY FOR THE VALVES



The valve holder to the left is for the input valve, and the two push-pull valve holders are placed and wired as shown between the compensating L.F. transformer and the pentode output choke (right).

WE RECOMMEND—

Loudspeakers.—
Special Q.P.P. types—Amplion, Celestion, Epoch, Rola, B.T.H.
Standard types—Amplion, Celestion, R. & A., Marconiphone, H.M.V., Blue Spot, B.T.H., Epoch, Ormond, Rola.

Batteries.—120- to 150-volt H.T. or special quiescent type (Siemens, Every Ready, Lissen, Pertrix, Drydex, Marconiphone, Magnet, Ediswan).
2-volt L.T. (Exide, Block, Pertrix, G.E.C., Oldham).
16½-volt bias (Ever Ready, Siemens, Marconiphone, Pertrix, etc.).

Pick-up.—Bulgin, Celestion, B.T.H., Marconiphone, Audak, Bowyer-Lowe, Radiophone).

In this event, the anodes of the pentodes will go to two of the speaker transformer terminals and the H.T. to the third of the speaker terminals. No matching will be required, for in ordering the speaker you will have to state the valves you are going to use in your amplifier.

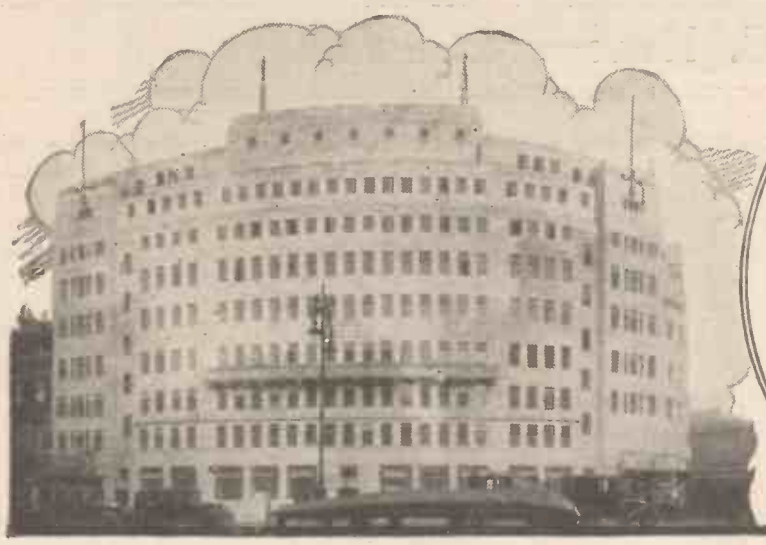
For H.T. you can use either 120 or 150 volts, the full voltage being taken to H.T. terminal of the amplifier. For grid bias you will want about 12 or 13½ volts with H.T. at 120, and about 16½ volts for an H.T. voltage of 150.

Feed-Back Prevented

There is one important point regarding the use of the amplifier, and that is that the leads to the pick-up should be metal screened. Special screened flex is available, and to the metal covering of this should be connected the pick-up casing and also, at the other end, the L.T. negative of the amplifier.

This prevents any feed-back between the speaker leads and the pick-up, with possible instability. The trouble about such instability would be that it would probably take place at super-audibility, and would only be recognisable by either distortion in the results or else a rise in the milliammeter reading when the set was quiescent.

If you care to do so you can use an earth as an extra precaution.



B.B.C. NEWS

Topical notes regarding British Broadcasting Personalities and Programmes.

By Our Special Correspondent

Our Empire Ambassador

THE unfortunate illness of Mr. Malcolm Frost in South Africa after he started his world tour in connection with the Empire Broadcasting Service has considerably upset the plans of the B.B.C. Mr. Frost is now back in London, and the B.B.C. is planning to send a substitute to complete the mission.

Major Gladstone Murray, who is now in New York on his way to Canada, might have carried out this work if it had not been that his duties in London required his early return.

During the past nine years there have been few occasions on which the outside contacts of the B.B.C. have passed from the hands of Major Gladstone Murray. I believe, indeed, that in his brief visit to Ottawa last year he maintained continuous contact by transatlantic telephone.

Less Mechanisation

The attitude of the B.B.C. towards mechanical programmes is undergoing a change. During the crisis of 1931, it was believed that direct studio performance would cease. In the interval, however, prospects of the revision of the financial arrangements with the Post Office and the Treasury have brightened sufficiently to enable the B.B.C. to reduce the proportion of mechanical programmes.

Behind this, I understand, there is an interesting political bargain. Obviously, the Ministry of Labour, the Government, the Musicians' Union and the other theatre organisations would be equally pleased by the B.B.C providing new opportunities of employment. Nor could it be argued that the B.B.C. would be displeased by the prospect of a substantially larger share of the licence revenue when the subject comes under review, two years hence.

The G.T.C. versus The B.B.C.

The attitude of the B.B.C. towards the General Theatres Corporation, of which Mr. George Black, as managing director, represents the Ostrer interests, has been one of mild toleration in the face of difficulties. There was, of course, no hope of the success of the war which the G.T.C. declared on the B.B.C. in connection with variety artistes under contract to the G.T.C.

Stage variety has never been an unqualified success "on the air," and it was probably an advantage to the B.B.C. to be forced to make plans for substitutes. As long as it was possible for the B.B.C. programme people to count on having recognised variety talent, it was easy to build broadcast variety programmes on the stage model.

Adapted to Broadcasting

It has been noticeable that since the G.T.C. declared its war, the variety programmes of the B.B.C. have been better adapted to broadcasting than they were before. Of course, the fallacy in Mr. George Black's argument was that the broadcast variety damaged his theatres.

Nothing of the kind. If Mr. Black's theatres have suffered from broadcasting, it has been from broadcasting as a whole and not from any particular part.

"SILENT SINGING" BY RUDY VALLEE

The famous American Orchestra leader crooning to an audience of millions and visible through the sound-proof windows of the National Broadcasting Company's studio, in New York.

B.B.C. News—*continued*

Marius B. Winter

Mr. Marius B. Winter, the well-known dance orchestra conductor, has put up to the B.B.C. an interesting proposal for the creation of a reserve dance orchestra which would be ready to replace Mr. Henry Hall's orchestra at holiday time and also to do the odd jobs which now place a serious burden on Henry Hall. I shall be interested to watch the progress of this proposal, especially as Marius Winter and Henry Hall are close personal friends.

And while on the subject of B.B.C. dance music, I continue to hear intriguing rumours of the attitude and policy of the great Jack Payne. In the corridors of Broadcasting House the typists whisper mostly of two things: the first, naturally, "Are there going to be any rises in April?" and the second, "Is our Jack coming back?"

Provincial Orchestras

If people in the Provinces think that the B.B.C. contemplates restoring Regional orchestras to their pre-crisis strength, they are gravely in error. The B.B.C. has made up its mind on the subject, which is another way of saying that Sir John Reith has decreed with finality that Regions must put up with the present small combinations.

I would not be surprised, however, if this policy is changed in 1937, with the beginning of a new regime. Also, there may be more money about then, which will remove the only valid argument against normal Regional orchestras.

Book Criticism

There is growing public discontent with the book reviewing of the B.B.C. Undoubtedly it is too high-brow. Most of the books selected are too expensive and intellectual to reach more than a negligible minority of the listening public. This programme feature needs broadening and adapting to real needs.

Song-Plugging Again

There is evidence of a fresh attack of song-plugging fever among music publishers and their agents. The rage of "hot numbers" has initiated an era of fierce competition, and it is believed that the "plugging appropriations" have been doubled in recent weeks.

This means a golden harvest for dance bands; but, of course, it also means fresh anxiety at Broadcasting House, where Mr. Gerald Cock is busy devising plans to stamp out the evil. Until the B.B.C. takes responsibility for all dance music broadcast, there will be no effective check to this practice.

Promotion at Broadcasting House

I hear a lot of complaints about the system or lack of system of promotion in the B.B.C. staff. The allegation of the malcontents is that promotion seems to bear no proper relation to the merits of the persons concerned.

I hesitate to accept this view; but I do think it would be a good plan for the B.B.C. to make public its method of promotion and retirement. For example, are the staff outside London given fair chances to compete for head-office jobs?

An All-British Staff

Recently there has been a careful examination of the original nationality of all members of the staff of the B.B.C. It has always been the rule to employ only British subjects, but the arrival of a number of anonymous accusations set an inquiry in motion.

I have not heard of anyone being turned out as a result; nor did it seem likely that the Governors would accede to the demand that no one born outside the United Kingdom should be employed. This would mean the dismissal of the few Canadians and Australians that are employed by the B.B.C.

Weak Singing

Despite a tightening up of the audition conditions, the standard of solo work in the B.B.C. is not satisfying the public. It is absurdly uneven, and the vibrato is appearing once more.

Dr. Boult is alive to this deficiency and is examining the problem now.

Perhaps it would be better for the B.B.C. not to spread its net quite so widely.

Many people are of the strong opinion that a sound nucleus of proficient artistes might provide better programmes than the present conglomeration.

STEERING AIRCRAFT BY HETERODYNES

This ingenious radio apparatus helps the pilot flying a plane by a musical note, which alters in tone if he deviates from his radio-directed course.

A PRACTICAL MAN'S CORNER

By R. W. HALLOWS, M.A.

"Postage Stamp" Condensers

POSTAGE stamp fixed condensers are very handy little components for the construction of wireless receiving sets. Not only are they of tiny size, but also they can often be suspended in the wiring or used as connections from point to point.

The latter is a very valuable asset in grid circuits where, as everyone knows, it is desirable to keep leads as short as possible. The ideal is to attach one lug of a postage stamp grid condenser to the grid terminal of the tuning coil, and the other to the grid terminal of the valve holder, in which case connections are brought down to the absolute minimum length.

Overcoming a Difficulty

But it often happens that a postage stamp just cannot be fitted in this way. The components concerned have to go into particular places to conform with the layout, and the condenser by itself is, perhaps, half an inch too short to be used as the connecting link.

Fig. 1 shows two ways of overcoming the difficulty. In the first a short piece of wire is soldered to one of the tags; the other tag is, of course, fixed to a terminal. This is one of the easiest of soldering jobs; the wire is merely passed through the hole in the tag, twisted up with a pair of pliers, and secured with a blob of solder.

Into these pages, month by month, our contributor packs a wealth of practical information and advice on constructional work. The regular reader of this "Corner" cannot help picking up a more or less complete training in radio workshop practice, while every month there are wrinkles to read, gadgets to make, and hints to help you.

There are, though, many who either can't or won't solder, and these may find the tip illustrated in Fig. 1b of use. Cut off about six inches of any stiff wire (No. 22 is admirable for the purpose), pass the end up through the hole in the tag and then twice round the neck, finishing the turns as tightly as you can.

A Secure Joint

Then take the end to the main part of the wire and twist it tightly with pliers. This makes a secure joint, though the soldered connection is naturally still better. Whichever way it is put on, the little piece of wire enables the condenser to be fitted in, and the connections to be made with leads of the shortest possible length.

PROVIDING SOUND CONTACT

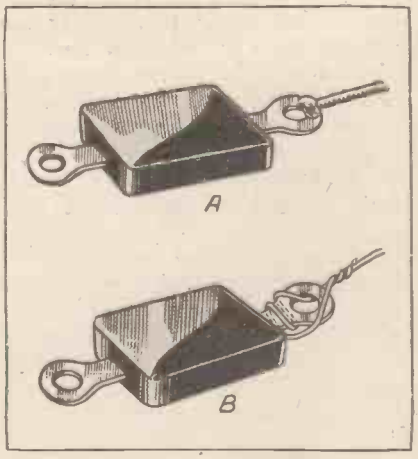


Fig. 1. Two ways of joining a wire to small condensers. (A) is for the man who solders, while the lower (B) will make quite a good joint without soldering.

Armouring Leads

In many of the sensitive circuits of to-day it is desirable to avoid stray couplings by armouring, at any rate, the plate leads of screened-grid valves, and in some cases other leads as well may with advantage be provided with coverings of metallic sleeving. If you have a set containing a screened-grid valve which shows some tendency to instability with a plate lead of ordinary plain flex, it is as well to try the effect of armouring the lead, for this sometimes works wonders.

Metallic sleeving can be bought from most wireless shops. Usually it is sold either with an interior tubing of systoflex-like insulating material, or with single or double flexible wire within. The trouble with the kind that has an insulating tube is that the diameter of the latter is generally too small to allow flex to be passed through it. Again, with the kind of metallic sleeving that encloses flexible wire, baring ends is a fiddling and annoying job.

FOR A NEAT FINISH

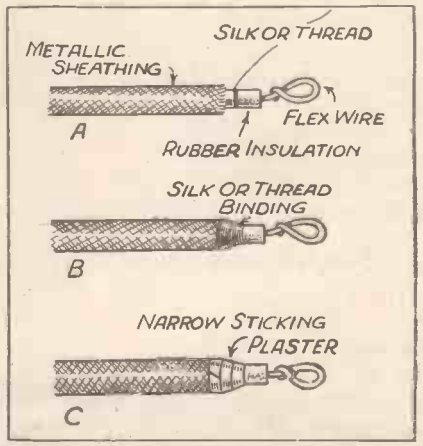


Fig. 2. The three stages in binding the ends of metallised wire—first with silk or thread, and then with narrow sticking plaster.

A Practical Man's Corner—*continued*

In either kind, my own method, which readers will, I think, find a time and trouble saver, is to begin by removing the insulating tube or the "built-in" flex altogether. This is quite easily done.

The outer sleeving is worked back with the fingers until a grip can be obtained upon what lies within it. One hand then gently pulls on this, whilst the other continues to work the sleeving back.

Making the Leads

Now make a plain flex lead of the right length, or use that which is already in the set. Cut off a piece of metallic sleeving about an inch shorter than the insulated covering in question and pass the flex through it.

The greatest care must be exercised in binding down the ends of the sleeving, for something particularly fine in the way of short-circuits can be produced if a single "whisker" of an earthed sleeve comes into

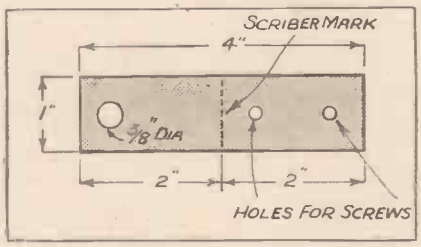


Fig. 3. The large hole takes the component, the smaller ones being for baseboard fixing. After drilling the metal is bent as shown in the top diagram.

contact with so much as one loose strand of the inner flex carrying H.T. for the plate of the S.G. valve.

Fig. 2 shows an effective way of finishing off the ends. Begin as shown at A by binding three or four turns very tightly round the rubber covering of the flex—*not* round the sleeving. These turns should be so tight that they sink a little into the rubber.

Put on in this way, they will never shift, and they form a firm anchorage for the binding. For the binding, silk or thread may be used. Myself, I prefer a good, strong thread. Continue by binding down the end of the metal sleeving as shown at B, cutting off any protruding strands.

Secure the end of your thread, and give the binding, if you like, a light dressing with shellac varnish. Finish as shown at C with a few turns of narrow sticking plaster. Treat the other end in the same way, and the armoured lead is complete.

Aluminium-Sheet Brackets

When you are dismantling an old set containing aluminium screens or an aluminium panel, don't throw the metal away, however useless it may seem at the moment. It comes in handy for many purposes in wireless construction, and one of these is illustrated in Figs. 3 and 4, which show the construction of a bracket for mounting a volume control, a switch, or some other component, upon a baseboard.

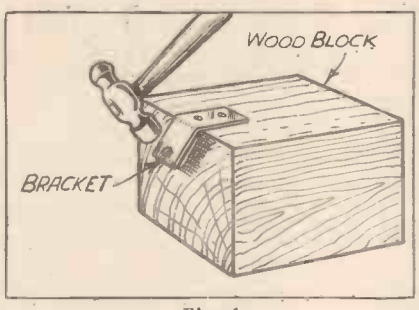


Fig. 4.

CONSTRUCTING USEFUL BRACKETS FROM OLD SCREENS, AND DETAILS OF THE BEST WAY TO DEAL WITH COPPER FOIL FOR BASEBOARDS.

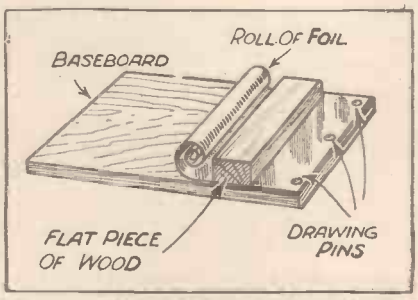


Fig. 5. With the aid of drawing-pins and a flat piece of wood you will be able to attach copper foil easily and smoothly to a baseboard.

Sheet aluminium of 12, 14 or 16 S.W.G. is excellent for the purpose, and it is easy to work. Fig. 3 shows how a strip cut with tin-shears or a hacksaw from the metal is drilled with a ⅜-in. hole near one end for the fixing bush of the component, and with a couple of screw holes near the other.

The dimensions shown are suitable for a volume-control bracket, but this may be adapted to suit the requirements of any component.

The drilling having been done, make a deep scribed line, as shown in the drawing, across the metal of the strip. The purpose of this line is to weaken the metal slightly so that it may be bent exactly in the right place. The method of shaping is illustrated in Fig. 4.

The strip is placed on a rectangular wooden block with the scribed line lying on the edge of the latter. A few taps with a light hammer are now all that is required. Good panel brackets can be made in the same way from sheet aluminium of reasonably stout gauge.

Copper Foil

Though there is much to be said for the all-metal chassis, the wooden baseboard or chassis covered with copper foil is a good deal more convenient from the constructor's point of view. It is easy and cheap to make; there is no difficulty about mounting components; it can be

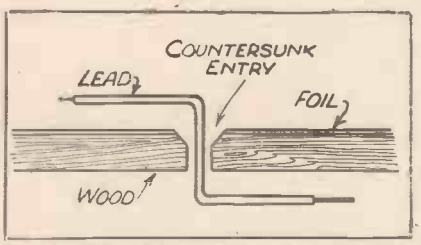


Fig. 6. When leads have to pass through a metal-covered baseboard, it is a wise precaution to countersink the hole on the foil side to avoid insulation abrasion.

constructed in the home workshop in any desired size.

The only bugbear is the copper foil itself, for it is by no means an easy business to apply this tightly and without rucks or creases to the wood, especially if the baseboard or panel is of largish size. Some constructors go gaily ahead. With never a thought of impending troubles, they tack or screw down one end of the foil and then proceed to deal in the same way with the long edges.

Before long they make the sad discovery that the foil is too slack in some places and too tight in others. When the job is finished it is reminiscent of a beginner's efforts at wall-papering.

Use Drawing-Pins

Foil, unfortunately, does not usually arrive in the flat; it comes tightly

(*Please turn to page* 448)

From My Armchair by "S.T."

PLACE: Lat. 52° 57′ N. Long 1° 8′ W.

Time: 10.15 p.m., Tuesday.

I am in bed as I write this. 'Flu? No. Merely Nottingham.

I once read in a novel that nothing exciting in life happens before ten o'clock. In Nottingham nothing whatever happens after. So I've decided to come to bed, read a big bundle of letters picked up at Tallis House, and write a few jottings.

* * *

I am doing it on an empty stomach (my notebook rests there) because there do not seem to be any eating houses open after ten. Except that tripe shop opposite the Theatre Royal. I heard a voice relaying orders to the kitchen as I passed: "Two large tripes with a bit of dark on." "One small tripe with some thick, please."

Perhaps Nottingham (or Lancashire) tripe fanciers can initiate me into these mysterious rites; but perhaps it is better not to know.

Tragic but True

This city of lace and cigarette manufactures is full of keen radio constructors. Within a few hundred yards of the County Hotel there are half-a-dozen shops vying for custom. Two had "S.T.400s" in the window. One was a pretty good imitation using all the components I had carefully excluded from my list; in addition, the anode and aerial coils had their positions reversed, although the coils were very plainly marked.

Someone will buy that set (yes, it is a few shillings cheaper than my standard) and then blame me.

