The MODERN RADIO ENGINEER

VOL. I. Season 1934 Number 1.

Price 3D

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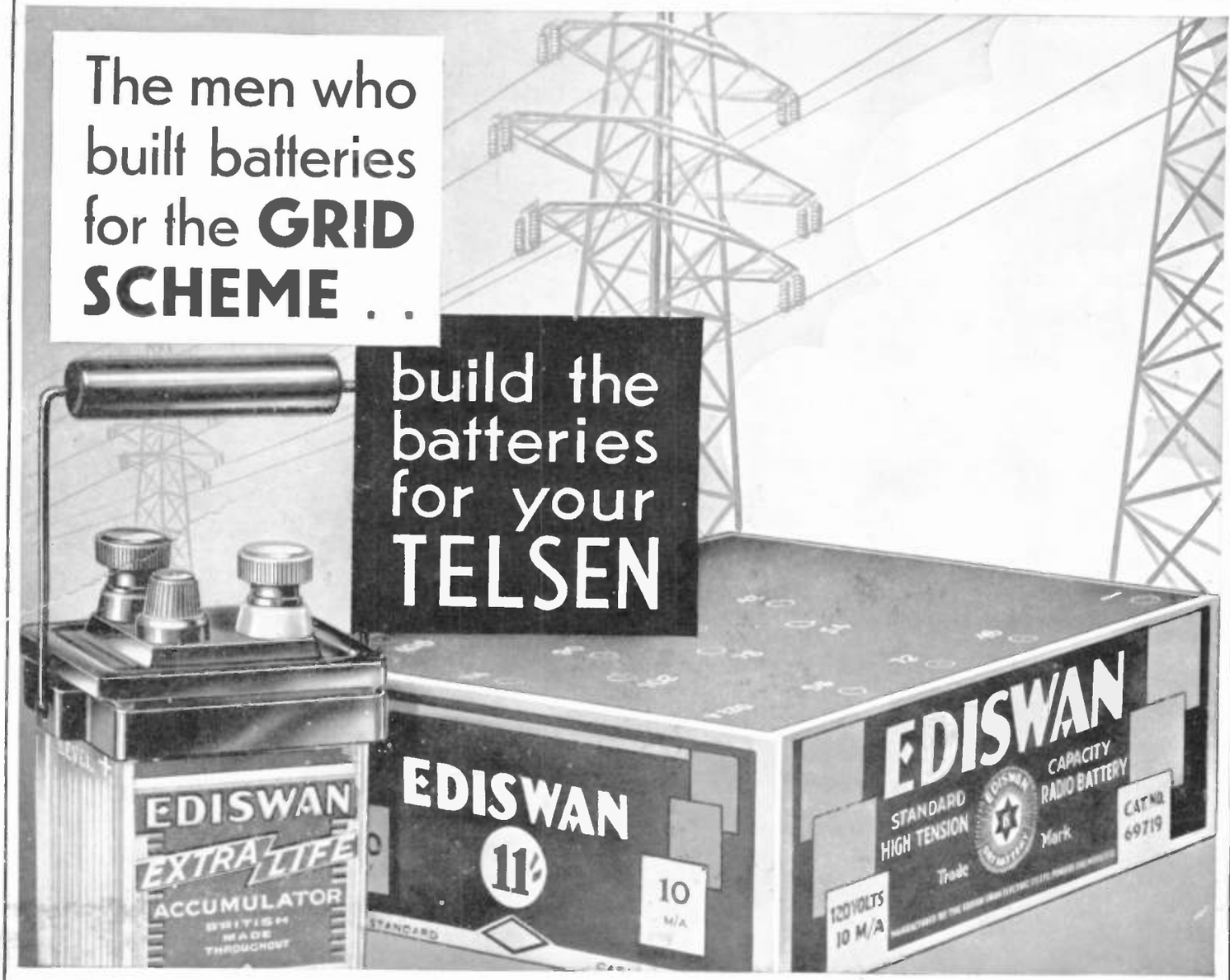

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The Modern Radio ENGINEER

VOL. 1. No. 1. SEASON 1934. PRICE 3d.

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THE EDITOR'S NOTE BOOK

IN this age of multi-valve receivers the possibilities of the simple and quite inexpensive circuits have been completely overlooked. So much is heard of six and seven valve receivers that few realise what can be done with a modern "two valver." The advent of the multi-valve instrument has been occasioned by the desire for both great range and extreme selectivity. It is, however, very doubtful whether these things should be sought after to the exclusion of other features.

A radio receiver is first and foremost a musical instrument and its primary requirement is high quality reproduction. Except in the case of extremely expensive apparatus this desirable feature is sacrificed to the attainment of range and selectivity, i.e., the ability to receive a large number of stations and to adequately separate them.

The enormous strides that have been made in radio design during the last few years, have made it possible to secure first class reproduction at low cost, and with quite simple apparatus. There can be little satisfaction in building costly and complicated receivers which sacrifice quality to range and the consequent need for "knife edge" selectivity.

Furthermore, practically no attempt is made to cater for the absolute beginner in radio home construction. Only the few can grapple with the complicated circuits of multi-valve receivers. Therefore, commencing with a simple one valve receiver, the constructor can, by following the instructions in this magazine, progressively build more and more ambitious instruments. Very special attention has been given to the cost, and no expenditure is advocated that is not absolutely necessary. As far as possible all the components used in one receiver are incorporated in the next.

In putting forward this new journal an attempt has been made to provide the constructor with easily understood instructions which cover almost the entire field of radio development. While giving sound instruction in the science the simple directions enable the constructor to produce in his own home, with no tools other than a pair of pliers and a screwdriver, radio receivers that give first class reproduction, and are thereby unsurpassed for real and lasting entertainment value.

The interests of the advanced experimenter and constructor have not been overlooked, and extensive information is given of some of the most outstanding developments that have emanated from the Telsen Laboratories.

STOP PRESS

Since going to press the Telsen Electric Company, Ltd., announce a wonderful new development in the launching of their G.S. series of transformers. These transformers incorporate spaced layer windings and non-hygroscopic impregnation and other special features similar to those employed in the Telsen D.R. range of L.F. transformers which are listed at the end of this book. The price of the new G.S. types is the same as the D.R. series, i.e., 8/6 each.

In addition, they have also introduced a remarkable new S.G.3 Kit which sells at the amazing price of 39/6. Incidentally we understand that apart from the very many special features this kit incorporates, it also includes one of their new D.R. series of transformers.

We also wish to state that the Telsen Electric Co., Ltd., are prepared to supply all readers with a complete set of full-sized Blueprints for the nine sets which are described in this issue at the special inclusive price of 2/6 per set, post free. Alternatively, any one Blueprint can be obtained separately for the price of 1/- post free.

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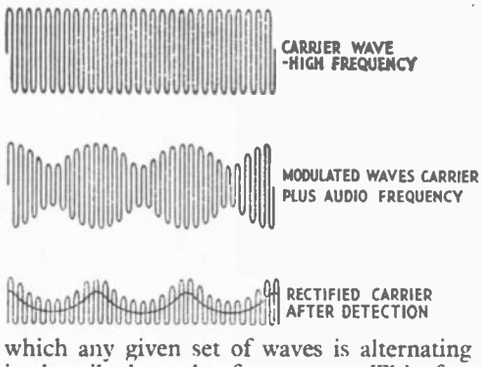
ELEMENTARY PRINCIPLES

THE home constructor who is in possession of a little theoretical knowledge has an enormous advantage over his less informed friends. Few beginners have the opportunity of acquiring the elementary principles. Most radio journals of the present day confine themselves almost entirely to matter suitable for the advanced constructor, and leave the absolute beginner to find out as best as he may what principles are involved in the instrument he builds. As this magazine is intended to provide information for the beginner as well as the more advanced constructor, a brief description of some of the rudiments of the science will be given.

Broadcasting is effected by setting up in the ether of space a continuous stream of waves or ripples, which travel with the speed of light. These waves are similar in their behaviour to the waves or ripples produced in a pond when the surface is disturbed. If for example a stone is cast into the centre of a pond, waves are set up which radiate in all directions, in circles of ever increasing magnitude, but becoming less and less perceptible as they get further and further from the source of the disturbance. The "audio" frequency or sound waves p o-duced in the air by musical instruments or by other means, and the radio or high frequency waves produced by a broadcasting station also radiate in all directions and become fainter or more attenuated the further they travel. To return to the pond analogy. Assume that a cork is floating near the point where the stone enters the water, while another cork is floating some distance away. The cork that is near the seat of the disturbance will bob up and down violently, while that which is some distance away, will move only slightly, the force of the waves acting upon it, being much less. Now the corks can be likened to the aerials of receiving sets. Some are near the Transmitter while others are a long distance away. The waves set up by the transmitter, when they impinge on the listener's aerial set up corresponding oscillations in the aerial. When the aerial is near to a transmitter these oscillations are quite powerful, but in the case of aerials situated many miles from the transmitter the oscillations induced are extremely weak. The importance of the aerial in securing good reception therefore becomes apparent especially when reception of distant stations is desired, and readers are advised to study carefully the instructions for erecting an efficient aerial. As a large number of transmitting stations are broadcasting at the same time the aerial has induced into it a corresponding number of alternations. Therefore, the first object of the receiver is to attune the aerial to the wanted signal and select that signal from all the others. This process is known as tuning. It is made possible by the fact that each transmitter sends out waves that are alternating at a faster or slower rate than the others. The rate at



which any given set of waves is alternating is described as the frequency. This frequency determines the length of the waves. The speed at which wireless waves travel is three hundred million metres per second, and this figure is the product of the wavelength and the frequency. Thus if the waves are vibrating at say, one million times per second, each wave will be 300 metres long. Accordingly, each Transmitter is assigned a given frequency which determines its wavelength. Most broadcasting stations are allotted wavelengths on either the medium wave band (200-550 metres) or the long wave band (1000-2000 metres). In order to select the wanted signal a coil and variable condenser are coupled to the aerial. This coil and condenser form a closed oscillatory circuit which will oscillate at a frequency depending upon the value of the inductance of the coil and the capacity of the condenser. If, therefore, the inductance or the capacity or both are made variable, the frequency at which the circuit will resonate can be altered to any required value. When the circuit is adjusted to any given value, it will offer a very high impedance to currents flowing in the aerial which are of the same frequency as the frequency to which it is tuned.

The impedance offered to other frequencies will be negligible, and they will flow to earth. Usually the inductance is fixed for each wave band, and the capacity is varied by using a variable condenser. A suitable switch is incorporated in the receiver to alter the inductance when changing over from the medium to the long wave bands or vice versa.

It will be seen from the above that by varying the setting of the tuning condenser we adjust the aerial circuit to any required frequency, and can in consequence select any particular transmission that we may require.

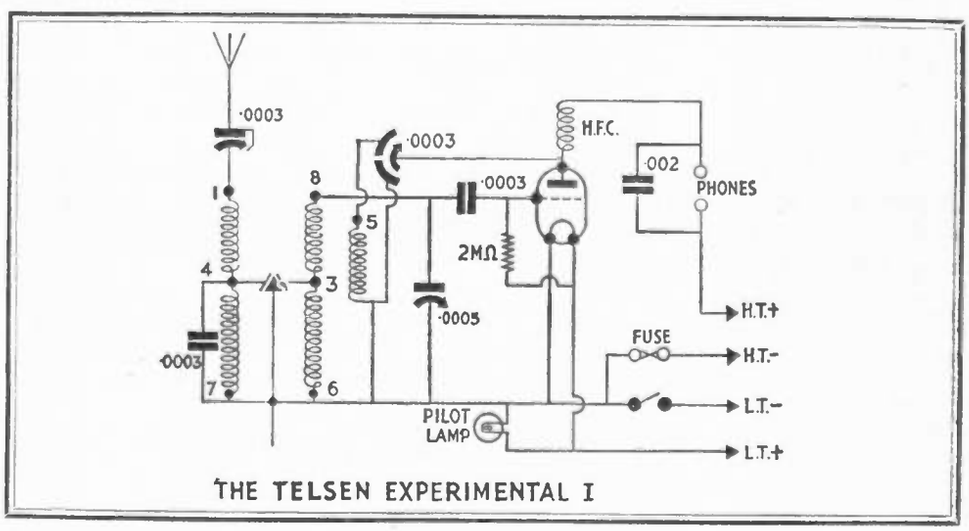
The frequency or rate of vibration of the waves sent out by the broadcast station are however, so high that they are quite inaudible and they are only used as a means of carrying the audible signals. These high frequency waves are called the carrier waves, and the frequency or wavelength of a broadcast station is the frequency or wavelength of its carrier wave. The audible frequencies that produce the music or speech are superimposed on the carrier wave, and this is called modulating the carrier. Before an audible signal can be obtained it is necessary to remove the high frequency carrier wave, leaving only the audible or modulating portion. This is known as demodulation, detection or rectification, and is perhaps, the most important function of a wireless receiver. It will, therefore, be evident that if we construct an instrument that will select a required carrier wave and then demodulate it we have the simplest form of a wireless receiver. Such a receiver is the Experimental One described in this journal and it provides a practical demonstration of the points so far discussed.

The TELSEN EXPERIMENTAL 1

AN EFFICIENT, YET SIMPLE, ONE VALVE RECEIVER FOR LOCAL STATION RECEPTION

EVEN the simple one valve receiver possesses a merit all its own. While being the stepping stone to the building of other instruments described in this journal, it performs a function around which all other receivers, no matter how complicated, are built. This function is known as detection or rectification, and constitutes the translating of the signals as received in the aerial into low frequency currents which will actuate the telephones or loudspeaker. There are several methods by which detection is accomplished. In the early days of broadcasting a crystal detector was employed. The detector made use of certain crystals which possess the property of unilateral conductivity, that is they will only allow a current of electricity to flow through them in one direction. If, therefore, an alternating current, similar to the high frequency carrier of a broadcasting station be applied to such a crystal, the alternations are rectified and only a pulsating current flowing in one direction remains. This current is, however, rising and falling in step with the audio frequency currents super-imposed upon the original carrier, and this varying current is used to actuate the headphones. The crystal is, however, a very insensitive device and a valve is now usually employed. There are several ways in which a valve can be used as a detector, but space does not permit of reviewing all of them. The most popular method is known as leaky grid detection, and is widely used in receivers in this country. Its popularity arises from the fact that under proper working conditions it gives good quality and is at the same time more sensitive than any other method. Leaky grid detection is used in all the receivers described in this book. It secures its name from the fact that the high frequency currents are applied through a condenser to the grid of a valve, across the grid and filament of which is fixed a high resistance called a grid leak.

It is impossible to undertake an exact description of the action of a leaky grid detector except in highly technical language, but as concise an explanation as possible is given.



