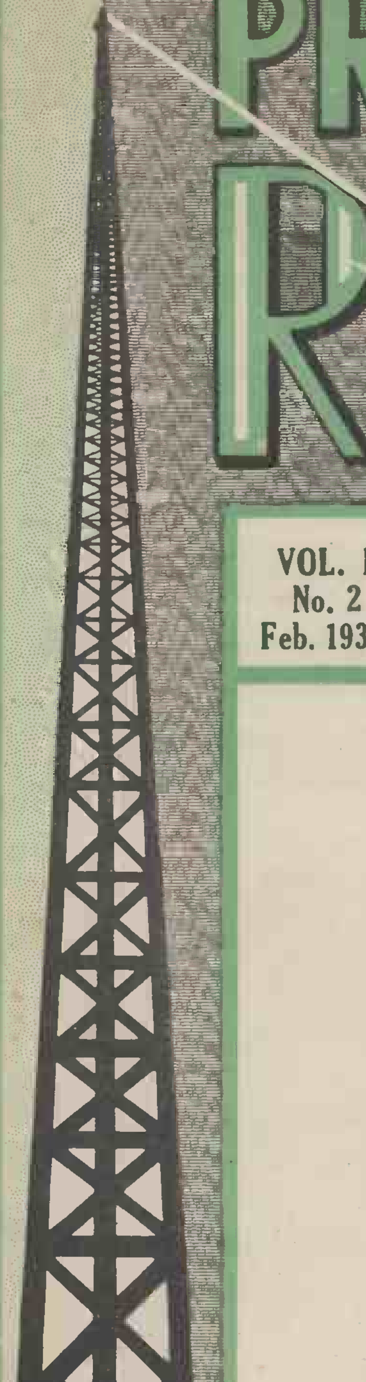


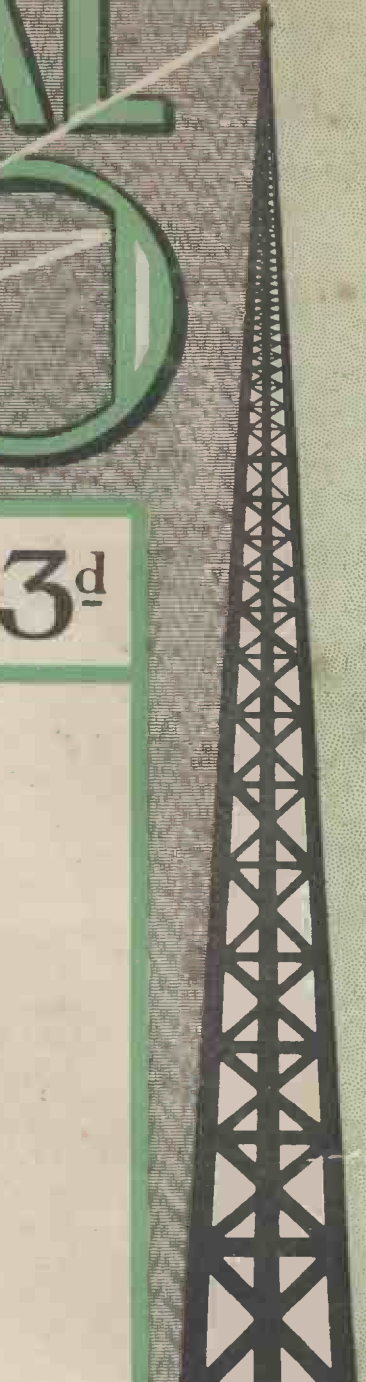
PRACTICAL RADIO

VOL. I
No. 2
Feb. 1932

PRACTICAL RADIO WITH ECONOMY

3d

CONTENTS



The

LUMOPHON 5 CONSOLETTE

Here is the splendid new all-electric Lumophon Five Consolette receiver, combining the famous chassis-built all-mains Lumophon Five with the British Rola Moving-coil loudspeaker—the whole housed in a beautiful example of British hand-polished walnut cabinet work. Two models—W.440 and K.400.

Model W.440
Including Valves and Royalty **17 gns.**

Model K.400
Including Valves and Royalty **18 gns.**

Attractive hire purchase terms are available.

Ask your radio-dealer to demonstrate this Beautiful New Set

Lumophon

BRITISH LUMOPHON Ltd., Stal House, Judd St., Kings Cross, W.C.1

Practical Radio

Up-to the Minute Information on All Radio Matters

Managing Editor: - - H. N. Moss
Technical Editor: - - Alfred Deutsch
Advertising Agents: - - Central News, Ltd.
Editorial & Advertising Offices: 7 Fisher St., W.C.1

FEBRUARY, 1932

Cruiser S.G. 3 Special Supplement on Pages 19 to 26

Vol. I No 2.

Price 3d.

PRACTICAL RADIO WITH ECONOMY

Editorial Jottings

Number Two and All's Well!

IT is usual in the second number of a new Journal to speak of the phenomenal success of Number One—suffice to say a second edition had to be printed to meet the demand, and we now offer Number Two in a spirit of quiet confidence.

Cruiser Circuits.

We publish in this issue the first of the Cruiser Circuits, a S.G. 3-Valve of exceptional merit. Cruiser Circuits are going to be one of the outstanding features of radio in 1932. We have been fortunate in securing the co-operation of the Triotron Laboratory, who will unreservedly place at the disposal of "Practical Radio" readers the wealth of experience gained in the manufacture of Wireless Valves since the inception of the industry. Cruiser Circuits will be built of well-known British-made components, and are designed to work with Triotron Valves, although Ring Valves of similar characteristics can be used and will be specified.

"Cruiser 3" Competition. £100 Cash Prizes.

Full particulars of an interesting and simple competition for kit builders will be found on page 18, the conditions are so simple that a novice has as much chance of winning one of the valuable cash prizes as an advanced amateur. So even if you have never built a set in your life—Go in and WIN!

Another interesting competition built round a Jig-Saw Puzzle will be found on page 6.

Short Wave Radio.

In this issue Mr. Mander Barnett, Vice-President of the Short Wave International League, contributes an interesting introductory article to this fascinating branch of radio. Mr. Mander Barnett also reports on the Short Wave Receiver designed by Mr. G. Stratton Loughton, of Eddystone fame; a pioneer in this field.

Radio-Grams. and the Patent Position.

The Licensing pool have recently decided to make a charge of ten shillings per Valve Holder on all Radio-Gramophones sold to the public. There is no doubt that this will adversely affect the future of a new and promising industry, but it will encourage the amateur to build his own Radio-gramophone.

Our next issue will contain an article which will help the reader to obtain electrical reproduction of gramophone records from his present receiver, and a detailed, descriptive article complete with diagrams that will enable the amateur to build a radio-gram equal in performance to a high-class factory built instrument.

The American Invasion.

Signs are not wanting that the tide of the American Invasion is receding, beaten back, as was the invasion of the Cycle Market some years ago, by the adaptability, resilience and inherent ability of the British Manufacturer. American practice has had a considerable influence on British Radio and by fostering the competitive spirit has resulted in improved Selectivity, and Cabinet work, and the production of reasonably priced moving coil speakers. It can be definitely stated that the modern British-made Receiver is the most satisfactory instrument for British Broadcasting conditions.

Our Programme Providers.

We are not of those who consider they could make a better job of programme providing than the British Broadcasting Corporation, and we welcome signs that it is gradually dawning upon the Masters of the B.B.C. that they have no divine mission to "uplift" the British Nation.

The majority of listeners are neither "High-Brow" nor "Low-Brow," just "Middle-Brow" folk who sometimes feel the need for a little "Uplift," but who, more often than not, require something light and amusing, and are entitled to demand that the fare provided should be designed chiefly for their entertainment and edification.

The Passing of "Jack Payne."

Millions of listeners heard with regret of Mr. Jack Payne's decision to sever his connection with the British Broadcasting Corporation. Although lately we have heard the opinion expressed that "Character Items" have formed too great a feature in his programmes, the fact remains that time and again "The Payne that was Jack" was the only bright spot in a heavy programme—Farewell and Good Luck!

Jack Payne and his Orchestra.

Incidentally this raises the interesting question as to whether long-term contracts with variety artists are advisable. After all, the essence of entertainment is variety, and variety implies change. We are interested to hear that Mr. Payne's successor proposes to make a feature of more melodious Dance Music. This is a mad world, my Masters, when we have to look to the Kings of Jazz for melody. What have our "High-brow" friends to say about this?

"Good-night, Vienna."

Let us have more items like this musical show, which was by far the most enjoyable yet. It was splendidly produced, melodious, "catchy," with good chorus and orchestral work, and showed a distinct advance in Broadcasting technique. To those whom the rush and strain of present conditions still leave a little sentimental, the Baroness's "Mickie '*Daarling*'" was a sheer delight.

The New Spirit in Literature.

There will be many who will wonder how this series of talks by Mr. Harold Nicholson got past the official blue pencil. The fact remains that they were splendidly stimulating and enjoyable to enquiring minds, and opened up new fields of thought to many thousands.

THERE IS NOTHING VERY MUCH WRONG WITH A SERVICE that can give such variety for ten shillings per annum—oh, I forgot the Sunday programmes!! H. N. M.

Fifty 10/- VOUCHERS Free!

for solving this fascinating JIG-SAW.

It looks easy doesn't it? How many minutes do you think it will take you to solve it? Read the Rules carefully and enter for this interesting competition to-day!

RULES.

1. Cut out the fifteen black shapes from the panel below and fit them together to make the name "CRUISER 3"
2. When you have solved the puzzle, paste your solution on a sheet of white paper.
3. Fill in the coupon below and post it with your solution in a sealed envelope to "CRUISER JIG-SAW CONTEST," Practical Radio, 7, Fisher Street W.C., to arrive not later than March 30.
4. There is only one correct solution and this has been locked in the Editor's safe and will remain in a sealed envelope until the competition closes.
5. Entries will be examined on April 3rd. The senders of the first fifty correct solutions opened on that date will each be awarded a voucher value 10/- for the purchase of radio goods which are negotiable at any wireless shop.
6. The Editor's decision is final, and legally binding, and no correspondence will be entered into.

COUPON.

Available till March 30th for one entry.

CRUISER 3 JIG-SAW CONTEST, "PRACTICAL RADIO" No. 2

By MANDER BARNETT,

Vice-President, International Short Wave Radio League.

During the past few years, the attentions of serious radio experimenters have been turned to the higher radio frequencies, or what are now popularly known as the " short waves." Before we proceed, we will make it clear that when we talk of " short " waves we are referring to these wavelengths between 10 and 200 metres —those below ten are termed the " ultra-short " waves, and those above 200 are the " medium " and " long " waves. Now, how does it come about that these so-called short waves are receiving so much attention nowadays? What are their advantages, and in what manner, if at all, do they differ from the medium and long wavelengths? This short article will attempt to answer these questions. There is a vast field for much experimental work to be done on the short waves, and the home experimenter or radio amateur can, in a smaller way, derive very much pleasure, not without its thrills, in investigating these short waves, and, moreover, the apparatus to be used certainly need not be costly.

The short waves came into prominence in the first place when it was discovered that they possessed remarkable distance-covering properties. Thus it is possible to-day, with a small short wave receiver to hear broadcasting stations broadcasting actual speech and music from any of the continents during a twenty-four hour spell. We will assume that our short wave " spectrum " extends from 10 to 200 metres, and examine the way in which these wavelengths behave themselves. First of all, we must understand what is meant by the so-called " skip-distance " effect, as it is impossible to get a proper understanding of the short waves without taking this skip-distance effect into account.

Mr. Mander Barnett who has been engaged in wireless research in this country since 1922 and is well known for his activities in Short Wave Radio—is Vice President of the International Short Wave Radio League and Associate Editor of " International Short Wave Radio News" a magazine published simultaneously in England and America and accepted in most Countries as an indisputable authority in its particular sphere

A skip-distance, briefly, is an area which surrounds a short wave station, in which signals from the station itself cannot be heard, although the signals can be heard at good strength *outside* this area. The area varies very greatly according to the time of the day, and according to the wavelength used. Let us take, for instance, as an example, our own short wave station, G5SW, which, although it can hardly be heard in the British Isles, is well heard in America and Australia. Now, at very close range, within an area of a few miles, we can presume that this station's signals could be fairly well heard. This area is very minute, however, and could not give what is called a definite service. Outside this range, the signal strength falls away. At the writer's home, for instance, G5SW is only very rarely heard at all, generally only a very weak carrier wave being heard. There are exceptions to this, however, and at certain very rare times, loud signals have been picked up from this station, equally as loud as the local medium wave station, but these occasions can only be looked upon as " freak " conditions. The skip-distance may extend as far as 1,000 miles at night time, after which the signals will come in really loud. They will, however, still be subject to fading, and it may be a very violent form of fading, which is encountered only on the short waves. The signal may fade several times a second, in which case the resulting sounds will be very distorted. The period of fading depends on the atmospheric conditions, and at the other extreme the signals may only fade slightly every few minutes.

The accepted theoretical answer to the reason as to why the short wave skip-distance effect should exist, is that there is above the earth, at a certain distance, a layer

Short Wave Radio Continued.

of ionised atmosphere, called the "Heaviside Layer." Short wave signals do not follow the curvature of the earth's surface—this is proved by the fact that they are inaudible at short distances—but strike off the transmitting antenna at an angle. Now, having left the earth's surface, they are bound in time to hit the Heaviside layer. This layer reflects the signals back to earth at an angle, and they are therefore heard again at some point on the earth's surface many miles from the original transmitting station.

The distance of the area inside the angle caused by the Heaviside layer, or, in other words, the distance in which the signals will *not* be heard, depends both on the wavelength used and on the hour, as the distance between the layer and the earth's surface is supposed to vary with the clock. Now, the following is roughly the effect produced by the Heaviside layer on our short wave spectrum, taking into due account the wavelength or frequency of the signal and the hour of transmission. Stations at a distance working between 13 and 20 metres will be best heard during the mid-day and afternoon hours. Thus the stations in the Dutch East Indies, working on wavelengths around 15 metres, are heard very well in England at about 2.00 p.m., though better perhaps during the summer months than the winter months. The American telephone stations, WMI, WNC, WND, and one or two others, are generally to be heard quite well during the afternoon hours. In the summer time, signals around 15 metres can be heard quite well into the early evening, but in the winter time they fade away with the approach of darkness, and are rarely to be heard after 4.00 p.m. From about 20 to 25 metres the effect is pretty much the same, excepting that the whole process takes place at a later hour. Thus, station W2XAD at Schenectady, New York, working on 19.56 metres (quite close enough to 20 metres for the sake of our illustration), is often heard quite well in the evening up to about 9.00 p.m., after which he fades away, and is heard no more until the same hour the next evening. This again is not a hard and fast illustration, and he is at times quite well heard even at midnight. Now, again, the wavelengths between 25 and 35 metres behave in a different manner, and produce a different effect. Stations working on wavelengths around 30 metres are usually heard well into the night, but do not show themselves up very well during the daytime. Thus, for instance, station W2XAF, sister station to W2XAD just mentioned above, and operating on 31.48 metres, is heard at his best after 10.00 p.m., and continues to come over well through the early morning hours until he signs off, somewhere around 5.00 a.m. here, although this is only midnight in the States.

There is a cluster of broadcasting stations around 50 metres, dotted all over the globe, and ranging from W9XF at Chicago, or JOAK at Tokyo, to the giant RW59 station at Moscow. These stations are heard at their best during the night hours, in much the same way as the 30 metre stations. However, stations operating on 50 metres do not have such carrying powers as those operating on the 30 metre group. More power is needed at the transmitting end to get their signals across, and the 50 metre group is also subject to more atmospherical interference.

Talking of atmospherics reminds us that here we have another very interesting and attractive feature of the short waves here, *i.e.*, in the fact that the short waves, as a rule below 50 metres, are only very slightly subject to atmospherical interference. Short waves have proved their worth in tropical countries, where reception above 50 metres is seldom pleasant owing to the very great amount of atmospherics or static to be heard. Owners of short wave receivers, however, can escape this, and do so by concentrating their radio reception on stations below 50 metres.

Against this feature, however, we have a drawback, in that short waves are more liable to interference from man-made static than are the longer waves. Thus interference from motor cars, electric refrigerators, electric signs, street cars, and, in fact, from any type of electrically-driven machinery, is

Continued on page 10

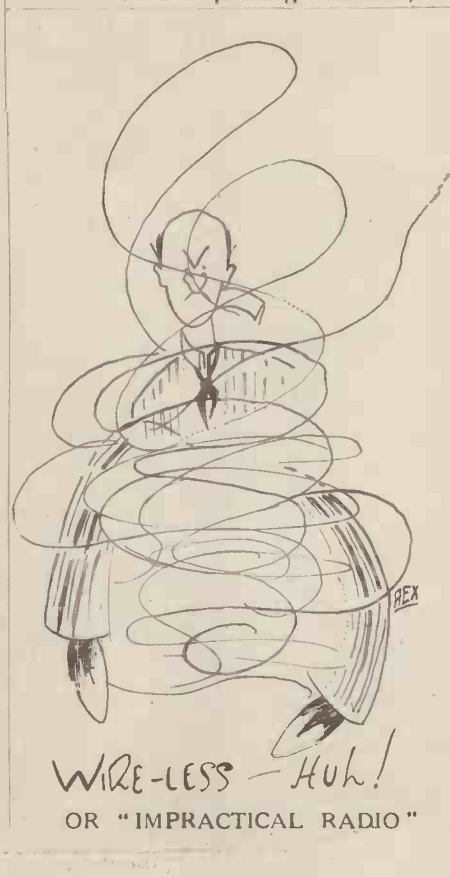
Short Wave Radio, continued

heard to some extent in a short wave receiver. The interference is not very great, however, and the receiver requires to be at fairly close range to the actual apparatus before any annoying effects are heard. Several prominent manufacturers of electrical machinery have taken steps to equip their apparatus with smoothing chokes and condensers so as to minimise these bad effects. Certain types of tramway cars are, of course, also heard on a broadcast receiver, or rather, the electrical interference is heard, and certain tramway authorities have already taken steps to minimise this effect. There is a cure for practically all types of man-made radio interference and the responsibility for keeping the apparatus in order, as far as this effect is concerned, generally rests with the owner.