I do not believe that more than one out of four sets are built to correspond with the author's. This is tragic, but true.

Responsibility Declined

Where a constructor has some components on hand one can understand his desire to at least *try* them. But the wilful purchase of new and unsatisfactory parts means *you* must take the full responsibility for any inferior results. I positively decline to do so.

Included in this month's subjects:

USING WRONG COMPONENTS — LION-SHOOTING IN AFRICA — SHORT-WAVES — CHIMNEY-SWEEPS — 77-YEAR-OLD CONSTRUCTORS — BRICKBATS — RECEPTION IN CORNWALL.

Well, let's have a look at the mail. Some of it is specially marked PERSONAL. But I never get anything more exciting than a stamped, addressed envelope in these suspiciously thick personal letters.

Personal letters asking advice are often greatly delayed and are not treated in any different way. All readers are treated alike. And even if you knew my brother in Egypt during the war, or have studied cotton spinning technology under my father, you will not receive special treatment.*

* I must have at least twenty-five brothers, and as for uncles and cousins . . .

The chances are, in fact, that I shall carry your letter about in my coat pocket for a few weeks and then forget to reply. This is the penalty of being so personal! You get treated as a friend.

Of course, I always live in hopes that these personal letters will contain something exciting. And here in to-day's batch is certainly one out of the ordinary.

It comes from Nyassaland and suggests that I go out there lion-shooting.

Chipandi Estate,
Blantyre P.O.,
Nyassaland.

Dear Sir,—What about coming along with a real short-wave set for us who are out amongst the lions in the Blue?

We badly want a good short-wave set. You can come along here to me and test it for East Africa, and get a shot at a lion at the same time. What about it?

Meanwhile, just get a move on, old lad, and consider the Colonials.

Yours sincerely,

G. J. HUMPHREY,
President, Nyassaland Golf Union.

Right-ho, old cock, I'll see what I can do—but "the maximum benefit for the maximum number" is the guiding principle of my work.

Fascinating Field

The shorter waves are not, as yet, very popular over here owing to disappointing reception. It is a very fascinating field, but the crop it grows

"A Better Judge of a Set Than I Am"

is not very sturdy; it is not everybody's meat.

That is why I have kept off the short waves. The fine edge of expectation has been too often blunted by subsequent results for the average constructor to be whipped into a froth of frenzied excitement over world-wide radio.

Setting an Example

I shall never attempt to make my readers enthusiastic over something I am not really keen on myself. The world-wide range of a set having a short waveband is a spectacular thing. It is magnificent, but it is not entertainment.

Incidentally, I believe that these waves should be received on a superheterodyne, and that attempts to "make do" with the technique and components of a straight set designed for longer wave reception are little more than a waste of time. *C'est magnifique, mais ce n'est pas le radio.*

Of course, thousands will disagree with me. They always do. I console myself with Nietzsche's aphorism: "He who is attacked grows strong."

Here's a letter from a reader who says: "In your 'S.T.400' article you said: 'I do not follow fashions; I start them.' You certainly seem to have paved the way for other designers who have chosen four valves for their boom sets and have come round to the idea of 'more knobs.' Even zone tests and aeroplanes have been featured."

Well, why not? If better sets for home constructors thereby result, I do not mind. There is one thing better than following a good example, and that is: *setting* a good example.

* * *

After the hairdresser comes a chimney-sweep. Mr. A. Pearson, who normally spends his time looking at the black side of things in Blackpool, has a few bright words for the "S.T.400":

Stations Galore

"I built your 'S.T.400' just before Christmas, and I find it the best set I have ever handled. As soon as I joined up the batteries I could bring in stations galore. I am a chimney-sweep, and I hear many makes of sets, but none to come up to the 'S.T.400.' I am very pleased with the 'S.T.400,' as I am not a one-knob man."

I have always avoided chimney-sweeps in the house, but I shall certainly have a talk to the man who "does" my chimneys. He is probably a better judge of a set than I am. Let us now have the views of rate collectors, electric sweeper demonstrators and linoleum-layers.

* * *

A most interesting letter follows from Captain Harold Browne, R.N., of Sudbury, Suffolk. He obtains London Regional clear of Stuttgart without difficulty, and Stuttgart clear of London (an easier job from my experience of Suffolk). He adds:

KEEPING WAVELENGTH CONSTANT

This apparatus is of interest to every listener to the foreign stations, for it represents the latest British technique in keeping wavelength constant. It embodies a tuning fork and two-valve oscillator, and is intended to keep the sending station's frequency constant within one part in ten million!

"By the way, I lately heard one of my offspring bragging to a neighbouring child: 'My daddy's set's got more knobs on it than your daddy's has!' Which was true, and may be considered a hitherto unenumerated advantage of the 'S.T.400.'"

My gallant reader agrees there has been too much human interest photography of my face, but suggests that I should grow side-whiskers for the next set, "to fitly symbolise the introduction of a push-pull output stage."

From this warship commander I now turn to greet Mr. J. F. Thompson, of West Kensington, who has constructed the "S.T.400"—"the finest set I have ever built"—*and who is over 77 years of age!* I congratulate these vigorous young men whom new ideas can still stimulate. Such reports put to shame many who obviously believe in "leg-theory" when it comes to brick-bat bowling.

* * *

Why people want to boast about their poor results I cannot imagine, but several readers are simply itching to see their names in print. Here is one: Mr. F. W. Ruskin, 53, Clemence Street, Burdett Road, London, E.14. The only stations he gets are National and Regional. He has received *nothing* from the other side of the English Channel. "I agree with D. M. Fincham, of Rosyth. The 'S.T.400' is a washout."

Of course, we all agree Mr. Ruskin's "S.T.400" is a washout, but the smallest fault could explain that. It astonishes me the number of people there are who prefer to make sweeping statements rather than admit a component, a valve, or even themselves may be a cause of ill-success.

* * *

Mr. F. C. Blake complains that the set is no use in Cornwall. He lives at Helston. "No, sir! As far as you and your set are concerned the ether in Cornwall is just the same as ever it was; and, what is more, to prove it, I defy you to publish this letter in the next WIRELESS CONSTRUCTOR. Neither will you publish one letter of enthusiasm from Cornwall. You haven't the courage to do the former, and you cannot do the latter because there isn't one in existence."

Reports from Cornwall

I hope that publishing Mr. Blake's outburst will improve his local ether.

I have, you see, Mr. Blake, the courage to publish your condemnation of the set; but you will find excellent reports from Cornwall; I have been in your own town, and the "S.T.400" works supremely well there; I can also refer you to a fellow-townsman.

Meanwhile, other Cornishmen may care to write to me about their results.

Letting Off Steam in Print

I hope readers will stop "defying" me to do things. It is so futile getting all red about the neck when I'm quite happy to place your view-point before the public. I never mind publishing "failure" letters. I never believe in suppressing criticism. Better to enable readers to let off steam in print than let them attempt to spread bad reports by word of mouth.

Provocation by Radio

As a matter of fact, I believe in readers washing their dirty linen in public. The fresh air and sunshine of publicity is the best way of putting complaints in their right perspective.

Personally, if I had built an obviously good set and got poor results, I should not go and boast of my failure; I should lie low until I had found the trouble.

* * *

More international complications:

Some time ago I meekly suggested that the crashing out of *Deutschland über Alles* at the close of German programmes was a trifle provocative.

To me it represents the banner of intense nationalism to which Germans may yet again flock with rifles in their hands.

We of Britain feel quite different about our own mournful national hymn. We take our patriotism lightly and go to our deaths with a jest. We almost love our enemies and certainly, in this year of grace, we cannot summon up enough fire to sing about our Land of Hope and Glory—far less to set flame to Europe with another war.

What Was It About?

The smug and pompous self-satisfaction of the Victorian era with its map-reddening Imperialism has given place to a rather careless good nature. The empire on which the sun never sets may have been "good business" in its time, but it holds very precariously together. The last of the great empires of the world has become diffused into a commonwealth.

Sic transit gloria. Our patriotism at the best of times, in the days of our "greatness," consisted chiefly in sending out a small army which did great deeds while we sat safely at home and read Kipling. Only during the 1914–1918 cataclysm did we as a nation take up rifle and revolver. But none of us really knew what it was all about. Like most others, I am still wondering.

How different is Germany's patriotism! *Deutschland über Alles.* At five I was taught to sing it by a German governess and smacked for getting it wrong. (And twelve years later I was taught how to lunge twelve inches of steel into German bodies.)

This topic has re-arisen because a reader raps me over the knuckles for suggesting that the German national anthem means "Germany above all others," and tells me that a B.B.C. lecturer explained that the phrase merely proclaimed that Germany should come first in the thoughts of its citizens.

A Song of Superiority

I am left cold. The song is as blatant a piece of self-glorification as you could find. Almost as bad as some of the lesser-known verses of our own anthem. But whereas our hymn in normal times is associated chiefly with the closing of a performance, the German one is threatening to herald the opening of a new drama.

The actual words are unctuous and fatuous and express a school-child mentality. ("My father's better than your father.") They tell us, *inter alia*, that German women are above all others in the world and that German wine is above all others in the world. In fact, everything German is above everything else in the world.

It must be lovely to be so convinced of one's superiority.

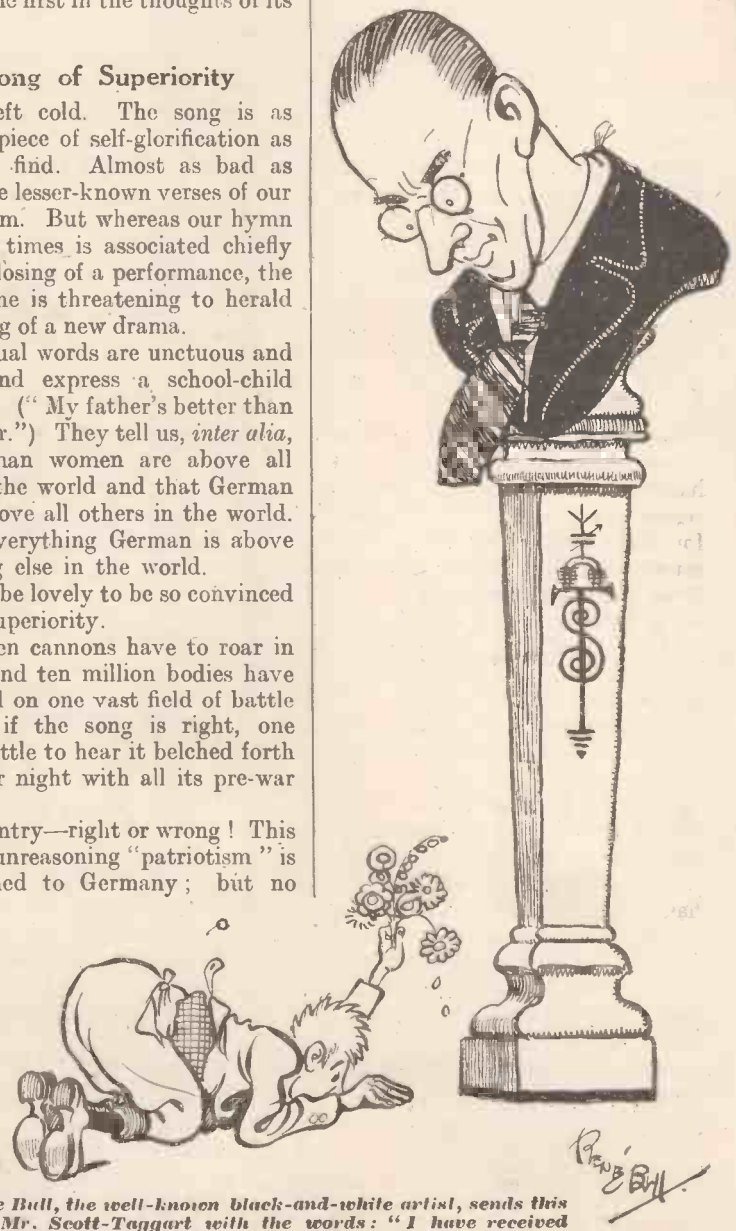
But when cannons have to roar in Belgium and ten million bodies have to lie dead on one vast field of battle to prove if the song is right, one winces a little to hear it belched forth night after night with all its pre-war lustiness.

Our country—right or wrong! This rampant, unreasoning "patriotism" is not confined to Germany; but no other country in the world to-day is so fundamentally militaristic. The Prussian ideal—*Das Volk in Waffen*—remains. A nation in arms!

Herr Hugenberg, who has joined Hitler's cabinet, is the greatest propagandist on the Continent. A great industrialist, he owns a huge machine which includes newspapers and films, for directing German opinion. In German cinemas at the time of writing one would see and hear a film glorifying the chivalry of the submarine

(*Please turn to page 446*)

SAYING IT WITH FLOWERS!



Major Rene Bull, the well-known black-and-white artist, sends this tribute to Mr. Scott-Taggart with the words: "I have received Muhlacker clear of London Regional. Can I do more than the above?"

PICK-UP HINTS AND TIPS

Some interesting notes on various practical aspects of radiogram reproduction.

By A. BOSWELL

How often does a needle get used twice because the changing of it is forgotten? More often, I reckon, than might at first be imagined.

Many is the time I have heard people say, after changing a record or re-winding the motor, "Let me see, have I changed the needle?" I am, of course, referring at the moment to those who use ordinary needles with which the slogan is "One side, one needle."

Making Certain

Personally, I make a point of always changing the needle first. After all, it is necessary to lift the pick-up before removing the record, so the needle might as well be changed right away. If you do it first, you will always be certain it has been done.

Perhaps this seems a small point to harp so much upon, but it is really quite important. Present-day records have long lives if treated properly so there is no need deliberately to shorten them by using a needle twice.

And that brings me to another point about needles which I want to emphasise. You all know that as a record plays the needle wears so that it fits more and more into the groove, and that at the end of the record it is no longer round at its point, but has definite "flats" worn on it, and is in effect wedge-shaped.

The Chisel Effect

If the needle is not moved, and is used to play a second time, this wedge effect will fit into the grooves properly; namely, in just the same way as it fitted in the first case, when it was worn. But supposing the needle is removed and later put back again?

The chances that it will be put in just as before are so slight they can be neglected. The needle is bound to be turned so that the wedge effect is at an angle to the grooves—perhaps a right-angle—and under such conditions will perform quite a good chisel effect.

Too often, when needles are running short, the user decides that it won't matter if they all get used up, for there are plenty in the used tray that have only been used once. That's where the mistake is made. If you find yourself running short of needles, start using them twice before they are all used (unless, of course, you can procure some more right away).

WELL WORTH HEARING

Just a Little Home for the Old Folks, and Puss, Puss, Puss.
Blue Mountaineers (Dance Band) Broadcast

Hungarian Rhapsody No. 2.
The State Opera Orchestra of Berlin Broadcast

In a Monastery Garden.
Commodore Grand Orchestra .. Broadcast

Sweethearts of Yesterday.
Reginald New (Cinema Organ) Broadcast

My Grandfather's Clock.
Jetsam (Vocal) .. .. .. Columbia

Classical Fragments.
Sidney Torch (Cinema Organ) Columbia

What More Can I Ask?
Anona Winn (Vocal) .. .. Columbia

Ave Maria.
Yehudi Menuhin (Violin) .. H.M.V.

On the Track.
Jack Simpson (Xylophone) .. H.M.V.

Just an Echo in the Valley.
Ray Noble and His Orchestra .. H.M.V.

Tapping the Time Away Stomp.
Washboard Serenaders (Dance Band) H.M.V.

Black Laughter.
Cole Brothers (Vocal).. Regal-Zonophone

While on the subject of record wear, let me tell you a little scheme I adopt, and which I suggest you follow.

Worn Records

When I get dissatisfied with the reproduction obtained from a record because it is wearing, I put it in a "used record" box, having first made ure the trouble is not in the amplifier.

The records in this box are only played for the sake of the "tune." Quality of reproduction from them is ignored, and if there is no particular interest in their "numbers," they soon get smashed up.

Changing Amplifiers

In this way I have a collection of good records sorted out ready for test purposes, and any new amplifiers or alterations to the present amplifier can be checked over without the issue being confused by a mixture of good and worn records being played. If you are inclined to doubt the necessity of this, just buy a new disc of an old recording you have on hand and compare the two!

It's a fact which has often been set forth for listeners' notice, that when a change from a poor to a good amplifier is made, there is likelihood of the speaker showing up badly. Very often the overall results sound worse, and the cause of the trouble is laid at the door of the amplifier, and there may follow a degenerate step back to the old amplifying apparatus.

This, as I say, is continually being brought to the listener's notice as a warning to give a new amplifier a fair chance by using a really good speaker with it.

Distorting Pick-Ups

But although it is just as often the case with pick-ups, seldom is the fact referred to.

So if you go over from a mediocre amplifier to one that has been designed specially to give good quality. don't misjudge it because you are using "a cheap and nasty" pick-up. It may be that the pick-up is producing horrible peaks and distortion at frequencies which the old amplifier will not look at.

But the new amplifier will, and these peaks and distortion are now heard to the detriment of what was before passable reproduction.

A Tip to Try

To conclude my notes this month, here is a tip to try when you are getting distortion through feed-back. Incidentally, it is one which has proved particularly effective where quiescent push-pull amplifiers are concerned.

Around the outside of the pick-up leads wind in an open, spiral form a piece of insulated wire, and join its end to either the pick-up casing or L.T. negative, or both. Should there be an earth connection on the amplifier, however, this idea seems to have little effect.

AS WE FIND THEM

NEW APPARATUS TESTED

Under this heading we publish reviews of apparatus submitted by radio manufacturers and traders for examination and test in "The Wireless Constructor" laboratories.

A Multi-Range Meter

THE Sifam Electrical Instrument Co., who are well known as manufacturers of moderately priced moving-iron and moving-coil meters, have recently sent us one of their Multi-Range Test Sets.

This set consists of a high-grade moving-coil meter having a facial diameter of 2 in. and a sensitive jewelled movement.

HAS NINE RANGES

This Sifam testing set incorporates a sensitive moving-coil meter and covers all the voltage and current ranges required for radio purposes. The instrument is completely self-contained.

As many as nine different ranges are obtainable on the one instrument, the necessary resistances and shunts being contained in the case. There is a common positive terminal, which is coloured red, and any desired range becomes instantly available simply by changing one connecting lead.

The ranges are: *Volts:* 0–10, 0–100, 0–250, 0–500. *Milliamperes:* 0-2·5, 0–25, 0–100, 0–250. In addition there is a 0–1 ampere range.

When used as a voltmeter the current consumption is only 2·5 milliamps., and the instrument may therefore be used for taking mains unit voltages. We would point out here that only high resistance moving-coil meters are suitable for this class of work.

The makers guarantee the accuracy to be within 3 per cent on all scales, and we found this to be borne out on test.

The movement is well damped, the needle taking up its position positively and with an entire absence of oscillation.

Robust in construction, and very moderate in price, this instrument should meet with considerable popularity among constructors and service dealers. Its variety of uses should prove an invaluable asset in all experimental and test work. The price complete is £3 15s. 0d., and the makers' address, York Avenue, Browning Street, London, S.E.17.

Wearite Transformer

Last month we made brief reference to the type T.21A mains transformer recently produced by Messrs. Wright and Weaire, 740, High Road, Tottenham, London, N.17.

This component is a noteworthy attempt on the part of the makers to place before the public a transformer which, in the hands of the constructor, is absolutely safe and thoroughly reliable.

Judging from the sample submitted, Messrs. Wright and Weaire have been eminently successful in achieving their object. On the mains input side there is a rotating mask or disc, together with a wander terminal. In use this disc is rotated until the appropriate mains voltage appears opposite a small slot, and the wander terminal is then screwed into the rating required. There are tappings ranging from 200–250 volts in steps of 10 volts.

The high-tension output is centre-tapped and rated at 250–0–250 volts at 60 milliamperes. In addition, there are two low-tension windings giving 2–0–2 volts at 1 ampere and 2–0–2 volts at 4 amperes respectively.