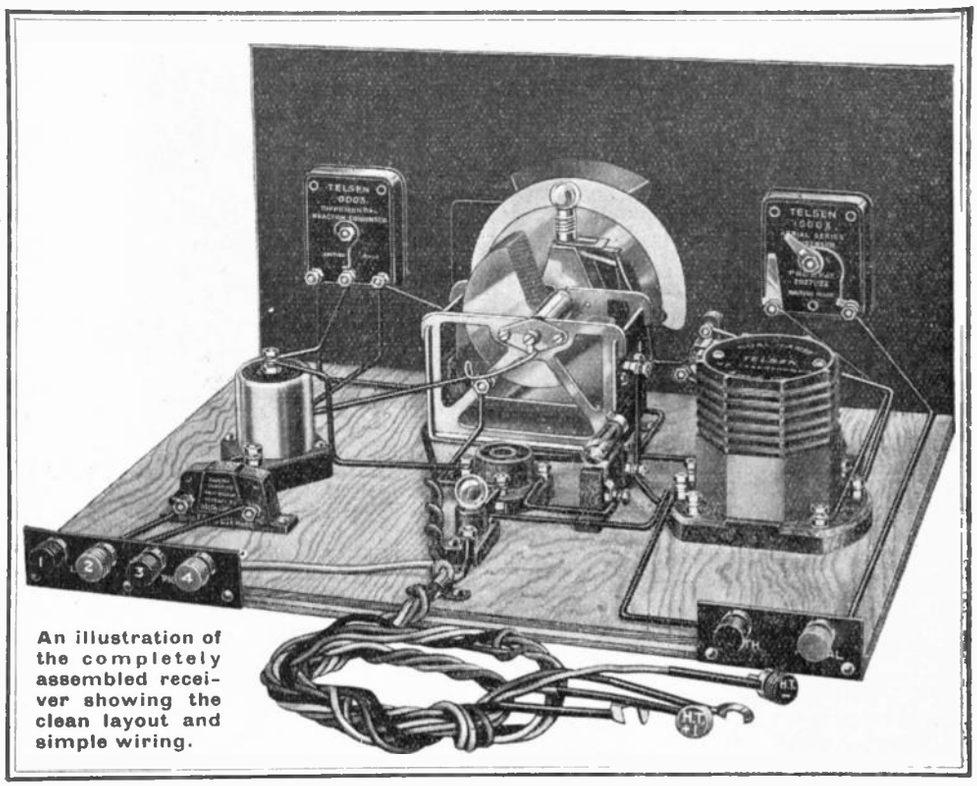
THE TELSEN EXPERIMENTAL I

The presence of the high resistance, or grid leak, which is connected between the grid and positive side of the filament causes a current to flow around the grid filament circuit of the valve. When the high frequency carrier wave is applied to the grid, the amount of grid current flowing is increased. This current is flowing through the grid leak. When a current is passing through a resistance a potential difference or voltage is set up across the resistance. But it will be remembered that the high frequency current is varying in accordance with the audio frequency signals imposed upon it. In consequence a varying voltage is set up across the grid and filament of the valve. This produces a corresponding variation in the anode current of the valve, and the original audio frequency signals are therefore transferred in an amplified or magnified form to the telephones, which are in the anode circuit of the valve. The instrument, except when very close to a powerful transmitter, will not be sufficiently sensitive to operate a loud-speaker and should therefore be used with headphones. It is in this that its peculiar merit lies. The operator is enabled to listen in and experiment with his receiver, without interfering with the activities of any

THE TELSEN EXPERIMENTAL ONE—*continued*

other person who may be present, an advantage that the junior in particular will greatly appreciate. The most important component is the famous Telsen Aerial and Transformer Coil W.154. This, when used in conjunction with the separator condenser will enable the local regional transmissions to be completely separated at any distance over five miles, and under favourable conditions on winter evenings quite a number of foreign stations can be identified. The sensitivity of the receiver is secured by the use of reaction, and this is controlled by the differential reaction condenser. This device must be used with care and detailed instructions as to its use are given under the article dealing with the operation of the receiver (see page 17). Reaction is obtained by feeding back energy from the anode of a valve to its grid, and it helps to overcome certain defects that are inherent in the type of detector used. Although the detector valve as described above separates the required audio frequency signal from the high frequency carrier wave, it does not prevent some of the high-frequency currents from passing through the valve. Consequently amplified H.F. currents appear in the anode circuit and these are made use of when applying reaction. To prevent these H.F. currents from reaching the 'phones a high frequency choke is inserted in the anode lead. This offers no resistance to the passage of the audio frequency currents but impedes the path of H.F. currents. As a further precaution a fixed condenser is connected across the 'phones so that any H.F. current which may be left will flow to earth instead of through the 'phones. The amplified H.F. currents that are kept back by the H.F. choke are then fed back to the grid coil by means of the reaction condenser. This condenser is so constructed that the amount of current fed back can be controlled, while it by-passes to earth that which is not required.

A complete list of the components required is given at the end of this article. It will be noticed that this includes a constructor's outfit. This outfit is invaluable to the constructor and experimenter and will be found suitable for a large number of the receivers described in this magazine. It includes a metal panel already drilled, baseboard, insulating washers, terminals, special "pull-back" wire and battery cord etc., in fact all the necessary small parts as well as suitable spanners for tightening all connections. The general notes on construction and operation given elsewhere in this book should be carefully read before commencing to build the receiver. Particular attention should be paid to the insulating of reaction and separator condensers from the metal panel, also the instructions for mounting the grid leak on the condenser. Having assembled the panel and baseboard in accordance with the instructions given on page 7, the wiring can now be carried out. No difficulty should be experienced if the wiring diagram is carefully followed in conjunction with the following wiring instructions. For those constructors who prefer it, a full size Blue Print can be obtained price 1/- on application to Telsen.



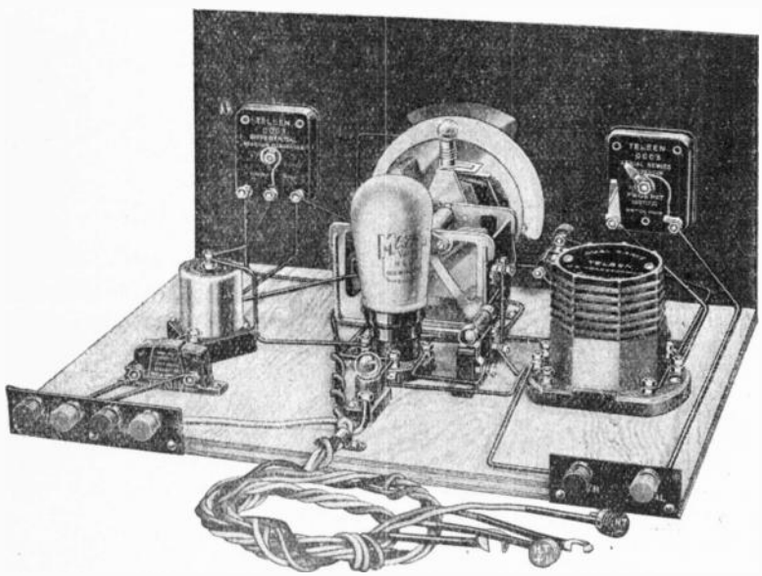
An illustration of the completely assembled receiver showing the clean layout and simple wiring.

WIRING

Connect Terminal :—

E on Aerial Strip to 7 on Coil.
7 on coil to 6 on coil.
6 on coil to 16 on condenser "B."
16 on condenser "B" to 15 on Switch.
15 on switch to 14 on pilot lamp holder.
7 on coil to 9 on fuse holder.
9 on fuse holder to 10 on valve holder.
10 on valve holder to 17 on tuning condenser.
17 on tuning condenser to 18 on choke.
18 on choke to 19 on reaction condenser.
19 on reaction condenser to 20 on switch.
20 on switch to 21 on panel.
11 on valve holder to 12 on condenser "A."
12 on condenser "A" to 13 on pilot lamp holder.
22 on tuning condenser to 23 on condenser "A."
23 on condenser "A" to 8 on coil.
24 on condenser "A" to 25 on valve holder.
26 on aerial series condenser to "A" on aerial and earth terminal strip.

THE TELSEN EXPERIMENTAL ONE—*continued*



Another view of the Telsen Experimental One complete and ready for testing out.

27 on aerial series condenser to 1 on coil.

28 on 3pt. switch to 3 on coil.

29 on 3pt. switch to 30 on condenser "B."

30 on condenser "B" to 4 on coil.

31 on reaction condenser to 5 on coil.

32 on reaction condenser to 33 on choke.

33 on choke to 34 on valve holder.

35 on choke to 36 on .002 fixed condenser.

36 on .002 condenser to 37 on L.S. terminal strip.

38 on .002 condenser to 39 on L.S. terminal strip.

All the leads in the battery cable supplied with the constructor's outfit will not be required on this receiver, and the H.T.+2 and all G.B. leads should be removed. These leads should be preserved as they will be required for other receivers described in this journal. The battery leads should be prepared as instructed on page 8 and then connected as follows.

Connect :—

Red wire L.T.+ to terminal No. 11 on valve holder.

Black wire L.T.— to terminal No. 40 "on-off" switch.

Blue wire H.T.+1 to terminal No. 39 on "L.S." terminal strip.

White wire H.T.— to terminal 41 on fuse holder.

Constructors should note that although terminals marked "pick-up" are provided on the terminal strip, no connection is made to them as they cannot be effectively used with this receiver. Having fitted the battery cord the receiver is ready for its first test. Read carefully the instructions given elsewhere under "Preliminary Test," as if you adopt the procedure suggested you will be able to locate any fault which may have been made, and thus avoid damaging your valve, or other parts of the receiver.

The following accessories are required :—

1 pair Headphones.
1 H.L.2. Valve. Mazda.
1 100 volt H.T. Battery. Ediswan.
1 2 volt accumulator. Ediswan.

Connect the headphones to the terminals marked "L.S." and the batteries as follows:

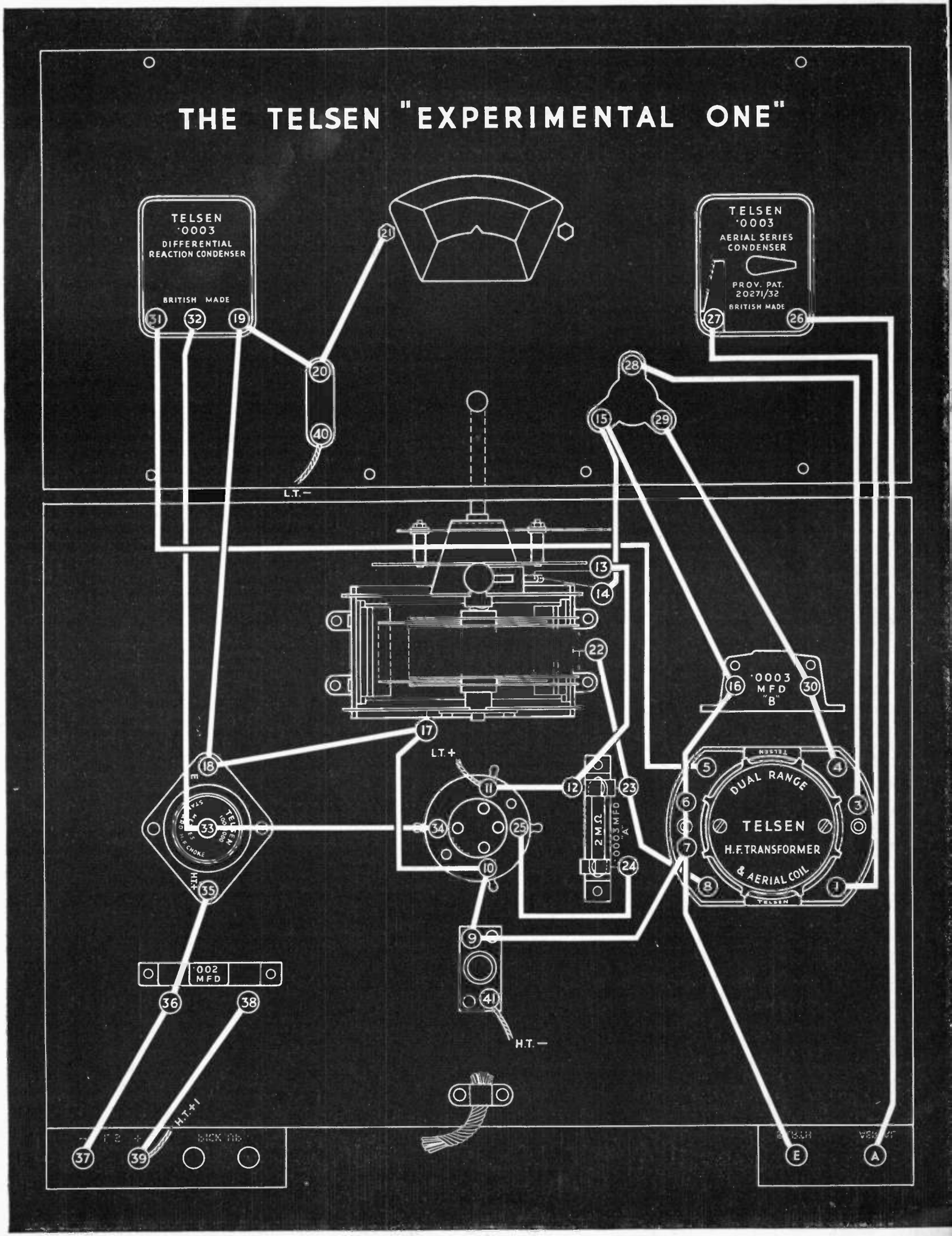
L.T.+ to + terminal of accumulator.
L.T.— to — terminal of accumulator.
H.T.+1 to 100 volt socket of H.T. battery.
H.T.— to — socket of H.T. battery.

When you are satisfied that the wiring is correct the valve can be plugged into its holder. Separate operating instructions are given, applicable to all receivers, and these should now be followed (see page 17).

THE TELSEN EXPERIMENTAL ONE

LIST OF COMPONENTS

Quantity	*Description*	*Cat. No.*	*Price*
1	Telsen 4-pin Anti-microphonic Valve Holder	W.222	8d.
2	,, .0003 mfd. Mica Condensers	W.242	2/–
1	,, .002 mfd. Mica Condenser	W.246	1/6
1	,, 2 meg. Grid Leak	W.251	1/–
1	,, Fuse Holder (Battery type)	W.146	6d.
2	,, Pilot Lamps	W.417	1/–
1	,, Standard Screened H.F. Choke	W.341	3/6
1	,, Dual Range H.F. Transformer Coil	W.154	5/6
1	,, Single Condenser Unit	W.339	8/6
1	,, Aerial Series Condenser with Switch	W.350	2/6
1	,, .0003 Differential Reaction Condenser	W.351	2/6
1	,, 3-point Push-Pull Switch	W.108	1/3
1	,, 2-point Push-Pull Switch	W.107	1/–
1	,, Modern Radio Engineer's Constructor's Outfit	W.445	5/6



BUILDING instructions and hints for CONSTRUCTORS

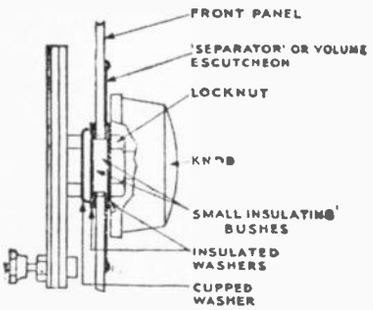
SOME USEFUL SUGGESTIONS FOR THE BEGINNER ABOUT TO CONSTRUCT HIS FIRST RADIO RECEIVER

THE first five receivers described in this journal are built round the special "Modern Radio Engineer's" constructor's outfit No. W.445. The instructions which follow are therefore applicable to all receivers using this outfit.