Short waves are used for many other purposes than for actual broadcasting. There are many hundreds of telegraph stations transmitting press messages, etc., to the ends of the earth. The trans-Atlantic telephone is now operated on the short waves, as also are several other telephone systems in other parts of the world. For these short wave telephones, the Beam system is used, which concentrates the radio energy in a single beam directed towards the receiving station. Much lower power stations can be used when this system is in use as the energy is not broadcast to waste in all directions.

Short waves are also used for the transmission of still pictures across the Atlantic, and the pictures which you see in your morning paper of big events, such as a boxing match which took place in the States the night before are able to appear solely through the use of the marvellous short waves. In the States also there are a number of television transmitters, and these are all working on the short waves, perhaps in some instances by force rather than by choice, as television transmissions are not permitted on the broadcasting bands in the U.S. owing to the fact that the transmissions "spread" too much and a 10 kilocycle separation between stations, such as that in force now in America, is not sufficient when television signals are being broadcast. So the television stations have now all gone down on to the short waves. The upper part of the short wave spectrum is generally used, somewhere between 100 and 200 metres, and there is room here for a very great number of television stations to operate simultaneously without causing mutual interference. The police forces of several of the big cities also use the short waves to keep their motor patrols in touch with headquarters, as also does the fire department in one or two cities.

And so it will be seen that although they have not been in use for a very long period, the short waves have already found a place for themselves under the sun, and it is certainly correct to say that they will provide the greatest scope for development in the future. Already a number of experiments have been made with transmissions below ten metres, and the B.B.C. is erecting a transmitter to work on about 7 metres, whilst several other European broadcasting authorities are investigating their properties. There are distinct possibilities for the wavelengths below 10 metres, even as far as local broadcasting is concerned, and it is quite possible that with the passing of time, a large amount of the world's broadcasting will take place below 10 metres.



OR "IMPRACTICAL RADIO"

So much for the practical aspect of the short waves. Now we come to a few technical considerations. The radio amateur who is now taking his first introduction to the short waves will at once ask himself what further apparatus will he require? We have already stated that it need not be costly, and the apparatus is simple to build at home, or economical to buy if one prefers to use ready-made apparatus. Before making up one's mind as to the exact type of apparatus to begin with, let us issue a warning. Do *not* attempt to receive short waves on your broadcast receiver merely by changing the coils. The design of a short wave receiver, although it is not radically different from that of a broadcast receiver, differs fundamentally in one or two points, and although it is quite true that it *is* possible to receive short wave signals on certain types of broadcast receivers merely by changing the coils, results will definitely *not* be satisfactory, and the amateur would probably be discouraged from investigating the short waves further by an unsuccessful first attempt.

A short wave adaptor provides a very simple introduction to short wave reception, and results are generally very successful. There are several types on the market now, or they are very easy to build at home. The best course would perhaps be to start off with a short wave adaptor, and learn something about the tricks and features of the short waves before actually purchasing or building a short wave receiver. This, of course, is by way of looking at the question purely from an economical point of view, and for those to whom a second receiver, specially constructed for short wave reception, in addition to the ordinary broadcast receiver, is not an objection, then there is no better course to take.

Short wave receivers are generally actually simpler in construction than those of the broadcast type. This is due to several causes, chief of them being perhaps the fact that at present it is not necessary to pay very much attention to the

Continued on page 11

Short Wave Radio continued.

selectivity of a short wave receiver. Thus the tuning section is generally of the simplest possible type. The majority of short wave receivers use merely a detector valve, followed by two audio frequency amplifying valves, and in some cases one stage of either tuned or untuned high or radio frequency amplification ahead of the detector valve. A high frequency valve only amplifies to a very small degree as low down as 30 metres, even when that valve is of the screened grid type, but the addition of a high frequency valve has certain other advantages which become apparent as soon as it is used. For instance, the natural wavelength of some aerial and earth systems sometimes falls somewhere in the short wave tuning range, and this will cause a very annoying effect. The natural inductance and capacity possessed by an aerial system will naturally depend on the length, height, etc., of the aerial itself, but it will very likely fall somewhere between 15 and 40 metres. Or, if the natural wavelength of the aerial is outside this range, a *multiple* of the natural wavelength may occur somewhere here. When a tightly coupled aerial is used with a short wave receiver of the plain detector valve type, the receiver will generally refuse to oscillate when it is tuned to the same wavelength as that of the aerial, unless the coupling is loosened and this, of course, decreases the signal strength. Now, this effect is mighty troublesome, but it will not appear if a high frequency valve is used ahead of the detector. Also, there are several other advantages to be had by adding a valve of this type, but these need not be gone into here.

It is to be hoped that some of the above remarks will have given the reader a general indication of some of the practical and technical points to be encountered in the use and construction of short wave apparatus, and that the reader will henceforth decided to take the plunge and delve into the mysteries of short wave radio.

We hope in the future to publish technical matter of such a nature as to help the reader with his short wave work, both in the design, construction and use of short wave receivers.

The STENODE RECEIVER

Dr. JAMES ROBINSON, D.Sc., Ph.D., M.I.E.E., F. Inst. P.

James Robinson, the Inventor of the Stenode, was born at Seghill in Northumberland in 1884. After a brilliant school career he obtained a B.Sc. with distinction in both Physics and Mathematics in 1906 at Armstrong College in the University of Durham. In the following year he was elected to a Fellowship of the University and studied Physics on the Continent. In 1909 he became a Master of Science and a Doctor of Philosophy, taking this last degree in Physics. From that time until 1915 he was engaged in research work in Physics, and he held successively appointments as Senior Demonstrator in Physics at Sheffield University, Senior Lecturer in Physics in the University of London and Examiner in Physics for the University of London. Dr. Robinson is now a Doctor of Science, a Doctor of Philosophy, a Member of the Institute of Electrical Engineers, a Fellow of the Institute of Physics. He has served as a Member of the Council of the Physical Society of London, as a Member of the Committee of the Radio Research Board, and as a Member of the Wireless Board. The Wireless Board, on which all the Services are represented, is the chief wireles authority in this country.

He is regarded as one of the most brilliant of the younger scientists of the day—and in these younger men lies the greatest hope of progress, since they are able to attack the scientific problems of the day with vigour, freshness, and the courage to abandon, if need be, old theories that have long been regarded as unassailable.

That there is a very close connection between selectivity and quality of reproduction is a fact now well recognised. On a wave band from 175 to 1,935 metres there are in Europe 204 Broadcasting Stations. To meet the demand of the public, modern receivers have been constructed to bring in many of these stations, but until the advent of the "Stenode" principle this was only possible at the sacrifice of quality.

With the "Stenode" Receiver many more stations can be received, whilst the quality of reproduction is far higher than anything hitherto obtainable.

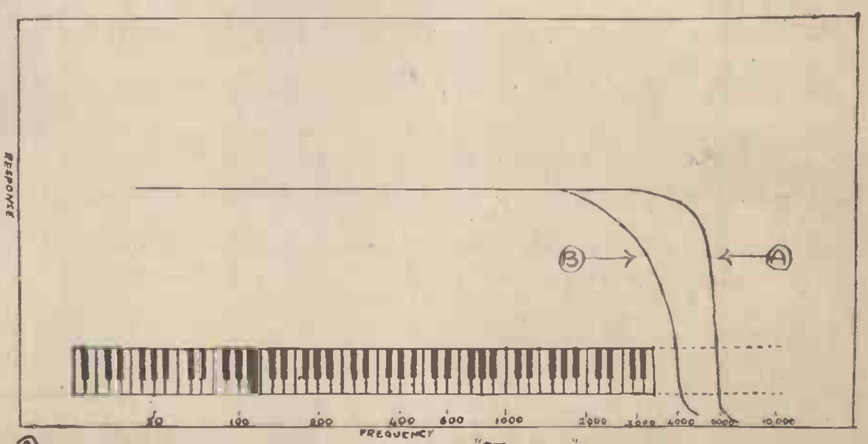
Users have written the inventor, Dr. J. Robinson, telling of the reception of over 100 stations, two-thirds of which were received with good "entertainment value." It is impossible to exaggerate the importance of the "Stenode" principle, for it has solved the problem of clearing the overcrowded ether—a problem which has puzzled experts for a long time.

The standard by which the reproduction of a wireless receiver should be judged is this: can the different instruments of the orchestra be distinguished with certainty? The individuality of each instrument is primarily determined by the high frequencies present; that is, by its "overtones" or "harmonics." The "Stenode" reproduces all notes or frequencies equally up to 6,000 or 7,000 cycles per second, as may be desired, and this without loss of selectivity as evidenced by the performance cited above.

Though many other commercial sets obtain a good degree of selectivity, it is of an artificial nature and is secured at the expense of the higher frequencies. In consequence there is a noticeable loss of quality.

This question of the reproduction of the higher frequencies is of the greatest importance, for it is the presence of these frequencies which enables the listener to distinguish one instrument from another. For example, the highest note on a piano has a frequency of 3,450 cycles per second, and in order that this note may be recognised as coming from a piano and not from, say, the voice or a violin, still higher frequencies are involved and must be reproduced.

As shown by Curve "A" in the accompanying diagram of a piano-keyboard, the "Stenode" reproduces frequencies up to at least 6,000 cycles per second, thus enabling true and brilliant reproduction to be obtained. Average sets of high selectivity begin to cut off



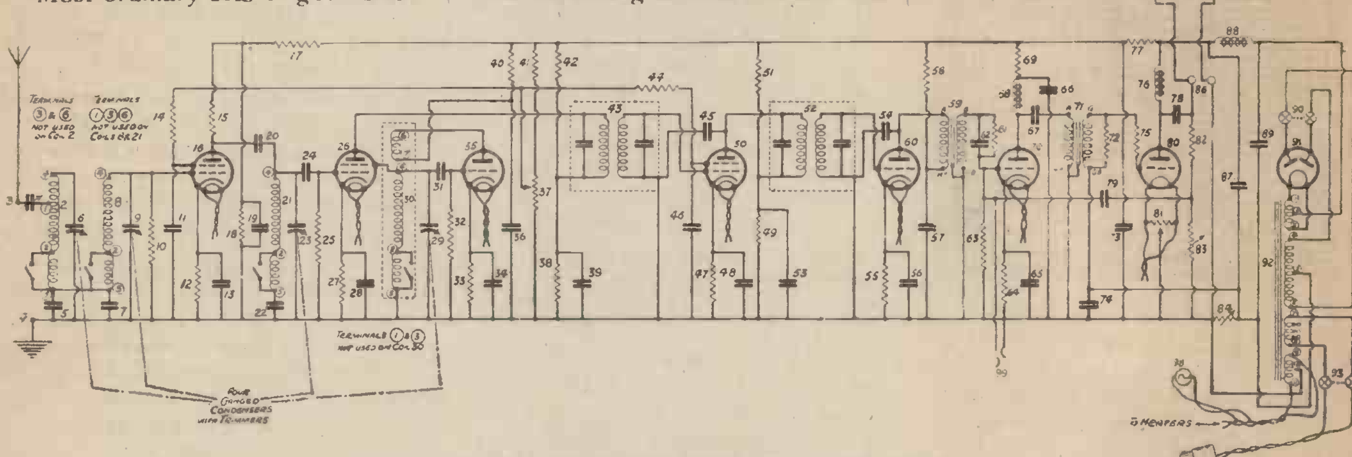
(A) ACOUSTIC FREQUENCIES REPRODUCED BY THE "STENODE" RECEIVER
(B) ACOUSTIC FREQUENCIES REPRODUCED BY AN ORDINARY RECEIVER OF AVERAGE SELECTIVITY

at frequencies considerably below this, and a typical response curve of such a receiver is given (Curve "B").

The "Stenode" principle has been incorporated in a superheterodyne model with sharply tuned intermediate frequency, circuits. Persistence effects are introduced by the high selectivity, and lead to a greater amplification of the low frequencies than of the high, this being remedied in the low-frequency stages by means of a special corrector circuit.

Most ordinary sets of good selectivity are noisy in operation, and there is much "mush" present. The "Stenode," on the other hand, is extremely quiet as regards background, and this feature is of great value when listening to distant stations.

It might be thought that to obtain the many advantages possessed by the "Stenode," a somewhat complicated system of controls would be necessary. The reverse is the case—the "Stenode" is so simple to operate that a child can handle it. A single knob controls the tuning on both medium and long wave bands, and a second knob the volume of sound. In "Stenode" Radiogramophones this second knob controls the volume both of radio and gramophone, and serves to switch the set on and off. A switch is provided to change over from medium to long waves, and from radio to gramophone. A special feature is a "tone control," operating on both radio and gramophone.



CIRCUIT OF A TYPICAL "STENODE" RECEIVER

ON THE LOW FREQUENCY SIDE

By H. J. BARTON CHAPPLE,
Wh.Sch., B.Sc (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

We have only to glance through the pages of any wireless journal to realise quite forcibly that radio has advanced far beyond that hackneyed "infancy" stage, and is growing up rapidly. Inevitably the conclusion is forced on one that radio technique is developing and improving so speedily that in order to keep an equipment constantly up-to-date, replacement of obsolescent components and an occasional complete rebuilding of the home set is necessary.

Now these changes are in no way dictated by the whims or the rapacity of radio manufacturers. It must be realised that radio is essentially a highly scientific industry which has developed during the most active portion of a highly scientific era. The latest and most up-to-date models of receivers, loudspeakers, and so forth, are sponsored primarily for the service of the newcomer or for the established wireless man whose equipment has become out-of-date, but everyone should study technical developments, and then, at convenient intervals, review their apparatus in the light of recent knowledge and carry out such renovations or remodelling as may then seem advisable.

Some instances arise where the adoption of a new or improved product *immediately* renders necessary an alteration in another section of the set. A case in point is the substitution of new and more efficient types of valves. Everyone must realise that of late the efficiency of receiving valves has been greatly increased. This may be proved by comparing the mutual conductance or "factor of goodness" of various makes with their counterpart of, say, two or three years ago. Furthermore, the methods employed for inter-valve coupling have also progressed, and the net result is a very much larger overall stage gain in amplifiers.

Mr. H. J. Barton Chapple is a well known authority on radio and television. After completing a three years' course of study at the City & Guilds (Eng.) College and amongst other things being awarded the Siemens Memorial Medal and Premium for proficiency in Electrical Engineering and the Henrici Medal for proficiency in Mathematics he took up a lectureship in Electrical Engineering and Radio at Bradford Technical College. On resigning, he joined the Staff of Radio Press Ltd., and subsequently acted as consultant to various radio manufacturers carrying out several designs. Has made an intensive study of radio and television and is still actively engaged on this work. Contributes to many wireless periodicals, journals and newspapers. Joint author of "Television To-day & To-morrow," consultant to Television Magazine.

It is when applying these new and more efficient valves to a receiver designed originally to operate with the older and less efficient ones that a trouble is often experienced in the form of howling, or that curious intermittent popping that has earned for itself the title of "motor-boating." It is unfair to lay the blame for this trouble on the new valve, for the fault in nearly every instance is due to the fact that the new valves are being used in an old and quite likely inefficient receiver. The only reason for the ill which has arisen (it is known technically as "low frequency oscillation") is unwanted coupling between stages, and this may arise from any one of several causes.

First of all there is the likelihood that the L.F. transformers used for inter-valve couplings are of a very old pattern. If so, there may be a magnetic leakage and, due to this, a portion of the energy in the circuit of one transformer is transferred magnetically to another transformer circuit. This is then reamplified, and since the effect is cumulative, we have the final resulting oscillation upsetting the receiver in a most unpleasant manner.

Some low frequency transformers exhibit one or more "resonance frequencies," and this is another possible cause of low frequency oscillation. This is especially so with older patterns, there being an unequal amplification throughout the range of required frequencies. At any one or more definite frequencies such transformers are liable to give a degree of amplification enormously greater than that over the frequency band which has to be covered. This fact, combined with the higher overall amplification obtainable with the more modern valves, may easily give rise to the difficulties mentioned.

The only real cure for oscillations arising from either of the two cases just mentioned is to substitute for

Continued on page 15

the old and inefficient transformers components of modern design and high performance.

Pursuing our investigation a stage further, low frequency oscillation is caused frequently by electrical coupling between circuits due to a fairly high resistance common to more than one circuit. Usually a portion of the high tension battery is common to two or more anode circuits, and if the resistance of this common portion is high, the alternating voltage drop across it due to the current in one circuit will be impressed upon other circuits with the result that energy will be fed back from one circuit to another and cumulative amplification, with consequent oscillation, produced. The cure in this case lies in ensuring that the various high tension voltages used for the set are obtained through separate voltage dropping resistances from one maximum tapping on the H.T. battery or battery eliminator.