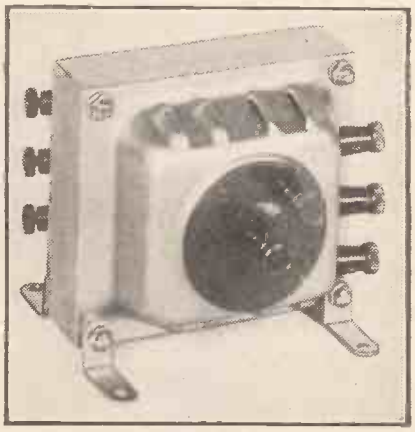
All terminals are definitely insulated and well separated, the various voltages being clearly marked on the cover.

The case is of gilded metal, having eight louvres in each half to give adequate ventilation. The insulation undergoes a 1,000-volt test at the works, and we have no doubt that this transformer will achieve considerable popularity.

A larger model called the T.21B is also available. This instrument has an output of 350–0–350 volts at 120 milliamperes, and 2–0–2 volts at 2·5 amperes, and 2–0–2 volts at 3–4 amperes.

The type T.21A is priced at 25s. and the T.21B at 27s. 6d.

RELIABLE AND SAFE



The latest Wearite mains transformer in which a clever method of setting the primary to the correct input voltage is used. There is a rotating disc and a wander terminal. The disc is turned until the number representing the voltage of the mains appears opposite the slot and the wander terminal is then screwed into place.

As We Find Them—*continued*

We have used the T.21A with highly satisfactory results and recommend it.

"Superflex" Connecting Wire

"Superflex" is a particularly attractive form of covered connecting wire supplied by Electro Insulators Ltd., Meadow Works, Sheffield.

The pliable tinned copper wire is treated with a special cellulose varnish which has a high insulation resistance, withstanding, the makers state, a breakdown test of 5,000 volts.

"Superflex" is available in various distinctive colourings, the cellulose covering giving a particularly fine finish to the wire.

Apart from its "well-groomed" appearance, "Superflex" is efficient.

We gave the samples submitted several practical tests. For instance, we "lagged" a length of "Superflex" tightly with bare copper wire and then applied 500 volts between the metal sleeve so formed and the connecting wire. The insulation at this voltage was above suspicion. The covering also passed our flexibility tests with flying colours, and these were far more drastic than are ever likely to occur in normal use.

One of the advantages of "Superflex" is the fact that there are no frayed edges to spoil the neatness of the wiring.

From the set constructor's point of view this connecting wire is extremely easy to handle. The cellulose-covering can be removed so as to bare the end of the wire simply by gripping with a pair of cutting pliers and pulling. The covering then comes off in the form of a tube and leaves the bared end ready for joining to the appropriate terminal.

"Superflex" adequately fulfills the requirements of set constructors, especially those who like to give their receivers "that professional touch."

FOR QUIESCENT PUSH-PULL

The R.I. quiescent push-pull input transformer and output choke. The primary inductance of the input transformer is 30 henries at zero D.C., and 20 henries with 1 milliamp. flowing.

R.I. Components

We have had the opportunity of testing the new R.I. "Difeed" and quiescent push-pull transformers.

The "Difeed" is a small, inexpensive transformer having a core of nickel alloy, known as "K" metal, and is designed for use as a direct-feed instrument, as distinct from the "Parafeed," which is intended for parallel-fed circuits. The name "Difeed" means direct-feed, as opposed to parallel-feed, and the transformer will carry up to 4 milliamps. in the primary winding. Hence, it can be used in all normal circuit arrangements without danger of saturation.

The "C" metal core used for the "Parafeed" type of transformer is, of course, not suited to direct-feed circuits, and must be employed in conjunction with a resistance condenser feed to deflect the anode current from the transformer primary.

The price of the "Difeed" is 7s., and it is remarkably good value for money.

The quiescent push-pull transformer has a centre tapped secondary, the primary inductance being 30 henries with no D.C., 20 henries at 1 milliamp., and 16 henries at 2 milliamps.

There is a special quiescent push-pull output choke for use in conjunction with this transformer, four tappings being provided to ensure satisfactory matching.

We have tested the two transformers and also the choke, and found them to give very good results.

The price of the quiescent input transformer is 16s. 6d., including royalties, and the output choke is 12s. 6d.

The makers are Radio Instruments, Ltd., Purley Way, Croydon. Leaflets giving details of quiescent circuits are available free on application to Messrs. R.I.

A MATTER OF TESTING

Demonstrating the importance to every set owner of owning and understanding a meter.

"I've tested all the components." A statement glibly and often enough made by constructors seeking assistance because their sets will not work properly. But have they really tested all the parts? Can they?

More often than not such tests are merely a verification of the existence or otherwise of continuity, according to the component under test. Occasionally the charge-holding properties of a condenser are proved, but correct capacity and resistance values do not receive attention.

Not Good Enough

Disregard for these and other vital factors largely excludes the possibility of tracing the trouble. Comprehensive testing of components requires apparatus beyond the usual phones and dry-cell combination, and yet a surprising amount of test work is possible with just one good meter.

Real Benefit

I do not intend to go into means and methods here, but I assure constructors that they will benefit greatly by learning something about the ways of testing components. The subject interests as well as instructs, which adds to the incentive of the inquirer.

Testing by substitution affords an alternative to meter work, but is a somewhat unscientific alternative. By replacing a suspected component with another, or trying it in a different set, one can ascertain only whether it works or does not work. There is the drawback of working in the dark—far better to have the light shed by a good meter.

To the initiated, the wagglings of a needle are as illuminating when fault-searching as the stethescope is to the doctor. At first you might find "needle-work" a little puzzling, but after a bit you will begin to wonder how you ever managed to get along without them.

Almost Useless

To be quite candid, a set without a meter is almost like a car without any instruments on the dashboard!

A. S. C.

A STRAIGHT TRACKING PICK-UP ARM

By G. L. Wakefield

Proper tracking is a most important factor in good pick-up results, and perfect tracking is only obtained when the needle moves in a straight line across the record—a condition which appertains in the easily made "arm" described below.

As every radiogramophone enthusiast is aware, tracking is one of the most vital factors affecting the life of a record.

When a record is made, the cutter follows a straight path from the circumference towards the centre of the master wax. To obtain perfect reproduction and the minimum of record wear, the needle in the pick-up must follow the same path. Obviously this ideal is unattainable with the conventional radial type of pick-up arm, but the one about to be described permits the pick-up to track straight, and it also has other advantages.

Easy Record Changing

The photograph on this page shows the pick up and arm in position across the turntable. The pick-up is mounted on a brass carriage which slides on two thin steel rods. These latter are supported across the turntable by wooden blocks in such a manner that the whole arm can be lifted to facilitate the changing of records.

The pick-up is arranged so that as the arm is lowered gently on to a revolving record the point of the needle drops on to the outside margin, when a slight touch sends it into the track. When a record has finished playing the arm is raised, and the pick-up (which is prevented from falling on to the record by a stop) slides down the arm in readiness for the next record, as can be seen in the second photograph.

The Construction

It is practically impossible for anyone to drop the pick-up on to a record and ruin it, as is so easy with an ordinary arm.

Commence the constructional work by cutting the two end blocks out of $\frac{7}{8}$-in. mahogany or oak. Fig. 1 shows the dimensions. Cut the shaded portion out of each block with a saw and sharp chisel, and cut two blocks out of the same wood to fit snugly into each aperture.

Pivot the loose piece to block B by drilling a $\frac{1}{16}$-in. hole through both pieces, and thrusting a piece of stiff steel wire through. (A 16-gauge steel knitting pin will do admirably.) To make the block pivot it is necessary to round off the back bottom edge as shown in Fig. 1.

Now drill two $\frac{3}{16}$-in. holes to a depth of $\frac{5}{16}$ in. in each small block. These are to hold the steel rods in position and are indicated also in Fig. 1.

The carriage mounting for the pick-up is made from 24-gauge sheet brass. The pattern is given in Fig. 2. Bend it carefully to shape along the dotted lines, solder along the edges that butt together, and the result should be as Fig. 3.

Smooth Running Essential

Now obtain two 13-in. lengths of $\frac{3}{16}$-in. silver steel rod, and also about $2\frac{1}{2}$ in. of brass tube of such an internal diameter that it slides nicely over the rod. Take care that there is not too much play on the rod, otherwise the pick-up will wobble and probably chatter as it goes across the record.

Polish the inside of the tube with

AT RIGHT ANGLES TO EVERY GROOVE

The pick-up moves straight across the record on two "rails," no swinging arm being employed. It is thus possible for the tracking to be exactly right both on the outmost and inmost tracks of the record.

A Straight Tracking Pick-Up Arm—*continued*

fine emery cloth to ensure smooth running, for if there is any unnecessary friction the advantages gained by the straight tracking will be counteracted by the excessive pressure on the outer wall of the record groove necessary to draw the pick-up across.

A Little Play

Drill the holes marked A in Fig. 2, taking care that they are opposite one another. They are of the same diameter as the outside of the brass tube, which is passed through both of them and soldered in position. Leave only ¼ in. of the tube projecting on the right of the pick-up carriage, otherwise it will not be able to slide right back to the edge of the turntable.

The lower hole on the carriage is ¼ in. to start with, but it is enlarged with a round file when the arm is assembled, so as to give the pick-up a little play up and down.

Sound Insulation

The method of fixing the pick-up to its carriage depends on the type used. The one illustrated was fixed by a nut and bolt passed through a hole drilled in the back plate of the pick-up.

In whatever way the fixing is done it is a good plan to put two small rubber washers, cut from an old cycle tube, between the carriage and pick-up, for a sensitive instrument may detect and reproduce any slight noise caused by the brass tube sliding on the rod.

You can now assemble the pick-up arm. Push the ends of the steel rods into the holes of one of the blocks, slide on the pick-up and carriage, and then fix the other block. Stand the complete arm on the motor-board over the turntable, and put a needle in the pick-up.

It must be so mounted that the point of the needle will pass exactly over the centre of the turntable when the pick-up is slid across.

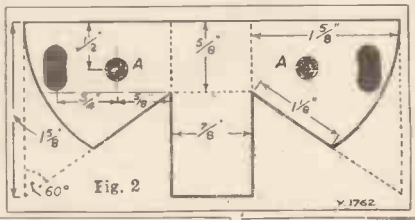
Fix the end blocks to the board by means of screws, the hinged block on the right, and being kept as far as possible away from the edge of the turntable to allow ample room for the pick-up.

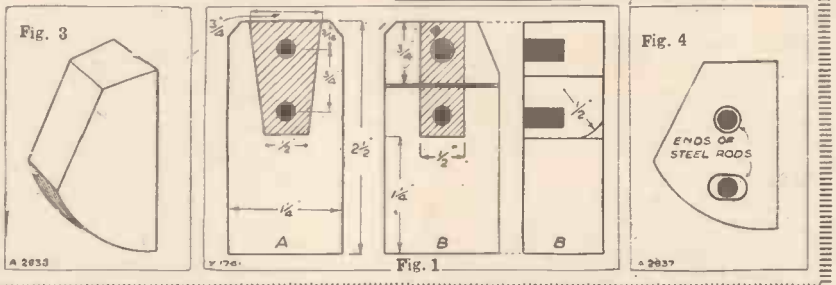
Now elongate the two lower holes in the carriage, so that when a record is being played the lower rod does not touch the carriage at all. (See Fig. 4.) When the arm is lifted it is the lower rod that prevents the pick-up falling on to the record. The hole should also be large enough to allow the pick-up to be lifted slightly to slide it along to the edge of a 10-in. record.

Although the pick-up arm as here described is intended for use on 12-inch records, it would be a simple matter to arrange a stop for 10-in. records, so that if it is intended to play a number of these consecutively there is no need to slide the pick-up along.

PRACTICAL DETAILS

With these four diagrams and the information contained in the text, the construction of the straight tracking pick-up "arm" is readily followed.



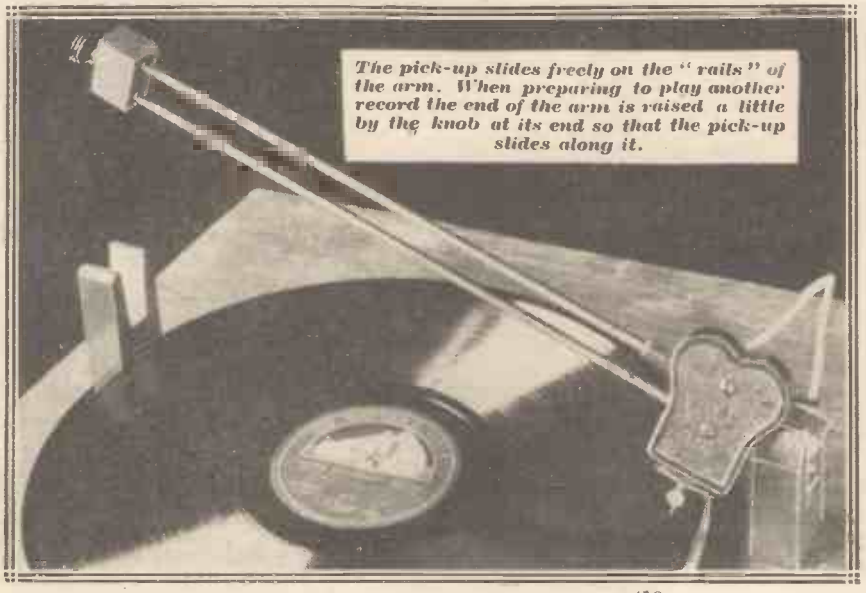


Final Adjustments

If when the arm is lowered the point of the needle falls too near the edge of the record, a rubber washer at the end of the top rod will remedy this. If, on the other hand, the point falls right inside the track, it will be necessary to file a little off the end of the brass tube. A little petroleum jelly smeared on the rods will make the pick-up slide easily.

To make the arm look smart and to harmonise with the gramophone cabinet, a coat of chocolate enamel paint given to the pick-up carriage and the two wooden blocks will make them resemble moulded bakelite. A small knob screwed on to the unhinged block not only makes a neat finish but also assists in raising the arm.

RETURNING PICK-UP BY RAISING THE ARM



The pick-up slides freely on the "rails" of the arm. When preparing to play another record the end of the arm is raised a little by the knob at its end so that the pick-up slides along it.

THAT "GOODNESS" FACTOR

By R. SWIFT

A term commonly met with in connection with valves, and which sometimes proves a bit of a "puzzler," is "mutual conductance." What it is and how it can be found are explained in this article.

IF you happen to possess an old valve catalogue and care to examine the particulars given in its pages you will find that, apart from the filament voltage and current, and possibly the maximum plate volts permissible, only two characteristic figures are given as a rule for each valve. These are the impedance and the magnification factor.

A Third Value

If you care to go a step farther and look through valve advertisements of the same period—I am talking now of six or seven years ago—you will find that a point that many makers strove to bring out most strongly was the excellent magnifying powers of their products.

Glance next at the particulars given in a modern valve catalogue and at modern advertisements. In the former you will see that a third factor appears—the mutual conductance of each valve. In the latter you will frequently find that makers lay stress upon the high mutual conductance of one or other of their products.

Now let us see if we can find a simple way of seeing just what mutual conductance is and why it is so important. Once we have done that I will go on to show you a method whereby you can yourself measure the mutual conductance of any valve in a matter of moments, so long as you possess that essential wireless instrument, the milliammeter.

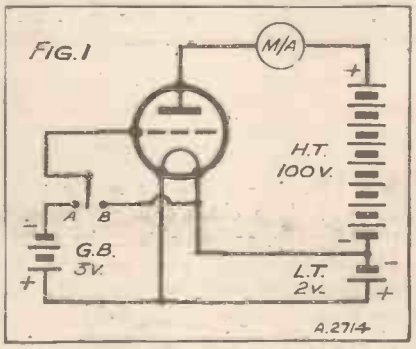
What It Is

Mutual conductance is simply the amplification factor divided by the impedance. If you divided the latter figure into the former just as they stand you would obtain the answer in "amperes per volt." We want it in *milli*amperes per volt (I am going to explain what this means), so the simplest method is to knock off the thousands of the impedance ohms before doing the sum.

Now for this business of milliamperes per volt. This being expanded would read "milliamperes of plate current per volt on the grid." The whole business of the valve is to act as a relay; little changes in the applied grid voltage produce big changes in the plate current.

The bigger the plate current changes for a given grid voltage change the more efficient clearly is the valve. If we state that the mutual conductance figure of a valve is 1·5 milliamperes per volt, or 1·5 MA/V as it is usually printed, we mean that a change of 1 volt on the grid will produce a change of one and half milliamperes in the plate current, or a change of 3 volts in the grid voltage will alter the plate current by 4·5 milliamperes, and so on.

OBTAINING ONE-VOLT G.B.



By connecting G.B. positive to L.T.+, the same effect as a 1-volt cell with its positive to L.T. negative is obtained.

A moment's thought will show that we can define mutual conductance as the change in plate current divided by the change in grid voltage. But we should obtain a variety of different figures for the mutual conductance if we made the plate potential, say, 50 volts, 75 volts, 100 volts, 150 volts, and 200 volts.

In order, therefore, to be able to obtain a figure which will enable us to compare one valve with another it is usual to measure mutual conductance with the plate voltage at 100. Again, though we talk about the straight portion of a valve characteristic curve, there is no part of it which is actually a perfectly straight line.

Measured at 100 Volts

Thus with the plate voltage at 100 we might obtain slightly different results if we varied the grid voltage between 0 and minus 1, or between minus 1 and minus 2, or minus 6 and minus 7, and so on. For this reason, makers usually state that the mutual conductance is taken at grid volts zero. This means that it represents the change in plate current (with plate volts 100) produced by altering the grid bias from zero to 1 volt negative.

This immediately suggests an easy way of measuring the mutual conductance of any valve. We have seen that the mutual conductance is equal to the change in plate current divided by the change in grid volts.

No Calculations

Very well, then; make the change in grid volts 1 and there is no calculation to be done. The change in the plate current when the grid is altered from zero to 1 volt negative *is* the mutual conductance. We can thus use the milliammeter to obtain a direct reading of the mutual conductance factor.

But how, if only 2-volt accumulators or 1½-volt dry cells are available, are we to obtain a change of 1 volt in the grid bias? Fig. 1 shows a very simple way of doing this. The low-tension supply is from a 2-volt accumulator cell, whilst the high

That "Goodness" Factor —*continued*

tension is provided by a tapping with a value of approximately 100 volts (there is no need to be exact) from a dry or accumulator H.T.B.

The grid-bias battery used consists of two dry cells (or the sockets between 0 and —3 of a standard grid battery) connected so that the positive goes not to L.T.— but to L.T.+. Grid potential is measured with respect to the negative end of the filament.

Direct Readings

In the circuit shown in the diagram the positive end of the filament is, of course, 2 volts positive to this. Hence the negative pole of the grid-biassing battery and the grid itself is — 3 + 2, or 1 volt negative to the negative end of the filament. By means of the switch the necessary change of 1 volt in the grid bias of the valve is made instantly.

With the moving arm at A the grid of the valve is 1 volt negatively biassed. Move the switch to B and the grid bias is zero. Suppose that the milliammeter reads 4 milliamperes with the switch over to B and 2½ with the switch turned to A, then the mutual conductance of the valve is simply the difference between the two readings, or 1·5 milliamperes per volt.

A simple test board for valves is very easily made up on the lines indicated in Fig. 2. With this the mutual conductance of any but power valves and pentodes can be read off instantly by the mere movement of the switch and the subtraction of one milliammeter reading from the other. The only parts required are a board about six inches square, a single-pole change-over switch, a valve holder and eight terminals.

If the valve to be tested is a screened-grid a slight alteration in the connections will be necessary, since what is normally the plate socket of the holder serves the screening grid.

Connect H.T.+75 to the H.T.+ terminal of the board and short-circuit the milliammeter terminals by means of a short piece of wire. Connect the milliammeter negative terminal to the terminal at the top of the bulb of the valve and the positive terminal of the instrument to H.T.+ 100.