The outfit itself is a great boon to the constructor as it includes panel, baseboard, wire, terminals, etc., and even the necessary spanners for tightening all nuts. Consequently the constructor can, with this outfit, proceed to build the receivers described, with no tools other than a screwdriver and a pair of pliers.

The panel and panel components are identical for each receiver, and should be assembled first in the following manner.

The escutcheon plate supplied with the variable condenser should be placed in position and the fixing screws inserted. The nuts may then be screwed on at the back and tightened. Next mount the "separator" or aerial series condenser in the hole on the extreme left of the panel, taking care to see that the spindle is insulated in the following manner. Special insulating washers are provided with the constructor's outfit and the method of fixing is shown in the adjoining



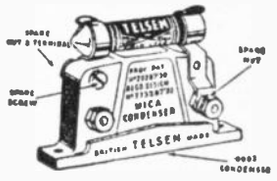
sketch. First, fit over the condenser screwed fixing bush one of the cupped washers supplied with the constructor's outfit, so that the cupped portion faces away from the condenser body. Follow this with a large insulating washer, then by a small insulating washer. Now from the back of the panel insert the spindle and fixing bush of the condenser into the appropriate hole. See that the cupped washer and the large flat insulating washer lie flat against the back of the panel. The small insulating washer should fit into the hole in the panel, and should project at the front a little as it is slightly thicker than the panel. Over this projecting portion the appropriate escutcheon plate is fitted, i.e., in the case of the aerial series condenser fit the escutcheon marked "separator" and for the differential reaction condenser use the escutcheon marked "volume." Follow the escutcheon with another large insulating washer and then the condenser fixing nut. Rotate the escutcheon plate until the indication is at the top, then holding the whole assembly firmly in position screw up the fixing nut tightly by means of the special spanner provided. The knob can now be fitted. The differential reaction condenser should be fitted to the hole on the right of the panel and insulated and secured in the same manner as the separator condenser.

Next fit the two push-pull switches as shown on the Black Prints. To mount these, unscrew the knobs and tighten up the hexagon lock nuts. Then insert them in their respective holes in the panel, and after securing them in position with the extra lock nut provided in the constructor's outfit, replace the knobs. The mounting of the components on the baseboard may now be commenced. Their positions are clearly indicated in the drawings and photographs. The variable condenser should be fitted in accordance with the instructions supplied with it.

As the panel is already pierced the constructor will not of course have to make use of the special template, unless a wood or other panel is substituted for the one supplied with the Constructor's Outfit.

A supply of wood screws of various lengths is included with the constructor's outfit, for the purpose of securing the components on the baseboard. The correct length of screw should be selected for each component, as it will be found that some components require longer screws than others. Screwing short screws into plywood is no easy matter unless the screws are driven dead square and a suitable pilot hole is made first. The top ply has a tendency to fray and if you get through that, the cemented joint resists the entry of the screw and lifts the loosened wood away as the screw rotates. Therefore to do the job properly file an old bradawl to a point. After placing the components in the positions shown in the drawings mark on the baseboard the point where the fixing screws enter. The sharpened bradawl can then be placed on these points and hammered a short way into the baseboard. If this method is adopted it will be found that the screws can be inserted without damaging the ply, and the components will be firmly fixed in position. When fixing the terminal strips to the back edge of the baseboard a similar method should be adopted, but it is advisable to squeeze a little "Seccotine" into the holes before screwing up. This strengthens the wood round the hole if there should be any tendency to split when the panel or terminal strip is strained.

The grid condenser and its associated leak should be fitted up exactly as shown in the accompanying sketch. Note that one clip is



fitted on the terminal side of the condenser and makes connection with one of the terminals, while the other clip is fixed to the reverse side of the condenser and is in no way connected to the other terminal of the condenser.

When all the components have been assembled the wiring should be commenced. Detailed point to point wiring is given for each receiver, and attention is drawn to the following wiring instructions.

BUILDING INSTRUCTIONS AND HINTS FOR CONSTRUCTORS

—continued

WIRING

Soldering tags are provided on every component for the benefit of those who wish to solder all their connections permanently. This, however, is not essential, and constructors would probably prefer to adopt the following alternative method. Special insulated tinned copper wire, which is designed to enable receivers to be safely and easily wired without soldering, is supplied with the Constructor's Outfit.

It will be observed that the tinned copper wire is protected by an insulating material that is firmly affixed to the wire. The wire should be cut off in lengths as required; the lengths being about 1 inch more than the distance between any two terminals, which have to be connected. Allowance should, of course, be made for any bends that may be necessary to give the finished wiring a neat appearance. About ½ inch of covering should be removed from each end exposing the bare tinned copper wire. To do this the covering should be cut round with a pair of cutting pliers, or a safety razor blade, taking care not to cut the wire. The piece of insulating material to be removed can then be pulled off the end with a pair of pliers.

Now make a loop at each end from the exposed portion of the wire and slip the loops over the terminals.

The loops can be quickly made by gripping the extreme end of the wire with a pair of round-nosed pliers and then twisting the wire round the pliers. When placing the loops over the terminals see that they are curled round the terminal screw in a clockwise direction. This ensures the wire binding tightly, when the terminal nut is screwed down. After placing the wire in position, the terminal nut should be screwed down as tightly as possible with the fingers. The last operation in wiring is the fixing of the battery cord, and it is advisable to prepare it in the following manner.

PREPARING THE BATTERY CORD

Although it is possible to use the battery cord just as sent out, it gives a much more "professional" look to the job if it is all separated first. The wires can then all be run straight to their respective terminals, drawn fairly tight and bunched together under the clip shown on the Black Print near the middle valve holder. It also improves the appearance of the set if the ends of the flex are cased with any spare bits of sleeving you may have. Slide the braiding back about ¼" and cut off the rubber covered wire to the same length. The braid can then be brought forward again, moistened, and screwed to a point between finger and thumb. It is then easy to thread on an odd half-inch of sleeving, thus :—

which can be brought up to the terminal when the joint has been made, thus covering any loose end of braiding.

If you are not sure of your terminal gripping the wire properly, make a knot in the flex and slip the loop over the screw.

The Plugs and Spade terminals should be connected as follows :—

Red wire.	L.T.+	Spade terminal
Black wire	L.T.—	„ „
Blue wire.	H.T.+1	Red wander plug
Maroon wire.	H.T.+2	„ „ „
Speckled wire	G.B.+	„ „ „
White wire	H.T.—	Black „ „
Yellow wire	G.B.—1	„ „ „
Green wire	G.B.—2	„ „ „

Great care should be taken to see that the Plugs and Spade terminals are connected correctly. A wrong connection may mean the loss of 3 valves.

THE FUSE

It will be noticed that a fuse is specified in all the circuits given in this journal. Its importance cannot be overestimated. Ask those constructors who, when making some adjustment to their receiver without disconnecting batteries, have lost an entire set of valves through an accidental short circuit.

It is advisable to buy a spare fuse and holder and fix them in an odd corner of the set. A spare will then always be to hand when wanted.

An ordinary flash lamp bulb will afford no protection. A radio fuse or .06 amp. type of bulb is essential.

The lamp will not light when in use, unless there is an excessive drain on the H.T. battery by reason of a partial or complete short circuit. If the set unaccountably goes "dead" suspect a blown fuse or one not properly screwed down in its holder.

THE PRELIMINARY TEST

When a receiver has been completed, it is essential to conduct the preliminary test suggested here, if you are to avoid serious damage to valves or components.

While care is taken in setting forth instructions that are clear and easy to follow, it is possible to make a mistake sometimes. Care in connecting up and testing is the sign of the expert. Twenty minutes spent in testing and checking up, is much cheaper than a new set of valves.

Valves, of course, are the most vulnerable part of the instrument, and it is important first to ascertain that the filaments have been wired correctly. The filaments are very fragile and their rated voltage must on no account be exceeded.

If by chance any high tension leads have been so wired that current from the high tension battery flows in the filament circuit the valves will be destroyed.

First, connect the battery leads L.T.+ and L.T.— respectively to the + (red) and — (black) terminals of the accumulator.

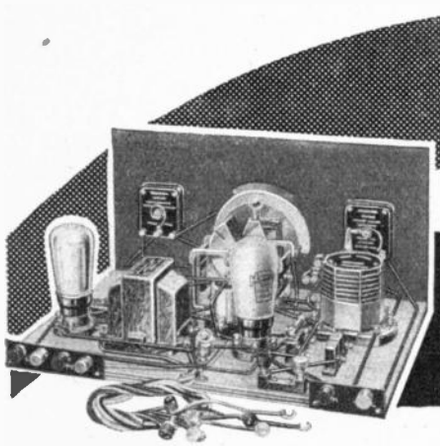
G.B.+ should be plugged into the + socket of the grid bias battery and the G.B.— leads into the sockets giving the voltages specified for the set. Now connect the H.T. battery. H.T.—, of course, plugs into the — socket of the high tension battery and the H.T.+ leads should be plugged into the H.T. voltages given for each individual receiver.

Do not fit the valves.

Screw the pilot lamp bulb W.417 into the pilot lamp holder and switch on the set.

Now screw the fuse into its holder. Watch it carefully as you screw it in. If there is anything wrong with your wiring, it may burn out immediately it makes contact with the bottom of the holder. The most likely causes of H.T. short circuits are, failure to insulate reaction condenser from metal panel, a defective coupling condenser, when either R.C. or Choke coupling is used, and the tuning condenser if the moving vanes are fouling a terminal or component connected to H.T.+

Assuming that the fuse bulb does not flash, and that the pilot lamp is glowing at normal brilliancy it should be safe to proceed. Connect up the loudspeaker or headphones, and the aerial and earth. Now unscrew the fuse bulb about one turn, just sufficient to clear the bottom contact, and insert the valves in their holders. The set is already switched on as indicated by the pilot lamp. Screw down the fuse until it makes contact. There should be a click from the loudspeaker and a sigh of relief from you. The set is now ready for use.

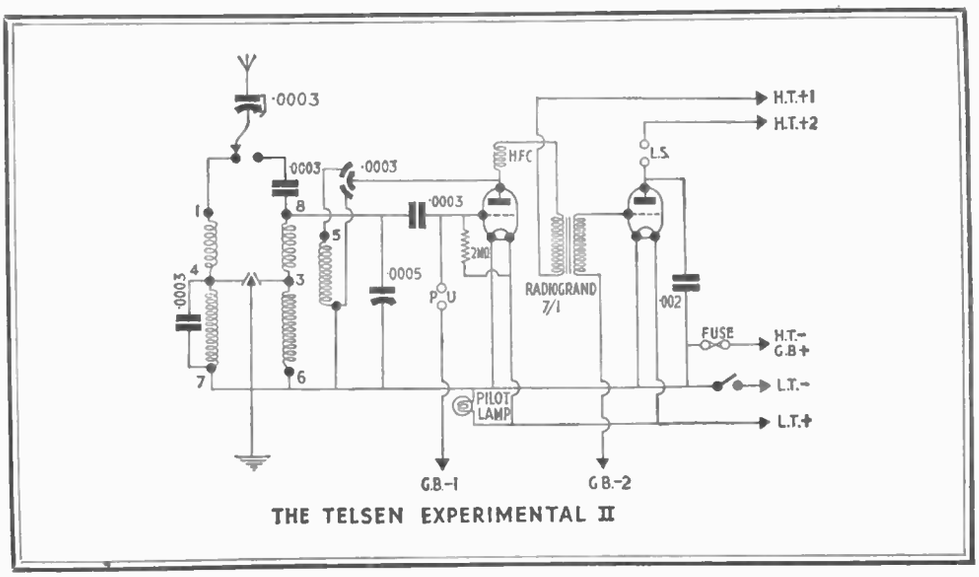


The TELSEN EXPERIMENTAL 2

A SIMPLE "TWO VALVE" RECEIVER EASY TO BUILD BY THE BEGINNER—YET WILL GIVE FULL LOUDSPEAKER RESULTS FROM THE REGIONAL—AND A FEW OF THE MORE POWERFUL CONTINENTAL STATIONS

THOSEconstructors who have built the Experimental One receiver will have become thoroughly familiar with the principles of detection and tuning. The power obtained from the set, however, leaves much to be desired, as the signals received are only of sufficient strength to operate headphones. Those constructors who wish to operate a loudspeaker must therefore take steps to increase the power of the set. Instructions are given elsewhere in this journal for the benefit of those who wish to construct a loudspeaker for themselves. This loudspeaker will be found remarkably sensitive and will give an excellent performance when used in conjunction with the receiver about to be described. When only moderate loudspeaker volume is required the 2 valve receiver, if well designed, can give adequate separation of local transmissions when more than five miles from the Regional Stations, and a high standard of reproduction that would please the most exacting ear. The addition of one valve and its associated couplings to the 1 valve receiver already described will provide the necessary amplification. The added valve is a low frequency amplifier, so that the circuit employed consists of a detector and one stage of audio frequency amplification. This latter means amplification of the signals after they have been converted by the detector valve to an audible frequency.

There are three popular methods of securing low frequency amplification, all of which make use of the valve. These are, Resistance Capacity Coupling, Choke Coupling and Transformer Coupling. Both resistance capacity and choke coupling when employing components of the correct value give first class results from the point of view of quality. They do not, however, give as much amplification as transformer coupling. Furthermore, the quality obtainable with transformer coupling is equal to that of either resistance or choke coupling, providing a first class transformer is used. The modern low frequency transformer such as the Telsen Radiogrand, can give practically even amplification over the whole of the audible spectrum, while providing additional amplification according to the ratio of its primary to its secondary winding. The maximum amplification obtainable with resistance or choke coupling is always less than the total amplification of the valve. A well designed transformer can give the same amount of amplification multiplied by the ratio of its windings. The Telsen Radiogrand transformer employed in this receiver has a ratio of 7:1. Therefore the low frequency amplification obtained will be seven times that which can be secured with resistance or choke coupling. The audio frequency signals from the anode of the detector valve are fed into the primary of the L.F. transformer. The voltage is stepped up by the secondary and applied to the grid of the L.F. valve. This valve further amplifies the signals and passes them on to the loudspeaker. It will be noticed that the "pick-up" terminals can now be brought into use. They should be wired into circuit in the manner shown. If a pick-up is now connected to these terminals it will be possible to obtain electrical reproduction from gramophone records. A separate volume control will be found necessary and a pick-up incorporating this control should be employed.