If a type of eliminator not including such provision is to be used, or if the high tension supply is obtained from dry batteries, it is necessary to feed the anode of each valve from the maximum tapping of the eliminator or battery through a separate resistance of such value that the requisite voltage drop is obtained. These resistances should be by-passed to earth by a fixed condenser of at least 2 mfds. capacity somewhat as indicated in Fig. 1.

Back coupling is sometimes caused by the output leads, especially if they are carrying a large anode current. A certain cure in this case is the adoption of a choke filter circuit, as this diverts the direct current component of the total anode current and permits only the audio frequency component to pass through the leads.

Speaking generally, the tendency to motor-boating is usual at a low frequency, although actually these popping noises may appear at intervals of about one second, each pop comprising a group of frequencies which may be in the neighbourhood of a hundred cycles per second according to the characteristics of the particular circuit employed.

In those cases where one is using an inferior amplifying device which does not amplify the very low frequencies, motor-boating may be removed as far as audible sounds are concerned. Since the effects of such a tendency are present, however, they must, and actually do, affect the shape of the overall amplification curve of the receiver.

Furthermore, it has been proved that motor-boating often has a greater tendency to occur in those receivers in which the first stage is resistance capacity coupled. This may be due to the fact that in such sets the signal on the plate of the detector valve is in the opposite direction from that on the plate of the output valve at the same instant, whereas, if both stages are transformer coupled, the signal is in the same direction.

For this reason, if one reverses the secondary connections of the transformer, the normal condition as regards signal direction is produced, but one is bringing into force a kind of low frequency reaction which may alter the shape of the amplification curve. Hence, although this method is comparatively satisfactory as a palliative for motor-boating, it is not always to be recommended as a cure.

It will be appreciated from these remarks that motor-boating is usually the outcome of a defect in the source of the H.T. supply. While this may be minimised, and

Continued on page 16

On the Low Frequency Side continued from page 15

in some cases avoided, by the provision of large by-pass condensers alone between each H.T. tapping and earth, it may sometimes arise that the internal resistance of the condensers used is sufficient to cause the trouble. To get really satisfactory results decouple the individual circuits in the manner suggested previously and shown in simple form in Fig. 1.

While on this topic let me give just one further cause of motor-boating. This is the existence of high frequency currents in the low frequency portion of the receiver. No detector valve works at 100 per cent. efficiency, and in all receivers a very small amount of high frequency energy passes the detector valve into the low frequency amplifier.

In most instances undesirable effects due to this high frequency energy can be avoided by by-passing the H.F. pulses to earth through a small condenser of about .0001 mfd. capacity, either fixed or of the semi-variable type, after having first checkmated them with the aid of a high frequency choke included in the detector anode circuit as indicated in Fig. 1.

While on the L.F. side it is opportune to mention another very important point, namely, that dealing with the choice of valves for a power amplifier. Owing to the number of valves on the market, difficulties often arise in selecting the power valve best suited to one's needs. Complications arise because of the multitude of figures regarding the valve's published characteristics, and these include generally such names as grid bias, amplification factor, impedance, slope or mutual conductance, and so on.

Which of these characteristics determine the suitability of the valve as a power amplifier, and on what basis should the merits of two valves be compared?

Before answering these questions it is advisable to consider for a moment what happens in a power amplifier. Imagine a set is switched on (filament, G.B. and H.T.) but no signals are being received. A steady direct current will flow in the circuit consisting of the source of H.T. voltage, the loudspeaker, and the anode to filament path of the power valve. This direct current will, of course, produce no sound in the speaker except a click when switched on or off.

When signals are received, however, impulses at low frequency, corresponding to the sounds produced before the microphone, will be applied to the grid of the power valve, and will set up variations in the current flowing through the speaker. These variations follow exactly (or should do if distortion is absent) the impulses applied to the valve grid. The power available to operate the speaker, and therefore the volume of sound obtainable, depends entirely upon the *extent of the variations* in the anode current of the power valve and not *upon the actual value of that current*.

In other words, the movement of the diaphragm (or the moving coil) of the speaker depends upon the "depth of modulation," that is, the amplitude of the audio frequency variations in the anode current of the power valves, better known as the A.C. output of the valve.

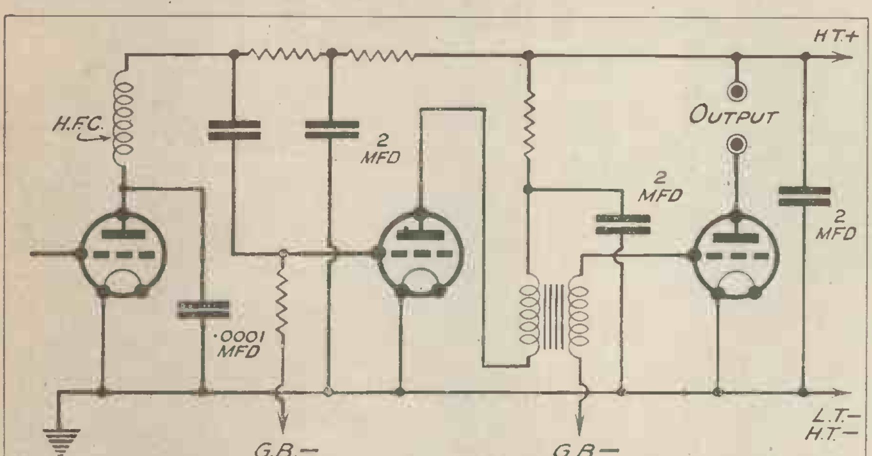


FIG. 1.

Other things being equal, the A.C. output of a valve can be increased by increasing the extent of the voltage variations applied to the grid, but there are limits beyond which the "grid swing" cannot be increased without introducing distortion. There are, however, other factors which control the A.C. output of a valve. These are its amplification factor and impedance.

Space does not permit a full analysis of these two quantities, but speaking generally, it may be said that under identical working conditions, a valve with a high amplification factor and low impedance will give a greater A.C. output than a valve with a lower amplification factor or higher impedance.

The mutual effect of the amplification factor and impedance is expressed by the "mutual conductance" or "factor of goodness" of the valve. When selecting a power valve, therefore, the valve of higher mutual conductance will be preferred. Of two valves having approximately equal mutual conductance, the one having the higher amplification factor will be better. By using a valve with a high amplification factor, less intermediate amplification between the detector and power valve is necessary, and the risk of introducing distortion is correspondingly reduced.

The Query Dept. Now only 6d.

Apologies to those readers whose queries were not answered by return—we were snowed under. This department so obviously fills a need that we have decided to reduce the fee to 6d. per inquiry.

Practical Radio's Prize Offer

£100 TO CONSTRUCTORS OF THE Cruiser S.G. 3

2ND. £10

1ST. £25

3RD. £5

and Twenty-five prizes of £2

Additional prizes to radio dealers who supply kits to the first three prize winners—£5 0 0, £3 0 0 and £2 0 0.

RULES :—

(1) Every entry for this competition must be accompanied by an entry form cut from the current issue of "Practical Radio."

(2) Every entry form must be accompanied by a receipt for the purchase of a Cruiser 3 kit at the full fixed retail price of 69/6.

(3) The closing date for entry to this competition is March 30th 1932. Competitors whose entries are received not later than the first post on March 31st will be eligible.

(4) Answers to the questionnaire must be posted to reach us not later than April 16th.

(5) No correspondence can be entered into regarding this competition and the decision of the judges is final and binding.

(6) No employee of Practical Radio Publishing Co., or any associate Company will compete in this competition.

(7) No one connected, or employed in the wireless trade will be eligible to compete.

WHAT YOU HAVE TO DO

Buy one of the new Cruiser S.G. 3 kits from your local radio dealer and get a receipt for the purchase price.

Build the receiver, taking care to follow the wiring diagrams accurately and make as neat a job as you can.

Fill in the form below and post it with your receipt to :—"Cruiser S.G. 3 Competition", Practical Radio Publishing Co., 7 Fisher Street, W.C.1.

On receipt of your entry form a questionnaire will be sent you, which you will have to complete and return, with a statement signed by an independent witness, testifying to the accuracy of your replies.

From your answers to the questions, the judges will decide whether your set should be sent in for their examination.

Read carefully the rules set out in the column on the left of this page.

Prizes will be awarded by a system of marks for :—

1. Neatness of wiring.
2. Care in assembly.
3. A Constructional Criticism of the kit in 100 words.
(Literary merit will not be taken into consideration)

JUDGES : H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.). A.C.G.I., D.I.C., A.M.I.E.E.
Leonard Norris (Late Wireless Officer, R.F.C. and R.A.F.)

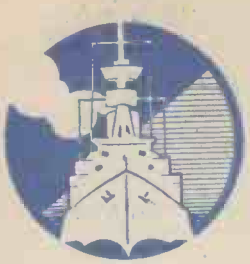
ENTRY FORM

To :—"CRUISER 3 COMPETITION,"
Practical Radio Publishing Co.,
7 Fisher Street, London, W.C.1.

I have read and agree to abide by the rules and conditions of this Competition.

Name..

Address...



THE CRUISER SCREENED GRID 3

As British and as far reaching as the Royal Navy
Designed in the Triotron Laboratories
Sponsored by H. J. BARTON CHAPPLE,
Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

The Cruisers 14 Big Guns:

1.—All-metal chassis.

2.—Simplified construction and wiring.

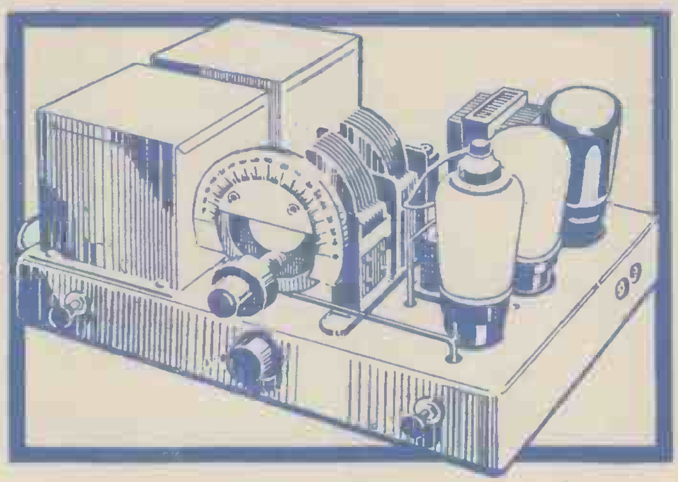
3.—No soldering required.

4.—No hand-capacity.

5.—No stray-field interference.

6.—Matched Tuning.

7.—Precision tuning by one knob. (200/600 metres, 1,000/2,000 metres.)



8.—Simple wave change switching.

9.—Extraordinary selectivity.

10.—Exceptional sensitivity.

11.—Pure full tone.

12.—Pentode output alternative.

13.—Low initial cost.

14.—Economical battery consumption. 8 m/A.

The Cruiser S.G.3 kit is the result of months of careful thought and preparation.

There have been *cheap* (and nasty) kits, *good* (but expensive) kits, but never such an expensively built and technically efficient kit designed regardless of expense at such a ridiculously low price.

In factory-built All Mains Receivers the all-metal completely screened chassis is an established fact. Simplified construction, simplified wiring, complete cutting-out of the once dreaded hand-capacity, no stray-field interference—these are some of the advantages of the all-metal chassis.

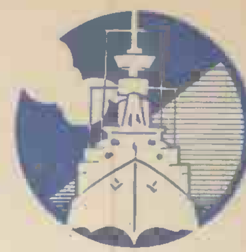
We have put all the latest developments of the up-to-date Mains Receiver into this battery kit, and this explains its astonishing efficiency.

The metal chassis, with sub-baseboard wiring, specially designed square screening boxes, screened condenser and metal-coated S.G. and Detector valves, make it possible to achieve the highest degree of sensitivity with perfect stability.

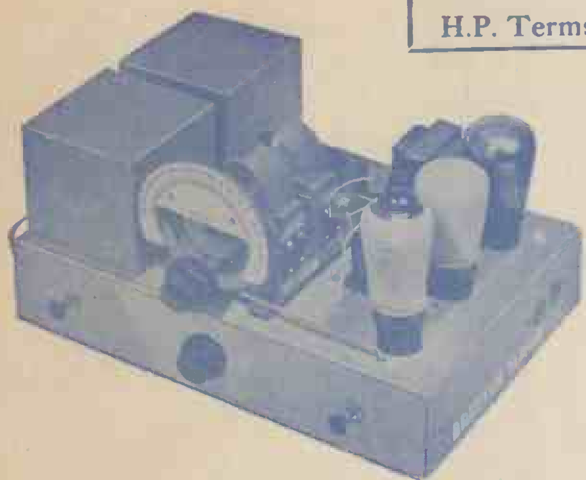
The coils of the two tuned circuits of the S.G. H.F. stage are exactly matched by means of precision tests. The "Polar Uniknob" condenser with its two fine adjustments, ensures perfect ganging over the whole range of both frequency bands.

The Stal type P. L.F. transformer gives perfect reproduction of all audible frequencies.

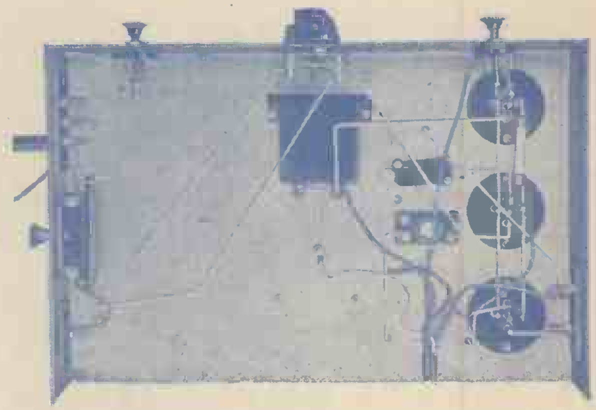
CRUISER
SCREENED GRID 3



69/6
Less Valves
H.P. Terms: 7 payments of 11/-



Top Deck

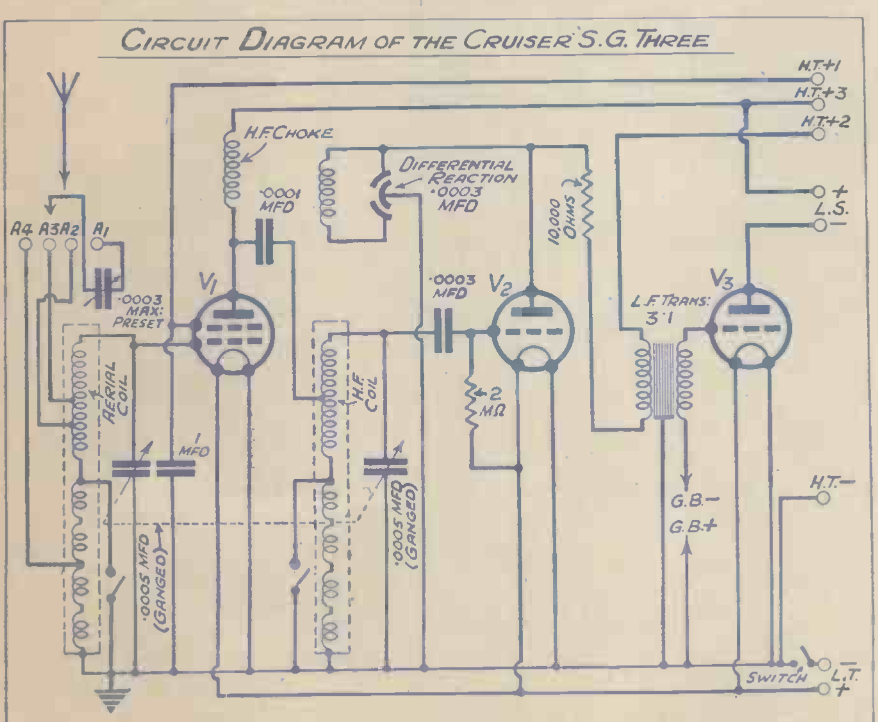


Between Deck

We fully realise our responsibility choosing a British Battle Cruiser as the 'Motif' of our Kit.

The Kit justifies the name.
Look at the straight clean design of the Top Deck!

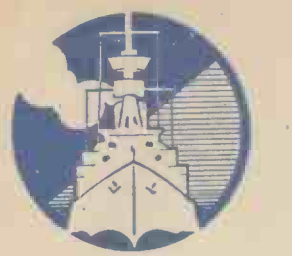
Look at the splendidly designed yet simple layout "Between Decks"!!



COMPONENTS

RETAIL PRICES

	£	s.	d.
1 Ready-drilled Chassis, complete with nuts and bolts, etc. Stal.	0	7	6
1 Twin-gang Condenser .0005 (each section) (Polar Uniknob)	1	1	0
1 .0003 Differential Reaction Condenser (Polar)	0	3	0
1 Pair Cruiser Coils (E.L.S.)	0	11	0
1 .0003 Condenser, Type S. (T.C.C.)	0	1	3
1 .0001 Condenser, Type 34 (T.C.C.)	0	1	6
1 L.F. Transformer (Stal)	0	4	9
1 3-point Switch (Goltone)	0	1	3
1 2-point Switch (Goltone)	0	0	10
1 2 Megohm Grid Leak (Daly)	0	0	6
1 H.F. Choke, D.X.3 (Watmel)	0	4	6
2 4-pin Panel Mounting Valve Holders (Clix)	0	0	10
1 5-pin ditto	0	0	6
1 10,000 ohms wire-wound Resistance (Watmel)	0	2	9
1 1 mfd. Flat-mounting Condenser (T.C.C.)	0	2	6
1 Preset Aerial Condenser (Goltone)	0	1	0
7 Sockets. (Clix)	0	0	10½
6 Plugs (Clix)	0	0	7½
Sundries—			
Battery Cord, G.B. Leads, S.G. Connector, Connecting Wire Stal.	0	3	4
	£3	9	6



ASSEMBLY INSTRUCTIONS

A screwdriver, a pair of pliers, an old knife and YOU CAN'T GO WRONG

The actual construction of the "CRUISER S.G. 3" is so simple that anyone can assemble and connect up the components in a couple of hours.