With pentodes and super-power valves a difficulty occurs. Though makers generally give the mutual conductance for these valves with plate volts 100 and grid volts zero, you will generally find in the leaflet accompanying such valves a warning against ever making the grid bias zero!

The warning is eminently sound, for owing to the enormous rush of high-tension current that would take place with the grid at zero many valves of these classes might be seriously damaged if such an occurrence were allowed to take place.

How then is the mutual conductance of a pentode or an output valve to be measured? The best and safest way is, I think, to use a starting grid bias of —4 and to increase this to —6. The change in grid bias is thus 2 volts, and to obtain the mutual conductance the difference in the milliammeter readings must be divided by 2; not a very difficult sum.

Obtaining 4 Volts G.B.

The reader may object that he doesn't quite see how to obtain a grid bias of —4 volts from an ordinary grid battery, or how to change this quickly to —6. The slightly more elaborate testing board shown in Fig. 3 shows how this may be done.

This board is similar to that illustrated in Fig. 2, except for the addition of the second single-pole change-over switch S.W.2. Turn the switch arm to X and grid battery positive is connected to low-tension positive; turn it to Y and G.B. plus is connected to L.T. minus.

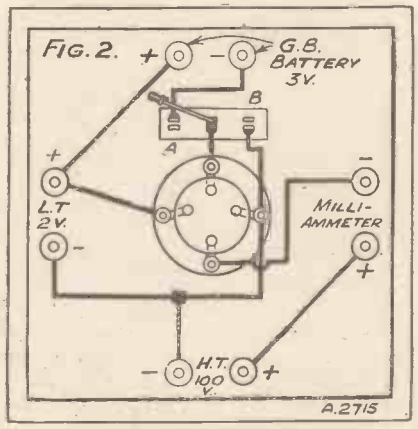
A Warning

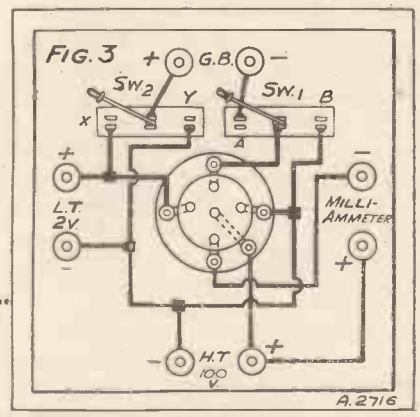
To obtain 4 volts negative grid bias, turn the switch arm of S.W.2 to X and that of S.W.1 to A. To the G.B. positive terminal on the board connect the positive of an ordinary grid battery. Place the wander-plug connected to the G.B. minus of the board in the —6-volt socket of the battery.

The grid of the valve under test is now +2—6, or —4 volts with respect to the negative end of the filament. Turn the arm of S.W.2 over to Y and the grid becomes 6 volts negatively biassed. One word of warning. Never move the arm of either switch when a pentode or power valve is under test without disconnecting L.T.

The valves obtained will probably not quite agree with the makers' figures, for theirs are taken at grid volts zero. They do, however, give the *working* mutual conductances.

It must be remembered that the mutual conductance stated by the makers for any particular valve is an average figure. Do not be surprised, therefore, if when testing new valves you obtain figures somewhat above or below those stated. If the reading is higher, so much the better; if it is lower, the valve is still a perfectly good one.





VALVE TEST UNITS THAT SHOW MUTUAL CONDUCTANCES

On the left is a simple unit for measuring the mutual conductance of valves which do not pass a high anode current. The unit on the right serves the same purpose, but is also satisfactory for power valve and pentode tests. Details for using these testers are given in the text.

SOME NEW IDEAS FOR YOUR SET

BY VICTOR KING

A.T.B.—one of the most recent of radio inventions, and the newly revived quiescent push-pull scheme of amplification, are dealt with in this article from the point of view of the home constructor.

THERE are always new things, but newness alone is not often what most of us want. Of course, there are some people who are out for novelty all the time, and who don't seem to pay much attention to utility.

However, wireless constructors aren't in that class. And if in the past "novelty appeal" has been somewhat unscrupulously exploited by opportunists, I think there is now less and less chance of such gentry being able to get away with it.

In The Right Direction

Modern constructors know too much, and when their knowledge and experience fails them, they turn for advice to those whose profession it is to guide their steps in the right direction.

I know that, because I receive and answer dozens of letters a day. But I must quickly add that, glad though I am to be of assistance in this way when I can, I am already working "to capacity," and would not exactly welcome any additional post just yet! But, as it happens, many of my correspondents are asking identically similar questions. Here are some of the more common ones: "What is this A.T.B.? And can it be added to any set?" "What are your opinions of quiescent push-pull? Is it really worth while?" "Can compensating L.F. transformers be used with advantage in any set?" "Can quiescent push-pull be added easily to an existing receiver?"

I will first of all deal with quiescent push-pull, or "push-push" as it is frequently styled.

Q.P.P. can quite easily be built into practically any set, and at least one firm is selling complete conversion kits for the purpose.

The Few "Extras"

The main alterations are few and simple. The L.F. transformer preceding the last stage in the set is removed and the special Q.P.P. transformer is installed in its place.

A valve holder is needed for the extra valve (two valves are used in a Q.P.P. stage), and a special output choke is necessary.

Many also advocate the use of a milliammeter fixed in an easy-to-see position. This is to enable the grid bias to be correctly adjusted for each of the two valves.

QUIESCENT PUSH-PULL TRANSFORMERS

A group of components for quiescent push-pull amplification. From left to right they are, Sound Sales input transformer and output choke, R.I. input transformer, R.I. output choke, and two of the Multitone quiescent components.

Pentode valves are most commonly employed for Q.P.P. Ordinary valves can be used, but I personally have had no great success with them.

There has been a tendency to overrate the saving of H.T. through the use of Q.P.P. There is a big saving when compared with the consumption of ordinary power stages of equivalent outputs.

In Terms of Watts

But Q.P.P. usually presupposes more power than many constructors employ. An average output power for a 2-volt power valve is in the neighbourhood of 250 milliwatts.

If such an output satisfies you, then Q.P.P. is not so likely to be your meat. With Q.P.P. we talk in terms of one and one and a half watts. Q.P.P. enables you to obtain powers of that order with less H.T. than in normal circuits.

Certainly, when Q.P.P. is in the "quiescent" state, i.e. no music or speech coming through, the H.T. consumption for the Q.P.P. stage (the others—detector, S.G., etc., are not affected) may be a mere couple of milliamperes.

And taking intervals, station searching and record-changing into consideration, sets rest in a "quiescent" state for a surprising time. Thus the *average* H.T. consumption of Q.P.P. is undoubtedly low, having regard to its output. It will be only about 9 milliamperes or so.

Decidedly Worth While

Which means that for a receiver total of about 14 milliamperes you get results comparable with those of a mains set. And that, I think you will agree, is decidedly worth while.

Q.P.P. is definitely on the map and, in my opinion, is worth the serious consideration of all constructors.

I do not propose to discuss "Class B" amplification (an alternative method), for the very simple reason that I have not yet tried it.

Some New Ideas for Your Set—*continued*

A.T.B., or automatic tone balance, to give it its full title, is a much simpler affair, although, in its way, just as novel and every bit as effective.

This, too, can be added to practically any existing receiver.

Circuit Arrangements

Only three components figure in the system. The reaction condenser, a special L.F. transformer, and a fixed condenser.

The reaction condenser is standard, except that it must be of the differential type and modified so that one set of fixed vanes short to the moving vanes at the minimum reaction position. Many differentials can easily be modified to do this by the constructor himself.

One circuit arrangement is such that the shorting fixed vanes join to the fixed condenser (·01 mfd.), the other terminal of this going to earth.

The moving vanes connect to the plate of the valve and the other fixed vanes to the reaction coil.

Straight-Line Amplification

As you will see, the effect of the short-circuit between the fixed and moving vanes is to bring the fixed condenser across anode and earth or, in effect, in parallel with the primary of the special L.F. transformer.

The condition is, then, that you get an approximation to "straight-line" amplification.

But the moment the reaction is used the short-circuit is removed, the fixed condenser becomes non-effective, and the special compensating transformer is free to introduce its high-note lifting qualities and so compensate for the high-note loss occasioned by reaction.

An extremely ingenious scheme, and one which, as I have found in practice, gives amazing results.

The reproduction of even those distant stations for which plenty of reaction must be used is wonderfully good. I fancy A.T.B. will prove extremely popular because of its simplicity, cheapness, and indisputable effectiveness.

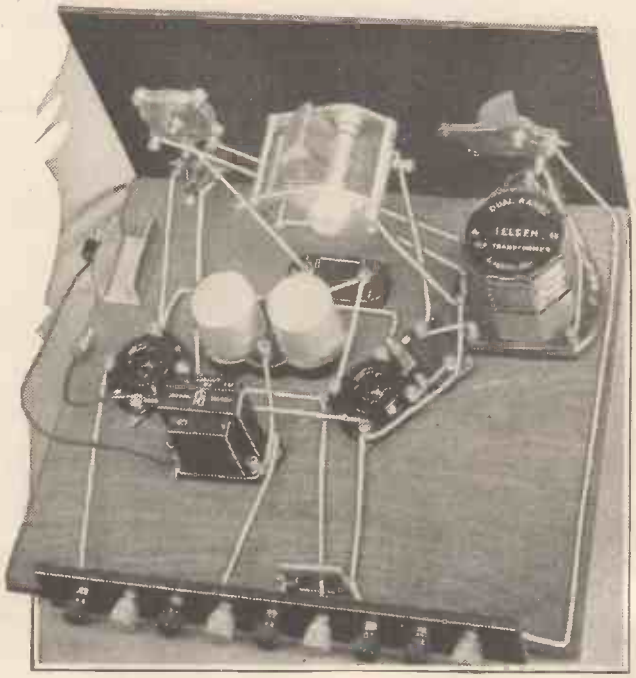
High-Note Loss

The compensating transformers developed for the system can be used alone with considerable effect. Many, probably most, sets suffer loss of high notes either because of their selectivity (side-band cutting) or reaction, or because their speakers fail in that quarter.

A compensating transformer, used in place of an ordinary L.F. transformer, makes good such a loss in a very striking fashion.

COMPENSATING TRANSFORMERS FOR "A.T.B."

The left-hand one is made by Radio Instruments, the centre one is the Telsen, and the other one the Varley compensating transformer.



A TWO VALVER WITH "A.T.B."

The advantages accruing from automatic tone balance, which is described by Victor King on this page, are in no way paid for by added complications in set construction. A fact well proved by this receiver incorporating the principle.

HONOUR WHERE DUE

An amateur experimenter pleads for due recognition from the radio industry.

THE EDITOR,
THE WIRELESS CONSTRUCTOR,

Sir,—I have been extremely interested in watching the success which has met the recent revival of the form of push-pull, now designated as Quiescent Push-Pull.

I cannot help feeling, however, that the manufacturers who claim to have done so much for this success, as no doubt they have, often overlook the fact that many of these "new ideas" originated in the "experimenter's" laboratory, whether it be a private one or one of the "press" laboratories. The present case is one in point, because full particulars of this form of push-pull were published by me so long ago as January, 1930, in THE WIRELESS CONSTRUCTOR.

The present vast industry is undoubtedly founded upon, and derives considerable benefit from, the earlier works of the amateurs.

Yours truly,
L. E. T. BRANCH.

Ilford, Essex.

THOSE VAUDEVILLE PARTNERSHIPS

"WHAT is the secret of radio success?"

There was a time—about 1924 and 1925—when certain vaudeville entertainers (many of whom were raw amateurs before the wireless age) were in universal demand.

As in almost every branch of entertainment, it's team work that counts. Think of the most successful turns in radio variety — Clapham and Dwyer, the Hulberts, Flotsam and Jetsam, Mabel Constanduros and Michael Hogan—all of them partnerships. Which is why they have succeeded when others have failed.

BY A CORRESPONDENT

Some of them still are. Ronald Gourley, Norman Long and Stuart Robertson, to name threeat random. But such as these are exceptions, and the probability is that even they do not know why!

The majority of those past radio stars have disappeared and are only remembered by the older listener.

An analysis of a modern wireless programme provides, one believes, the secret of radio success. It is a secret which, while respecting the niceties of microphone technique and the fickleness of public opinion, has little to do with either. In a nutshell, it is *team work.*

Enduring Teams

Consider the number of vaudeville teams which have broadcast within the past few years. Most of them are broadcasting to-day. And of the newcomers, it is the teams which have endured, and the individuals who have fallen by the wayside.

It would not be easy to state the most successful radio combination which has ever broadcast. In a world review the palm would probably go to Amos 'n' Andy, the American black-faced comedians, who for nearly three years were paid one thousand pounds a week by a toothpaste company for their wireless services.

Britain's Favourites

But conditions of broadcasting in the United States are so different from our own that no true comparison between the two countries is possible. Certain it is that of British radio teams, the Bugginses—in other words, Miss Mabel Constanduros and Mr. Michael Hogan—occupy a very high place indeed.

Theirs is an example of team work *in excelsis.* Yet before Miss Constanduros went to the B.B.C. she was an amateur.

Forming a Partnership

She broadcast with moderate success, and became a member of the B.B.C. Repertory Society. It was there that she made Mr. Hogan's acquaintance. One day over a cup of tea in a popular teashop they discussed the possibility of joining forces—with what result every listener knows.

Mr. Hogan is the perfect foil to Miss Constanduros' bickering humour. Between them they write all their "patter," and their technique is of a very high order. Incidentally, it is worth while noting that Mr. Hogan considers his partner better as a tragedienne than as a comic. It is doubtful, however, whether her public

Flotsam and Jetsam, whose popularity with listeners has never waned since the early days of "Little Miss Bouncer" (who loved an announcer), and the musical news bulletins. Incidentally it was Flotsam and Jetsam who really started the "signature tune."

The Real Secret of Broadcasting Success

will permit her to desert her Buggins family.

A radio combination of equal merit is that of Clapham and Dwyer. Both worked in similar teams before they met. Yet success, such as they know it to-day, was to them only a hazy dream.

Dwyer worked most of his day in the city; Clapham was a barrister's clerk in the Middle Temple. A discerning friend introduced them. They came to a decision, rehearsed, and gave their first public performance before the Duke and Duchess of York.

Introducing "Cissie"

That was not more than seven years ago. For a time they worked at masonic concerts and the like, gradually building up prestige and a reputation. Then they recruited "Cissie," introduced her—with themselves—to the powers-that-be at Savoy Hill, and lo!—not one, but *three* stars were born to the radio firmament.

Another pair whose team work is remarkable for its originality is Flotsam and Jetsam. Both had established reputations before they set up in their present partnership, but it is simply as "Flotsam and Jetsam" that they will be treasured in the wireless archives.

They first met in Australia before the war. Flotsam, a composer and lyric writer, and Jetsam, known then as Malcolm McEachern, a bass of enormous range. Jetsam has toured Australia with Melba in Grand Opera, and after the war was for some years with Sir Henry Wood.

It was at the Queen's Hall, London, that Flotsam heard him singing one day. Their friendship was renewed, and shortly afterwards their remarkable partnership was started.

Polished Artiste

Of Flotsam's musical ability little need be said. He has a wide and understanding knowledge of classical music, and on one occasion entertained Benno Moisiewitch, Mark Hambourg, and Albert Sammons for a whole hour with Weber's Perpetuo Rondo.

Claude Hulbert is a perfect example of the "team" mind. A polished and experienced artiste by himself—yet he chooses to entertain wireless listeners almost entirely through one or other of his partnerships.

Written by Himself

He has appeared—and is appearing—in "Those Four Chaps" (Claude Hulbert, Paul England, Bobbie Comber and Eddie Childs); "Those Two Pairs" (Claude Hulbert, Enid Trevor, Paul England, Pat Paterson); "The Family Party" (Claude Hulbert, Jack Hulbert, Enid Trevor, Cicely Courtneidge); with Jack Hulbert in "The Hulbert Brothers"; and with Enid Trevor in "Claude Hulbert and Enid Trevor."

Miss Trevor, by the way, is Mrs. Claude Hulbert, and the daughter of Colonel Philip Trevor, the well-known sporting journalist.

Nearly all Claude Hulbert's material is written by himself, and on his own authority, based on incidents which he encounters in everyday life. For that reason Miss Trevor is particularly guarded in her conversation with him—otherwise she finds her words coolly written up on her broadcasting manuscript.

Famous Combination

But that, after all, is by the way. The great point is that together they are a splendid broadcasting team—they share a spirit which typifies all the Hulbert family. That is the real reason of their broadcasting success.

One of the most famous radio partnerships is that of Alexander and Mose. They were inspired through the success of the Americans, Amos 'n' Andy, and the ever-fertile brain of Mr. Billy Bennett, known as Mose.

Mr. James Carew, the actor, who played Alexander for many months, has recently given way to Mr. Albert Whelan, the Australian, but the popularity of Alexander and Mose has been in no way impaired by the change.

It is Mr. Bennett who writes all the material for the act.

Temporarily Lost

One might go on endlessly quoting the history of this and that partnership in this history of radio success. There is that delightful pair, Muriel George and Ernest Butcher, who have been temporarily lost to wireless listeners because of certain engagements undertaken by Mr. Butcher. When they return to the microphone—as they undoubtedly will—they will prove as popular as ever.

One of the Best

There is Edith Day and Robert Naylor, the Drury Lane stars, and, at the time of writing, the newest of radio partnerships. It is interesting to note that the "team" was suggested by the booking manager of the London Palladium, after "The Land of Smiles" had finished at Drury Lane Theatre.

And one must not forget that very different sort of radio team—Christopher Stone and his gramophone. Theirs is one of the oldest, but still one of the best, entertainments provided through the B.B.C.

DARK SUBJECTS—WITH THE PAINT OFF

Billy Bennett and Albert Whelan, both successful in their individual turns, have scored additional and remarkable success in double harness—as "Alexander and Mose." Billy Bennett is "Mose" and is seen on the left of this photograph taken at rehearsal.

An AMATEUR'S AERIAL

By R. C. DAVIES

How to erect aerial masts of galvanised iron piping.

IT is remarkable what little effort the majority of radio "fans" take in making something approaching the ideal aerial, especially when one of "commercial" appearance can be erected at an amazingly low cost. It may be that the average "fan" does not fully realise the advantage and extra "pep" that a carefully erected aerial can give to a set.

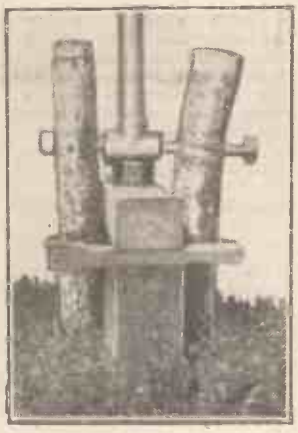
Materials Required

For the benefit of those readers who are keen on trying their hand at erecting an antenna worthy of their aspirations, I shall describe an aerial which I erected mainly for the benefit of those ether waves that have travelled so many miles in search of rest.

It is situated close to the site of the old Towyn Marconi Wireless Station, and I have heard people inquiring, seeing my aerial, whether the station had reopened.

The chief materials used were 24 ft. of 1¾-in., 48 ft. of 1-in. and 24 ft. of ¾-in. galvanised iron water pipes (second-hand), and sufficient 12 gauge galvanised iron wire.

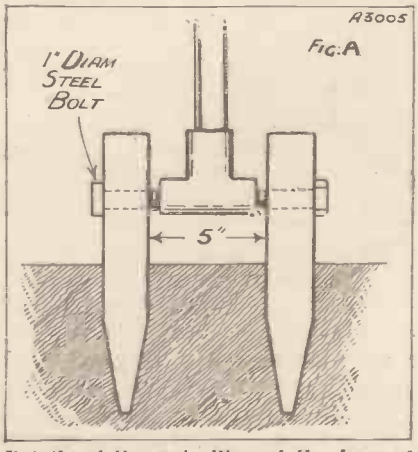
The masts were constructed in sections as follows: The highest mast (60 ft.) being in three sections, viz., 24 ft. of 1¾-in. pipes screwed on to 24 ft. of 1-in. by means of a diminishing collar, and the 1-in. section screwed to 12 ft. of ¾-in. with a similar suitable collar; the smaller mast (36 ft. high) is in two sections, 24 ft. of 1-in. pipe screwed to 12 ft. of ¾-in. pipe. At the top and bottom of each mast a T piece is screwed, the bottom T's acting as swivels and the top ones as for attaching the guy wires and pulley for hauling the aerial wire up.