THE TELSEN EXPERIMENTAL II

A slight modification in the aerial circuit has been introduced. This is to enable the constructor to obtain a tighter aerial coupling and so increase the range of the receiver. If the wire coming from terminal 38 on the separator condenser is connected to terminal 37 on the terminal block the aerial will be

THE TELSEN "EXPERIMENTAL TWO"—*continued*

connected to the primary winding of the aerial coil. If the wire is connected to the terminal 36 on the terminal block the aerial will be automatically connected to the grid coil. This considerably tightens the coupling and distant stations will be brought in at greater strength. Unfortunately, however, this affects the selectivity of the receiver and should therefore only be used when the local station is not working. The receiver employs all the components used in the Experimental One receiver, but requires the following components and accessories in addition.

1 Loudspeaker
1 Valve P.220. Mazda.
1 7:1 Radiogrand L.F. transformer W.60.
1 Valve holder W.222.
1 Fixed condenser W.242.
1 Terminal block W.204.
1 Grid bias battery. Ediswan 9 volt.

Four more leads should be inserted in the battery cord, these are

Maroon Wire H.T.+2
Speckled Wire G.B.+
Yellow Wire G.B.—1
Green Wire G.B.—2

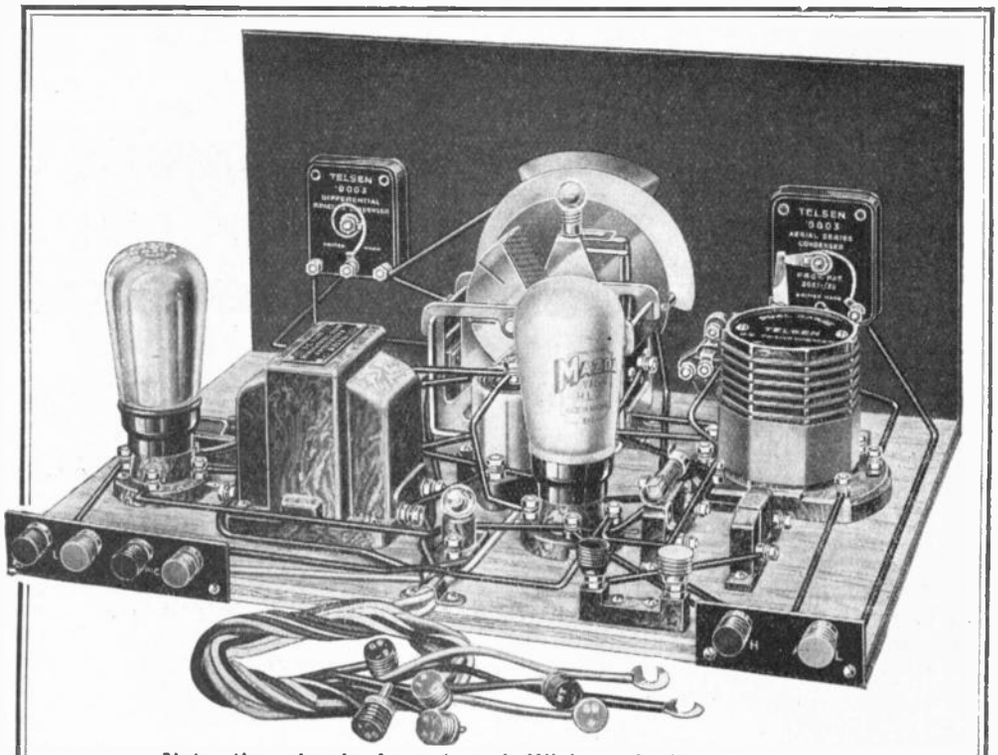
Those constructors who have built the Experimental One will have only to dismantle the baseboard. The panel components and variable condenser can be left in position. Constructors who have not built the Experimental One should follow carefully the instructions given on page 7, taking particular care to see that the reaction and aerial series condensers are properly insulated from the panel, and that the grid leak clips are correctly assembled on the grid condenser.

After assembling the baseboard in accordance with the diagram and photograph the wiring can be commenced. The following detailed point to point wiring instructions should be carefully followed in conjunction with the wiring diagram. For those constructors who prefer it, a full size Blue Print is obtainable price 1/- on application to Telsen.

On looking at the wiring diagram it will be seen, that all terminals are numbered, and wires should be connected between the terminals in the following order :—

Connect Terminal :—

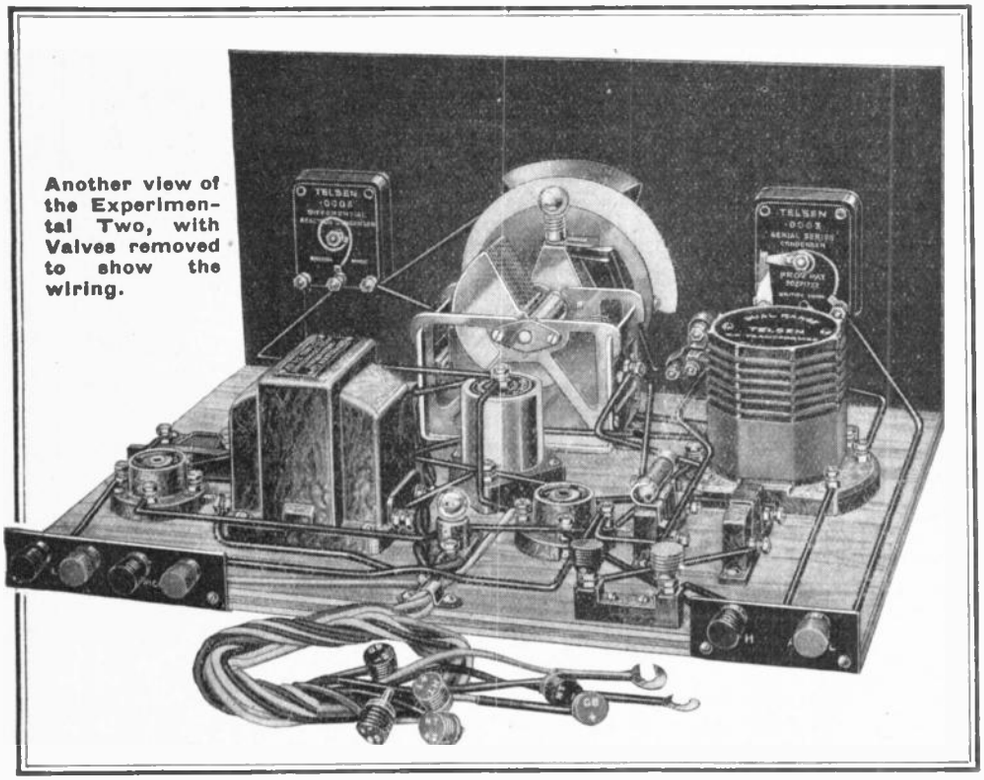
16 on .002 fixed condenser to 17 on Radiogrand transformer.
17 on Radiogrand transformer to 19 on tuning condenser.



Note the simple Layout and Wiring of this Receiver. The Photograph shows the set all ready for connecting up to the Batteries and Loudspeaker.

19 on tuning condenser to 18 on H.F. choke.
18 on choke to 6 on coil.
6 on coil to 12 on fixed condenser "A."
12 on condenser "A" to 20 on switch.
20 on switch to 21 on pilot lamp holder.
4 on coil to 29 on fixed condenser "A."
29 on condenser "A" to 28 on switch.
3 on coil to 27 on switch.
A on aerial terminal strip to 39 on aerial series condenser.
9 on valve holder V2 to 10 on fuse holder.
10 on fuse holder to 11 on valve holder V1.
11 on valve holder V1 to 7 on coil.
7 on coil to 6 on coil.
E on aerial terminal strip to 11 on valve holder V1.
31 on condenser "C" to 30 on V1.
30 on V1 to 32 on loudspeaker terminal strip.
33 on fixed condenser "B" to 34 on condenser "C."
34 on condenser "C" to 8 on coil.
8 on coil to 23 on tuning condenser.
19 on tuning condenser to 26 on switch.
26 on switch to 24 on reaction condenser.
24 on reaction condenser to 25 on panel.
1 on coil to 37 on terminal block.
35 on condenser "B" to 36 on terminal block.
38 on aerial series condenser to either 36 or 37 on terminal block (*Note.* No. 37 is the selective tapping and should be used during local broadcast hours).
5 on coil to 43 on reaction condenser.
13 on valve holder V2 to 14 on valve holder V1.
14 on V1 to 15 on condenser "C."
15 on condenser "C" to 22 on pilot lamp holder.
42 on reaction condenser to 41 on H.F. choke.
41 on H.F. choke to 40 on V1.
44 on choke to 45 on Radiogrand transformer.
46 on Radiogrand transformer to 47 on V2.
48 on .002 fixed condenser to 49 on V2.
49 on V2 to 50 on loudspeaker terminal strip.

THE TELSEN "EXPERIMENTAL TWO"—*continued*



Another view of the Experimental Two, with Valves removed to show the wiring.

This completes the wiring except for the fixing of the battery cord. This should be connected as follows :—

Connect :—

- L.T.— Black lead to 51 on switch.
- L.T.+ Red lead to 14 on valve holder V_1.
- H.T.— White lead to 52 on fuse holder.
- G.B.+ Speckled lead also to 52 on fuse holder.
- H.T.+ 1 Blue lead to 56 on Radiogrand transformer.
- H.T.+ 2 Maroon lead to 55 on L.S. terminal strip.
- G.B.— 1 Yellow lead to 54 on L.S. terminal strip.
- G.B.— 2 Green lead to 53 on Radiogrand transformer.

The receiver is now ready for the preliminary test (see page 8).

A complete list of the necessary accessories is given hereunder.

- 1 H.L.2 valve. Mazda.
- 1 P.220 valve. Mazda.
- 1 100-120 volt H.T. battery. Ediswan.
- 1 2 volt accumulator. Ediswan.
- 1 9 volt grid bias battery. Ediswan.
- 1 Pilot Lamp W.417.
- 1 Loudspeaker.

The batteries are connected as follows :—

L.T.+ to + terminal of accumulator.

L.T.— to — ,, ,, ,,

G.B.+ to + socket of grid bias battery

G.B.—1 to —1½ volt socket of grid bias battery.

G.B.—2 to —4½ volt socket of grid bias battery.

H.T.— to — socket of high tension battery.

H.T. +1 to 80 volt socket of high tension battery.

H.T. +2 to 100-120 volt socket of high tension battery.

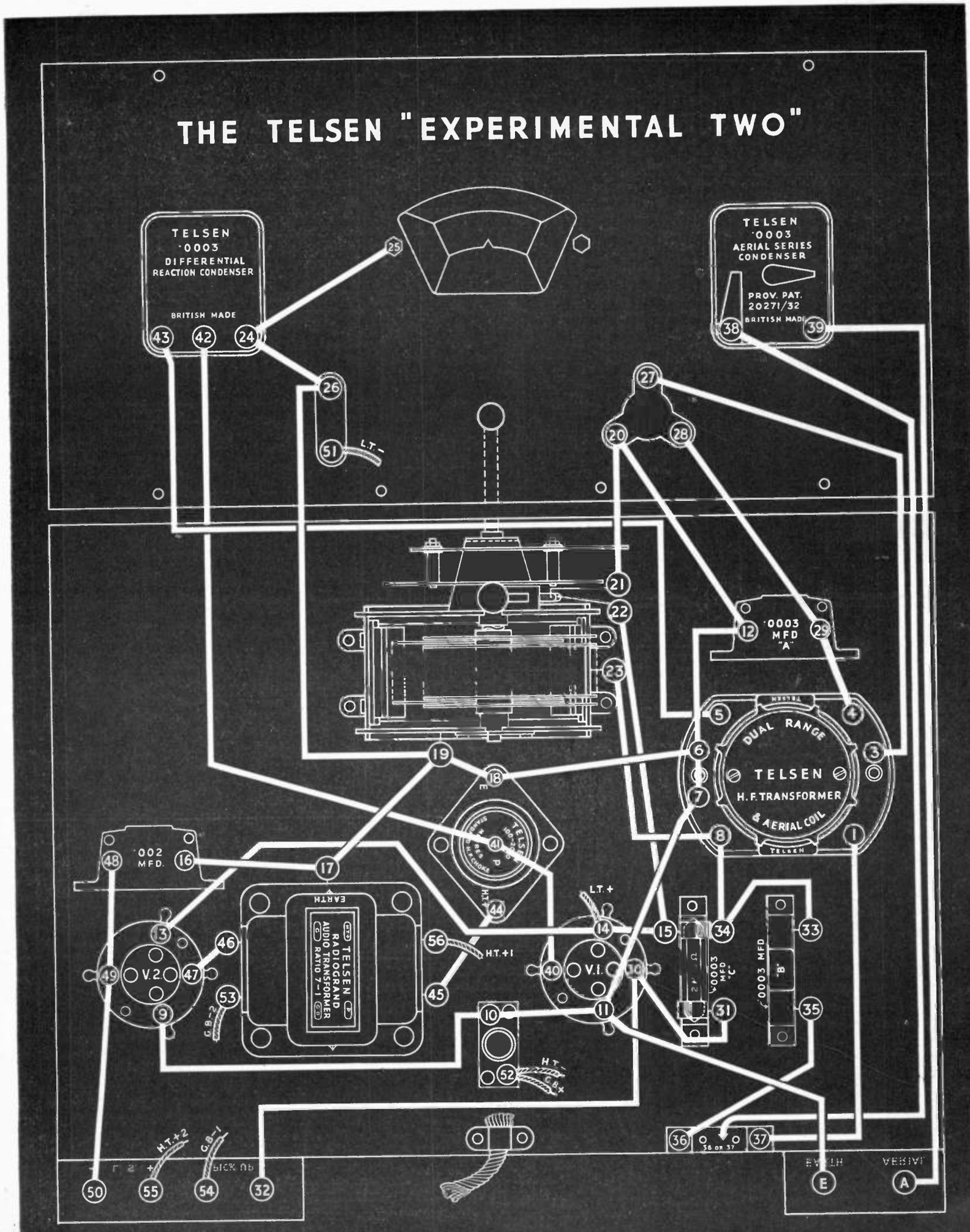
For operating instructions turn to page 17.