The use of a drilled metal chassis predetermines the exact position of each component, and the wiring diagrams show how and where to make each connection. Every connection is numbered, and if the wiring is carried out in numerical rotation each wire can be checked as you proceed.

First, of course, the components must be mounted in position, as shown on diagrams, commencing with the reaction condenser and switches on the panel.

Reference to the wiring diagrams will show you that a short piece of bare wire (A and B) must be connected to one terminal of each switch and clamped behind the bakelite base, so that a direct contact is made with the chassis when the switch is tightened down. Make sure that you have the switches in their correct positions, i.e., the 3-point switch on the left and the 2-point switch on the right facing the panel.

Next, bolt into position the four components underneath the base-plate, the 10,000 ohms resistance, .0003 flat condenser, 1 mfd. condenser, and the pre-set aerial condenser on the left side of chassis in the centre bakelite strip.

At this stage fix the 7 sockets supplied with the kit, the two loudspeaker sockets on the bakelite strip on the right, the four aerial sockets in front and rear bakelite strips on the right-hand side. The earth socket is fixed direct to the chassis in the hole behind the A1 socket.

Now reverse the chassis and fix the transformer, H.F. choke and twin-gang condenser, .0001 condenser and both coils into position. The diagram clearly shows the correct position for these components. Pay special attention to the transformer and tuning coils because if these components are connected wrongly disaster will follow. One coil is marked "Aerial" and the other one "H.F." The aerial coil is mounted at the front of the chassis, and the H.F. coil at the rear immediately behind the first one. The transformer must be mounted so that the letters A. and H.T. face the coils, with G. and G.B. towards the valve-holders.

Now for the wiring. First the six-way battery cord. Each wire is distinctly coloured and is ringed at one end to facilitate connecting, and marked accordingly on the diagram. The white H.T.– lead No. 3 is connected to chassis together with connection No. 36 by the rear fixing bolt of ganged condenser, as marked on diagram No. 1.

Now follow through the remainder of the numbers, checking each wire carefully as you proceed. Each wire may be easily fitted in the following manner. Take your coil of Lacoline wire, measure the length of wire required and cut it off, allowing a little extra length to bend round the terminals. Then with an old knife, remove the insulation by rolling the wire between the knife blade and the thumb, sufficiently to cut through the insulation, and slip the insulation off. The wire may then be looped round the terminals and secured by screwing down the terminal.

A few connections require special mention.

No. 12 is the 2 megohm grid leak which has its connecting wires already joined, and can be fixed in position very easily. No. 14 should be raised well above the baseplate, being brought up straight from the terminals of the resistance and then bent to go straight to the reaction condenser.

No. 16 is a piece of flexible rubber-covered wire which is connected to the pre-set aerial condenser, and passes out through a rivet hole in the side of the chassis. One of the aerial plugs provided should be attached to this wire outside the chassis.

Nos. 17, 18, 19, 20, 21, 22, 23, 24, 28, 29, 30 and 31 all pass through eyeletted holes (each one marked with corresponding letter on both diagrams) in the chassis, and care should be taken that the insulation is not scratched at the point where the wire goes through the chassis. Each wire should be bent in such a way that it passes cleanly through the hole without any strain being put upon it. This sounds rather difficult and unnecessary, but actually it is simple enough to carry out, and necessary because the position of each wire has been carefully thought out, and we want you to get exactly the same results as we obtained with the original "CRUISER 3."

No. 33 is a piece of flexible rubber-covered wire for connecting the top (anode) terminal of the screened grid valve. No. 34 is the flexible wire with the black plug attached, and No. 35 bears the red plug.

Now fix the square screening covers over the coils, allowing the wires Nos. 32, 19, 25 and 26 to pass out through the small nicks provided.

Full operating details are given elsewhere, but an explanation of the various aerial tappings will enable you to get the best out of your CRUISER.

There are four aerial tappings, three of which are taken direct to the coil. The fourth connects via a pre-set condenser to any of the other three, giving you a choice of six different degrees of selectivity. On the medium wave band A3 is the tapping to use under normal conditons, A2 is for increased selectivity. In districts where exceptional selectivity is required, the aerial should be plugged into A1 and the plug from the pre-set condenser should be inserted into A2 or A3. The selectivity can then be varied over an exceptionally wide range by unscrewing the knob of the pre-set condenser. Incidentally this condenser is a very efficient volume control.

This arrangement was found to be most effective when the set was tested in a district a few miles from the twin transmitters at Brookmans Park. The same procedure may be used on the long wave band, but here you have additional tapping A4, which is for the long wave band only. On this wave band the series condenser also prevents any possibility of interference from powerful medium wave local stations.

Extensive tests have been carried out at the Triotron laboratories to find the best possible combination of valves. After several adjustments, the circuit was finally built round the combination 072, SD2, YD2.

The a.c. impedance of the tuned circuits is matched to the screened grid type 072, ensuring high gain and efficiency in the H.F. stage.

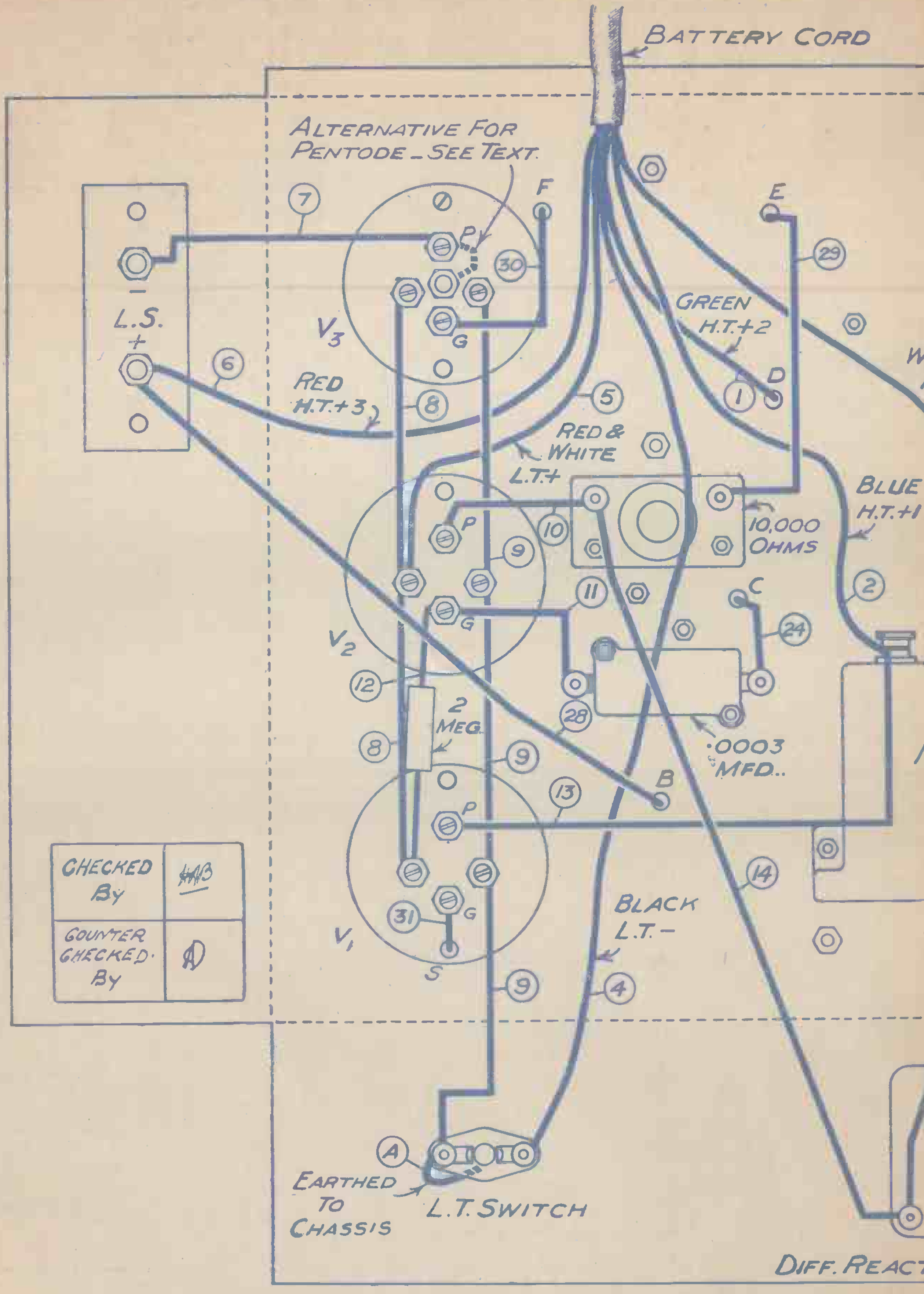
The metal-coated types in the H.F. and detector stage permit the set to be adjusted to maximum sensitivity without danger of instability.

The steep-slope output valve type YD2 (or the new type E. 235) will handle considerable inputs without trace of distortion.

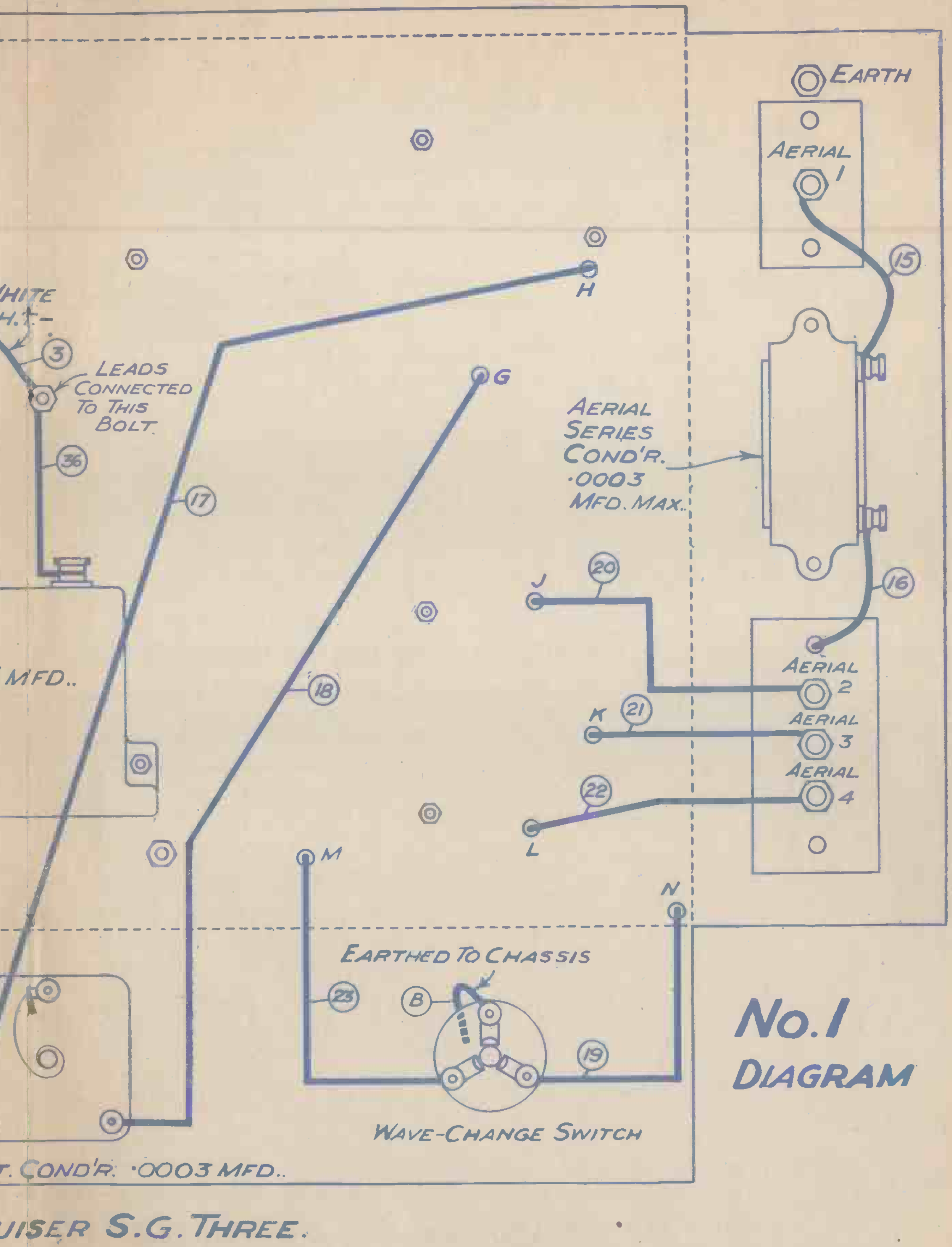
The total H.T. consumption of the circuit using the correct TRIOTRON types is 8 milliamps, an extremely low figure, which ensures maximum service from your H.T. battery. If the H.T. voltage on the power valve varies from the value given in the operating instructions on page 26, grid bias must, of course, be adjusted in accordance with the valve maker's rating, but be sure to switch off the set before removing the G.B. plug.

If full amplification and volume is not required, type YD2 may be replaced by type ZD2, which has considerably lower H.T. and L.T. consumption.

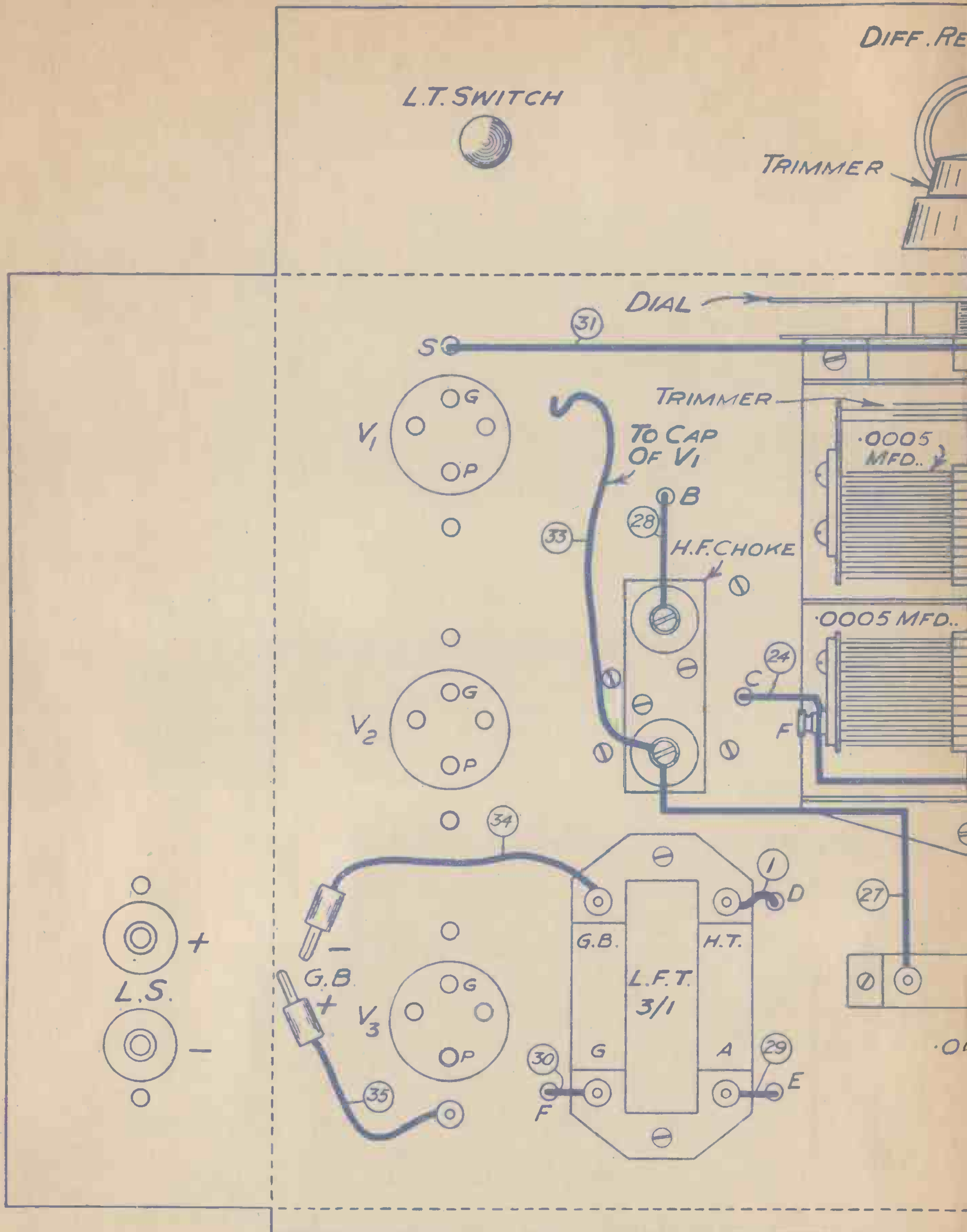
For the benefit of those who wish to increase the amplification of the receiver at slightly increased H.T. consumption by using a pentode valve, we have fitted a 5-pin valve-holder for the power stage. The only alteration necessary is to connect the centre pin of the 5-pin valve holder to the plate pin (P). It is, however, essential to use TRIOTRON Pentode, type P. 215 only, otherwise distortion may occur.