THE BASE IS FIRMLY HELD

The stakes supporting the bolt are driven firmly into the ground.

HINGED FOR LOWERING



Details of the swivelling at the base of the masts which permits them to be lowered.

Constructing the Base

Having decided on their respective positions, the next job was to mark out and fix suitable stay anchors and base for each mast as per Figure B (shown on page 445).

The base was constructed of two oak posts (3 in. × 3 in. × 3 ft.) suitably tapered for driving into the ground and placed 5 in. apart with about 1½ ft. in the ground. Two holes were then drilled in the posts to take the 1-in. steel bolt, this going through the T pieces acted as a swivel to haul up the mast. Actually, I have an ebonite sleeve on the bolt to insulate the bottom of the mast, as in Sketch A.

Having got the mast attached to its base, the next job was to arrange the stays (20 in all, i.e. 5 to each anchor, arranged at even distance at each joint, each section of the mast being of equal length). This is the part where one had to exercise most care, as it would not do to find one of the stays was too short when the mast was half-way up. Of course, the length of each stay was worked out (Pythagoras' Theorem).

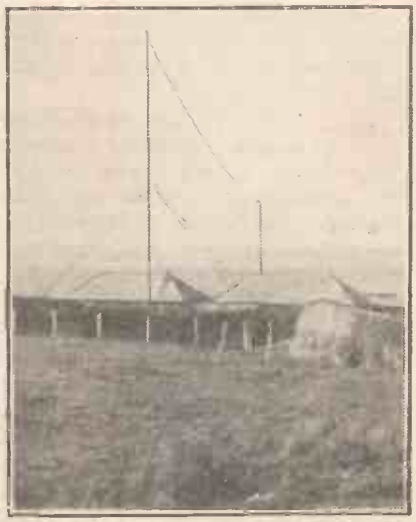
Hauling It Up

The mast should now be resting directly in line with one of the anchor posts, with all stays attached to it.

We were now ready for the task of arranging to haul the mast up. To do this, a strong pole was borrowed

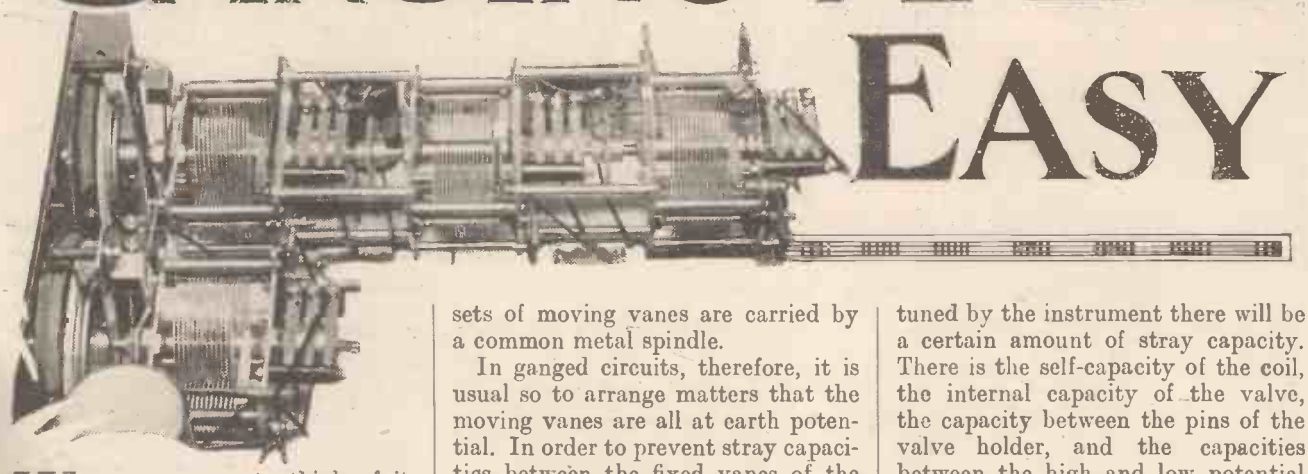
(*Please turn to page* 445)

THE OTHER MAST



This view is taken from the end of the aerial opposite to that shown in the heading picture of this page.

GANGING MADE EASY



WHEN you come to think of it, one of the chief differences between the modern wireless set and the receiver of five or six years ago is that in the former most of the knobs do several things at once, whilst in the latter (with one or two notable exceptions) every knob did one thing, and one thing only. I have just opened a bound volume of THE WIRELESS CONSTRUCTOR for 1927, and the first big set that I come across (big is the right word, for the cabinet was over 3 ft. long by 1½ ft. in depth !) had four tuned circuits each with its own knob and dial.

Towards Simplicity

There were also several other knobs with duties of their own, but in the modern set these four circuits would be tuned by means of a single knob and dial driving a four-gang condenser. In the same way we gang our radio and gramophone volume control, and use switches with three or even four positions. Every knob, in fact, has to pull its weight.

The ganged condenser marked one of the biggest advances towards simplicity in the history of wireless construction. Only those who were wireless enthusiasts in the early days can imagine what searching was like with a set containing four separately tuned circuits. It is no exaggeration to say that the big sensitive receiving set could never have been handled by the ordinary listener had the ganged condenser not been invented.

The ganged condenser consists of a number of separate sections, two, three, four or five in number. The fixed vanes of each section are completely insulated from those of other sections, but in most cases the various sets of moving vanes are carried by a common metal spindle.

In ganged circuits, therefore, it is usual so to arrange matters that the moving vanes are all at earth potential. In order to prevent stray capacities between the fixed vanes of the various sections the ganged condenser is provided with a metal screening box divided into compartments; each section of the condenser is housed in its own compartment.

Receivers with ganged tuning condensers are the rule these days rather than the exception. But not nearly enough importance is attached to correct trimming in obtaining good results. Our contributor shows you how exact trimming may become easy if it is tackled the right way.

If you remove the cover and examine the sections within you will probably find that the outer fixed vanes of each section are slotted, and probably you will see that certain of the pieces between pairs of slots have been bent slightly outwards. Do not try to straighten them; the bending was done in the makers' test department; and you should never on any account tamper with it.

Designing the Vanes

The reason why it is done is this. In designing a ganged condenser the maker knows that in every circuit tuned by the instrument there will be a certain amount of stray capacity. There is the self-capacity of the coil, the internal capacity of the valve, the capacity between the pins of the valve holder, and the capacities between the high and low potential leads of the wiring. He strikes what he considers a good average figure and designs his vanes accordingly.

Stray Capacities

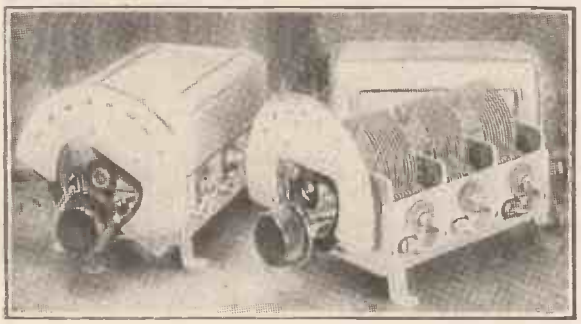
But no matter how carefully they are cut and assembled, it is always found when laboratory tests are made that the various sections of the "gang" do not at first keep quite in step with one another when the dial is moved from minimum to maximum position. This is where the slots in the outside fixed vanes come in.

By slightly bending these it is possible to make the sections tune almost exactly together from one end of the dial to the other.

If only the stray capacities of all tuned circuits were equal, no further adjustment would be required when the ganged condenser was brought into use in a receiving set. Actually, there are rather big differences.

Let us suppose that we have a four-valve set containing two screen-grid high-frequency amplifiers, a detector and a note-magnifier. To begin with, there will be much less inter-electrode capacity in the screen-grid valves than in the detector, since the whole

MODERN GANGED CONDENSERS ARE SCREENED



To ensure a minimum of interaction between one unit of a gang condenser and another, a screen is interposed between the various sections, and the whole is arranged in a metal case. Incidentally this metal case also serves to keep dust from getting between the vanes.

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2	**COLVERN** coils, "S.T.400" type	9	10
2	**ORMOND** ·0005 variable condensers, type R.493	15	0
1	**POLAR** ·0003 differential condenser	3	0
1	**LOTUS** ·00035 differential condenser, type MD.35	3	0
2	**TELSEN** ·0003 pre-set condensers	3	0
1	**READY RADIO** ·0001 differential condenser	2	6
3	**BENJAMIN** Vibrolder valve holders	2	6
1	**W.B.** Universal valve holder	1	0
2	**TUNEWELL** 2-point switches	1	3
1	**TELSEN** binocular S.G. choke	5	0
1	**LEWCOS** reaction choke	2	6
1	**GOLTONE** ·0003 fixed condenser		5
1	**GRAHAM FARISH** ·006 fixed condenser	1	0
1	**DUBILIER** ·006 fixed condenser, type 670	1	6
2	**IGRANIC** 2-mfd. fixed condensers, Nondu	5	6
1	**DUBILIER** 1-mfd. fixed condenser, type 9200	2	9
1	**FERRANTI** synthetic grid resistance, 1 megohm, with holder	1	6
1	**IGRANIC** 1,500 spaghetti resistance		6
1	**IGRANIC** 50,000 spaghetti resistance	1	0
1	**IGRANIC** 20,000 spaghetti resistance		9
1	**LEWCOS** 60,000 spaghetti resistance	1	6
1	**BULGIN** toggle switch, type S.80	1	6
11	**BELLING & LEE** terminals, marked	2	3½
1	10" × 6" screen, drilled to specification	1	9
1	**PETO-SCOTT** baseboard, 16" × 10", with 10" × 7" aluminium foil ready mounted	2	0
1	**RED TRIANGLE** black ebonite panel, 16" × 7" × 3/16", ready drilled	3	3
1	**RED TRIANGLE** black ebonite terminal strip, 16" × 1½" × 3/16", ready drilled		9
1	Each **BELLING & LEE** anode connector and twin tap plug, together with wire, screws, flex	2	1
1	**FULL-SIZE BLUEPRINT**, with copy of "Wireless Constructor," "S.T. 400" issue		GRATIS
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Ganging Made Easy—*continued*

purpose of the screening-grid is to reduce this capacity.

Then the capacity of the grid circuit of the first H.F. valve will differ considerably from that of the second. The first is coupled to the aerial-earth system by means of the aerial coil, and a good deal of capacity is so introduced.

Fine Adjustments

The second high-frequency valve is likely on the whole to have a lower-capacity tuned circuit than the detector, since there will probably be less components in it. In the detector circuit, if this is of the leaky-grid-condenser variety, we have also to take into account the damping introduced by the flow of grid current. The effect of this is to broaden the tuning somewhat—and, in any case, to make it rather different from that of the second and first valves.

TYPICAL MODERN GANGED RECEIVER

By screening the sections of ganged condensers as well as the coil units themselves, stability is attained with multi-stage high-amplification circuits using S.G. valves.

It is clear, therefore, that when a ganged condenser is used for all three valves each section will require certain fine adjustments if the best results are to be obtained. To make this possible each is provided with a miniature adjustable condenser known as a trimmer.

The trimmer allows what we may call the fixed capacity of each circuit to be brought to exactly the same value. When this has been done carefully all of the circuits tune exactly in step, and the receiving set, as a whole, is enabled to do its best.

Set owners and constructors often fail to realise the importance of trimming; or if they do so they carry out the process in a rather haphazard way, and then wonder why the sensitivity of the set is not equal to that claimed by the designer. Trimming is really a very simple business, and here is the way to set about it in a set of the non-band-pass type, such as that discussed a moment ago.

I would recommend you to set each of the trimmer adjusting screws at about the mid-position to start with. To find this, turn each screw right home—whatever you do, don't force it—and then give about two complete turns in a counter-clockwise or unscrewing direction. Now tune in your local station.

You will be able to do this even if the circuits are not quite in step, though its strength may at first be disappointing.

When you come to think it out, you cannot wonder that the volume is disappointing. Suppose that the local station's wavelength is 399 metres. In all probability the first circuit is tuned to something well over 400 metres, the second to perhaps 390 metres, and the third to something betwixt and between. Imagine what the performance of a modern car would be like if none of its cylinders was exactly timed, and you have a fairly close parallel!

My own method is to begin with the section tuning the aerial and the grid of the first valve. With a small screwdriver—or a box spanner, as the case may be—the trimmer of the first section of the condenser is moved very slowly this way and that, whilst the ear listens carefully to detect a rise or fall in signal strength.

Using a Meter

As a matter of fact, I don't depend on my ear when ganging. I connect a milliammeter into the plate circuit of the detector valve.

If the detector is of the leaky-grid-condenser type the optimum setting of the trimmer is that which produces the lowest reading of the milliammeter. On the other hand, if yours is an anode-bend detector, an upward movement of the milliammeter needle indicates that you are "getting warmer," and the highest upward reading indicates the best setting.

Next I tackle the section which tunes the grid of the detector. The job is done in exactly the same way with the help either of the ear or of the more reliable milliammeter.

Lastly the middle section of the ganged condenser is dealt with, and when this has been done I search for a distant station and then finish off the process with the fine adjustments needed for bringing this transmission up to the best volume.

It may be, though, that if you gang perfectly on, say, 419·5 metres, which is the wavelength of Berlin Witzleben, there is something lacking when you tune in either Budapest near the top of the medium waveband or, say, Nurnberg down towards the bottom. In this case, slight readjustments are made until the best average results are obtained in all three positions.

A Useful Tip

It sometimes happens that one or other of the sections simply refuse to trim properly. You may, for instance, find with the trimmer of No. 1 in the minimum position and that of No. 3 nearly so that you cannot quite get the best volume even when the trimmer of No. 2 is screwed right home.

(*Please turn to page* 447)

BOOSTING UP THE BASS

By K. P. HUNT

Some useful suggestions where increased low-note response is desired.

REALISM in radio reproduction, to many listeners, is largely a matter of sufficient bass. When the tuba in a dance band can be vividly heard pounding out the rhythm, when the roll of the tympani at a promenade concert sounds natural, and when a grand organ swell has that majestic depth, then there is an undeniable satisfaction, let theorists say what they will.

Vitally Necessary

The method of increasing low-note response most frequently recommended consists in shunting across the loudspeaker a condenser of about ·25 mfd. capacity in series with a resistance variable from 0 to about 20,000 ohms. As the value of this resistance is reduced an increasing proportion of high notes is drained off, instead of passing through the speaker, and this gives to the resulting reproduction an effect of increased bass.

Apart from the undesirable fact that this negative method of tone control cuts down volume to quite an appreciable extent, there is the strong objection that we seldom wish to diminish a receiver's high-note response, especially if the usual cone-type of speaker is used. Those high notes are vitally necessary for clarity, crispness, and the individualising of every instrument and voice.

Increasing Volume

Obviously it would be preferable to boost up the bass by actually passing more bass through to the power valve, leaving the high-note response undisturbed. Such a procedure would increase the total volume instead of diminishing it, as it is well known that a radio set's horse-power is nearly all in the lower register.

Listeners possessing a receiver incorporating a resistance-capacity stage can readily make such a modification.

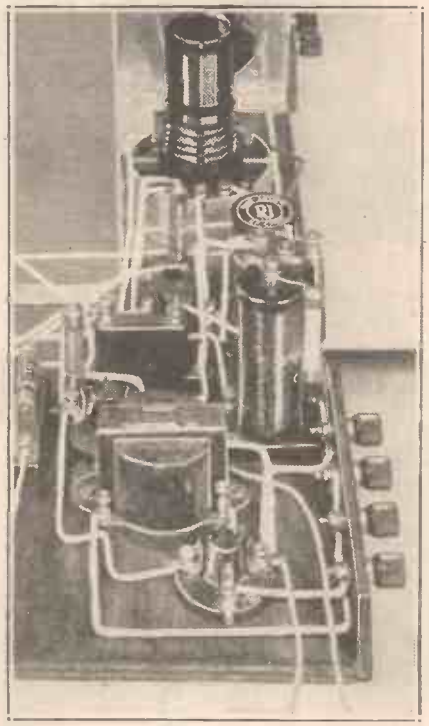
Even Response

There are thousands of detector and 2 L.F. sets comprising a resistance stage, followed by transformer coupling, still in use, but a receiver with transformer coupling alone cannot easily be adapted.

Resistance-capacity coupling is usually supposed to give greater purity and a good, even response all along the musical scale, much superior to that of the average transformer, and this is generally true, up to a point. Trouble with this form of coupling arises when strong signals are being received.

The coupling condenser tends to choke, its charge not escaping rapidly enough through the leak. The succeeding valve is then paralysed until the charge has leaked off.

WITH AN R.C. STAGE



Variation of the value of the R.C. coupling condenser and grid leak enables bass response to be controlled to some extent.

Condenser and Leak Values

Now the amount of bass passed on by this form of coupling depends chiefly upon the proportion between the condenser and leak. With a leak of 2 megohms a coupling condenser no larger than ·005 mfd. is usually practical. If we increase the condenser to, say, ·01 mfd., in order to pass more bass, it becomes necessary to reduce the value of the leak to about 1 megohm, otherwise choking occurs, but this readjustment unfortunately frustrates our object.

On the other hand, if the leak is increased to 5 megohms, a better bass response is obtained, but generally, except perhaps on weak signals, the condenser must then be reduced correspondingly to avoid choking, a restitution of proportions that again immediately counteracts the needed improvement in bass.

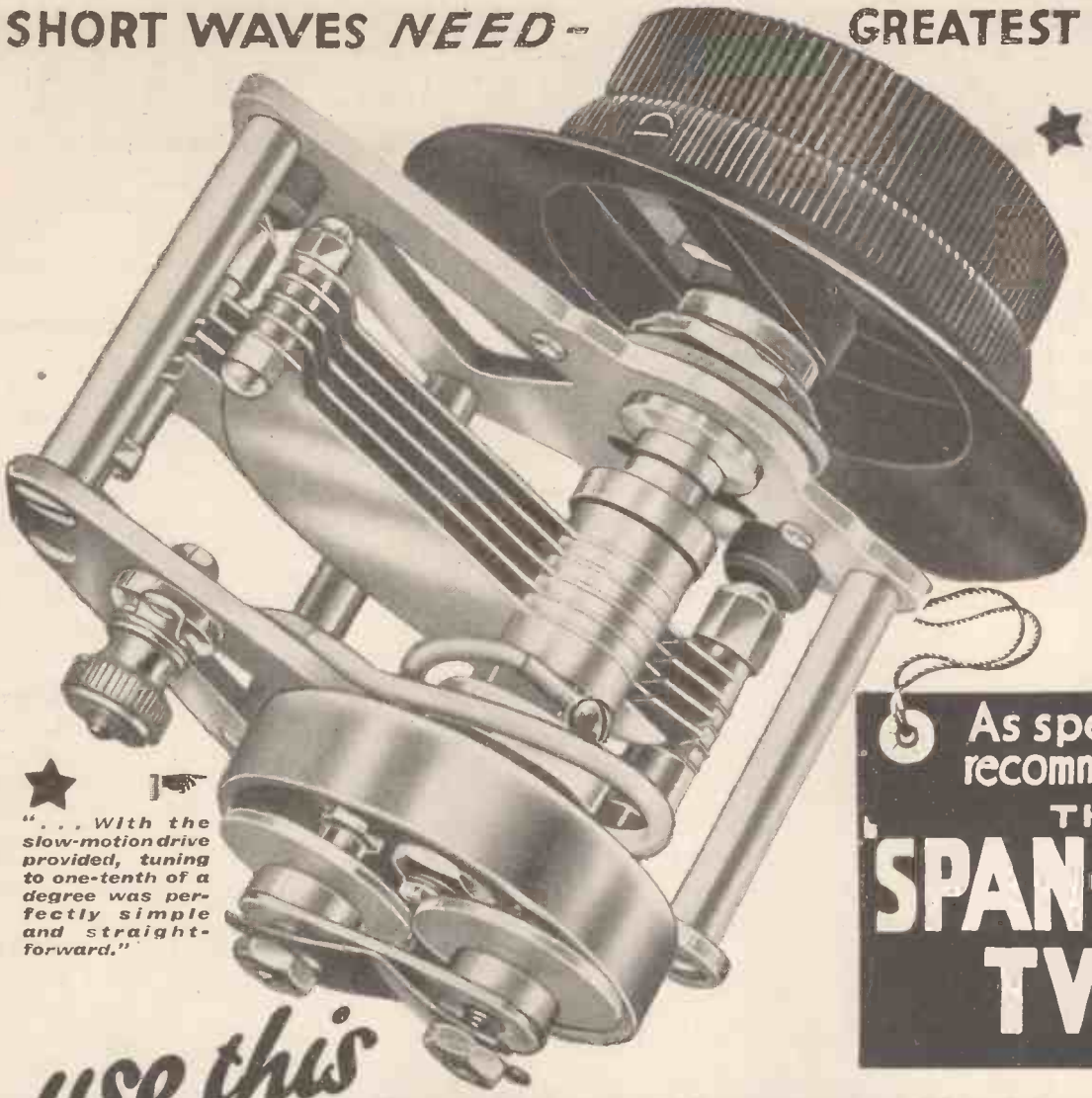
Satisfactory Solution

This dilemma can be got over satisfactorily by substituting a large inductance for the grid leak. The secondary of practically any old L.F. transformer serves admirably.