THE TELSEN "EXPERIMENTAL TWO"

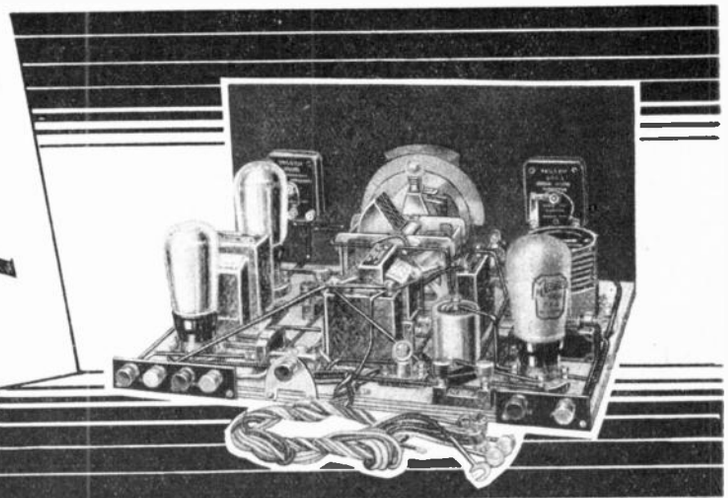
List of Components

Quantity		*Description*	*Cat. No.*	*Price*
2	Telsen	4-pin Anti-microphonic Valve Holders	W.222	1/4
3	,,	.0003 Mica Fixed Condensers	W.242	3/–
1	,,	.002 Mica Fixed Condenser	W.246	1/6
1	,,	2 meg. Grid Leak	W.251	1/–
1	,,	Battery type Fuse Holder	W.146	6d.
2	,,	Pilot Lamps	W.417	1/–
1	,,	Standard Screened H.F. Choke	W.341	3/6
1	,,	Dual Range H.F. Transformer Coil	W.154	5/6
1	,,	Single Condenser Unit	W.339	8/6
1	,,	Aerial Series Condenser with Switch	W.350	2/6
1	,,	.0003 Differential Reaction Condenser	W.351	2/6
1	,,	3-point Push-Pull Switch	W.108	1/3
1	,,	2-point Push-Pull Switch	W.107	1/–
1	,,	"Radiogrand" Transformer 7 : 1	W. 60	10/6
1	,,	Terminal Block	W.204	6d.
1	,,	Modern Radio Engineer's Constructor's Outfit ..	W.445	5/6

THE TELSEN "EXPERIMENTAL TWO"



The TELSEN EXPERIMENTAL 3



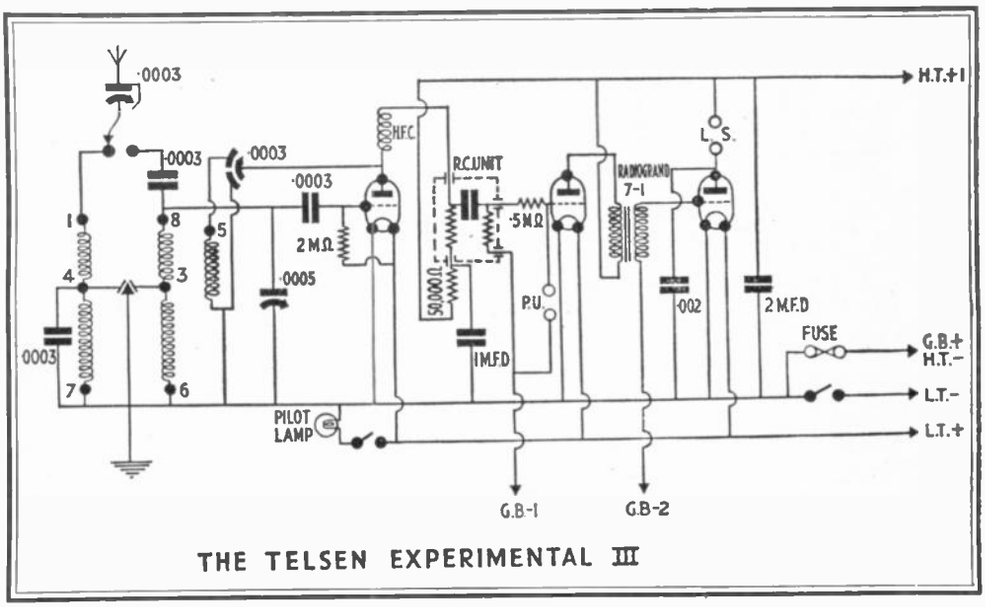
AN EFFICIENT "STRAIGHT THREE" VALVE RECEIVER—GIVING EXCEPTIONALLY GOOD QUALITY OF REPRODUCTION—SELECTIVITY AND SENSITIVITY.

EXCEPT for very special purposes two stages of low frequency amplification are the maximum needed. In fact, the maximum amplification that could be obtained from two stages is more than is ordinarily required. For many occasions however, one stage is inadequate and it becomes necessary to increase the volume by the addition of a power output stage. The receiver about to be described incorporates such a stage. It is probably the most economical and efficient instrument of its type ever devised. While it is both cheap and easy to build it incorporates a special circuit arrangement that makes the instrument extremely economical to run. The reproduction is unsurpassed by anything of its type, and the wealth of volume obtainable is surprising considering its modest cost. All the components used in the Experimental Two are incorporated in this receiver with a few additions. The more valves that are used in a receiver the greater the current taken and the shorter the life of the high tension battery.

Unfortunately when the high tension battery begins to run down its internal resistance increases. When a number of valves are in use and they are all obtaining their current from the one battery a certain amount of undesirable coupling exists between them. This is increased as the resistance of the battery increases and ultimately the receiver develops a howl or whistle. This can of course, be cured by the expensive expedient of purchasing a new battery. Fortunately this is not essential, as it can be obviated by the introduction of what is known as decoupling, and the useful life of the battery is thereby enormously increased. In the type of receiver under discussion it is only necessary to introduce the decoupling in the detector anode circuit.

This is achieved by incorporating a special resistance-condenser filter feed in the detector H.T. lead. In spite of its high sounding title it consists merely of a condenser and resistance, and is quite inexpensive. The principle involved is that the resistance will offer a high impedance to the path of low frequency currents, while the condenser being of large capacity will offer a very low impedance to such currents. It will therefore be evident that by selecting components of suitable value we can arrange to divert currents of differing frequency. The howl, whistle or motorboating occasioned by back coupling in batteries of high resistance is generally of a fairly low frequency, and it is therefore necessary to use a large capacity condenser. For this purpose a 1mfd. condenser is used in conjunction with a 50,000 ohms resistance. The resistance has wire ends and instructions for fitting it are given under the point to point wiring directions.

A further component introduced into this receiver is the reservoir condenser. The high tension battery is a chemically operated device and when the battery has been in use for some time the action of the chemicals becomes sluggish and occasionally intermittent. This gives rise to crackling and frying noises often wrongly attributed to atmospherics. If a 2mfd. Paper type condenser is connected in parallel with the high tension battery it will act as a reservoir



THE TELSEN EXPERIMENTAL III

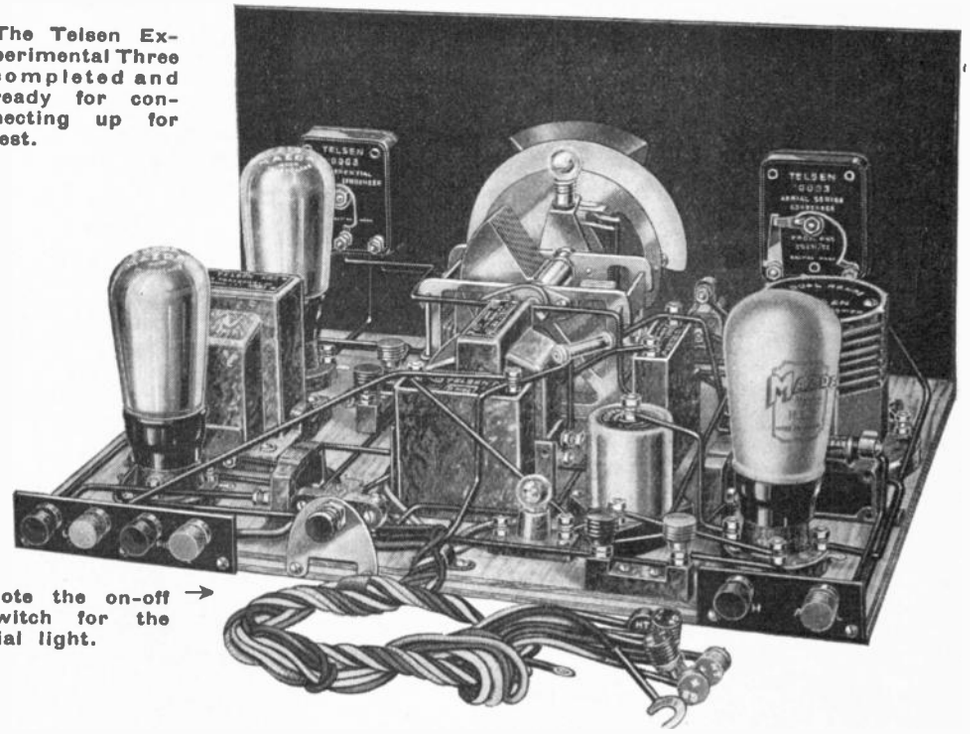
THE TELSEN EXPERIMENTAL THREE—*continued*

and smooth out any irregularities in the current supplied by the battery, thereby entirely eliminating these undesirable cracklings. It can safely be assumed that the incorporation of decoupling with the addition of the reservoir condenser, will increase the useful life of the high tension battery by 50%. Of course the results will get weaker as the battery runs down, but providing the grid bias is reduced in proportion to the drop in H.T. voltage the purity of tone will be retained until only the lack of sufficient reaction makes it necessary to invest in a new battery. This, and all other receivers described in this magazine employ a pilot lamp to illuminate the tuning dial. Normally, the dial light is only required when actually tuning in the required station. An economy in low tension current can therefore be effected if a switch is fitted in the leads to the pilot lamp, so that the lamp can be switched off when not required. A special bracket is supplied with the constructor's outfit, which is designed to carry a suitable 2 point switch. The switch should be fitted to the bracket and the assembly then screwed to the back edge of the baseboard in the position shown in the drawing. The addition of the low frequency power stage does not call for any special comment. The coupling used in the last stage is the 7:1 Radiogrand transformer. As the full amplification of a further transformer coupled stage is not required, resistance capacity coupling is employed in the first L.F. stage. This makes use of the Telsen R.C. unit W.285, which gives an absolutely even response over the whole of the audible frequencies. The following are the components and accessories required in addition to all those used in the Experimental Two receiver.

- 1 Valve. Mazda P.220A.
- 1 R.C. unit W.285.
- 1 4 pin valve holder W.222.
- 1 1mfd. condenser W.227.
- 1 2mfd. condenser W.226.
- 1 50,000 ohms resistor W.420.
- 1 2 point switch W.107.
- 1 Terminal block W.204.
- 1 500,000 ohms resistor W.383.

Only one H.T.+ lead is required and the H.T.+2 lead should therefore be removed. Keep the spare H.T. lead as it will be required on other sets.

Those who have built either of the receivers so far described will have only to dismantle the baseboard, as the panel assembly and variable condenser remain as before. Constructors who commence with this receiver should turn to page 7 and follow carefully the instructions for mounting the components paying particular attention to the proper insulation of the reaction and aerial series condensers from the metal panel.



The Telsen Experimental Three completed and ready for connecting up for test.

Note the on-off switch for the dial light.

Having assembled all the components in the positions shown on the black print the wiring can be commenced. For those constructors who prefer it, a full size Blue Print can be obtained price 1/- on application direct to Telsen. Those constructors who have built the receivers so far described should experience no difficulty in following the point to point wiring instructions given hereunder.

Connect Terminal

- E on aerial and earth strip to 9 on valve holder V1.
- 9 on V1 to 10 on H.F. choke.
- 10 on H.F. choke to 11 on fuse holder.
- 11 on fuse holder to 12 on 2 mfd. condenser.
- 12 on 2 mfd. condenser to 13 on .002 condenser.
- 13 on .002 fixed condenser to 14 on V3.
- 10 on H.F. choke to 7 on coil.
- 7 on coil to 6 on coil.
- 7 on coil to 15 on 1 mfd. condenser.
- 15 on 1 mfd. condenser to 16 on R.C. unit.
- 16 on R.C. unit to 17 on tuning condenser.
- 17 on tuning condenser to 18 on switch S2.
- 18 on switch S2 to 19 on escutcheon.
- 18 on switch S2 to 20 on reaction condenser.
- 20 on reaction condenser to 21 on V2.
- 21 on V2 to 22 on Radiogrand transformer.
- 23 on V1 to 24 on condenser " A."
- 24 on condenser " A " to 25 on switch S1.
- 25 on Switch S1 to 26 on V3.
- 26 on V3 to 27 on valve holder V2.
- 28 on switch S1 to 29 on pilot lamp holder.
- 30 on pilot lamp holder to 31 on switch S3.
- 31 on switch S3 to 32 oncondenser "B."
- 32 on condenser " B " to 6 on coil.
- 33 on switch to 34 on condenser "B."
- 34 on condenser " B " to 4 on coil.
- 35 on switch S3 to 3 on coil.
- 36 on condenser "A" to 37 on V1.
- 38 on condenser "A" to 39 on condenser " C."
- 39 on condenser " C " to 8 on coil.
- 40 on tuning condenser to 8 on coil.
- 41 on aerial series condenser to " A " on aerial and earth strip.
- 42 on condenser " C " to 43 on terminal block " D."
- 1 on coil to 44 on terminal block "D."
- 45 on aerial series condenser to 43 or 44 on terminal block " D." (*Note.* No. 44 is the more selective tapping.)
- 46 on valveholder V1 to 47 on choke.
- 47 on choke to 48 on reaction condenser.
- 5 on coil to 49 on reaction condenser.
- 50 on R.C. unit to 51 on choke.
- 52 on R.C. unit to 53 on 1 mfd. condenser.

Now connect 50,000 ohms resistor (green body, black tip and orange band) between terminal 53 on 1 mfd. condenser and terminal 54 on 2 mfd. condenser.

THE TELSEN EXPERIMENTAL THREE—*continued*

Connect terminal

54 on 2 mfd. condenser to 55 on " L.S." terminal strip.
56 on L.S. strip to 57 on V3.
57 on V3 to 58 on .002 fixed condenser.
59 on V3 to 60 on Radiogrand transformer.
61 on Radiogrand transformer to 62 on V2.
63 on Radiogrand transformer to 55 on " L.S." terminal strip.
64 on V2 to 65 on terminal block " E."
66 on terminal block " E " to 67 on R.C. unit.

Now connect a 500,000 ohms resistor (green body, black tip with yellow band) between 65 and 66 on terminal block " E."

Connect terminal

68 on R.C. unit to 69 on " L.S." terminal strip.
65 on terminal block " E " to 70 on "L.S." terminal strip.

This completes the wiring and constructors should now fix the battery cord, as follows.

Connect

Red wire L.T.+ to terminal 25 on switch S1.
Black wire L.T.— to terminal 73 on switch S2.
Blue wire H.T.+1 to terminal 54 on 2mfd. condenser.
Speckled wire G.B.+ to terminal 72 on fuse holder.
White wire H.T.— to terminal 72 on fuse holder.
Yellow wire G.B.— to terminal 68 on R.C. unit.
Green wire G.B.—2 to terminal 71 on Radiogrand transformer.

This completes the wiring.

The instrument is now ready for the preliminary test described on page 8.