UNDER CHASSIS WIRING OF THE CR

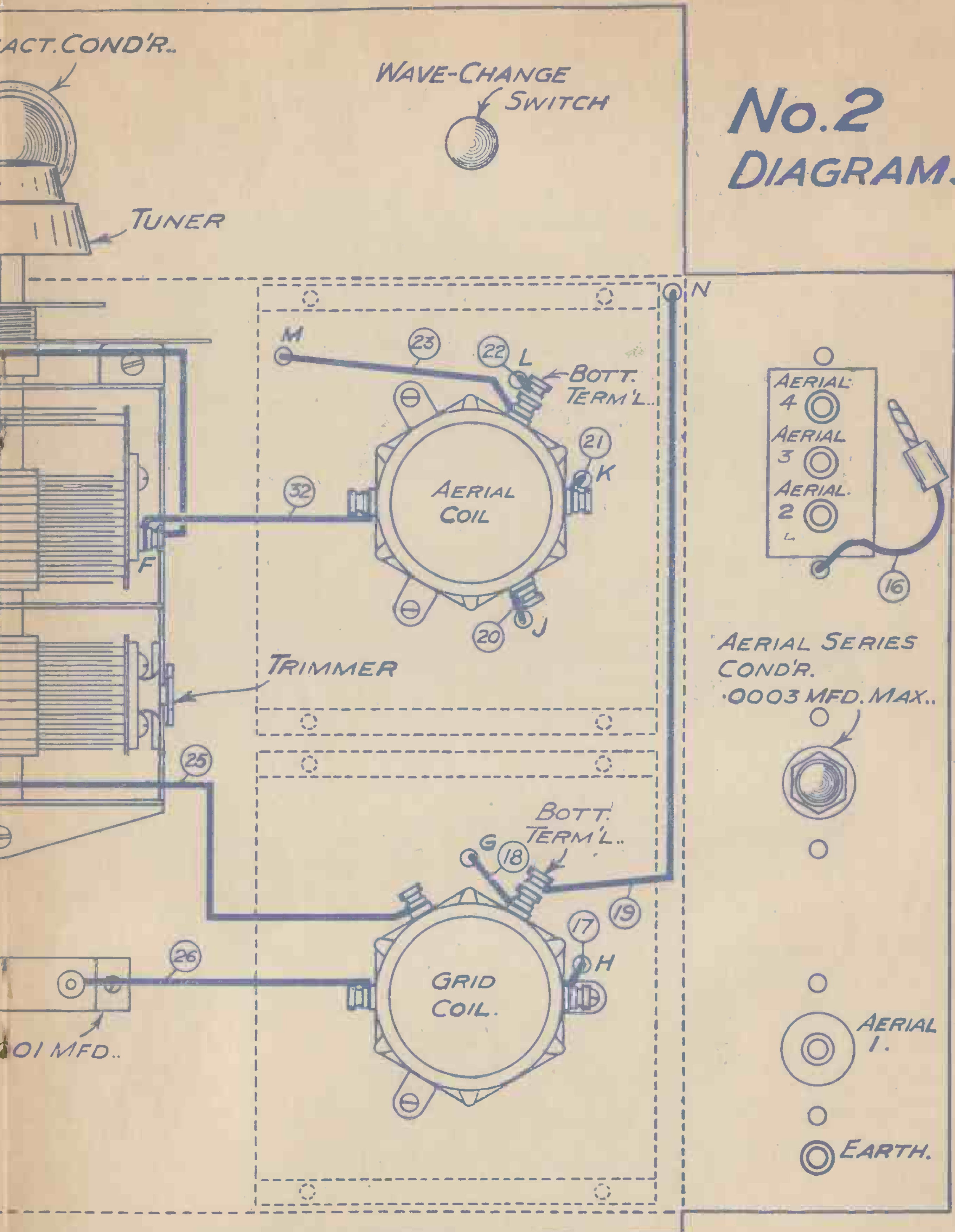

EARTH
AERIAL 1
15
WHITE
H.T.-
3
LEADS CONNECTED TO THIS BOLT
36
17
H
G
AERIAL SERIES COND'R. ·0003 MFD. MAX.
J
20
16
AERIAL 2
K
21
AERIAL 3
AERIAL 4
22
L
MFD..
18
M
N
EARTHED TO CHASSIS
23
B
19
WAVE-CHANGE SWITCH
T. COND'R. ·0003 MFD..
UISER S.G. THREE.

No. 1 DIAGRAM



ABOVE WIRING OF CHASSIS OF THE

No. 2 DIAGRAM.



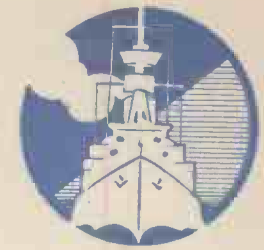
CRUISER S.G. THREE.

TEST REPORT

by

BARTON CHAPPLE

Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.



YOU can get equal results!!! And please note this result was obtained on a purposely mediocre aerial 6 miles from Brookmans Park

The Editor of "Practical Radio" asked me to test out thoroughly the Cruiser Three battery set, designed by Triotron Radio Co., Ltd.

I understand that this receiver is the first of a series of designs which is being prepared, so let me say at the outset that as a result of a very searching and thorough test I can only say that if the other designs live up to the standard of performance of this first one then potential constructors will have every reason for congratulating the designers.

The tests, which spread over a comparatively long period, were undertaken in a district which is normally bad for reception purposes, the situation being only about six miles from the powerful twin Brookman's Park transmitters. Furthermore, the aerial system employed was purposely of only mediocre efficiency so as to make the tests more thorough in character.

My first impression of the set in question was a very pleasing one as the components, mounted above and below a metal chassis, had been symmetrically disposed, while the amount of wiring had been reduced to a minimum. I learn also that this receiver will be supplied in kit form at the remarkably low figure of £3 9s. 6d. (ex valves), together with very complete instructions for building.

The coils are well matched and tuned by a twin ganged condenser, while wave changing from medium to long waves and *vice versa* is effected by a simple push pull switch. "Trimming" is allowed for on the ganged condenser and this is very effective.

One very outstanding feature is the admirable provision for selectivity. There are two tappings on the medium wave section of the aerial coil and a further one on the long wave section. In addition, a semi-variable condenser has been included, so that with this combination adjustments can be made on site to suit every condition of selectivity desired.

The reaction control uses the modern type of differential condenser and is quite smooth in operation, while the total plate current consumption—using the two volt valves specified—is only 8 to 10 milliamperes.

Reproduction with this set, when used in conjunction with a good loud speaker (I employed both a double cone and an expensive permanent magnet coil) was really very commendable, there being no sign of distortion when the valve voltages had been correctly adjusted.

Bearing in mind the exceedingly low figure at which this kit is marketed I am pleased to say its overall performance is remarkable. During the course of my trials I was able to tune in eighteen stations on the long and medium waves, each of which could be listened to in comfort on a loud speaker in the average sized room. To give details of the exact stations received, to my mind, is always misleading to the reader for the reception of foreign stations varies so much in different localities. However, in any district, the constructor is assured of a good choice of programmes, both British and Continental.

OPERATING INSTRUCTIONS.

Installing and operating the Cruiser Three is very straightforward. Connections to the H.T. and L.T. batteries are simplified by the use of a six-way battery cord. Join the two spade tags to the two volt accumulator terminals—red to red and black to black.

A 120 volt H.T. battery is preferable to the 100 volt one and having procured this insert the plugs in the following sockets:—

(1) White into H.T. –.
(2) Blue into 75 volts.
(3) Green into 90 volts.
(4) Red into 120 volts.

The grid bias leads are at the right-hand corner of the set, and the voltage required in this instance is from 7½ to 9 volts.

The three Triotron valves should be inserted in their respective sockets, V1—072, V2—SD2, M.S., V3—YD2 or E235.

Now connect the loud speaker leads to the two plugs provided and insert them in the appropriate sockets on the right side of the set. Join the aerial and earth leads to their appropriate plugs, and insert them in the marked sockets. Now insert the plug from the semi-variable condenser into one of the three sockets mounted together, turn the reaction knob (lower centre) to its minimum setting (as far as possible in an anti-clockwise direction), set the push pull switch on the left for your own local station, *i.e.*, in for long waves and out for medium waves, and switch on the set by pulling out the switch knob on the right.

By turning the larger of the two centre knobs tune in your local station. Now adjust both the plug position for the aerial sockets and the value of the aerial pre-set condenser to give you comfortable volume, and you will be delighted with the result.

To search for other stations, turn the reaction knob in a clockwise direction until the set oscillates (you will not cause any interference with your neighbour's set with this Cruiser Three) and then starting from a zero setting on your condenser dial, gradually increase the dial reading until you hear a shrill whistle decrease in frequency to zero and then build up again. Leave the condenser setting at the "zero" point of this whistle and reduce the reaction until the set just ceases to oscillate. A slight readjustment of the original tuning setting may have to be made, and in addition it may be advisable to alter the aerial plug to another socket to get just the volume and selectivity desired. This process can be repeated as you go up the condenser scale and similarly with the wave change switch in or out (depending upon which wave range you carried out your original test) the process can be repeated.

Before carrying out any searching for stations, however, it is really a better plan to adjust the ganging of your condensers. This is best effected by tuning in a fairly weak station at about the middle of the scale (90 degrees). Then slightly rotate the small "star wheel" on the left of the condenser chassis and move the large tuning knob backwards and forwards until this signal is heard at its maximum strength. Repeat this process with the other trimmer—that is the small knob in front of the main tuning knob.

Further adjustment of these "trimmers" should not then be necessary, although if at all in doubt about a station's final signal strength a slight readjustment may be made with the small trimmer knob at the front of the main tuning knob.

If these operating instructions are followed carefully, and after all they are quite simple, the user will become accustomed to them in a very short space of time. The most important points to bear in mind are the judicious handling of the reaction control (the smaller the amount of reaction employed the better the reproduction) and the taking full advantage of the excellent selectivity provisions made through the medium of the tappings on the aerial coil (do not forget that the aerial plug can be inserted direct into these tap sockets without having the semi-variable condenser in circuit) and also by having this condenser in series with the aerial and joining the plug from the other side of the condenser into any of the sockets.

INTERNATIONAL NEWS

WHAT ARE THE OTHER COUNTRIES DOING?

In our last issue we discussed the "Internationality" of wireless both in theory and practice. As a matter of fact, the exchange of ideas and their application in the wireless field is far more numerous and speedy than in any other modern industry. We consider it, therefore, our duty to give our readers first-hand information of radio's latest developments in all the big industrial countries, because a new circuit, a new component, or a new design introduced to-day in a far corner of the earth and unknown here, may be adopted as standard in a very short time.

AMERICA

By "America" we mean, of course, the United States, which at least as far as ideas and design are concerned, dominates both American continents. Now that the American design is gaining more influence in Europe, general opinion tends to conclude that all new ideas in radio come from America. America has certainly done a great deal to popularise radio and to adapt new ideas to mass production, but the fundamental ideas have almost invariably come from Europe. For instance, the Screened Grid and Pentode Valves were both European inventions, and were first industrially exploited in England. The design of the up-to-date American receiver is based on three main points:—

1. Chain broadcasting on medium wave band only.

2. Public demand for a self-contained set which at the same time has to be part of the furniture of the room in which it is used.

3. Public demand for an all-electric set in accordance with the general American slogan "electrification."

Without exception all American receivers are fitted with moving coil speakers which can work and require much greater amounts of energy than the moving iron type. An undistorted output of 2,500 mW. is quite usual average for a modern American receiver. To obtain this high undistorted output from the small aerials used in the crowded cities of the East and Middle West, the receiver must have very high amplification which, on the other hand, results in a high noise level caused by the amplification of "statics" and "tube noises."

The American receiver has invariably one L.F. stage only, either single or push-pull. Last year the L.F. stage incorporated a 3-electrode power valve with low impedance, but this year all sets have changed to pentodes. Although the pentode is much more sensitive than the triode, the greater part of the amplification must still come from the H.F. stages. Two or three H.F. stages with three or more tuned circuits are therefore the rule. The economic design of this circuit arrangement was only made possible by the exclusive use of Screened grid valves. All tuning condensers are ganged, and numerous ingenious arrangements have been devised to ensure perfect ganging and uniformity over the whole tuning range. Previously trimmer condensers were used to adjust the individual tuning condensers, but now the adjustments are carried out by bending the outer moving vane of the particular condenser, which has three or four radial cuts to facilitate the adjustment. This simple procedure has quite the same effect as the use of separate trimmer condensers and at the same time means, of course, a saving in production costs.

Capacitive or inductive reaction, as almost universally adopted in European receivers, is entirely unknown in American sets. This, together with careful design of the aerial coupling circuit, reduces the possibility of interference between neighbouring receivers by radiating oscillations to a minimum.

Another vital difference between American and European design is the method of volume control. The possibility of controlling the volume of a receiver by varying the grid bias applied to the H.F. valve was, of course, well known in Europe, but as far as I know, never used in a commercially produced receiver. The main reason for America to adopt this method universally is probably the ease with which it lends itself to automatic control and not any particular advantage over our methods. Automatic volume control is carried out by automatically varying the grid bias on one or more of the H.F. valves in sympathy with the strength of the received signal. A number of resistances are connected in series with the grid bias resistance which defines the minimum bias for the screened grid valve. Through the resistances flows the anode current of the detector valve or of a separate volume control valve.

If the detector valve is used to control the volume it must work as a 2-electrode detector, that is to say, it acts as rectifier only, but does not amplify the rectified signals. Usually the amplification of H.F. stages is sufficient to pass signals on to the power stage without detector amplification, in some receivers a dual detector stage is incorporated, the two detector valves being so connected that one acts as a 2-electrode rectifier and automatic volume control valve and the second one as L.F. amplifier

International News Continued

for the rectified signals. As this arrangement means, however, an additional valve, it is usually preferred to let the detector work in its conventional circuit and to use a separate volume control valve, the grid of which is capacitively coupled to the output from the last H.F. stage.

When a signal is tuned-in on the receiver, anode current will flow in the 2-electrode detector or in the volume control valve, this current flows through the resistances connected in series with the grid bias resistance and the voltage drop across these resistances is added to the normal grid bias of the H.F. valves. On very weak signals only little current flows through the detector-rectifier (or automatic volume control valve) and the voltage drop across the resistances is small. On very strong signals, however, an appreciable current flows through the detector rectifier, causing a larger voltage drop across the resistances, which is then added to the normal grid bias of the H.F. valves. This will move the working point on the characteristic of the valves towards the lower bend thereby reducing the amplification of the H.F. stages and the input to the detector stage. Variations in signal strength thus cause a continuous change in the amplification gain so that a practically constant loudspeaker output is maintained.

Automatic volume control is sometimes known in America as " fading compensator " because it obviously tends to compensate the fading effect of distant stations as long as the pick-up from the station does not fall below the maximum sensitivity of the receiver.

A disadvantage of automatic volume control is the difficulty to tune a powerful station exactly to resonance because the volume control flattens the output so that there is a uniform volume over a comparatively wide area, and it is hard to judge where the peak should be, by merely listening to the loudspeaker. On the other hand it is most essential to tune exactly to resonance with modern efficient band pass filter circuits because the slightest deviation from resonance means loss of side bands and quality. To overcome this difficulty most sets employing automatic volume control are fitted with a visual resonance indicator in the form of a milliameter showing the anode current of one of the automatically biassed H.F. valves. For resonance this current will, of course, be a minimum. The tuning meter is mounted in a reverse position so that the maximum deflection of the needle indicates minimum current and resonance point.

Lately, several manufacturers have replaced the tuning meter by the so-called " tune-a-lite " device, which consists of a narrow strip of reddish light, the maximum height of which indicates resonance. Combined with this Neon light is a special switch which cuts out the speaker during tuning so that the objectionable noise between the stations can be avoided.

The extensive use of automatic volume control during the last two years has clearly shown and greatly amplified a serious disadvantage of the Screened grid valve against the 3-electrode H.F. amplifier. The Screened grid valve in the H.F. stage tends to act as a rectifier, and very weak signals off tune are sometimes sufficient to cause cross-modulation of the frequency to which the set is tuned. This tendency increases, of course, as the working point on the characteristic curve is moved towards the lower bend by increased grid bias. All the disadvantages of the Screened grid valve have now been overcome by the introduction of the " variable mu " valve. The variable mu is very similar in external appearance to the old Screened grid type, but the control grid is so designed that the amplification factor (Mu) varies logarithmically from maximum value to practically 0 between 0 volts and 40 volts grid bias. The variable mu is still practically unknown on the Continent, but it has been successfully introduced recently in a number of British receivers.

Although the receiver with several tuned H.F. stages had reached a stage of perfection in America, this year's production has been universally changed to the superheterodyne circuit. This change was not carried out because of any special advantages of the superheterodyne circuit, but only to create a new sales appeal. It is true that the sensitivity of a superheterodyne can be made greater than that of a tuned H.F. set but at the same time the noise level is increased. All superheterodynes have pre-detector Screened grid H.F. stages (variable mu valves) and volume control is again obtained by varying the bias on the H.F. valves. Separate valves are usually used for the oscillator and the first detector stage. The tuning condensers of all H.F. stages are ganged together with the oscillator condenser. Specially shaped rotor plates in the oscillator condenser make the use of the so-called " series-parallel padding " unnecessary. The great number of condensers on a common shaft in some of the receivers make the whole condenser assembly liable to damage during transit. All the higher class American receivers have therefore the shaft of the condenser assembly mounted on springs and rubber blocks so that the assembly has freedom of movement inside the receiver.