One end of the secondary is connected to the grid of the second valve and the other end to grid bias, the inductance merely taking the place of the leak.

The size of the coupling condenser can now be increased with impunity up to about ·25 mfd. There is no tendency whatever to choking, and the larger condenser passes a decidedly bigger proportion of bass, at the same time giving a generally increased signal strength.

SHORT WAVES *NEED*— GREATEST ACCURACY!



"... Ease of tuning showed up particularly, a station on 49·02 metres being separated from one on 48·86 by a full degree."

"... With the slow-motion drive provided, tuning to one-tenth of a degree was perfectly simple and straightforward."

As specified & recommended for THE 'SPAN-SEAS' TWO

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This is typical of those "miracles of value" that only Ormond can offer. A triumph of precision manufacturing, it affords that hairbreadth accuracy of tuning which modern circuits make essential. Yet, such is the incomparable vastness of Ormond's manufacturing resources, it is offered at a price amazingly low.

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Easy to mount. One-hole fixing. Terminals and Soldering Tags for connections. Complete with 2½ in. dial and slow-motion knob.

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The Ormond No. 6 Friction Control Condenser, Cat. No. R/492, Capacity ·00035, Price 7/6, with slow-motion ratio 50-1, is the ideal reaction condenser for this receiver. Ormond Fixed Condensers will reduce frequency losses to a minimum. Cat. No. R/437, Capacity ·0001, Price 7d. Cat. No. R/442, Capacity ·002, Price 1/-.

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RULE THE SHORT WAVES WITH —

The VAGARIES of VOLUME CONTROL

A number of types of volume controls are described, and the main considerations governing them are dealt with. Simply made input controls are also described.

By J. F. CORRIGAN

THE very first principle of satisfactory and efficient volume control is to introduce the cutting-down process as soon as possible in the radio-receiving system. Indeed, if by some super-brainy inspiration you could devise a method of varying the strength of the radio waves in the immediate vicinity of your aerial, and before they were actually collected by the aerial, you would have hit upon the absolute ideal volume control.

Unfortunately, however, we can't perform scientific miracles of that sort; consequently we have to be satisfied with the best practical method of volume control, which, as I have said, consists in beginning your control process as early as possible in the receiving system, or in the radiogram amplifier, for that matter.

Made at Home

A simple yet effective volume control can be made by introducing a carbon resistance into the aerial circuit of the receiver. Here you cut down signal energy before it enters into the receiver. This method is quite a good one, particularly when you require to cut down the volume of near stations.

Any type of carbon resistance will suffice to conduct trials of this method. A bottle filled with a soot-sand mixture into which protrude two copper electrodes will provide one type of experimental control of this simple nature.

Another control comprises a carbon rod taken from a large battery. Here contact is effected at the terminal of the battery carbon, and also by means of a small earth clip which can be slid up and down the rod.

A variable resistance inserted in the positive lead of the H.T. feeding the first H.F. valve in the receiving circuit makes an effective volume

SIMPLE—BUT IT WORKS

Two copper wires dip into a bottle containing soot. By raising or lowering one of these wires, resistance, and therefore volume, is varied.

control by influencing the plate current of the H.F. valve, and so controlling the energy passed forward to the detector valve. A resistance having a 500,000-ohm maximum is the thing to use here.

Another volume-control method consists in placing a 15-ohm variable resistance in the filament circuit; that is to say, if the valves are fed from batteries. The positive filament lead should be chosen for this purpose.

For Radiograms

A potentiometer (about 250,000 ohms) connected across the earth of the set and the grid end of the coil, the slider of the potentiometer going to the grid itself, will provide an effective volume control also, and one by means of which distortion will be minimised.

For radiogram working the best volume control I have come across is a potentiometer (500,000 ohms), placed across the pick-up, the resistance slider being connected to the grid of the amplifier valve. By this arrangement the valve's input may be finely controlled.

Any value between 250,000 and 500,000 ohms may be employed for this purpose, but if the resistance is lower than the minimum given here, selective suppression of the high notes takes place.

Replacing the Grid-Leak

A good method of providing for effective volume control when building any R.C.C. amplifier unit, the volume-control, of course, being an integral part of the amplifier unit, is to use a 500,000 ohm (approx.) potentiometer as the grid leak, the potentiometer slider being connected to the grid of the next valve.

SATURATED CORES

Why parallel-feeding improves old transformers.

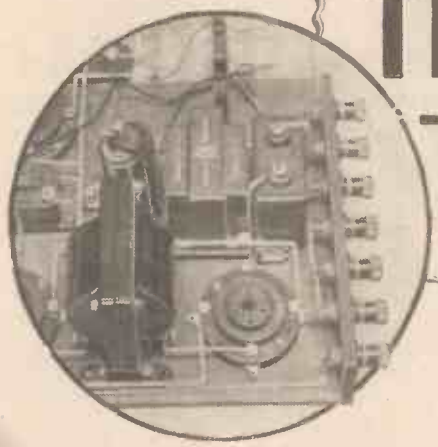
PARALLEL-FEEDING of H.T. is often recommended as a means of improving reproduction with old L.F. transformers. But the main reason for the improvement is not so frequently given.

It is the diversion of the steady anode current from passing through the primary. Many old transformers will not carry enough current without saturating, and when a core is saturated (namely, unable to be more strongly magnetised) the fluctuating currents cannot produce varying magnetism in accordance with their fluctuations.

The result is that the variations in magnetic field are distorted, with corresponding distortion in the secondary output and eventually in the reproduction.

A. S. C.

V 2382



THAT OUTPUT TRANSFORMER

An output transformer is for the purpose of matching the impedances of speaker and output valve, and correct matching is dependent upon correct transformer ratios. The method of arriving at the correct ratio is set forth very clearly on this page.

By G. LENNIE

IN some recent articles we have seen that the best average value of resistance in the anode circuit of the output valve is generally that which is about twice the value, in ohms, of the anode resistance of the valve.

The valve anode resistance is generally known, but the resistance of our loudspeaker may not be known. This value must be determined, either from the maker or from published information. Our problem now becomes one of how we shall modify our loudspeaker circuit to suit the particular output valve in use. It should be noted that when we say "resistance" with reference to the anode circuit we mean the resistance which the circuit offers to alternating current. This form of resistance is generally termed the "impedance," but nevertheless it is a resistance, or hindrance, to the flow of alternating current.

Adjusting the Load

Let us assume that the anode resistance of our valve is 2,000 ohms. We therefore require a resistance or impedance of 4,000 ohms in the anode circuit. If the impedance of our loudspeaker is 4,000 ohms, then, by connecting it directly in the anode circuit, we have the required condition. But supposing the loudspeaker impedance has not that value, what are we going to do? Fortunately, we do not need to buy a new loudspeaker, for by using an output transformer we can so arrange it that the load on the anode has the necessary impedance.

An Extreme Case

We shall consider an extreme case—that of a moving-coil loudspeaker whose impedance is 2·5 ohms. Obviously, it would be ridiculous to insert this directly in the anode circuit. At R in Fig. 1 we want 4,000 ohms, and we have 2·5 ohms. That is the problem—to suit the 2·5 ohms to the 4,000-ohm position.

Turns Ratio

We know that a transformer can be constructed to give us various voltages from a standard voltage. For example, if we have mains which supply 250 volts and we wish to use A.C. valves at 4 volts, we use a "step-down" transformer. The windings on the primary are in direct ratio to those on the secondary as the voltage on the primary is to that on the secondary. That is to say, if the primary has 250 turns of wire

FACTS AND FIGURES

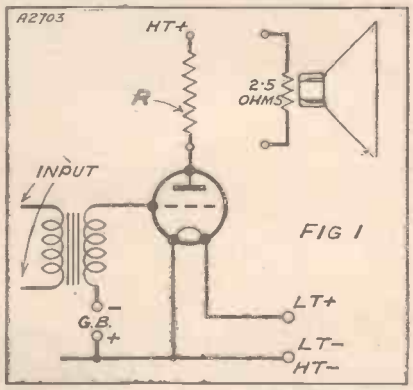


FIG 1

The resistance required at R may be 4,000 ohms, whereas the speaker's resistance is only 2·5. It is the duty of the transformer to make it possible to use the 2·5-ohm speaker in spite of the high anode resistance needed.

the secondary will have 4 turns to give us the required 4 volts from the 250-volt mains. Actually, the turns will be more; there might be 1,000 turns on the primary, when the secondary will have 16.

The fundamental point is that the ratio of the turns on the transformer are in the same ratio as the voltages.

In our valve problem we have a direct current of 20 m.a. flowing through the resistance in the anode circuit, but this is varied by the incoming frequency, and in the transformer it is only the variations that are transferred from the primary to the secondary. Incidentally, the transformer serves an extra purpose in that the steady anode current of the valve is prevented from flowing through the windings of the loudspeaker.

Transferring Power

Now, the variation in the current—or, as it is generally called, the alternating component—may be 10 m.a. All that is required is the transference of the alternating power from the anode of the valve to the speaker. From Ohm's law we have:

Power = volts × amperes, and volts = ohms × amperes, therefore power = ohms × amperes^2.

The 4,000-ohm resistance has a useful power in it of 4,000 × (·01 × ·01) watts (10 m.a. = ·01 ampere), so that the power is ·4 watt.

Working it Out

The voltage drop across the resistance is:

$$\frac{\cdot 4 \text{ watt}}{\cdot 01 \text{ amp.}} = 40 \text{ volts.}$$

The resistance of 2·5 ohms has the power of ·4 watt transferred to it, and so the current flowing in it is found thus:

$$\cdot 4 \text{ watt} = 2 \cdot 5 \times \text{amperes}^2,$$

$$\text{or amperes} = \sqrt{\frac{\cdot 4}{2 \cdot 5}} = \cdot 4 \text{ ampere.}$$

And the drop in voltage across it is:

$$\cdot 4 \times 2 \cdot 5 = 1 \text{ volt.}$$

(*Please turn to page 447*)

Professor Goop's latest ambition to evolve the perfect short-wave receiver has been attended by remarkable results—but not the kind he anticipated.

PROFESSOR GOOP has settled down to some highly specialised work upon short-wave receiving sets.

The other afternoon, when I went round to the "Microfarads" to see whether I could help, I found him standing within a light wire fence which enclosed what he calls his laboratory, though Edward Bugsnip, his gardener, terms it the potting shed.

"And what is that?" I called gaily, laying a hand upon the fence.

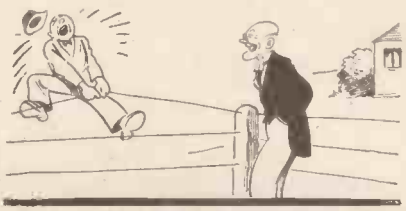
Next moment I was breaking high-jumping records, and having come down to earth I repeated the first bound instantly, for I was unlucky enough to touch the wire again.

Our Skip Area

"That," stammered the Professor, between bursts of heartless laughter, "that is what is known as the skip area. A few more of those jumps and I believe you would have reached the Heaviside Layer and would have been reflected off to goodness knows where."

We had lots of fun with our skip area before all Mudbury Wallow got to know of it. Sir K. N. Pepper,

SHOCKING EVENT



"Next moment I was breaking high-jumping records."

though he was somewhat annoyed at first, admitted afterwards that the exercise had done his liver more good than months of medical treatment. Miss Worple didn't jump. She caught hold of the wire and couldn't let go. Captain Buckett grabbed her to pull her away but discovered that he could not drop her. Tootle, rushing gallantly to the rescue, found himself adhering to the Captain, and a moment later Primpleson became firmly attached to Tootle. As the switch was found to be out of order, it was some little time before we could release the closely-entwined and writhing group.

Any little unpleasantness that might have occurred with the numerous visitors who touched and wished that they hadn't was easily dispelled when the Professor explained that in the sacred cause of science he had erected his zareba in self-defence against the incursions of Mrs. Goop, who in the past has spoilt many a fine experiment by arriving at the wrong moment.

A Few Paltry Yards

The woman who cannot see why her best spring mattress should be suspended between two apple-trees (this was when we were experimenting with counterpoises), who resents the staining of a few paltry square yards of her drawing-room carpet with accumulator acid, or who is annoyed when her lipstick is borrowed for marking positive terminals, is just not fit to be the wife of one of the world's greatest men of science.

But to—— that is to say, enough of Mrs. Goop. It is my pleasant duty now to give readers some information about the epoch-making short-wave set evolved by the Professor and myself, to a description of which an entire number of THE WIRELESS CONSTRUCTOR will shortly be devoted.*

Fourteen-Valve Superhet

I cannot yet give full details, but I may tell you that the set is a fourteen-valve superheterodyne from which all the snags connected with mere ordinary superheterodynes have been removed.

One of the first questions that I put to the Professor when we were discussing our preliminary experiments (I happened to be standing behind him at the time) was:

"Have you seriously surveyed the subject of sideband splash in superheterodynes?"

The Professor mopped his left ear with the bandana.

"Stop it," he yelled.

"Stop what?"

"That sideband splashing."

"I don't believe," I said, "that you know what sideband splash is."

A MYSTERY EXPLAINED

"Why is it that our good friends the Germans have lids to their beer mugs?"

The Professor's face broke into a weary smile.

"Of course I do," he retorted, "but I don't believe that *you* know anything about it. Now suppose you give me your ideas."

"Certainly," I replied. "Sideband splash is severest when strong stations transmit speech."

Lids to Their Mugs

The Professor reached for an umbrella.

"And which station," he inquired, "is most affected by it?"

"Stuttgart," I replied at once.

"Precisely," cooed the Professor, "and now you understand why it is that our good friends the Germans always have lids to their beer mugs. But look here, my dear fellow, in using a phrase like sideband splash, are you not soaring over the heads of a certain section of those who study your scribblings?"

I possessed myself of the umbrella.

"Perhaps," I conceded, "we should make it clear that sideband splash,

* This number will be published on February 31st, 1999. Order now to avoid disappointment.

In Lighter Vein—*continued*

which you can call sidewave splash if you want to be highbrow, is the ptzipp-ptzipp-ptzipp sound (here the Professor positively snatched the umbrella) which is heard if you manage to tune in Stuttgart whilst the London Regional is doing a topical talk."

"And what," asked the Professor, "would you put down as the primary cause of sideband splash?"

"It would seem," I returned, "that heavy damping has something to do with it. And after all, why not? Does not the very word 'waves' suggest water and splashing and things?"

Why We Use Aerials

"You know, of course," queried the Professor, "what a carrier is?"

"Why, yes. A bluish, flapping thing with red legs to which you tie a message rolled up in a little tube. And then you send it away by train and the stationmaster opens the basket and it ought to fly home to Wigan, but if it has got any sense it goes to Brighton instead."

"No, no. That's a carrier pigeon. I should, of course, have said carrier wave. You will readily understand if I explain that a carrier wave is to an ordinary wave very much what a carrier pigeon is to an ordinary pigeon."

"I see. That's why we put up aerials. Mine is always positively infested with carrier pigeons, and I presume that it has the same attraction for carrier waves. Don't you think that that's rather a neat way of putting it, or don't you?"

Beats—and Beets

"So long as you are satisfied," smiled the Professor. "Now in a recent report written in such popular

WHAT A "CARRIER" IS

"A bluish, flapping thing to which you tie a message rolled up in a little tube."

style that nobody except the higher mathematicians can understand it, the Radio Research Board has shown that sideband splash is produced by a beat."

"Look here," I cried, "vegetables are all jolly well in their place, but why drag them into wireless?"

"B-E-A-T, not B-E-E-T, you ass. A beat between the unwanted sideband——"

"Sidewave," I corrected.

TEARFUL EPISODE

"Just like sucking lemons in front of a brass band."

"——sidewave and the wanted carrier."

"Here, hold hard a minute. I thought sidebands—that's to say, sidewaves—had been abolished?"

"They had," remarked the Professor sadly, "but they've come back again, but only in theory. Let us get down to solid, practical work. I will now show you the sideband splash guard which I have designed for my short-wave superhet."

From a shelf the Professor took down a large box and raised its lid with a beaming smile. It was filled to the brim with onions.

"I see," I cried. "It's just like sucking lemons in front of a brass band. You will have people peeling onions in the broadcasting studios and the announcers and topical talkers and things will all burst into tears and so they won't be able to speak and there can't be any sideband splash——"

"Drat that fellow Bugsnip," roared the Professor, hurling the box through the window, which happened to be closed. He was just reaching for another box when the door of the laboratory opened and Mrs. Goop entered majestically with a pair of insulated wire-cutters in her hand.

The Bathroom Tap

"Put away your toys," she said, in her most acid voice, "and come at once and put a new washer into the bathroom tap."

Women, I fear, will never understand, though the Professor has faint hopes of success with the new laboratory protector that he has designed which consists of a combined tear gas and liquid fire projector.

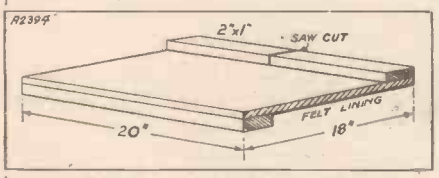
A TABLE-TOP BENCH

For doing odd jobs on the dining-room table.

MANY wireless enthusiasts who are again turning their attention to constructional work are doubtless concerned about the lack of bench accommodation for the various "jobs of work" they mean to do.

Even those who are fortunate enough to possess, or have access to, an outhouse with bench may often on winter nights desire to transfer themselves and their hobby to a more comfortable spot near the dining-room fire; but the domestic storms that would arise if a table top were scratched is sufficient deterrent to keep them out in the cold.

VERY USEFUL



The underside is lined with felt.

For any such enthusiasts the work-board or "bench boy" shown in the sketch may offer a solution to the difficulty.

To avoid warping, the board should preferably be made of plywood $\frac{3}{8}$ in. or $\frac{1}{2}$ in. thick, while the 2-in. by 1-in. strips or stops along each side of the board may be of any kind of wood which is not too soft.

Protecting the Table

A convenient-surface area is 20 in. by 18 in., as shown, but this may be modified as desired.

The whole under surface of the board and the stop which locates against the edge of the table should be lined with thick felt glued on.

A saw-cut at right angles to the edge of the top stop is useful as a guide when sawing. Another cut at an angle of 45 degrees may be added for use when cutting mitres.