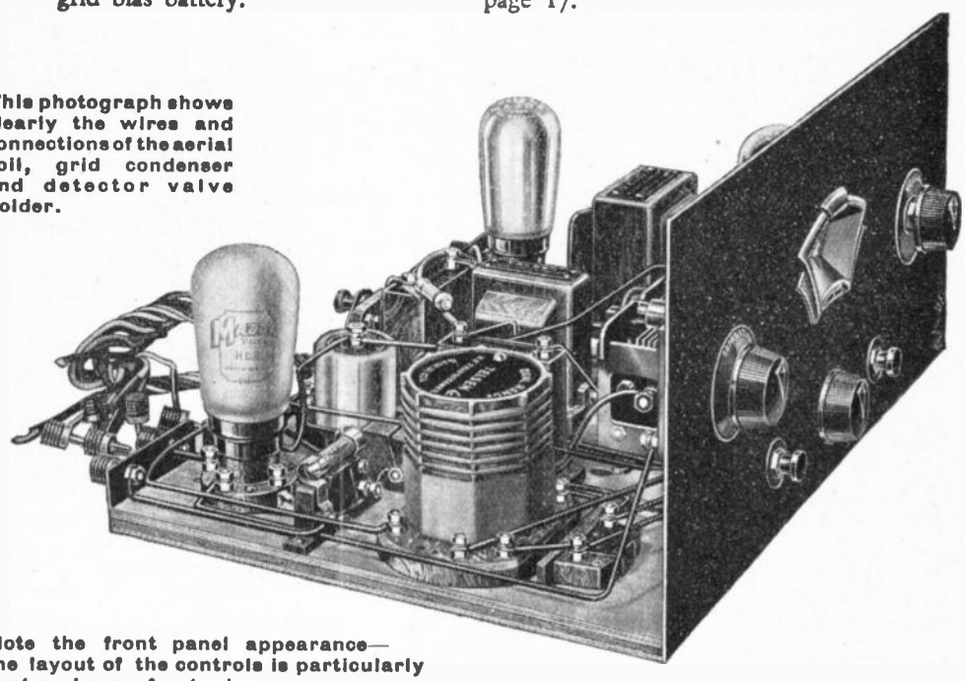
If not already in your possession, the following valves and batteries are required.

V1. Detector H.L.2. Mazda.
V2. 1st L.F... P.220. „
V3. Power .. P.220A. „
100-120 volt H.T. battery. Ediswan.
9 volt grid bias battery. Ediswan.
2 volt accumulator. Ediswan.

Equivalent types of other manufacture are equally suitable. The batteries should be connected as follows :—

L.T.+ connects to + terminal of accumulator.
L.T.— connects to — terminal of accumulator.
G.B.+ connects to + socket of grid bias battery.
G.B.—1 connects to —4½ volts socket of grid bias battery.
G.B.—2 connects to — 9 volts socket of grid bias battery.
H.T.— connects to — socket of H.T. battery.
H.T.+1 connects to + 100/120 socket of H.T. battery.

The operating instructions are given on page 17.



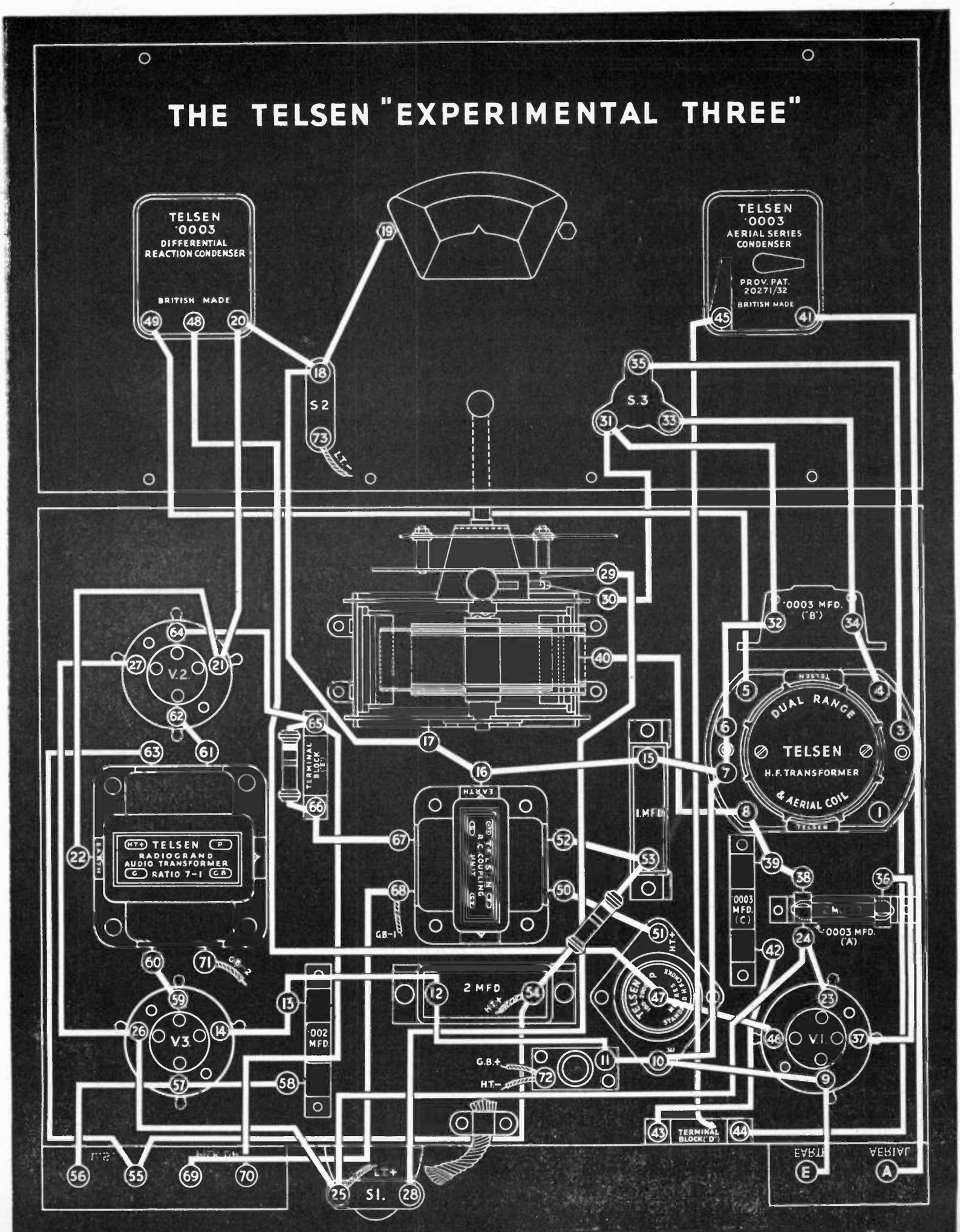
This photograph shows clearly the wires and connections of the aerial coil, grid condenser and detector valve holder.

Note the front panel appearance—the layout of the controls is particularly neat and easy for tuning.

THE TELSEN EXPERIMENTAL THREE

List of Components

Quantity	*Description*	*Cat. No.*	*Price*
3	Telsen 4-pin Anti-microphonic Valve Holders	W.222	2/-
3	„ .0003 Mica Fixed Condensers	W.242	3/-
1	„ .002 Mica Fixed Condenser	W.246	1/6
1	„ 2 meg. Grid Leak	W.251	1/-
1	„ Battery type Fuse Holder	W.146	6d.
2	„ Pilot Lamps	W.417	1/-
1	„ Standard H.F. Screened Choke	W.341	3/6
1	„ Dual Range H.F. Transformer Coil	W.154	5/6
1	„ Single Condenser Unit	W.339	8 6
1	„ Aerial Series Condenser with Switch	W.350	2/6
1	„ .0003 Differential Reaction Condenser	W.351	2/6
1	„ 3-point Push-Pull Switch	W.108	1/3
2	„ 2-point Push-Pull Switches	W.107	2/-
1	„ " Radiogrand " Transformer 7 : 1	W. 60	10/6
2	„ Terminal Blocks	W.204	1/-
1	„ R.C. Unit	W.285	4/-
1	„ 2 mfd. Paper Condenser	W.226	3/-
1	„ 1 mfd. Paper Condenser	W.227	2/3
1	„ 50,000 ohm Resistor	W.420	1/-
1	„ 500,000 ohm Resistor	W.383	1/-
1	„ Modern Radio Engineer's Constructor's Outfit ..	W.445	5/6



SIMPLE OPERATING INSTRUCTIONS

The operating instructions of a receiver are as simple as the five finger exercise on a piano but as in the case of the five finger exercise, the touch of the expert is plainly discernible as soon as the performance has commenced. The inexperienced operator of a radio receiver soon makes the night hideous with screeches and wails, and, though he may get his station in the end, anyone who really understands tuning can go to the set and get it a little bit better. Most of the receivers described in this journal have, apart from switches, three controls. The main tuning condenser, the separator or aerial series condenser, and the differential reaction condenser, or volume control.

This latter device is for feeding back energy from the anode of the detector valve to the grid circuit. Used in moderation it increases both sensitivity and selectivity, but care should be taken in using it. If too much reaction is applied the set goes into oscillation and re-radiates energy which causes interference with the reception of other listeners. The first sign that you are applying too much reaction, is when the quality becomes "rough," if you suspect that you have passed the limit, try a slight variation of the main tuning control. If your suspicions are correct the set will howl on each side of the dead tune position, and reaction should be slightly reduced.

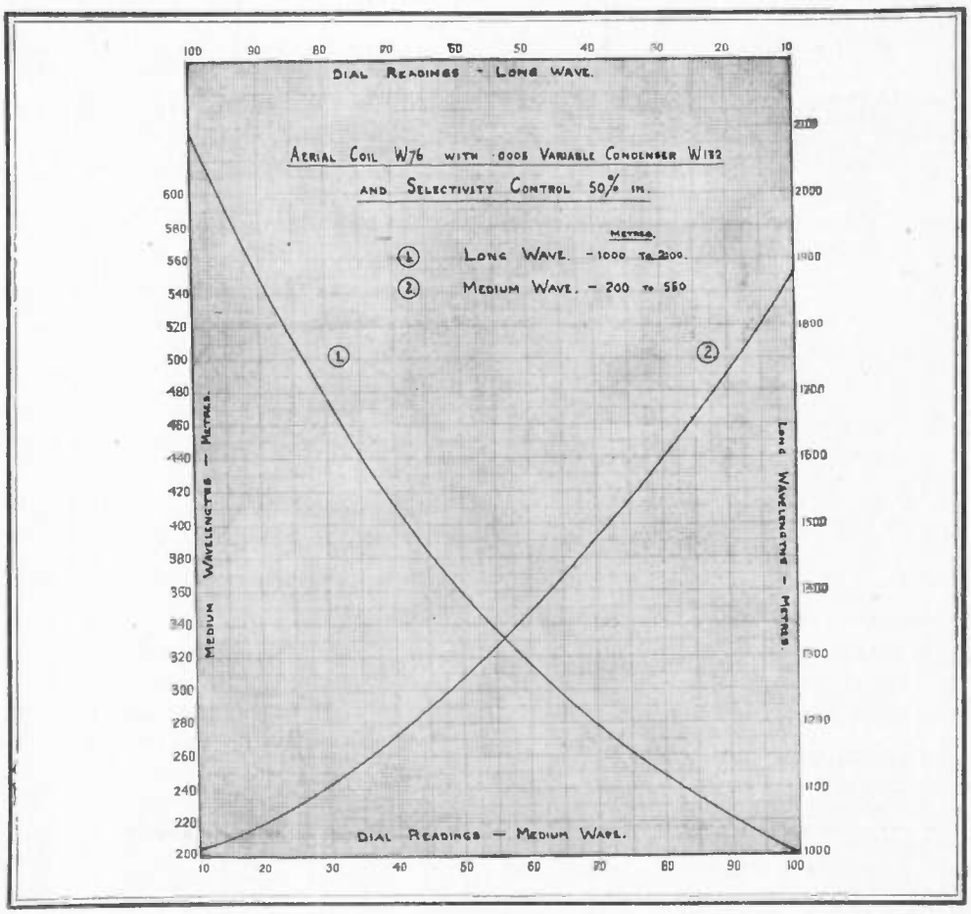
To tune the receiver proceed as follows :—Turn the separator to the maximum position, i.e., as far as it will go in a clockwise direction. This is the position giving maximum range or sensitivity and minimum selectivity. Rotate the volume or reaction control in an anti-clockwise direction, to its minimum position. Now set the wavechange switch. It should be pulled "out" for medium wave stations, and pushed "in" if long wave stations are required.

Turn the tuning condenser until a station is heard. This will be one of the local stations, and the condenser should be adjusted until signals are at their loudest. Now apply reaction by slowly rotating the volume control in a clockwise direction, and you will find that the strength of the signals will be increased up to a point where the set goes into oscillation. This is indicated by distortion, a howl, or a whistle, depending upon the accuracy with which the tuning condenser has been set. The reaction must, of course, be immediately decreased. A further slight adjustment of the tuning condenser may be necessary to bring the station in at full strength.

It will be noticed that the receiver is in its most sensitive condition when just *not* oscillating. Therefore, when searching for foreign or distant stations, the receiver should be kept in this condition as far as possible. The setting of the reaction control is not constant for any position of the tuning dial, and it will be found that more reaction is required when tuning at the top of the [illegible] searching for stations it is necessary to start at the bottom of the tuning scale (at "0"), and at that point the reaction should be adjusted until the set is just off the oscillating point. As the tuning proceeds up the scale the reaction should be slightly increased, keeping the set on the verge of oscillation. In this way it will be found possible to tune in weak or distant stations without causing interference with one's neighbour's reception.

Note.—Distant stations appear to tune more sharply than the locals, and the tuning condenser should be moved very slowly. The local stations will be found quite easily without the critical use of reaction. New listeners should be content for a time with reception from their local station, and should not indulge in searching for distant stations until they have made themselves thoroughly familiar with the set, and know instantly whether or not it is oscillating. It is of considerable assistance to prepare a tuning chart similar to the one which is reproduced on this page.

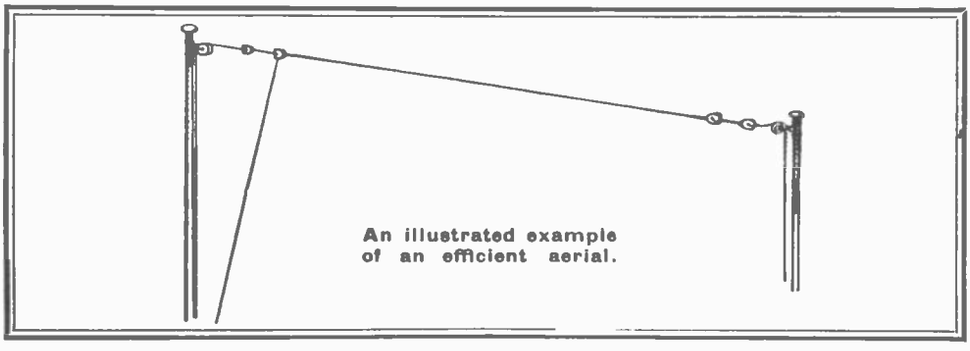
A sheet of squared paper is required, which is marked off in one direction with condenser readings, and in the other direction with wavelengths. As many stations as can be identified should be tuned in, and the dial reading of each station noted. The wavelength of each identified station should then be looked up. The daily papers publish the wavelengths of most of the more important broadcasting stations.