The intermediate frequency stages usually incorporate two Screened grid valves, and are tuned to 120 kc. The second detector and the L.F. stage in the superheterodyne receivers are of exactly the same design as previously described for tuned H.F. receivers.

The eliminator part of all American A.C. receivers is similar to European design. It must be remembered, however, that the smoothing circuit is designed for 60 cycles, so that it is sometimes not sufficient for European conditions. A mains choke is very often dispensed with, the unsmoothed D.C. being taken through the field of the moving coil speaker, which acts as a perfect smoothing choke. The fixed condensers in the smoothing circuit have been completely replaced by the electrolytic type which gives better smoothing effect and is " self-healing," i.e., after a momentary breakdown under sudden overload they return immediately to normal working condition.

Battery operated receivers which two years ago were believed in U.S.A. to have gone for good are lately coming into fashion again. New 2 volt battery type valves have been developed for motor-car receivers, and these valves brought new life in the battery receiver design. One of the most interesting battery receivers is an 8-valve super heterodyne receiver which only consumes 12 mA. H.T. This in-

Continued on Page 29

International News Continued

credibly low consumption has been achieved by using two high impedance valves in push-pull in the output stage which are so biassed that they are using practically no H.T. current. Each valve amplifies, of course, only one-half of the L.F. wave, but the push-pull transformer is so arranged that both together give perfect reproduction of the audible frequencies without H.T. consumption.

The same firm which has produced this interesting battery receiver has also introduced the D.C. to A.C. inverter. By means of two mercury vapour rectifiers (Thyratron tubes) connected to a grid oscillating circuit, it is possible to convert D.C. to A.C. of practically any periodicity and up to a power of 250 watts. With the aid of this apparatus all powerful A.C. receivers can be worked off D.C. mains.

FRANCE

In France the influence of the American type receiver has started earlier and has gone much deeper than here. A favourable feature for the American receiver in France was a liking of the French radio amateur for the superheterodyne circuit. As a matter of fact, France is the classical country of the superhet, and many of our readers will probably remember that one of the basic patents covering the supersonic circuit is the French Levy patent. Whilst there was a slump of several years in superhet circuits in this country, this circuit has never gone out of public favour in France. France was also leading in the development of the double grid valve as a combined oscillator and first detector. This arrangement was recently tried in several British receivers but without great success, because the use of a combined valve for oscillator and modulator favours the formation of higher harmonics in the oscillator circuit which cause one station to be tuned in on several positions of the tuning dial.

Apparently this disadvantage was not considered serious enough to discourage the use of the double grid valve in commercial and home-constructed French receivers. The French valve manufacturers are producing a double grid valve both for battery and mains operation. The battery valve is either fitted with standard 4-pin base and side terminal or with 5-pin base, the second grid being connected to the side terminal or centre pin respectively. The indirectly heated mains type is either fitted with standard 5-pin base with a side terminal for the second grid or with a peculiar base where 7 pins are arranged in a circle, the cathode having 2 symmetrical lead-ins.

GERMANY

As in all technical matters, Germany is following very fast in American footsteps. The Console type receiver with built-in moving-coil speaker practically dominates the market. The super midget type, that is the extremely small, combined receiver, which had been introduced last year in connection with the "bar valves," has disappeared and made place to the ordinary size loudspeaker set incorporating usually three or four indirectly heated A.C. or D.C. mains valves.

The 4-valve type is very popular in Germany, but there is a specific

difference between the British and the German 4-valve receiver. The British receiver almost invariably incorporates two Screened grid H.F. stages and one L.F. stage, whilst the German type has one Screened grid H.F. stage and two L.F. stages. The German arrangement makes it easier to obtain greater volume with good quality, but the pre-valve tuning circuits must be very carefully designed to obtain a selectivity comparable to the British 4-valve type.

Anode bend rectification is very much in favour at the moment. Screened grid valves are very often used in the detector stage. The multiple valve (three in one) is still manufactured by one firm which also manufactures a special set incorporating this valve. By the way, the idea of putting more than one valve in one glass bulb is now being tried out by a factory in Eastern Europe and by at least one firm in the United States.

The superheterodyne receiver could not gain much ground in Germany. It appears that the ordinary 4-valve receiver with very carefully designed band pass filter aerial input is sufficiently selective for German broadcast conditions.

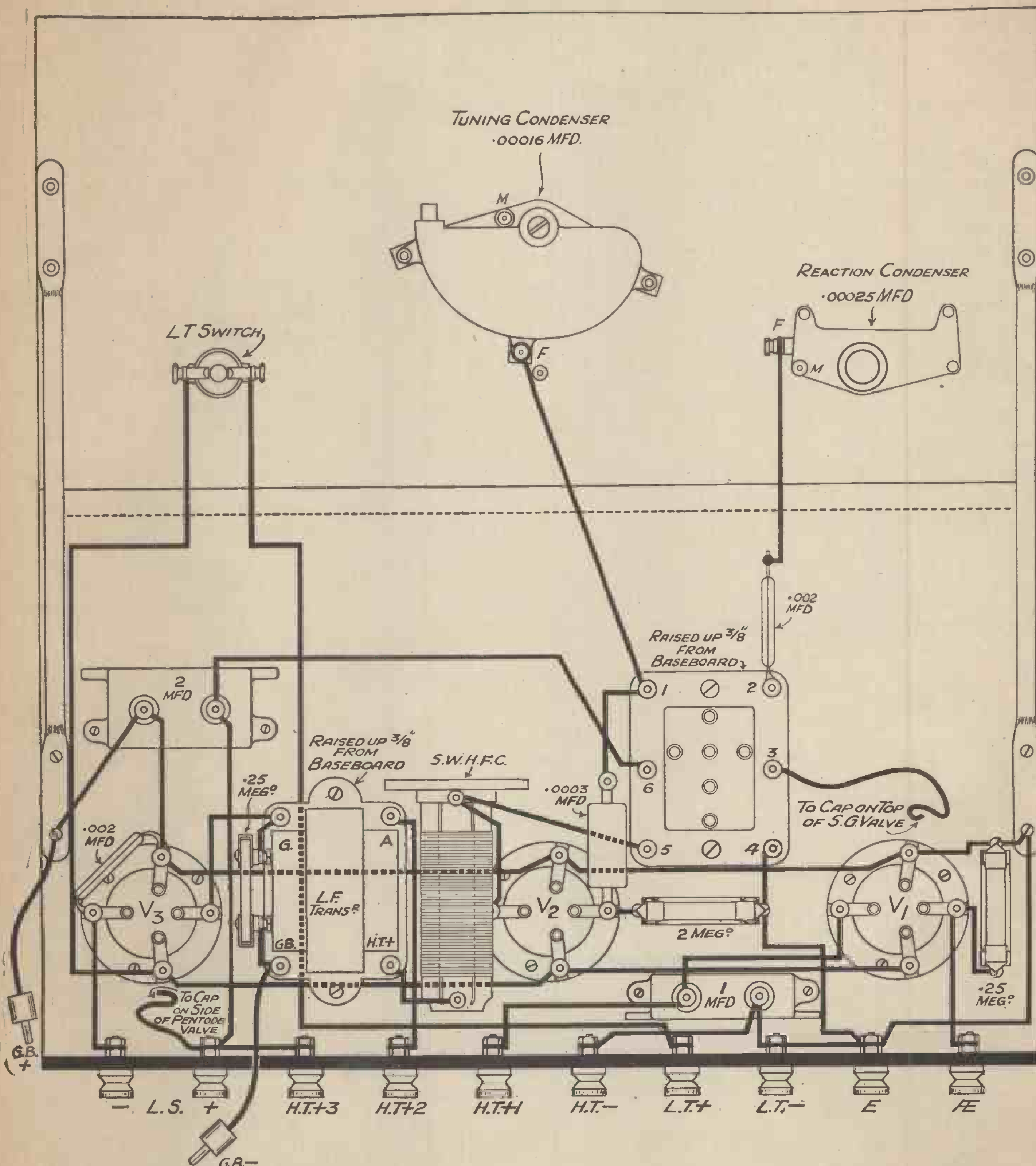
AUSTRIA

Austria, which since the war has lost much of its importance as an industrial centre, still keeps up its position as one of the leaders in wireless technique. A great number of very well designed receivers following British, American and German design is produced by its factories, which supply nearly the whole of the demand of the Eastern European and Balkan States.

An entirely new departure is the adoption of the direct coupled circuit by two or three Austrian manufacturers. The direct coupled circuit which uses no coupling element between detector and L.F. stage, but connects the anode of the detector direct to the grid of the L.F. valve has been developed by Loftin and White in America. Although it was well known that the Loftin-White circuit is able to give better quality than any other arrangement, it was never used in great style for broadcast receivers before.

"ATLANTIC THREE"

Constructor's Lay-Out



The "Atlantic Three" Screened Grid Short Wave Receiver

Constructional Details for Building this Powerful Short Wave Receiver

Designed by Eddystone

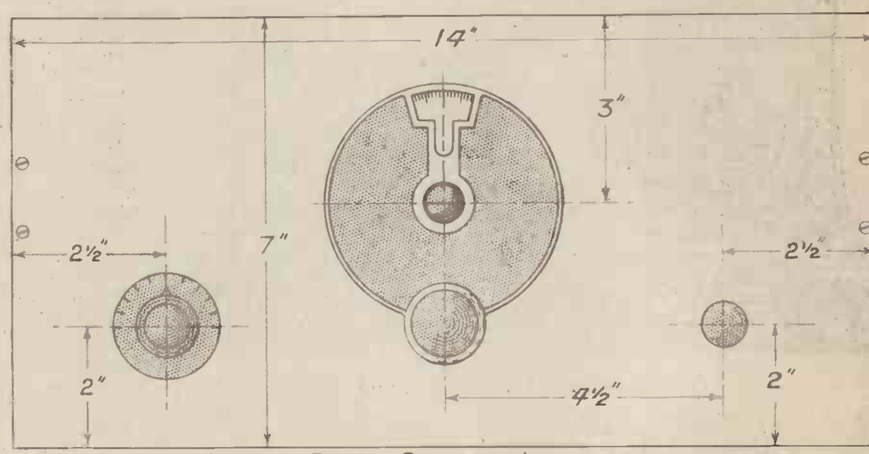
Wave length Range 12/60 Metres

Reception of short wave programmes is rapidly becoming more and more popular, and the production of a moderately priced short wave receiver for home construction will be warmly welcomed by many listeners who are interested in short wave programmes and wish to build a powerful set embodying modern principles.

The "Atlantic Three" has been evolved so that reception of the principal short wave stations throughout the world is possible at good loud-speaker strength, and the circuit employs a screened grid high frequency valve coupled to the detector valve by means of a high frequency transformer with tuned secondary.

The detector stage is transformer coupled into a pentode output valve. Special attention has been paid to the careful choice of suitable component parts so that maximum efficiency is assured, and the wiring system is the outcome of extensive experience and proved reliability.

The building of the set presents little difficulty, and the home constructor with very limited experience can safely undertake the work. The practical point to point diagram shows the layout of component parts and placing of wiring and a theoretical circuit is also provided for reference purposes. No soldering whatever is needed, and the only tools required to build the set are a screwdriver and pliers.



PANEL DRILLING LAYOUT

CONSTRUCTION.

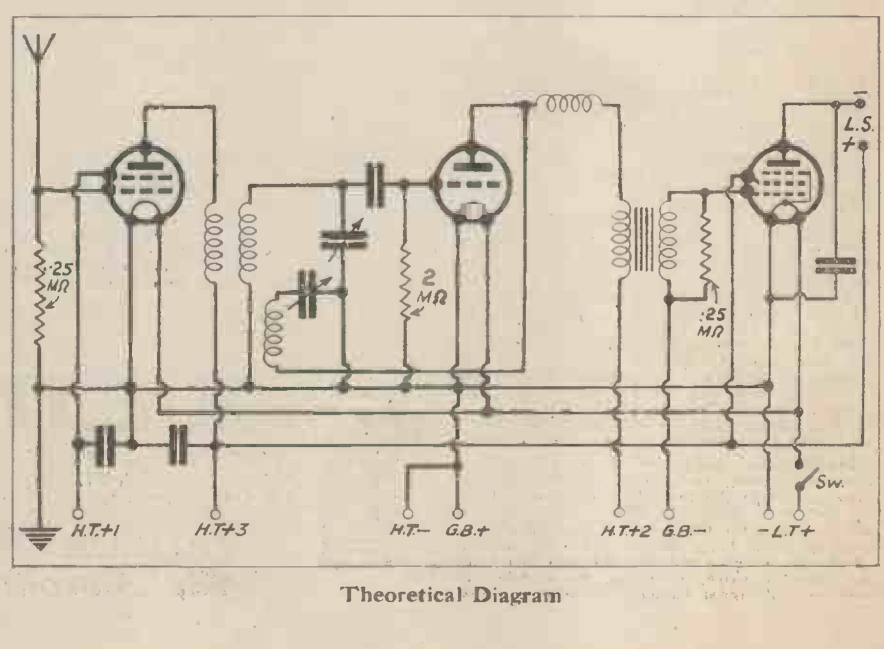
The first stage in assembling the set is to fix the metal panel to the baseboard by means of wood screws and the two panel supports provided for this purpose. The terminals are then mounted on the bakelite terminal strip which is affixed to the rear of the wooden baseboard. Valveholders, L.F. transformer, coil base, fixed condensers, resistance clips, etc., are next screwed in their respective positions (as shown in layout plan). The coil base and L.F. transformer are mounted on the ¼in. ebonite pillars, and it should be borne in mind that the high frequency choke and sundry fixed condensers are not screwed to the baseboard but are supported by direct contact by means of heavy gauge wire, with other components. The two variable condensers are fitted to the metal panel, which should be scraped quite clean (1 hole fixing) and the filament push-pull switch is mounted similarly, and this switch should be of such construction which allows for insulation from the metal panel. The tuning dial is next fitted to the condenser spindle and locked in place by means of two nuts which are located in the cone-shaped ebonite cap on the face of the dial. When adjusting this dial the condenser should be with the vanes all "in" and the dial reading set at 100 degrees. The control knob is then fitted to the reaction condenser by locking it into place with a grub screw provided. Grid bias leads should next be attached and the chassis is then ready for wiring. Special care should be taken to observe that the layout diagram is followed from point to point, and after completing the work, a thorough check should be made to confirm that the printed instructions have been followed, and the set is then ready for test.

TEST AND OPERATION.

The valves recommended for use with this receiver are Triotron 072, Triotron S.D.2, and Mullard PM22, and these should be inserted in their respective holders. A 2-volt accumulator will supply the filament current, and this should be connected to the low tension terminals on the terminal strip, the red terminal being taken to the positive on the set, and the black to the negative one. A 120-volt battery is recommended for high tension. The screen voltage should be between 70 and 75 (HT +1 on terminal strip), the detector 60-80-volts (HT +2), and the full 120-volts should be connected to HT +3. A 15-volt grid bias battery is required if 120 volts are used on the PM22.

The aerial should not exceed 60ft. in length and should be erected as high and free from screening as possible. An earth is needed and should be as short as is possible and of stout wire, connected either to a main water pipe or to a suitable earth tube well buried in the ground. The aerial and earth leads should be connected to their respective terminals on the terminal strip, likewise the loudspeaker.

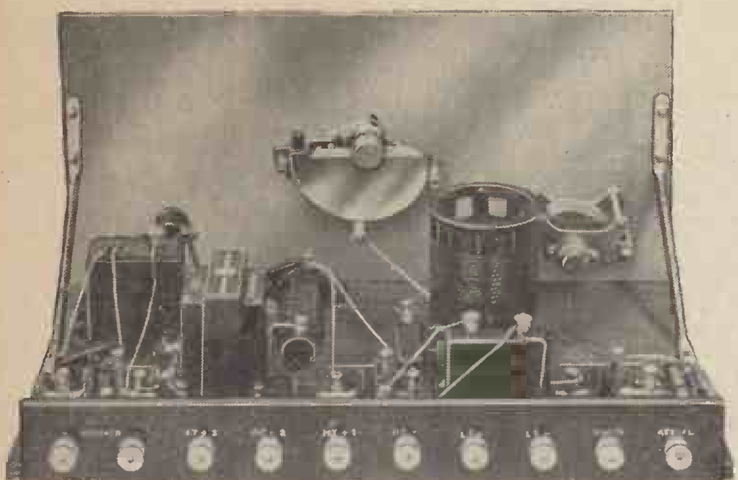
After making these connections insert in the coil-holder a coil covering the wave-range upon which it is desired to listen, and after setting both condensers at zero (plates all "out") switch on the set by pulling out the push-pull switch, and then slowly rotate the reaction condenser control knob until a "click" and slight "rushing sound" is heard in the speaker. This will indicate that the receiver is in an oscillating condition and ready to pick up either telephony or continuous wave Morse signals. With the set just on oscillating point, slowly rotate the



Theoretical Diagram

tuning dial until a whistling note is heard, thus denoting that a carrier wave is being picked up. The reaction can then be slightly slackened until the speech or music is resolved, and a final slight adjustment of the tuning dial brings in the station at its best strength. This is the easiest way of tuning the receiver, and there is no risk of interference being caused to local sets when this method is employed. A little practice, however, soon renders the listener competent to tune-in stations with ease and once the "feel" of the controls is mastered, reception of even the weakest signals becomes a simple matter.