Sawing, drilling, chisel work, etc., may be done on such a board, while the constructor has an easy feeling that no damage is being done to the table on which it rests.

D. M. B.

MORE REPORTS FROM READERS

WINCHMORE HILL (London, N.21).—"I have recently constructed the 'S.T.400,' and would like to send you my appreciation of what I consider to be the most efficient four-valve set yet designed. Although I am situated only five miles from Brookmans Park, I am able to tune out the twin transmissions and receive about 25 stations at full loudspeaker volume."—S. W. Giles, Winchmore Hill, N.21.

* * *

CAMBRIDGESHIRE.—"Having discarded the 'S.T.300' (a set I was justly proud of) and built the 'S.T.400,' you might be interested to hear a little about it. It's a wonderful set. My log at present is 54 stations identified. With a good moving-coil speaker the volume is terrific; station separation is easy and no interference is experienced on either waveband. The 'S.T.400' is a set anyone can build with confidence. I shall be pleased to demonstrate this set of the year to anyone interested."—W. T. Dring, East Park Garage, Chatteris, Cambs.

BURTON-ON-TRENT.—"May I be allowed to add my small contribution to the chorus of pleased, more pleased, and still more pleased constructors? Your set, 'S.T.400,' is three days old, and while I am a fairly old hand (six years of it—am now 19), I think the fact that I logged 71 stations (62 medium and 9 long wave) is more than enough proof of the exceptional powers of your set. Of these, 55 were logged in the level hour 7.15 p.m. to 8.15 p.m. on Monday, Feb. 6th. I must not forget to congratulate you on the very good tone even on high selectivity. Thank you for the 71 stations—exceptional volume—very good tone—more selectivity than necessary. I am an 'S.T.400' user till the 'S.T.500'!"—W. Felthouse, 72, Park St., Burton-on-Trent.

* * *

WINDSOR.—"I am more than pleased to be able to say I have one of your famous 'S.T.400's' which was constructed from a 'Pilot' Author's kit of components specified by you. What a beauty the set is! Stations roll in like turning tunes out of a barrel-organ. And there is enough volume to deafen one. Truly, you are the wizard of radio, I think! Wishing you and your 'S.T.400' all the success and praise it deserves."—D. Webb, Dedworth Rd., Windsor.

PORTSMOUTH.—"I feel it is about time I wrote to you to congratulate you on the marvellous set—the 'S.T.400.' Its simplicity and selectivity are amazing. I built the 'S.T.400' on Christmas Eve and very soon scrapped my old set, although it was pretty good—but not a patch on this one. Congratulations!—A. Snook, Buckland, Portsmouth.

Some representative extracts from the flood of letters appreciative of the "S.T.400." Remember the experiences of these other constructors when considering the building of an "S.T." set.

NORWAY.—"I have begun to realise the grand merits and possibilities of the 'S.T.400.' It was indeed a big joy to me being able to separate Oslo from Kalundborg, which by us in these parts is considered the best test of selective capacity. The quality is the best I have ever heard. In all, I am very satisfied with the results I have so far obtained, and my friend for whom I built the other 'S.T.300' is very eager to get it converted to the 'S.T.400.'"—Commander Bernt Dingsor, Royal Norwegian Navy, Horten, Norway.

NEW BARNET.—"Having made up your 'S.T.400' with meticulous care, I trotted it round to an old friend (who has an expensive set, but is always in trouble) to show him what it would do. Well, the result was he absolutely refused to part with it. In fact, I think he would have paid double its cost. Now I have to build another for myself!"—G., Crescent Rd., New Barnet.

NEWCASTLE.—"We can get Fécamp clear of Newcastle 5 N O, although the latter is only half a mile away. Have had W C A U, W T I C, W B Z, K D K A."—A. C., Brighton Grove, Newcastle-upon-Tyne.

CARDIFF.—"Many thanks for a fine and interesting set."—W. H. Batt, Waterloo Rd., Cardiff.

SALFORD.—"... Since then, the '300' has become the '400,' and I wish to add my thanks to the many others who have written you. It is a real musical instrument. Whatever station I get is free from any other, and this is what matters to a musician (I have been connected with orchestras and bands for 30 years). The 'S.T.400' is a set *par excellence*, pure tone, plenty of punch free from distortion (or assistance from bands in other lands!). I am proud of my set and of you, as my friends would tell you were they not bored stiff with my eulogies on the 'S.T.400.' I wish to express my thanks for a really fine set."—J. E. Draper, Wynford Street, Salford.

* * *

EDMONTON (N.9).—"I should like to let you know how much I appreciate your latest circuit—the 'S.T.400.' My set has been giving very good results for some two months. I have incidentally received four American stations between London Reg. and London Nat. readings. (I was first introduced to your circuit when you demonstrated your set at the house of a friend—Mr. Taylor, of Pelham Rd., Tottenham—when I had the pleasure of being one of the interested audience.)"

BRISTOL.—"Having read some of the remarks about your 'S.T.400' by Fincham of Scotland (who says it is a washout) and the triangular Robin, one is bound to smile at some of the piffle you must receive. My own first set was built in 1921, and I have just built the 'S.T.400,' having discarded a well-known commercial S.G. set. I must say the 'S.T.400' is all you claim and more. A little study of the knobs and one can do anything with it."—Stanley Jones, West Street, Bedminster, Bristol.

BURNLEY.—"I have built two 'S.T.300s' and one 'S.T.400' and I think they are wonderful."—W. H. Kitt, Wiltshire Avenue, Burnley.

HARLESDEN (N.W.10).—"I have recently converted my 'S.T.300' into the 'S.T.400' and I think it is a marvellous set, considering I have no specified parts except the coils."—N. W. W., Shakespeare Avenue, Harlesden, N.W.10.

(*Please turn to page* 440)

A HOME-MADE COIL-WINDER

Describing a simply-constructed aid to those who "wind their own."

By V. A. GILLIAN.

MOST wireless constructors have at some time in their experience been faced with the problem of winding coils, transformers and the like. The construction of apparatus of this type requires the assistance of a coil-winder that is adaptable to the work in hand.

To make a coil-winder that will give the necessary degree of flexibility with regard to the size of the coil to be wound, together with a fast winding speed, is simple both in construction and operation, and following is the description and constructional details of an efficient coil-winder I made for use in my own workshop.

Parts Required

Most of the parts required to make the machine will be found in the amateur's workshop, and consist mainly of the following:

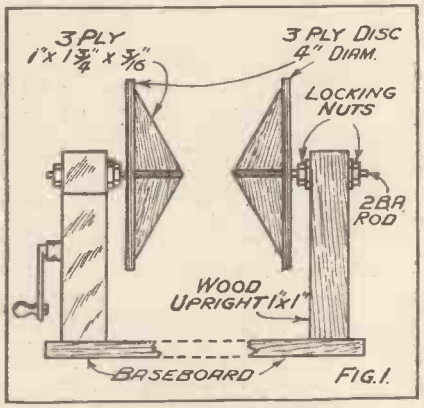
A small bench-type grindstone,
A piece of hardwood (size 8 in. x 4 in. x ½ in. approx.), and
A small quantity of 3/16-in. three-ply hardwood.

The first step in the construction should be to remove the grindstone from the winding spindle (special note being taken of the diameter of the shaft). This done, the two former-carriers should be made to the size and shape shown in Fig. 2, the triangular blocks being glued to the surface of the wooden discs.

With regard to the size of the holes at the centre of the discs, these are, of course—one—determined by the diameter of the grindstone winding shaft and the other by the diameter of the tail-stock shaft; this may be 2B.A. clearance as in the original model; but the size of this rod is immaterial, and any rod of similar size may be used provided it is of sufficient diameter to give the necessary rigidity.

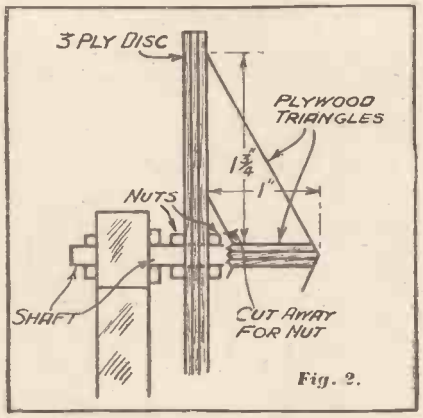
The tail-stock may now be made from a piece of 1 in. x 1 in. wood and should be drilled at such a point that when erected on the baseboard the tail-rod will be at the same height as the grindstone spindle.

DETAILED DIMENSIONS



All the essential measurements are given in this diagram.

FITTING THE CARRIERS



The former-carriers can easily be made from this detailed specification.

Ready for Use

This done, the grindstone and end block may be mounted on the baseboard by means of suitable wood screws driven through the base, and the discs mounted on their appropriate spindles, care being taken to see that locking nuts and washers are put on the 2B.A. rod to prevent any lateral movement.

The machine is now finished and ready for use. The method of loading the machine is a simple matter, the 2B.A. rod is adjusted by rotating the locking nuts until the former to be wound fits tightly between the two discs. The wire can now be anchored to the former in the usual manner and the wire fed to the rotating former.

MORE REPORTS FROM READERS

—*continued from page 438*

NORTHUMBERLAND.—"My 'S.T.400' has now been in operation some three months and I have nothing but praise for it. Above all things it gives QUALITY. I now wish to add a Q.P.P. output."—J. S. V. Rawlings, Sea Houses, Northumberland.

NEWQUAY.—"I have built your set, the 'S.T.400,' and I have found it extremely good for tone and selectivity. The first night I sat down to try it out, I brought in 65 stations (51 on the medium and 14 on the long-wave band), every one at loudspeaker strength and every one separate. I consider this very good for this part of the country. I have had other sets, some costing as much as £12, but none to equal the 'S.T.400.'"—J. H. Benney, Trencreek, Newquay, Cornwall.

* * *

THORNTON HEATH.—"I am getting excellent results both in quality and selectivity and am highly delighted with the set."—Vernon G. Kirk, 91, Tatton Road, Thornton Heath.

MILL HILL (N.W.7).—"I built the 'S.T.400' against the advice of all my friends, who on viewing the circuit said it only had two tuned circuits, could not be selective, the idea was preposterous, etc. Since building it, however, I have logged 119 (one hundred and nineteen) different stations and can reckon on at least 60 alternative programmes—excluding relays—all at good loudspeaker strength and of entertainment value. The reason I have written to you is that you advised a man in a recent issue not to build the 'S.T.400' because he happens to sit on the Brookmans Park masts. Well, so do I, almost—anyway, as near as makes no difference. I have not the faintest idea whether the above results are above the average for a four-valver, but they are facts pure and simple. I am not praising your set but merely telling you the results I get from it. I can get Hamburg's programme without interference from London. I am quite high up, with the gaunt spectre of Brookmans Park hanging over my wireless activities. Thanking you for all the enjoyment the 'S.T.400' has given me."—F. L. R., Billaey Park Avenue, Mill Hill, London, N.W.7.

* * *

FIFESHIRE.—"Thank you very much for a champion set—the 'S.T.400.' I have had it going for a week and given it critical tests. It's a dandy. Believe me, I am more than satisfied. The dials are alive with stations, and the volume—oh, boy!"—N. Sturrock, Graham Place, West Newport, Fifeshire.

OUR NEWS BULLETIN

This, of course, will not mean that Mr. Henry Hall's band will cease to present its own dance music, as usual.

Jack Payne in Holland

MR. JACK PAYNE, the famous dance band leader, recently left England on a Continental tour, commencing at Amsterdam where, it is understood, the fee offered him constitutes a record for Holland. Probably, by the time this issue is on sale, many of our readers will have heard Mr. Payne and his band broadcasting from Hilversum.

Jack Payne and his Boys expect to visit France, Germany, Belgium, Austria, Switzerland and Italy, and it is rumoured that, when the present contracts are concluded, there is a chance that listeners will hear once more regular performances of this band from B.B.C. stations.

Britain's Lead

It was reported in the Press the other day that there were 4,300,000 registered wireless listeners in Germany at the end of 1932, the number having increased that year by 300,000.

There are well over five million registered listeners in this country.

Statistics compiled in Ottawa show that Denmark has one radio set for every 8½ people, the United States one for every 10, Sweden one for every 12½, and Britain one for every 13.

Glasgow & Edinburgh

Here are some further statistics which should interest our Scottish readers. There are twelve wireless sets in use for every 100 persons in Glasgow, and ten for every 100 in Edinburgh. To-day the number of licensed listeners in Scotland is more than 354,000, representing an increase of 100,000 compared with 1931.

Successful Prosecutions

Incidentally, the number of wireless receiving licences issued during January, 1933, was approximately 958,000. After allowing for those which expired, the total number in force at the end of the month was 5,364,000, a net increase of 101,000. During the same month 224 prosecutions were successfully undertaken, and the total fines amounted to £231.

"Our Lovely Tongue"

Viscount Weymouth, President of the Society of Somerset Folk in London, speaking at a dinner recently, deplored the disappearance of country dialects and referred to the B.B.C. as "one of the worst influences of modern times."

"I would rather hear the broad speech of a Somerset farmer," said Viscount Weymouth, "than I would the best announcer of the B.B.C. If the highbrow academic interests of the B.B.C. have their way, I am

(*Continued on page* 443)

OUR NEWS BULLETIN

—continued from page 442

afraid that our lovely tongue will disappear."

A Hint!

The "Musical Times" is inquiring what is the real attitude of that famous conductor, Sir Landon Ronald, to the B.B.C. concert-room activities.

A few weeks ago, Sir Landon stated in the "News-Chronicle" that in view of the wealth of concerts arranged by the London Philharmonic, the London Symphony, and the New Symphony orchestras, the B.B.C. should withdraw from the concert room and confine its activities to the studio.

"Lot of Nonsense"

But, in a later issue of the same journal, Sir Landon made reference to "a lot of nonsense talked about the evil wrought by the B.B.C. by its invasion of the concert hall"; and in the "Radio Times" for January 6th, he wrote: "I had a long private talk with one or two of the highest officials (concerning the B.B.C.'s Queen's Hall concerts) and admit that, although they did not alter my opinion, they decidedly modified my views."

Sir Landon's Attitude

The "Musical Times" ventures the statement that it is not easy to understand how Sir Landon's views can be changed while his opinion remains the same.

"The fact is," states the "Musical Times," "that Sir Landon, first on one side of the fence and then on the other, is now safely on the top!"

Are They Messages?

Mr. I. H. Jacobs recently submitted to the North London magistrate that it is not an offence under the present law to work a wireless apparatus for the reception of the B.B.C.'s programmes without a licence, because such programmes do not constitute messages in law.

Late Licensing

Mr. Jacobs was defending a client who was summoned by the Post Office for working a wireless set without a licence, and for corruptly offering the gift, or consideration, of 5s. to a Post Office overseer.

When questioned by a Post Office overseer, Mr. Jacobs' client said he had worked the set for a week; he produced a licence taken out that day, and added: "I do not want any trouble. Can I square it?" As the overseer was leaving, two half-crowns were held out.

On the Evidence

Mr. Jacobs submitted that, on the evidence, no offence in law had been disclosed. The only offence known to the law under the 1904 Wireless Telegraphy Act was having a wireless apparatus for the transmission of messages without a licence. The 1925 Act added "reception" to transmission, and his submission was that a person could use a wireless apparatus, other than for the reception of messages as defined by the law, without a licence.

A Case for the Lords

The magistrate asked whether Mr. Jacobs was suggesting that there should be no prosecutions for working an apparatus without a licence, and the reply was "Yes."

"I am afraid," said the magistrate, "you must go to the House of Lords. I cannot waste time listening to rubbish of that sort."

The Magistrate's Ruling

Mr. Jacobs' client told the magistrate he merely offered the money because he had not a drink in the house to offer, but the magistrate inflicted a fine of 10s. and ordered the payment of two guineas costs on the first summons. On the second summons, the magistrate said it was necessary to teach the offender in question a severe lesson—that officers of this country were not to be bribed with impunity.

He was certain that the 5s. was offered in the expectation that the officer would take it and thus avoid proceedings. There would be a fine of £10 or one month's imprisonment.

Mr. Jacobs then asked the magistrate to state a case on the point of law, and the magistrate replied: "If you put it in writing, I will consider whether you have a point of law."

A Broadcasting Film?

René Clair, producer of "Le Milion," "Chemin du Paradis," and other popular films, has paid two visits to Broadcasting House within quite a short space of time.

On the occasion of his first visit, René Clair expressed a keen desire to make a film all about broadcasting, and his second appearance in Langham Place has given rise to rumours that the threat may soon be carried out!

THE TRUTH ABOUT THE COLD VALVE

—continued from page 394

At first sight the device does not look like a rectifier at all, but this impression is immediately removed by the explanation given.

The main curve goes straight upwards, and there is no point in extending it. You will notice that for the first quarter of a volt it is not linear, but thereafter it is practically straight.

Avoiding Damping

In Fig. 1 I show a "theoretical" circuit illustrating a Westector in use with a transformer. It is desirable not to include the primary of the transformer in series with the rectifier. A parallel-fed scheme is shown which prevents the D.C. component of the rectified current from passing through the primary.

This is not to prevent magnetiation effects of the core, but to prevent a load being thrown on the tuned circuit. The resistance may vary between 30,000 and 250,000 ohms.

Fig. 2 is a more elaborate circuit showing a full-wave Westector arrangement used as the second detector in a superhet. Note the filter for cutting out the intermediate frequency "carry-over." A volume control is also shown in the grid circuit of the output valve.

In giving this brief account of the new Westector, I ought to emphasise that while the rectifier itself is shortly to be "released," experimental work on its applications is proceeding. At the moment of writing (Feb. 23rd), I myself have received sample rectifiers and the public will no doubt be able to purchase them by the time this article appears.

A Suggested Application

The field for experiment is untilled. There is an almost unique opportunity for the general experimenter, as well as the research departments of manufacturing firms, to develop new uses for this rectifier. The manufacturers, incidentally, may be interested to look up a series of patents of mine dated 1919, 1920, and 1921 relating to automatic volume control. The employment of rectifiers (not merely valve rectifiers) for this purpose is fully disclosed, and new life will be given to these inventions by a convenient "cold" method of using them.

Meanwhile, readers of an experimental turn of mind may quite easily do very valuable work at a very small expense. I have indicated both the apparent limitations as well as the merits of the new device, and, so far as my own work for this journal is concerned, readers may rest assured that if there is "anything in it" for them, they will be informed of any really practical developments.

In the interim, keep cool about the "cold valve." No one deprecates exaggeration more than the makers of it.

IMAGINATION AND RADIO

A warning to constructors when "improving" their receivers.

WHAT a lot imagination can account for! Never was this more true than in radio; in fact, my advice to constructors is to beware of letting their imagination lead them astray and to keep it well in hand.

You fit a new condenser and the set seems much better. Is it? Remember that imagination is largely controlled by one's mental state.

If you have been hoping certain alterations will work wonders, you'll probably kid yourself the receiver is far better when they have been carried out.

And particularly where naturalness of reproduction is concerned does imagination tend to produce false impressions. After getting used to our speaker, which we consider is giving faithful reproduction, to hear an orchestra in real life may easily lead one to say somewhat like the farmer when he saw a giraffe for the first time, "There ain't no such music."

Be that as it may, I was forcibly struck by the orchestra in a London restaurant the other day where I was lunching. My friend and I had a table near the dais, and the bass drum was only just audible; yet had I heard that band on the radio it would have worried me if the drums were not, to say the least, prominent.

And some of the trumpet blares! Heard on a radio set one would be inclined to jump up and reach for the volume control under the impression the set was distorting due to overloading.

Yet it was quite a good dance orchestra.

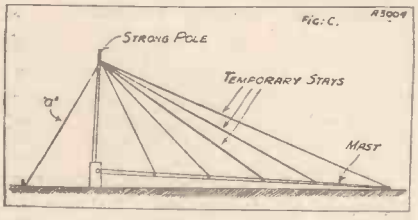
A. S. C.