(*continued on Page 43*)

NOTES on AERIAL & EARTH

IT is seldom realised how much the aerial and earth system contributes to getting the best out of your receiver. It may be said that the erection of an efficient aerial and earth is as good as adding a high frequency valve to your receiver. Such an addition would, of course, greatly increase the range of the set, but consider the expense and the work involved. In most cases, it would mean completely redesigning the receiver. Yet, the same results can be achieved by taking a few simple precautions when erecting the aerial and earth. Those extremely minute high frequency currents induced in the aerial spell success or failure, and should therefore be carefully conserved. The ideal is a long, high, unscreened aerial, and a short lead to a good damp earth.



An illustrated example of an efficient aerial.

A long aerial, while making for an improvement in the reception of weak or distant stations has the opposite effect upon selectivity, making the separation of interfering stations more difficult. On the other hand if the aerial is short and inefficient the number and strength of stations received will be considerably reduced, but the apparent selectivity will be improved.

In all Telsen receivers and circuits an extremely satisfactory compromise is effected, as use is made of the wonderful Telsen aerial series condenser W.350. This is known as the separator condenser, and has the effect of shortening the aerial, when required, while retaining the efficiency of the large aerial. Both the aerial and down lead should be kept as far away as possible from all objects, such as trees or buildings. The length recommended is from 60 to 80 feet including the down lead and the height should not be less than 30 feet. A single wire aerial is the most satisfactory. Stranded copper wire only should be used, enamelled for preference. Not less than two insulators should be used at each end of the aerial to ensure good insulation.

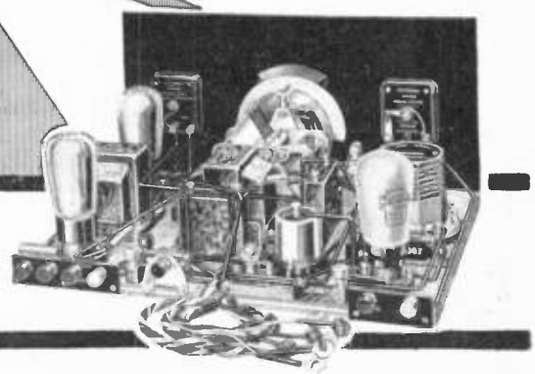
The lead in tube should be 12 in. long and the major portion should extend outside so as to keep the down lead from touching the side of the house. The lead in tube is most conveniently fitted in a hole drilled in the top of the window frame. The hole should not be drilled horizontally, but with a slight slope downwards to the outside. In this way the tendency for any moisture to find its way into the house will be avoided. On the inside of the house, the receiver, should be kept as near to the lead-in as possible, so as to avoid a long aerial wire from the lead-in to the aerial terminal of the set. Heavy rubber covered wire should be used.

Earth. The earth wire now claims our attention, and no less than the aerial, this should also receive very careful consideration.

It must be remembered that the aerial and earth together form two plates of a condenser and therefore the more we can have the earth directly under the aerial, the better.

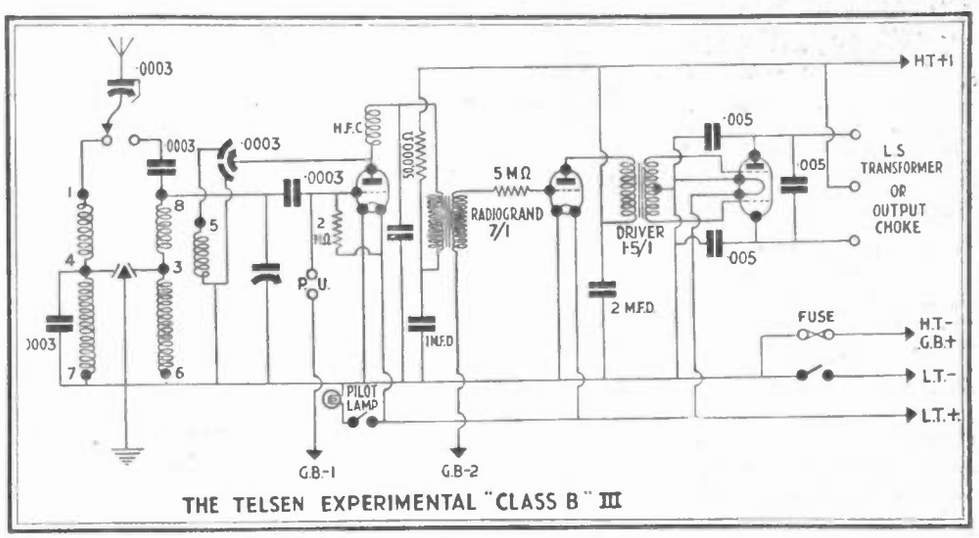
Probably the nearest approach to ideal earth conditions is to run a double thickness of wire or copper strip in the ground immediately underneath and along the entire length of the aerial, burying it about two or three feet deep. In an uncultivated garden, or one that has not yet been laid out for a new house, this proposition can be successfully carried out, and is worth considering; but while there are alternatives, no pressure for an earth of this description will be brought to bear in circumstances where the aerial is suspended over a bowling green or a bed of prize tulips! A direct water main connection by means of an earth clip has hitherto been considered the most efficient earth from a practical point of view, and often is the most convenient, but it is now generally acknowledged that a good copper tube or plate sunk well into moist ground near the aerial lead-in will serve equally well. Another method is to sink a tube or rod about eight feet long into the ground, placing round the top end and near the surface about five pounds of rock salt, pouring water over it until dissolved. In unusually dry ground it is also recommended that three or four of these should be sunk and joined in parallel. Inside the house it is advisable to have the earth lead also as short as possible. Too long a lead, or a bad connection will tend to reduce selectivity and volume. The same rubber-covered flex as used for the aerial inside the house should also be used for the earth lead. A gas main or the casing of electric light or power cables should not be used as an earth.

The TELSEN CLASS B



A STRAIGHT "THREE VALVE" RECEIVER—EMPLOYING "CLASS B" OUTPUT—GIVING "MAINS VOLUME" FROM H.T. BATTERIES

"CLASS B" is the latest and greatest boon conferred upon the battery set user. It is a recent development in low frequency amplification employing a special type of output valve. In the past it has been impossible to obtain from battery sets the large outputs given by mains receivers, without investing in expensive valves and very large capacity batteries. Consequently the listener who had no lighting mains available, generally had to be satisfied with a very modest output from his receiver, and could not take full advantage of the wonderful reproduction obtainable from a moving coil loudspeaker. Until the development of the moving coil loudspeaker, it was impossible for listeners to secure adequate reproduction of the lower audio frequencies, and in consequence the treble was apparently accentuated, while the bass was almost entirely absent. This was due to the inadequacy of the loudspeakers available at the time, as receivers were quite capable of giving an even response over the whole of the musical scale. While the moving coil overcomes the difficulty of correctly interpreting all frequencies, it is very much less sensitive than other types of loudspeaker. Consequently, only those listeners who had access to the electric supply mains could economically secure the requisite power to satisfactorily operate a moving coil speaker. With the advent of "class B" amplification all this is changed, and the battery set user can now obtain power and volume comparable with that of a mains driven receiver, and, what is more, this volume is secured without increasing the current taken from the high tension battery. The volume obtainable has to be heard to be believed. Some idea of the enormous strides that have been made by this system of low frequency amplification can be obtained by comparing the following figures. The average moving coil speaker requires a minimum input of one watt to secure reasonable volume. The output of the ordinary battery set using 2 volt valves and standard size batteries seldom exceeds 1/4 watt. "Class B" amplification, without in any way increasing the current taken from the high tension battery, can give the enormous output of nearly two watts. Curiously enough, very little modification of existing circuits is necessary to change over to "Class B," the system being chiefly made possible by the use of the new "class B" valve. The principle is a development of what is known as push-pull amplification, which employs two valves for one stage, the valves being arranged so that alternately one amplifies each positive half cycle of the low frequency currents while the other valve amplifies the negative half cycles. As explained, push-pull implies the use of two valves instead of one, but there is another disadvantage. Both valves, even when no signals are being received, consume a considerable amount of current. "Class B" overcomes both these difficulties. It has been shown that if the valve is required to handle only the positive or negative half cycles of the audio frequency currents, the amount of anode current required by the valve need only depend upon the intensity of the signal, and that no quiescent current is necessary. That is to say, when no signal is being received the valve need not pass any appreciable current, and when only small signals, such as quiet passages in music, are coming in, the amount of anode current required is correspondingly small. Furthermore, when two valves are used in push-pull, as each valve is only handling one half of each cycle it can be arranged that the total anode current required is divided between the valves. To achieve these results a special valve has been developed. Known as the "Class B" valve, it really consists of two valves in one bulb, there being two entirely separate sets of electrodes. The characteristics of the two sets of electrodes are matched and adjusted so that practically no current flows until a signal impulse is applied to the grids. The signals are fed to the grids by means of a special centre tapped L.F. transformer, which feeds the positive half

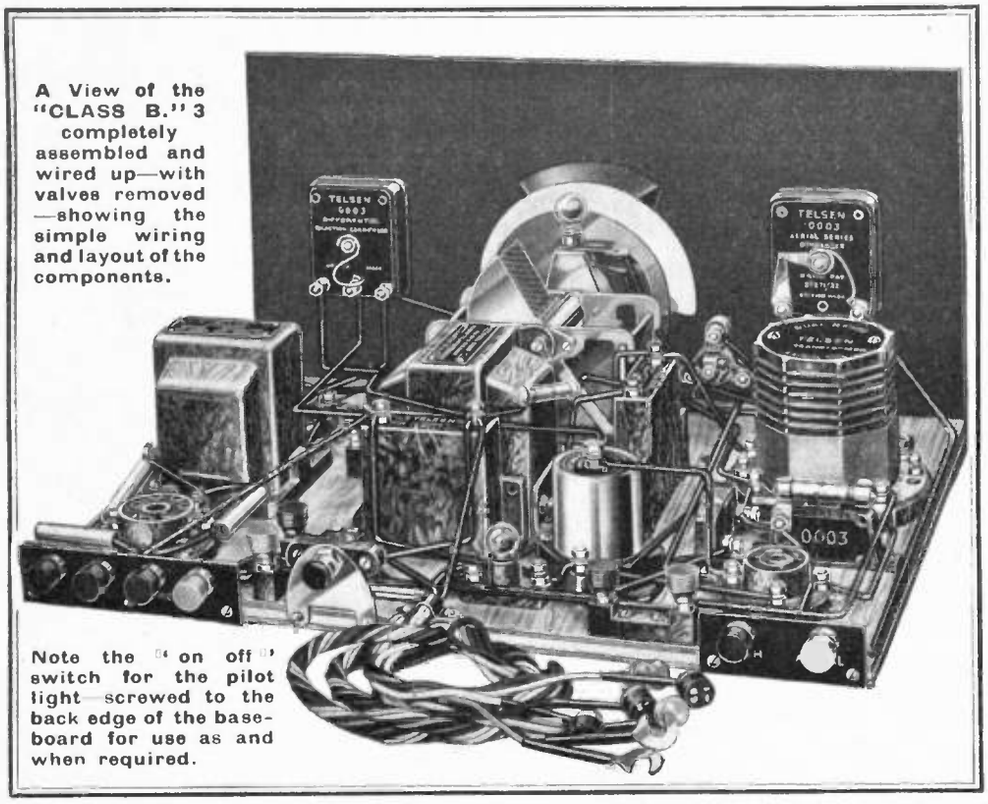


THE TELSEN EXPERIMENTAL "CLASS B" III

THE TELSEN "CLASS B."3 —*continued*

WIRING INSTRUCTIONS

cycles alternately to one grid and the negative half cycles alternately to the other. This transformer is known as the driver transformer, and the valve which precedes it is described as the driver valve. The driver valve is an ordinary triode, and this, with the aid of the driver transformer, supplies the power required in the circuit of the "class B" valve.



A View of the "CLASS B." 3 completely assembled and wired up—with valves removed—showing the simple wiring and layout of the components.

Note the "on off" switch for the pilot light screwed to the back edge of the baseboard for use as and when required.

Reference to the circuit diagram will show that when one grid of the "Class B" valve is receiving a positive half cycle, a heavy grid current will be flowing in that half of the driver transformer secondary which is connected to it. Consequently, the driver transformer must be of special design to meet the requirements of this type of circuit, and it has therefore, a low impedance secondary winding.

Reference to the circuit diagram will show that the receiver under discussion comprises a detector valve coupled to the driver valve with a 7:1 Radiogrand transformer and employing the decoupling introduced in the Experimental Three. The driver valve employed is the P.220 which is also used as the 1st L.F. valve in the Experimental Three, and this is coupled by the driver transformer to the special "Class B" output valve. This valve requires a seven pin valve holder, and care should be taken to see that this is wired up correctly. All the components specified for the Experimental Three receiver are used in the "Class B" Three with the exception of the R.C. unit, and one 4 pin valve holder. The following additional components and accessories are necessary.

- 1 driver transformer W.359.
- 1 7 pin valve holder W.338.
- 3 .005 tubular condensers W.408.
- 1 terminal block W.204.
- 1 "Class B" valve. Mazda PD.220.
- 1 moving coil loudspeaker with "Class B" transformer.

The terminal block marked "F" in the diagram can be sawn in half as only one half is required. This carries the connection leading to the centre tap on the loudspeaker transformer. If you already possess a moving coil loudspeaker that does not have a suitable centre tapped transformer fitted, it will be necessary to secure a Telsen "Class B" output choke. This can be screwed to the baseboard in a convenient position and the three primary connections taken to the three output terminals of the set. These are the 2 terminals marked "L.S." and the terminal on the terminal block "F." The output of the choke should be taken to the loudspeaker. The valve holder V2 becomes the driver valve holder while the 7 pin valve holder carries the "Class B" valve.

The construction of the receiver does not call for any special comment. The panel components are the same as those specified for the Experimental receivers described so far, and constructors who have built any of these sets will not be required to dismantle either the panel or the variable condenser. Constructors who commence with this receiver are referred to the special assembly instructions given on page 7. Having assembled the panel and baseboard in accordance with the diagram and photographs, the wiring can be commenced. Here again a full size Blue Print can be obtained price 1/- on application to Telsen Ltd. The following is the detailed point to point wiring list.

Connect terminal

E on aerial earth terminal strip to 9 on valve holder V1.
9 on V1 to 10 on H.F. choke.
10 on H.F. choke to 11 on fuseholder.
11 on fuseholder to 12 on 2 mfd. condenser.
12 on 2 mfd. condenser to 13 on valve holder V3.
10 on H.F. choke to 7 on coil.
7 on coil to 6 on coil.
6 on coil to 14 on 1 mfd. condenser.
14 on 1 mfd. condenser to 15 on .002 fixed condenser.
15 on .002 fixed condenser to 16 on Radiogrand transformer.
16 on Radiogrand transformer to 17 on tuning condenser.
17 on tuning condenser to 18 on valve holder V2.
18 on V2 to 19 on reaction condenser.
19 on reaction condenser to 20 on switch S2.
20 on switch S2 to 50 on panel.
18 on valveholder V2 to 21 on driver transformer.
21 on driver transformer to 22 on driver transformer.
6 on coil to 23 on fixed condenser "B."
23 on condenser "B" to 24 on switch S3.
24 on switch S3 to 25 on pilot lamp holder.
26 on switch S3 to 27 on condenser "B."
27 on condenser "B" to 4 on coil.
28 on condenser "A" to 29 on valve holder V1.
29 on V1 to 30 on switch S1.
30 on switch S1 to 31 on valve holder V3.
31 on V3 to 32 on valve holder V2.
33 on switch S1 to 34 on pilot lamp holder.