Components needed for The "Atlantic Three" Short Wave Receiver



View of the completed Receiver

		s.	d.
1	Eddystone aluminium panel, 14in. by 7in., drilled and finished brown	6	6
1	5-plywood baseboard, 14in. by 8in.	2	0
1	Pair panel brackets, Eddystone	1	6
1	Eddystone 00016 mfd. short wave variable condenser	10	6
1	Igranic indigraph dial	6	0
1	RI Dux transformer ..	6	9
1	TCC 1 mfd. condenser	2	10
1	TCC 2 mfd. condenser	3	10
1	Eddystone short wave H.F. choke	3	0
1	Standard 6-pin coil case	2	0
1	Red diamond "on-off" switch	1	6
1	Polar "QJ" Reaction condenser with vernier control .00025	9	6
3	Eddystone short wave valve-holders .. (each)	1	6
2	Grid leak holders ..	0	3
1	Telsen 3-meg. leak ..	0	9
2	,, .25-meg. leaks (each)	0	9
1	0003 Ormond grid condenser	1	0
2	002 Ormond condensers (fixed) .... (each)	1	3
1	Engraved terminal strip with 10 terminals	3	0
	Wander plugs, wire, flex, screws, nuts, etc.	2	0
1	Eddystone short wave coil, type 2LB, 10-70 metres	5	0
1	Eddystone short wave coil, type 2Y, 20-40 metres	5	0
1	Eddystone short wave coil, type 2R, 40-60 metres	5	0
	Total cost of parts £4	6	8

TEST REPORT of The "ATLANTIC THREE" Short Wave Receiver

by MANDER BARNETT, Vice-President International Short Wave Radio League.

The Eddystone short wave receiver to be described is a three-valve receiver consisting of an untuned screen grid H.F. stage, followed by a detector and a pentode output valve. The untuned H.F. valve is coupled to the detector by plug-in high frequency transformers which cover the normal short wavelengths. The detector valve is coupled to the output valve by the usual low frequency transformer, across the secondary of which is a 250,000 ohm resistance. This resistance lessens the tendency to threshold howling, so common in short wave receivers. Valves of the usual types are used and the receiver will operate off dry batteries or a high tension eliminator. In view of the fact that both a screened grid valve and a pentode valve are used, it would be advisable to use super-capacity dry batteries, if no form of mains supply is available.

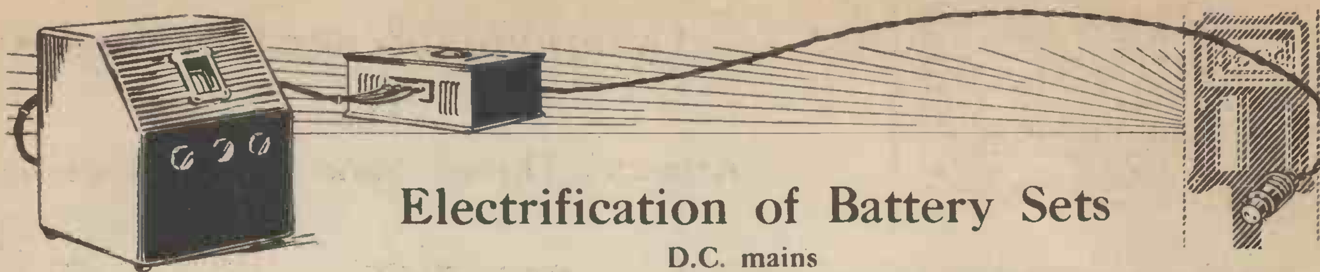
The receiver was put on test and proved to give good results. An H.T. voltage of 120 was applied to terminal "H.T.3," whilst about 70 volts was applied to the two remaining H.T. terminals. A number of the most popular short wave stations, including CT1AA at Lisbon, R.W.59 at Moscow, and a Buenos Aires Station were received at good strength. The output proved sufficient to work a loudspeaker at a fairly weak strength, but owing to the fact that only one low frequency stage is incorporated, the receiver would perhaps be more useful when used with headphones, even though a pentode output stage is used.

The reaction control was found to be particularly smooth, this being perhaps due to some extent to the fact that the grid leak in the detector circuit is wired to provide a negative bias for the detector, instead of the usual positive bias. Whilst this will be an advantage, it also reduces the sensitivity of the detector valve, resulting, as a rule, in some loss of signal strength. I think perhaps that the inclusion of a potentiometer would be an advantage here, as it would allow the detector stage to be adjusted to the greatest point of sensitivity for any type of detector valve which might be used. I would also have preferred the use of a high frequency choke instead of the 250,000 ohm resistance used by the makers in the aerial-earth circuit of the screened grid valve. When the resistance is used the receiver is more liable to pick up a slight hum from adjacent mains supplies, which is often present in short wave receivers, even when the receiver is used off batteries. I found this to be borne out in practice and the substitution of a choke for the resistance stopped all signs of a hum which crept in when the set went into oscillation.

A receiver of this type can be used with practically any type of aerial and will not suffer from "dead spots" on the tuning dial, owing to the blocking effect of the screened grid valve. The tuning is particularly smooth and the reaction practically constant over the whole tuning range. The reaction condenser also has no appreciable effect on the tuning and it is not necessary to "follow up" with the tuning condenser each time the reaction condenser is adjusted. The receiver oscillated very easily but at the same time was completely under the control of the operator. The Triotron SD2 valve proved particularly efficient in the detector stage. If it is not desired to use a loudspeaker, an ordinary three electrode output valve can be used to replace the pentode valve, with a consequent saving in high tension consumption. The receiver was also tested with a D.C. mains unit and there proved to be no appreciable increase in hum, whilst there were no signs of motor-boating.

I might add that the receiver worked perfectly with Triotron valves and they can certainly be recommended for use with this circuit.

The receiver was unfortunately tested at a time when short wave conditions were far from good, but it should prove capable of giving satisfactory performance under normal conditions.



Electrification of Battery Sets

D.C. mains

In our last issue we outlined the basic principles of electrification in general and the conversion to A.C. mains in particular (see pages 13 to 15). We found that a wireless receiver requires four different sources of electric energy, one of which is the actual received "signal," whilst the other three (H.T., L.T., G.B.) can best be satisfied by external D.C. sources.

The problem of the H.T. supply is comparatively simple. The voltage on D.C. mains is continuous but not absolutely constant, there are always slight fluctuations due to higher harmonics. These are removed by a smoothing circuit consisting of a single or dual filter choke with 2 MF condensers connected across on either side. The various anode voltages are obtained in the usual way through series resistances or by voltage divider. The maximum anode voltage we can get in the receiver is the mains voltage reduced by the voltage drop in the windings of the smoothing choke. To obtain best results under economic working conditions we recommend the use of specially designed chokes only, such as contained in the *STAL D.C. ELIMINATOR KIT*. The Stal D.C. Eliminator, a photo. of which is shown on this page, is supplied complete with variable voltage dropping resistances so that it can take the place of the H.T. battery without alteration to the set.

The L.T. supply represents some difficulties. With A.C. it is possible to transform the mains input to any desired voltage, higher or lower, practically without loss. With D.C. there is no possibility of "stepping-up," we can only *reduce* the input by using the "voltage-dropping" method. For this method we connect a resistance in series with the load so that the load current produces the required voltage drop in the resistance. This voltage drop is, of course, a loss. The actual amount of lost energy can be calculated by multiplying the voltage drop (in volts) by the load current (in amps).

It is clear that the usual L.T. circuit, where all the valve filaments are in parallel, cannot be used for D.C. mains. We must try to keep the total filament current as low as possible and the total filament supply voltage high to reduce the loss of energy referred to above.

To obtain this condition we connect the filaments of all the valves in the receiver in series, which, however, can only be done if all the valves have exactly the same filament current. All leading valve makers produce special ranges of valves for series connection in D.C. mains receivers, with filament ratings between 0.07 and 0.5 amp.

The diagram on this page shows a straight three receiver (see also page 13 of previous issue) converted for D.C. mains, using the TRIOTRON 0.1 amp range of valves. The conversion can be carried out step by step as follows:—

(1) Disconnect L.T.− from H.T−.

(2) Disconnect all grid return leads (grid leaks, transformer) from L.T.− and remove G.B. battery.

(3) Disconnect G.B.+ from L.T.−.

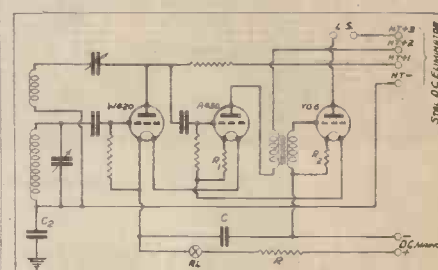
(4) Remove the filament wiring and rewire as shown in diagram.

It is not advisable to pass the comparatively high L.T. current through a L.F. choke, an electrolytic condenser C is therefore used for smoothing.

To find the exact value of the voltage dropping resistance R, part of which may be replaced by Baretter lamp R.L., deduct the sum of the valve filament voltages from the mains voltage, divide by the filament current and deduct from the result the grid bias resistances R^1 and R^2. The value of the grid bias resistances depend, of course, on the H.T. voltage.

(5) Connect grid return leads (see 2) to the new filament wiring as shown on diagram.

(6) H.T.− remains connected to the earth terminal in the set, but the earth



lead must be removed from earth terminal and a fixed condenser (say, 0.05 MF.) connected between earth and receiver.

THIS POINT IS VERY IMPORTANT TO AVOID SHORT-CIRCUITING THE HOUSE MAINS.

(7) Connect the H.T. leads from the receiver to the appropriate tappings on the STAL D.C. ELIMINATOR.

(8) Connect L.T. tappings to the mains, through a pair of fuses if possible. It is important to connect according to polarity shown on diagram, to avoid damage to the valves.

For different circuits deviations from the above routine may be necessary. Upon written application we shall be pleased to give exhaustive information for each individual case.

The Other End of the Power Supply

We feel sure that many of our readers are most interested to know more about the other end of the mains which supply their eliminators or all-electric receivers, we are therefore most indebted to the Hackbridge Electric Construction Co., Ltd., for their courtesy of supplying us with these interesting photographs and descriptions.

The radio amateur will find in this article many familiar expressions, with different meanings.

The "Grid" of the National Grid Scheme carries 132,000 volts—some difference against the 9-volt grid bias or the grid of a wireless valve!

Core and windings of a 45,000 KVA transformer are also slightly bigger than those of a L.F. transformer which works fractions of a milliwatt.

The rapid development of radio has kept pace with the general domestic and manufacturing demands made for electricity supply, and the problems entailed by the rapid increase in loading in recent years have had to be faced by supply engineers and electrical equipment designers, with a view to increasing the size of generating stations and the use of larger generating units, such as turbines and alternators, which has, of course, entailed the use of larger carrying capacity switches and transformers, as well as cables. Each year brings its increase in demand for more electricity, and a consequent train of problems are set up by this.

The National "Grid" Scheme has been designed by the Central Electricity Board, with a view to providing the interchange of large blocks of power between towns and districts, and thus ensuring the maximum efficiency and the minimum number of generating stations. The inter-linking of the "Grid" also provides alternative sources of supply.

To permit this transmission to be carried out economically, it is necessary to employ high voltages, and on the main "Grid" lines, the voltage has been standardised at 132,000. London has a secondary underground network of 66,000 volts, because of the special demands of the metropolis.

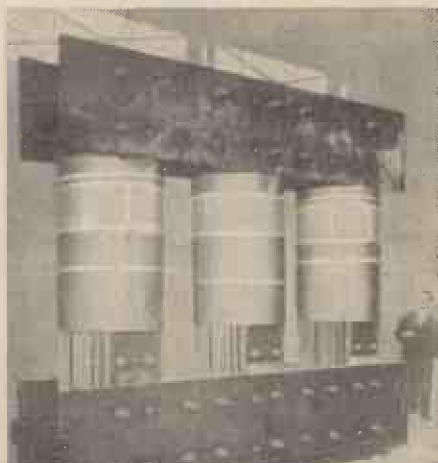
As generating voltages are limited, the most common figure in this country being 11,000 volts, it is necessary to step up the voltage at the generating stations through transformers to the overhead line, and step down to the distributing end through another set of transformers.

Very great progress has been made in the last five years in power transformer design and construction, in consequence of the demands entailed by the "Grid" system for large units. At the present moment there are being constructed in this country the largest power transformers in the world. These are destined for Barking "B" generating station, and have a rating of 93,750 k.V.A. They are 3-phase units, and have a ratio of 12,500/33,000 volts. Each unit will weigh 130 tons, excluding the bank of coolers, which are necessary to cool the oil which is circulated through the transformers. Each unit will be 25ft. long x 10ft. 6in. wide x 20ft. high.

The continuous rated output of these transformers is 103,125 k.V.A., which is equal to 139,000 h.p. These transformers will be used to supply the County of London Company's network from their new section of the Barking Generating Station, and will not only be the largest, but the most efficient transformers in the world. Their efficiency at full load will be 99.47 per cent.

Some of the problems having to be met with in the design, construction, transport and installation of large units of this character will be appreciated from the fact that the bursting stresses on the high tension coils under short circuit conditions are equal to 40 tons. Very great care has also to be exercised in the design and the grading of the insulation, in view of its electrical insulating properties and also its heat-conducting properties.

An illustration shown herewith is the core of a 30,000 k.V.A. 3-phase unit, designed to step down from 66,000 to 33,000 volts. This core weighs approximately 32 tons, and is built up of sheets of high permeability steel. Each plate of steel is ·014″ thick and the construction is so arranged to give an interleaved assembly and to provide the minimum spacing at the joints. In this illustration the core has been built up and has been given a preliminary test by means of turns wound round each leg for the purpose of checking the calculated



The core of a 33000 k.V.A. 3-phase unit

design figures of the magnetising current and the iron loss.

The heating of large cores is a feature that has to be very carefully considered, and ducts are arranged in the legs, through which the oil can flow.

A further illustration, Fig. II., gives a view of an assembled transformer of 45,000 k.V.A., designed to step down from 66,000 volts to 6.6 k.V. This unit was built for the Central Electricity Board, and is designed with a 5-limbed core. The advantage with this construction is that it possesses reduced overall height of the core. It will be noted with what care the windings are braced. Cast steel end rings are used top and bottom, and pulled together by steel tie-bolts. Extreme care has to be taken with this mechanical bracing to avoid the coils moving under short circuit stresses or surges.

Fig. II. Showing assembled transformer.

The core of this unit is shown in Fig. III.

The cooling of these transformers is carried out by the medium of oil. The oil also acts as an insulator between bare live parts and earth. The oil is forced through the transformer tank and the auxiliary banks of radiating tubes by means of motor operated

Fig. III. The core of the transformer

pump, and passes through an externally-mounted gilled tube cooler. A fan passes a current of air across these gilled tubes to assist the dissipation of the heat. This arrangement is shown in illustrations IV. and V. The air-blast cooler is on the extreme right, the pump and motor in the foreground.

In view of the necessity of maintaining a steady voltage on the distribution cables, it is necessary to provide on the step-up and the step-down transformers on the "Grid" system, switching equipment which can alter the transformer ratio and increase the voltage as the load increases, and thus compensate for the drop in the overhead lines. This ratio controlling equipment is designed to vary the transformer ratio under full load, so that there is no interruption of the supply when the transformer ratio has been changed. The method adopted is to take a number of tappings off the H.T. winding, each tapping being connected up to a selector switch, and as variation in ratio is required, it can be effected by a remote controlled motor operating mechanism, which moves the selector switch to the required tapping

Fig. IV. Air-blast cooler will be seen on the right hand side.

on the transformer winding.

To avoid open circuit when changing from tap to tap a choking coil or a small induction regulator is used to provide a parallel circuit between the two adjacent tappings, and after the change has been effected, this equipment is usually cut out of circuit.

The tank housing the selector switchgear and the transition induction regulator is shown on the left of the transformer, No. IV. and V. The general assembly of the tap changing equipment is shown in illustration No. VI. On the left

Fig. V. Showing a closer view of the gilled tube cooler.

of the auxiliary tank housing this gear is seen the step indicating mechanism and the gear box which controls the operation of the selector switches. The tapping selection is carried out simultaneously on all three phases of a three-phase transformer.

Fig. VI. General view of tap changing equipment.

There are, of course, many problems in design and construction of these large transformers, which are dictated by the particular characteristics of the system on which they are operating, such as the capacity of the generating station to which they may be coupled or adjacent; the length of line over which they may be transmitting power, and also transport facilities. The majority of these big units are transported by road, sufficient oil being put in the tanks to cover the windings, so as to obviate the necessity of drying these units out on site.

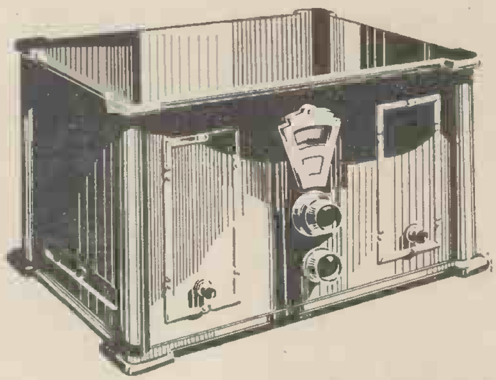
H. W. BISKEBORN.