AN AMATEUR'S AERIAL

—continued from page 425

the length of which was the same as the distance between the base and the anchor. This was placed on the ground at right-angles to the mast and the stays for that particular anchor attached to it and tightened up, keeping the pole at right-angles to the mast. The pole was then swung into a vertical position over the

HOW IT IS DONE



The method referred to by our contributor.

base and held in that position with temporary stays as in Fig. C, and suitably attached at the base.

Now for the task of hauling up, which was enlightened by the aid of pulley blocks on the guy rope "a," in Fig. C. Pulling at "a" brings the pole over and also the mast. This had to be done slowly, at the same time a careful watch had to be kept on all the mast guy wires, these having to be slackened bit by bit, but not too much. Particular care had to be taken when the mast approached the vertical position, as there was a danger of it toppling over due to the weight of pole and slack guy wires on the opposite side.

Having reached the approximate vertical position, all that had to be done now was to tighten up the wires generally and transfer the guy wires off the pole to their proper anchor.

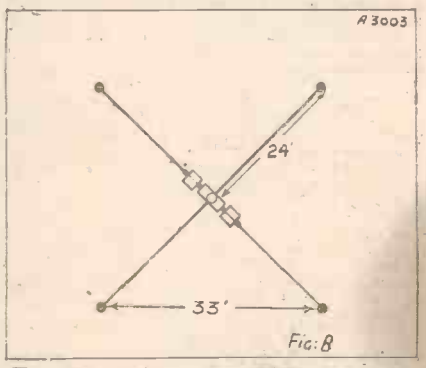
A Safety Measure

Since being first erected six years ago, the masts have been pulled down a number of times for painting and placing insulators on the guy wires to minimise any screening effect they might have on the aerial.

Just a word of warning to any reader who proposes to insulate his steel mast in a similar manner: always fit a spark gap between the mast and earth, otherwise a flash of lightning might take advantage of its insulated prominence, possibly with disastrous effect.

In conclusion, I should like to add that I have found it well worth the

AT RIGHT ANGLES



How the positions for taking the strain can be planned in advance.

trouble in erecting such an elaborate aerial system.

SENDING S O S

How the famous distress-signal came to be internationally adopted.

By J. F. CORRIGAN

SINCE the inception of wireless communication at sea there have been quite a number of different distress-calls, some of them local ones, some national, some almost universal.

The S O S signal, however, has always been the most famous of them all. It is the one which, owing to a sort of evolutionary process, has received world-wide assent and international usage.

Easy to Transmit

Before the reign of S O S, the most generally-known distress-call was C Q D. But this signal C Q D was found to be attended with several disadvantages in working practice. It was heavy and awkward to work in an emergency. What was worse, experience taught that there was apt to be some difficulty in identifying the C Q D call, particularly in a crowded ether-band.

And so arrived the now renowned S O S distress-call. It "caught on" fairly quickly, and it was a distress-call which was more or less welcomed because it was easy to send.

There are quite a lot of radio amateurs and other people who read about distress-calls at sea who labour under the mistaken notion that this now universal call for help was chosen merely on account of its alphabetical letters, letters which were then translated into Morse.

In actual fact, however, exactly the opposite was the case. The S O S call was selected because it is represented in the language of Morse by three dots, three dashes, and three dots, thus: . . . — — — . . .

Hence, you see, the call was only known as the S O S because those letters happened to be the translation of the Morse succession of three dots, three dashes, and three dots.

The S O S call is very easy to send. I don't think I should be wrong if I were to state that a child could send it. Three dots, three dashes, three dots. Three short taps, three long ones, three short ones. At all events, in an emergency any person of average intelligence could make some decent attempt at sending out the vital distress-call.

Attracting Attention

Then, again, the Morse succession, S O S, is a clearly defined one. It is sharp and distinctive, and even in the midst of a jumble of conflicting signals from other stations, the regularly repeated S O S, S O S, S O S stands a maximum chance of attracting attention.

In actual practice, an S O S distress-signal is sent out at a speed of about five or six words per minute, and, naturally enough, it is transmitted at full power, or at the maximum power available.

The signal is repeated several times at a stretch. Then an interval is allowed, and, after this, the operator transmits several more S O S successions.

Where Amateurs Err

Generally, the three dots, three dashes, three dots which represent S O S are not given in a perfectly uniform manner. It is the practice of most operators to give additional emphasis to the three dashes, thus making these (the "O" portion of the call) the main feature of the signal. Amateurs, in practising to themselves this signal, generally err in making the letters even. The contrary should always be observed—three short dots, three long dashes, three short dots.

It is a technical point, I know. Surely, however, you will agree with me when I state that every radio man worthy of his salt should at least have some idea and comprehension of the manner in which an S O S signal is most likely to be transmitted successfully!

FROM MY ARMCHAIR

—continued from page 413

campaign against Britain and "exposing" our treachery! Meanwhile, at Geneva—— But why bring that up.

Radio should be a shield against the jingoism and war-mongering of nations. It would be a good thing, as a start, if all national anthems were abolished. Instead, let us have cuckoo clocks, nightingales or the broadcasting of a Teutonic soup festival.

Let nation speak peace unto nation. It is not too far-fetched an idea to imagine the possibility of a war largely started by radio broadcasting friction. A single shot has, before now, precipitated a war. And remember the Polish incident.*

* Since writing the above I have received a handsome cheque from my German publishers for six years of book royalties and rather feel like singing *Deutschland über Alles* myself —J. S.-T.

A PRACTICAL MAN'S CORNER

—continued from page 410

rolled up and it is somewhat springy. Begin by fastening the end to that of the baseboard not with tacks or screws, but with drawing-pins. Fig. 5 illustrates the next stage in the procedure.

A flat piece of wood, planed smooth, is laid on the foil and pushed over it away from the edge first fixed down. The pressure of the forward edge of the wood causes the foil to unroll, whilst its lower surface presses it down flat on to the baseboard.

Further drawing-pins are put in at intervals to keep the foil in place. If there are any creases or slack places when the far end is reached, these are easily straightened out by altering the positions of some of the drawing-pins.

Not until most of the components are in place should the foil covering be definitely fixed down with small gimp pins. The best drawing-pins, by the way, for this and many other purposes are those with glass or crinoid heads; for these are so easily put in or taken out.

Safety for Leads

If you use the very convenient sub-baseboard method of construction, which enables decoupling condensers and resistances and other components to be tucked away out of sight and greatly simplifies low-tension wiring, a good many leads will have to pass through the metal-covered baseboard. You can, of course, simply drill plain holes of appropriate size and pass the insulated wires through them, but as a believer in safety first, I do not care about this method.

Small sharp jags are apt to be left in the foil on the entry side, and it is by no means unknown for these to cut the insulated covering of the wire in course of time. Quite apart from considerations of safety, it is generally advisable to keep certain leads carrying oscillating currents well away from earthed areas, such as a copper foil surface, in order to avoid undesirable stray capacities.

Fig. 6 shows a method of passing leads through a metal-covered baseboard which satisfies all requirements. It takes only a few seconds longer for each lead than the drilling of plain holes, and the slight extra time and trouble are well spent.

Having drilled your hole, countersink it at the upper end with a small, sharp rosehead. This trims off the metal edges, and if the entry is countersunk to a diameter of about $\frac{3}{8}$ in., the insulation of the lead will be well removed from the copper.

A Valve Holder Point

Many modern valve holders have very low bases, and if they are mounted directly on to either a metal chassis or a metal-covered wooden baseboard, there are two unpleasant possibilities that must be borne in mind. The first is that a short-circuit may be caused by the valve's being pushed right home so that its pins come into contact with the metal beneath; the second, that the grid-to-earth and plate-to-earth capacity may be high owing to the presence of flat metal contact pieces beneath the valve holder in close proximity to the earthed metal surface.

It is always as well to avoid any such possibilities, and for this reason I strongly recommend the use of a small "pad" of plywood between the valve holder and the metal surface. Three-ply is quite suitable for the job.

Cut from this as many $1\frac{1}{2}$-in. squares as you want, and drill in each a couple of holes to correspond with those provided in the valve holders for the fixing screws. Even if the valve holders themselves are tall enough to avert short-circuits of the kind described, there is little point in purchasing valves with small inter-electrode capacity and anti-capacity valve holders if you don't take steps to avoid unwanted capacities when mounting the holders themselves.

GANGING MADE EASY

—*continued from page 428*

In this case the capacity of the circuit tuned by No. 2 is so low that the trimmer will not bring its "strays" up to the value found in the others. What is to be done?

Here is a useful tip. To the earth terminal of this section attach a short length of Glazite, and do the same to the grid terminal. Twist the two pieces of Glazite together, taking care, of course, that the bare ends do not touch.

Adding Capacity

Set the trimmer near the minimum position and go on twisting the wires together until the volume shows distinct signs of increasing. You can now make the final adjustments with the trimmer itself. The twisted pieces of Glazite form a small extra condenser which helps to bring up the fixed capacity of this particular circuit to something near that of the others.

Ganging "band-pass" circuits is again very simple. Here I would recommend starting with the condenser which tunes the coil to which the aerial is coupled, and then dealing with that tuning the grid of the first valve.

Start as before with the local station and adjust the various sections until you obtain the best strength. So far, so good, but in band-pass circuits another difficulty sometimes arises.

"Double-Humping"

You are quite likely to find, even if you gang ever so carefully, on a station near the middle of the medium wave-band that when you tune in one much lower down there are distinct and most unwelcome signs of what is known as "double-humping." The London National, for instance, may come in strongly at about 15 on the condenser dial, be weakish from 16 to 19, and then arrive once more with a roar at 20.

Re-gang until this station comes in at one setting instead of two. Then try another station near the top of the band and make any small adjustments that may be necessary.

In the end you will discover the best average setting. It may be that you will not be able to adjust matters so that the London National is confined to a couple of scale divisions, but you can reduce the double-humping to something negligible, whilst, at the same time, ensuring that stations in the middle and at the top of the band are properly received.

So far we have dealt only with the medium waveband. In nine cases out of ten, a set, once ganged on the medium waveband, will perform well on the longer waves.

On the Long Waves

If, though, you find that reception is not too good on the long waves, it will be well worth your while to spend a little time in discovering settings which strike the happy mean. Ganged tuning must always be something of a compromise, since no matter how carefully condensers are designed, or how meticulously trimming is done, the sections can never be, from a laboratory point of view, precisely in step from end to end of both wavebands.

Still, by devoting an odd hour or so to your trimming, you will arrive at the adjustments which provide the best possible reception over both wavebands. And, if you will take this small amount of trouble, I am quite sure that you will not be disappointed with your results.

R. W. H.

THAT OUTPUT TRANSFORMER

—*continued from page 434*

Thus in the anode circuit we have 40 volts which we step down to 1 volt, necessitating a transformer of ratio 40 to 1.

We can simplify these calculations by noting that if we consider the ratio of the two resistances, namely, 4,000 divided by 2·5, we obtain the figure 1,600; furthermore, the ratio of the transformer is 40, and 40 squared is also 1,600. We therefore deduce this rule that the ratio of the two resistances equals the turns ratio squared. Or, as a formula:

$$\frac{\text{Required anode resistance}}{\text{Loudspeaker resistance}} = (\text{Transformer ratio})^2.$$

If you have an output valve of any resistance, and you know, or have obtained from the makers, the impedance of your loudspeaker, you can easily suit the one to the other.

For example, your loudspeaker may have a resistance of 400 ohms, and the output valve a resistance of 3,000 ohms. The ratio of the resistances is:

$$\frac{2 \times 3{,}000}{400} = 15.$$

Therefore, you require a transformer of ratio $\sqrt{15}$, or 3·87 to 1, which is approximately 4 to 1.

THE MONTH ON SHORT WAVES

—*continued from page 392*

9.0—9.30 P.M.

19·9	Heredia, Costa Rica (T I 4 N R H).	Sat., Sun., Mon.
25·27	Pittsburg (W 8 X K).	Daily.
25·6	Winnipeg (V E 9 J R).	Daily except Sat.
25·63	Radio Coloniale (Paris).	Daily.
28·98	Buenos Aires (L S X).	Daily.
30·43	Madrid (E A Q).	Sat.
31·25	Lisbon (C T I A A).	Tues., Fri.
31·3	Daventry (G S C).	Daily.
31·38	Zeesen (D J A).	Daily.
31·51	Skamlebaek (O X Y).	Daily.
48·86	Pittsburg, Pa. (W 8 X K).	Daily.
49·18	Chicago (W 9 X F).	Daily.
49·43	Vancouver (V E 9 C S).	Sun.
49·5	Cincinnati (W 8 X A L).	Daily.

9.30—10.0 P.M.

19·9	Heredia, Costa Rica (T I 4 N R H).	Sat., Sun., Mon.
25·27	Pittsburg (W 8 X K).	Daily.
25·63	Radio Coloniale (Paris).	Daily.
28·98	Buenos Aires (L S X).	Daily.
30·43	Madrid (E A Q).	Sat.
31·25	Lisbon (C T I A A).	Tues., Fri.
31·3	Daventry (G S C).	Daily.
31·38	Zeesen (D J A).	Daily.
48·86	Pittsburg (W 8 X K).	Daily.
49·18	Bound Brook (W 3 X A L).	Sat.
49·18	Chicago (W 9 X F).	Daily.

10.0—10.30 P.M.

25·27	Pittsburg (W 8 X K).	Daily.
25·63	Radio Coloniale (Paris).	Daily.
26·83	Funchal, Madeira (C T 3 A Q).	Tues., Thur.
28·98	Buenos Aires (L S X).	Daily.
30·43	Madrid (E A Q).	Sat.
31·0	Heredia, Costa Rica (T I 4 N R H).	Daily.
31·25	Lisbon (C T I A A).	Tues., Fri.
31·3	Daventry (G S C).	Daily.
31·38	Zeesen (D J A).	Daily.
40·3	Radio Nations (H B Q).	Sun.
48·86	Pittsburg, Pa. (W 8 X K).	Daily.
49·18	Bound Brook (W 3 X A L).	Sat.
49·18	Chicago (W 9 X F).	Daily.

10.30—11.0 P.M.

25·27	Pittsburg (W 8 X K).	Daily.
25·63	Radio Coloniale (Paris).	Daily.
26·83	Funchal, Madeira (C T 3 A Q).	Tues., Thur.
28·98	Buenos Aires (L S X).	Daily.
30·43	Madrid (E A Q).	Sat.
31·0	Heredia, Costa Rica (T I 4 N R H).	Daily.
31·25	Lisbon (C T I A A).	Tues., Fri.
31·35	Springfield, Mass. (W 1 X A Z).	Daily.
31·38	Zeesen (D J A).	Daily.
40·3	Radio Nations (H B Q).	Sun.
43·0	Madrid (E A R 110).	Tues., Sat.
48·86	Pittsburg, Pa. (W 8 X K).	Daily.
49·18	Bound Brook, N.J. (W 3 X A L).	Sat.
49·18	Chicago (W 9 X F).	Daily.

11.0—11.30 P.M.

25·27	Pittsburg, Pa. (W 8 X K).	Daily.
26·83	Funchal, Madeira (C T 3 A Q).	Tues., Thur.
28·98	Buenos Aires (L S X).	Daily.
30·43	Madrid (E A Q).	Sat.
31·35	Springfield, Mass. (W 1 X A Z).	Daily.
40·3	Radio Nations (H B Q).	Sun.
43·0	Madrid (E A R 110).	Tues., Sat.
48·86	Pittsburg, Pa. (W 8 X K).	Daily.
49·18	Bound Brook, N.J. (W 3 X A L).	Sat.

TESTING "S.T.400" DIFFERENTIALS

READERS who have built the "S.T.400" with differentials of types other than those actually used in the set may find that they have to be rotated in an opposite direction to that given in the operating instructions.

The Third Test

In the February CONSTRUCTOR instructions were given for testing the direction of the differentials, but the following third test should be used in place of that given on page 315 of the February issue:

To Test Reaction Distributor.—Having made master reaction and anode coupler work correctly, set master reaction at zero. Switch aerial circuit on to long waves (leaving anode circuit on medium waveband), and set anode coupler full left (i.e. zero). Turn distributor knob to "full left" (looking from the front of panel), i.e. anti-clockwise. Now "bring up" reaction on the master reaction control. The set should oscillate. (You should hear the usual plop as the master reaction knob is moved rapidly from zero to maximum.)

They Need Reversing

If, however, distributor knob has to be turned to the right before oscillation is obtainable with master reaction, this indicates that distributor fixed plates connections need reversing. (Turning differential other way up and re-connecting is the best way.)

The set should oscillate at any position of the right-hand dial. If it does not, there is a fault due to inadequate reaction. (Possible causes have been given, the most likely being the equaliser preset which may be "screwed-down" too much or "stuck-down," and therefore dud. Try completely disconnecting it. Incidentally, presets and spaghettis are the most fruitful source of trouble.)

J. S.-T.

INDEX TO ADVERTISERS

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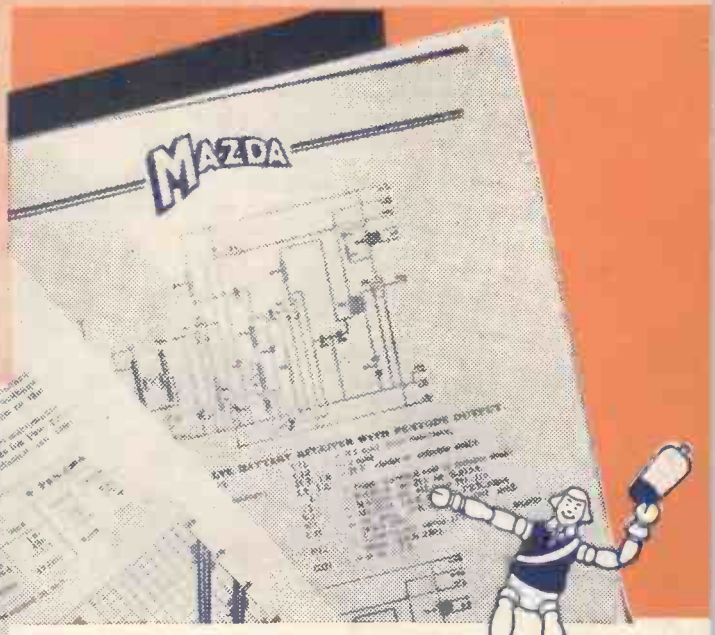

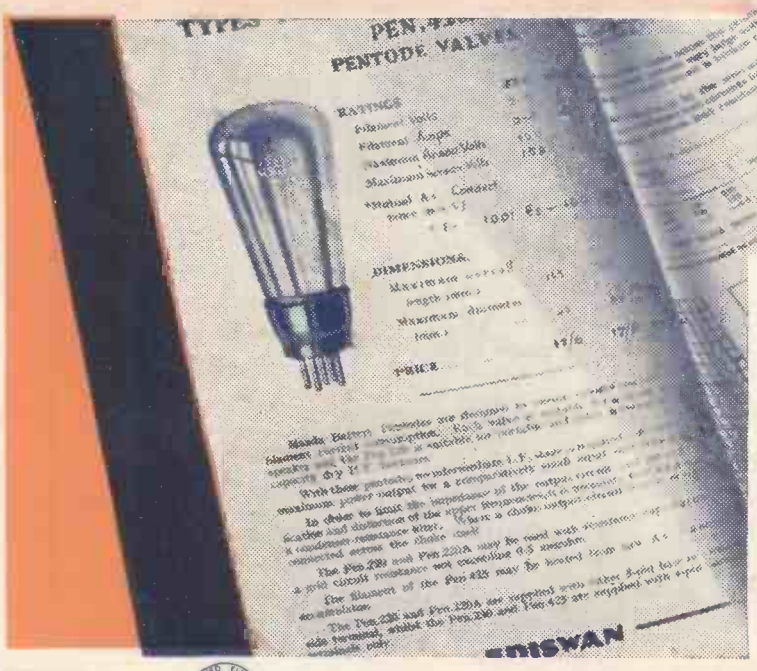

MAZDA THE BRITISH VALVES

THE EDISON SWAN ELECTRIC CO. LTD., 155 CHARING CROSS ROAD, W.C.2

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