PRACTICAL RADIO.

Information Coupon.

FEE 6d. February 1932

CABINETS *of* DISTINCTION



This is the authorised "knock-down" cabinet for the CRUISER S.G. 3. Assembled in a few minutes with eight screws, beautifully finished Oak colour.

12/6

AN "EEDE" CABINET GIVES TONE TO YOUR SET

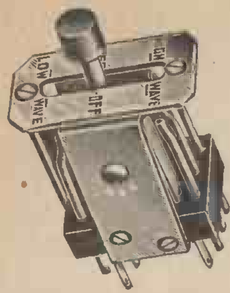
Look at this handsome dual purpose drawing room cabinet that will harmonise with almost any furnishing, shewn on the left. The cabinet may be lifted off and the pedestal, which has a polished top, may be used as a table.

Size of cabinet: 16″×20″ high × 10⅝″ deep
(inside measurement)
Pedestal table 24″ high

PRICE

Cabinet only - - -	**44/-**	each
Pedestal Table only - -	**25/-**	„

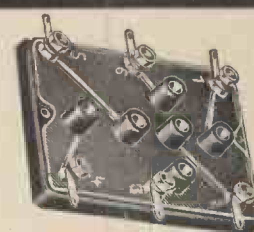
EDWARD DOHERTY & SONS
700-710 SEVEN SISTERS ROAD, SOUTH TOTTENHAM, N. 15.



MILLGATE COMPONENTS

LEAD THE WAY TO BETTER RADIO AT THE BEST PRICE

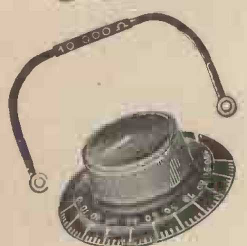
Be sure to ask your dealer for

"MILLGATE" PRODUCTS

USED THE WORLD OVER

"Millgate" Quality at the "Millgate" Price



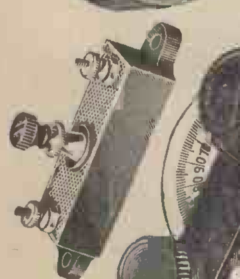

"Millgate" H.T. and Pocket Lamp Batteries
"Millgate" Valve Holders
"Millgate" Spaghetti Resistances
"Millgate" Chokes
"Millgate" Slow Motion Dials
"Millgate" Voltmeters
"Millgate" Condensers (Variable)
"Millgate" Speakers
"Millgate" Headphones
"Millgate" Hydrometers
"Millgate" Pickups
"Millgate" Coils
"Millgate" Switches
"Millgate" Ebonite Panels
"Millgate" Loudspeaker Units
"Millgate" Pickup and Tonearm

See that YOU get "Millgate"

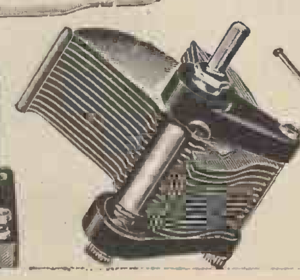
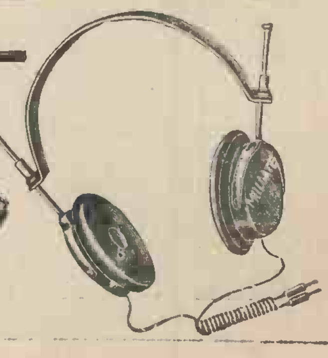
ALL MILLGATE PRODUCTS ARE NOW BRITISH MADE


Should you have any difficulty in obtaining supplies from your local dealer please communicate direct giving dealers name to :—

CHORLTON METAL CO., LTD.,
"Millgate House," Blossom St., (Op. Newton St.) MANCHESTER.
Telephone : CENTRAL:6642 3 (Private Branch Exchange).
Telegrams : CHORLMET-MANCHESTER





Fundamental Principles of Wireless Reception (continued)

A brief and comprehensive summary.

In our last issue we discussed the connection between "Wavelength" and "Frequency," and found that these are really only different expressions for the same thing inasmuch as we can always refer back from "Metres" to "Kilocycles," and vice versa, the connecting link being the figure "300,000," which is the speed of the light-ray in km/sec.

All wavelength between 7.5 cm (1 cm is the 1/100th part of a metre) and 30,000 metres (10 Kc.) have been tried, and most of them are regularly used for transmission of wireless telegraphy, telephony, and television.

These transmitters can be classified in four main "Wavebands." By the way, "Waveband" means nothing else but a continuous number of consecutive Wavelengths, e.g.; The Medium Wave Band comprises all wave lengths from 200 to 600 metres. Band width 1000 kc.

Everybody who owns a distant station receiver knows the FADING effect. How often did it happen that whilst you were listening to your favourite song broadcast from distant Spain the station faded right out, and in came another one talking "double-dutch" at the top of its voice. Our scientists explain the "fading" effect by the "Heavyside layer" theory, which roughly works as follows:—

All round the earth, at considerable distance from its surface, there is "something" which we call the Heavyside layer. This "something" has the property to reflect the electric waves in exactly the same way as a mirror reflects the light. Every transmitter of electric waves (broadcast, telegraphy, etc.) radiates two kinds of waves; the GROUND WAVE radiated in all directions but only along the surface of the earth, and the SKY WAVE, which goes up into the atmosphere surrounding the earth and is reflected by the "Heavyside layer." The relative energy of the Ground wave and the Sky wave and the individual behaviour of each of them varies greatly with the wavelength of the transmitter.

Generally speaking, the intensity and range of the Ground wave, on which reliable reception used to be based, is falling with the falling wavelength. A very rough estimate shows that the direct range of the Ground wave can be approximately obtained by expressing the wavelength in miles, e.g., the direct range of a station with a wavelength of 1,500 metres is in the vicinity of 1,500 miles. On the long wave band the direct range is practically unaffected by daylight conditions. Below 600 metres the direct range is greatly increased after dark, the difference between night and day-range increasing at the lower wavelengths.

The Sky wave is reflected by the Heavyside layer back to the surface of the earth and where it meets the Ground wave, interference results which may lead to a complete wiping out of the station at the spot where the two waves meet ("fading"). The distance of the Heavyside layer from the earth surface, the angle of reflection and, therefore, the fading effect is dependent on atmospheric conditions and the position of the sun.

On the LONG WAVE BAND from 1,000 to 2,000 metres (300 to 150 kc.) there is practically no Sky wave, and therefore no fading. The direct range of the Ground wave is long and least affected by daylight and atmospheric conditions. When broadcasting was first introduced these wavelengths were therefore used for the main national transmitters in European countries.

On the MEDIUM WAVE BAND from 200 to 600 metres (1,500 to 500 kc.) the Sky wave has already considerable influence on reception and causes fading during day and during night-time. A good example how the direct range of the Ground wave is reduced with falling wavelength are the London twin transmitters. London National at 261 metres and London Regional at 356 metres are supposed to have exactly the same power and still the actual antenna output (power in the transmitting aerial) of the 261 metres station is higher, and this station can actually be heard much louder in the vicinity of Brookmans Park. The greater attenuation of the shorter wavelength, especially in the atmosphere above great cities causes, however, the National Station to be weaker than the Regional already in the centre of London. The upper end of the MEDIUM WAVE BAND, the 600 metres wave, is exclusively reserved for S.O.S. calls from ships, which may be either telegraphed as "S.O.S." or telephoned as "Mayday" (from the French m'aider). The useful MEDIUM WAVE BAND as far as broadcasting is concerned, is therefore restricted to 550 to 1,500 kc., equivalent to a total band width of 950 kc. This means, of course, that only a limited number of broadcasting stations can work on these wavelengths if interference is to be avoided.

The SHORT WAVE BAND has only lately been explored, and 10 metres was the lowest limit up to very recently. On this band the range of the Ground wave is already fairly short, and the long distances covered by short wave stations during certain periods of the day are entirely due to the Sky wave, which is being reflected by the Heavyside layer and returned to earth at considerable distance from the transmitter, skipping over the intervening territory. The total band width between 100 m. (3,000 kc.) and 10 m. (30,000 kc.) is 27,000 kc. A far greater number of stations than on the medium wave band can therefore be accommodated, or alternatively the station can work with broader frequency bands.

The ULTRA SHORT WAVES from 10 metres down to about 7 cm, are just now being put into use. On these wavelengths the Sky wave is no longer reflected by the Heavyside layer, it penetrates the layer and disappears in the ether. The transmitter has therefore to rely on the Ground wave only. The ULTRA SHORT WAVES exhibit all characteristics of the optical wave usually known as light ray. Their range is practically limited to the visible horizon, and there is therefore no necessity and no occasion for high transmitting power.

How the carrier-wave conveys messages and music by means of modulation, and how the modulated wave is handled by the receiver will be the object of our next discussion.

RECORDS REVIEW

Current Numbers Reviewed

The growing popularity of Radio-Gramophones prompts us to publish below a list of the latest records which will be found particularly suitable for these instruments.

The list includes a delightful variety, and should meet most tastes.

Those who incline towards operas will do well to give H.M.V.'s "Madame Butterfly" an audition. It is rendered beautifully by Marek Weber and his orchestra, and should be a worthy addition to your collection.

Debroy Summers takes us back to war-time memories with "Overture 1914," and for those who are fond of such memories this is the record of the month. It is a Columbia record.

"When the Waltz was Through," played by Roy Fox and his band, is Decca's contribution for those who like a spot of sentiment with their jazz. It's a sweet tune.

"Miserere" is perhaps one of the most impressive selections from the operas. Winner have it rendered by Stiles Allen and Hardy Williamson. A Winner!

"The Changing of the Guard," sung by Mr. Flotsam and Mr. Jetsam, give us a delightful rendering of their popular song on a Columbia record.

"Rhymes" (two sides), played by the White Star Syncopators on a Piccadilly record, will no doubt amuse you intensely. A very suitable record for parties.

For jazz look to Piccadilly and Broadcast records. You will not be disappointed.

Other records of outstanding merit are marked *

L. N.

H.M.V.

Peter Dawson

Father O'Flynn and *When the Guards go Marching by*, Peter Dawson.
B.3838, 3/-

The Gypsy Princess Selection, De Groot and the New Victoria Orchestra.
C.2274, 4/-

Madame Butterfly, Selection, Marek Weber and his Orchestra.
C.2284, 4/-

Marriage of Figaro and *Il Seraglio*, Vienna Philharmonic Orchestra.
C.2194, 4/-

Friend o' Mine and *Shipmates o' Mine*, Peter Dawson.
B.3839, 2/6

Try Your Fortune, a record for parties.
B.3979

The Man who Broke the Bank and *Two Lovely Black Eyes*, Harry Fay.
B.3973, 2/6

**The Prayer Perfect* and *Ave Marie*, John McCormack.
DA.1177, 4/-

**If You were the Only Girl in the World* and *They Didn't Believe Me*, Ambrose and his Orchestra.
B.6077, 2/6

COLUMBIA.

Mr Flotsam & Mr. Jetsam

Overture "1914," a war march memory, Debroy Somers' Band.
DX.292, 4/-

The Changing of the Guard and *The Roman Road*, Malcolm McEachern.
DB.630, 2/6

Wrap Your Troubles in Dreams (And Dream Your Troubles Away) and *I Found You*, cinema organ solos by Terance Casey.
D.B.637, 2/6

Prélude à l'après-midi d'un Faune, Walter Straram Orchestra.
DX.279, 4/-

Whistling in the Dark and *Thrill Me*, organ solos by Reginald Foort.
DB.612, 2/6

**Good Night, Waltz*, and *Pardon, Madame Waltz*, Jack Payne and his B.B.C. Dance Orchestra
CB 348, 2/6

DECCA.

Gus Elen in "Its a Great Big Shame."

**It's a Great Big Shame*, Gus Elen, with accompaniment.
F2721

The Chocolate Soldier, Selection, and *The Quaker Girl*, Selection, Alfredo Campoli and the Dorchester Hotel Orchestra.
K.598, 2/6

Because and *Good-bye*, Frank Titterton
F.2470, 1/6

**Waltzes From Vienna*," Alfredo Campoli and the Dorchester Hotel Orchestra.
F.2472, 1/6

The Bandolero and *On the Road to Mandalay*, Horace Stevens.
K.601, 2/6

**Vienna, City of My Dreams*, and *White Hearts are Singing*, Frank Titterton.
F.2517, 1/6

**You are My Heart's Delight* and *I bring a Love Song*, Alex Taylor.
F.2505, 1/6

When the Waltz was Through and *Time Alone will Tell*, Roy Fox and his Band.
F.2513, 1/6

Cavalcade, Selection, Jack Hylton and his Orchestra.
K.619, 2/6

The Village Wedding, novelty record.
F.2221, 1/6

BROADCAST.

Henri Benito and his Accordion Syncopators

Waltzes From Vienna, Vocal Gems.
3082, 1/6

Blaze Away and *Marche Lorraine*, Band of the H.M. Welsh Guards.
3086, 1/6

Whistling in the Dark and *I Found You*, Bidgood's Good Boys.
748, 1/-

**Goodnight, Sweetheart*, and *Were You Sincere?* Lew Sylva and his Band.
737, 1/-

Grand Opera Company, Selections (conducted by Stanley Chapple with full Orchestra).
3108, 1/6

Smile, Darn Ya, Smile, and *That's What I Like about You*, The Manhatton Melodymakers.
3117, 1/6

**Tunes from 1899 to 1930* and *Cavalcade*, Harry Bidgood and Orchestra.
3121, 1/6

Vienna, City of My Dreams, and *The Song of Songs*, Terence O'Brien.
3122, 1/6

**Poet and Peasant Overture*, State Opera House Orchestra, Berlin.
3123, 1/6

Wine, Women and Song, and *Hungarian Dances*, Eugene's Magyar Tzigane Band.
3124, 1/6

WINNER (EDISON BELL).

Leslie Stuart Memories, G. H. Elliott.
L.5150, 2/-

Miserere (Scene from "Il Trovatore") and *O Rejoice that the Lord has Arisen*, Stiles Allen (soprano) and Hardy Williamson (tenor), with London Concert Orchestra.
L.5397, 2/-

Bells of Auld Lang Syne and *Bells of St. Malo*, Band of H.M. Scots Guards.
5352, 2/

Maritana, Vocal Gems, Stiles Allen, Hardy Williamson and James Baker
L.5370, 2/-

PICCADILLY.

Jerry Hoey

Roses of Picardy and *I Love You*, Dick Anderson.
833, 1/1

Nina Rosa, Medley, and *If You Haven't Got Love*, Ivor Dennis.
834, 1/1

**Zampa*, Overture, Metro Police Band "A" Division.
203, 1/1

Leslie Stuart Songs, The London Fire Brigade Band.
532, 1/1

Kiss me Goodnight and *Song of Happiness*, Jerry Hoey and his Orchestra.
839, 1/1

Spring Cleaning and *The Sweepstake*, George Crowther.
836, 1/1

Love's Old Sweet Song and *Silver Threads Among the Gold*, Blodwen Caerleon.
837, 1/1

Naw! I Don't Wanta be Rich and *So I Joined the Navy*, Leyland Franklin.
838, 1/1

Going Home and *A Beggar can Sing the Song of a King*, Douglas Graham.
835, 1/1

**Time Alone Will Tell* and *What's Going to Happen to Me?* Jerry Hoey and his Orchestra.
840, 1/1

Please Don't Talk About Me When I'm Gone, and *It's the Girl*, Jerry Hoey and his Orchestra.
841, 1/1

**It Always Starts to Rain* and *Jolly Good Company*, Jack Leon and his Band.
842, 1/1

You Can't Stop Me from Loving You and *Sunny Skies*, Jack Leon and his Band.
843, 1/1

Kiss Me Again and *I Love You in the Same Sweet Way*, Jack Leon and his Band.
844, 1/1

The Ice-Man Lives in an Icehouse and *Panicky Pete the Pirate*, Percy Chandler and his Band.
845, 1/1

More Melodious Memories, Band of H.M. Royal Horse Guards.
878, 1/1

**Maid of the Mountains*, Athenæum Light Orchestra.
709, 1/1

Faust, Selection, and *The Buffoon*, Selection, Louis Revel.
551, 1/1

In Old Madrid and *That's My Song of Love*, Norman Lambert (with Hawaiian accompaniment.
879, 1/1

If Ever I Meet the Sergeant and *Company Sergeant Major*, Bernard Dudley.
226, 1/1

Coster's Sister and *I'm One of the Old Froth Blowers*, Nat Travers (Coster comedian).
880, 1/1

Rhymes, White Star Syncopators.
881, 1/1

For the Sake of the Days Gone By, White Star Syncopators, and *Just Once for All Time*, Jerry Hoey and his Orchestra.
882, 1/1

Guilty, Jerry Hoey and his Orchestra, and *Life is just a Bowl of Cherries*, Cunard Dance Band.
883, 1/1

I Believe in You, Jerry Hoey and his Orchestra, and *Close Your Eyes*, Cunard Dance Band.
884, 1/1

**Joey the Clown* and *Rio de Janeiro*, Jerry Hoey and his Orchestra.
885, 1/1

Printed for the Proprietors, PRACTICAL RADIO PUBLISHING CO., by SIDNEY REEVE PRESS, 7 Fisher Street. Southampton Row, W.C.1
and published by HORACE MARSHALL & SONS 43 Farringdon Street. E.C.4