THE TELSEN "CLASS B."3 —*continued*

POINT-TO-POINT WIRING INSTRUCTIONS

A on aerial earth strip to 35 on aerial series condenser.
36 on aerial series condenser to 37 or 38 on terminal block " D " (No. 37 is the more selective tapping).
37 on terminal block " D " to 1 on coil.
38 on terminal block " D " to 39 on condenser C.
40 on switch S3 to 3 on coil.
41 on condenser "A" to 42 on V1.
43 on condenser "A" to 44 on condenser " C."
44 on condenser " C " to 8 on coil.
8 on coil to 45 on tuning condenser.
46 on valve holder V1 to 47 on H.F. choke.
47 on choke to 48 on reaction condenser.
49 on reaction condenser to 5 on coil.
51 on choke to 52 on Radiogrand transformer.
52 on Radio grand transformer to 53 on .002 fixed condenser.
54 on Radiogrand transformer to 55 on 1 mfd. condenser.

Now connect 50,000 ohm resistor (green body, black tip and orange band) between 55 on 1 mfd. condenser and 56 on 2 mfd. condenser. Connect terminal 56 on 2 mfd. condenser to 57 on terminal block " F."

58 on Radiogrand transformer to 59 on terminal block " E."
60 on terminal block " E " to 61 on V2.

Now connect 500,000 ohm resistor (green body, black tip, and yellow band) between 59 and 60 on terminal block " E."

Connect terminal
62 on valve holder V2 to 63 on driver transformer.
56 on 2mfd. condenser to 64 on driver transformer.
65 on driver transformer to 66 on V3.
67 on driver transformer to 68 on V3.

Connect a .005 tubular condenser between 22 on driver transformer and 69 on valve holder V3.
Connect a further .005 tubular condenser between 22 on driver transformer and 70 on valve holder V3.

Connect terminal
70 on V3 to 71 on " LS " terminal strip.
69 on V3 to 72 on " LS " terminal strip.

Connect a .005 tubular condenser between 71 and 72 on " L.S." terminal strip.
Connect terminal 42 on valve holder V1 to 73 on " L.S." terminal strip.
This completes the wiring.
Now fit the battery cord. It will be noticed that the H.T.+2 lead is not required and should be removed. The leads are connected as follows.

Connect
Red wire (L.T.+) to terminal 30 on switch S1.
Black wire (L.T.—) to terminal 77 on switch S2.
Blue wire (H.T.+1) to terminal 56 on 2 mfd. condenser.
Speckled wire (G.B.+) to terminal 76 on fuse holder.
White wire (H.T.—) to terminal 76 on fuse holder.
Yellow wire (G.B.—1) to terminal 74 on " L.S." and " Pick-up " terminal strip.
Green wire (G.B.—2) to terminal 75 on Radiogrand transformer.

The receiver is now ready for its preliminary test see page 8.

The following valves and batteries are required.

V1 Detector valve H.L.2. Mazda.
V2 Driver valve P.220. Mazda.
V3 "Class B" valve PD.220. Mazda.
120 volt H.T. battery. Ediswan.
9 volt Grid bias battery. Ediswan.
2 volt Accumulator. Ediswan.

It will be noticed that a 120 volt high tension battery is recommended, as the higher voltage will enable you to get the best out of the set. The battery should be of good make but need not be of more than standard capacity. The ordinary moving iron type of loudspeaker is unsuitable for " Class B " output and as previously instructed a suitable moving coil loudspeaker should be obtained. The batteries should be connected as follows :—

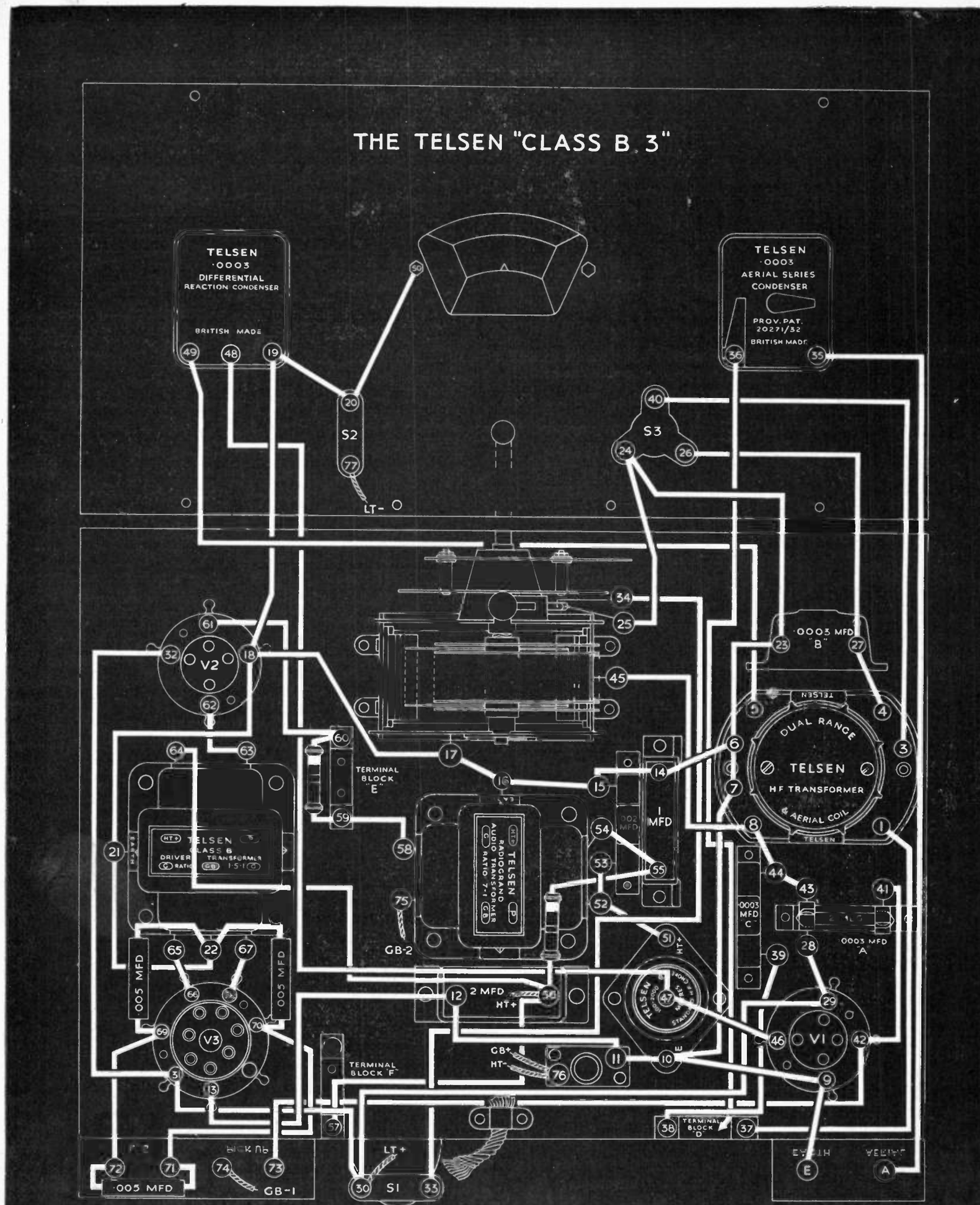
L.T.+ connects to + (Red) terminal of accumulator.
L.T.— connects to — (Black) terminal of accumulator.
G.B.+ connects to + socket of grid bias battery.
G.B.—1 connects to —1½ volts socket of grid bias battery.
G.B.—2 connects to —4½ volt socket of grid bias battery.
H.T.— connects to — socket of H.T. battery.
H.T.+1 connects to 100/120 vott socket of H.T. battery.

Provision has been made for connecting a gramophone pick-up, and it need hardly be said that used in conjunction with a good pick-up the reproduction of gramophone records will prove a constant source of delight. In this receiver the pick-up is wired to the detector valve and an external volume control will be found essential. The operating instructions are given on page 17.

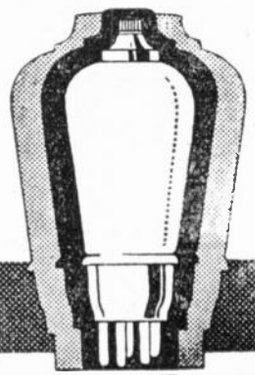
THE TELSEN "CLASS B."3

List of Components

Quantity	*Description*	*Cat. No.*	*Price*
2	Telsen 4-pin Anti-microphonic type Valve Holders ..	W.222	1/4
1	,, 7-pin Anti-microphonic type Valve Holder ..	W.338	1/9
3	,, .0003 Mica Fixed Condensers	W.242	3/-
1	,, .002 Mica Fixed Condenser	W.246	1/6
1	,, 2 meg. Grid Leak	W.251	1/-
1	,, Battery type Fuse Holder	W.146	6d.
2	,, Pilot Lamps	W.417	1/-
1	,, Standard H.F. Screened Choke	W.341	3/6
1	,, Dual Range H.F. Transformer Coil	W.154	5/6
1	,, Single Condenser Unit	W.339	8/6
1	,, Aerial Series Condenser with Switch	W.350	2/6
1	,, .0003 Differential Reaction Condenser	W.351	2/6
1	,, 3-point Push-Pull Switch	W.108	1/3
2	,, 2-point Push-Pull Switches	W.107	2/-
1	,, " Radiogrand " Transformer 7 : 1	W. 60	10/6
3	,, Terminal Blocks	W.204	1/6
1	,, 1.5 : 1 Driver Transformer	W.359	10/6
1	,, 2 mfd. Paper Condenser	W.226	3/-
1	,, 1 mfd. Paper Condenser	W.227	2/3
1	,, 50,000 ohm Resistor	W.420	1/-
1	,, 500,000 ohm Resistor	W.383	1/-
3	,, .005 mfd. Tubular Condensers	W.408	3/-
1	,, Modern Radio Engineer's Constructor's Outfit ..	W.445	5/6



High FREQUENCY AMPLIFICATION



THOSE constructors who have built and operated the receivers so far described in this journal, will have become thoroughly familiar with the technique of construction and operation. They will also have received an insight into the principles of detection and low frequency amplification, and should now be in a good position to tackle high frequency amplification.

The signals as they are received in the aerial are at high or radio frequency, and as explained previously are only rendered audible when they have passed through the detector valve. It has been demonstrated that when rectified by the detector the signals can be magnified to meet most requirements. Unfortunately, however, a detector is a relatively insensitive device and will not function unless the high frequency signal is above a certain strength. It therefore follows, that there is a limit to the number of distant or weak stations that can be received by a set that has the input taken direct to the detector valve. Listeners who are situated in a favourable area, and who have erected an efficient aerial are less likely to be troubled by a lack of stations than those who reside in an unfavourable area or for reasons beyond their control are unable to erect an efficient aerial and earth system. For these latter, high frequency amplification is the solution, as it will magnify the very weak impulses received so that they become strong enough to operate the detector valve.

It was discovered that the ordinary triode valve has strict limitations, especially when applied to high frequency amplification, owing to its inter-electrode capacity. This capacity although quite small is sufficient to cause a considerable feed back of energy from anode to grid. Therefore when the valve has an inductive load in its plate circuit a positive reaction effect is produced. Valves of the three electrode type with a high amplification factor are therefore impracticable as they only produce uncontrollable oscillation. To meet this difficulty a special valve for high frequency amplification was developed, known as the screened grid valve. As its name implies, it has an extra grid, which effectively screens the control grid from the anode. This modern high frequency valve therefore has an extremely small inter-electrode capacity but a very high amplification factor.

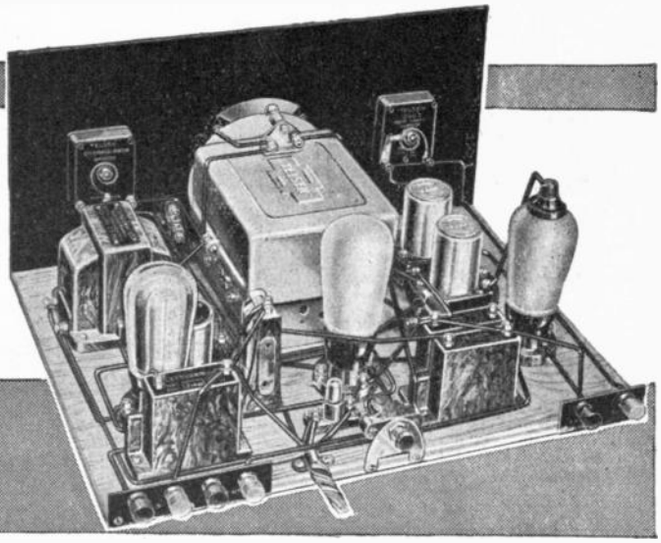
The problem of effective high frequency amplification is one to which the laboratories of Telsen have devoted a considerable amount of research. Questions of selectivity, stability, ganging, efficiency of inductances etc., have been carefully studied, and in consequence it can be said that the designs produced by the Telsen research staff are unsurpassed. As thousands of constructors know, the results of the labours of the Telsen technical staff are published in the well-known "*Telsen Radiomag*." No circuit or design is published that has not first been subjected to the most rigid tests. Constructors are given the very best that the science of Radio can offer, and it is extremely doubtful whether in the present state of knowledge, any improvement can be effected in the designs published in the "*Telsen Radiomag*." The circuits published, in order that they should have as wide an application as possible, have one or more high frequency stages.

Therefore to introduce the readers of this magazine to the principles of high frequency amplification, complete building instructions and point to point wiring of the Telsen Battery S.G. Three, culled from the No. 5 issue of the "Radiomag" are given.

The circuit is a perfectly simple one and the building will present no difficulty to the ordinary constructor. It will be observed that only one low frequency stage is incorporated, as the receiver makes use of a Pentode output valve.

A few words on this valve, therefore, would not be out of place. The characteristics of the screened grid valves are not suitable for handling the large inputs required of low frequency valves. The presence of the screening grid, which is at a high positive potential, produces a negative kink in the anode volts—anode current curves. In order to overcome this, and give the valve a long straight characteristic, a "suppressor grid" is introduced. The valve now has five electrodes, hence its name, the Pentode. The grid is connected internally to the filament, while the priming grid is brought out to an additional terminal or pin on the base of the valve. The Pentode, therefore, is a low frequency valve with a very high amplification factor, and in the case of certain two volt types, is capable of giving an output of one watt, sufficient to drive a moving coil speaker. It will therefore be seen that the valve is an excellent substitute for two ordinary low frequency stages.

THE TELSEN BATTERY S.G.3



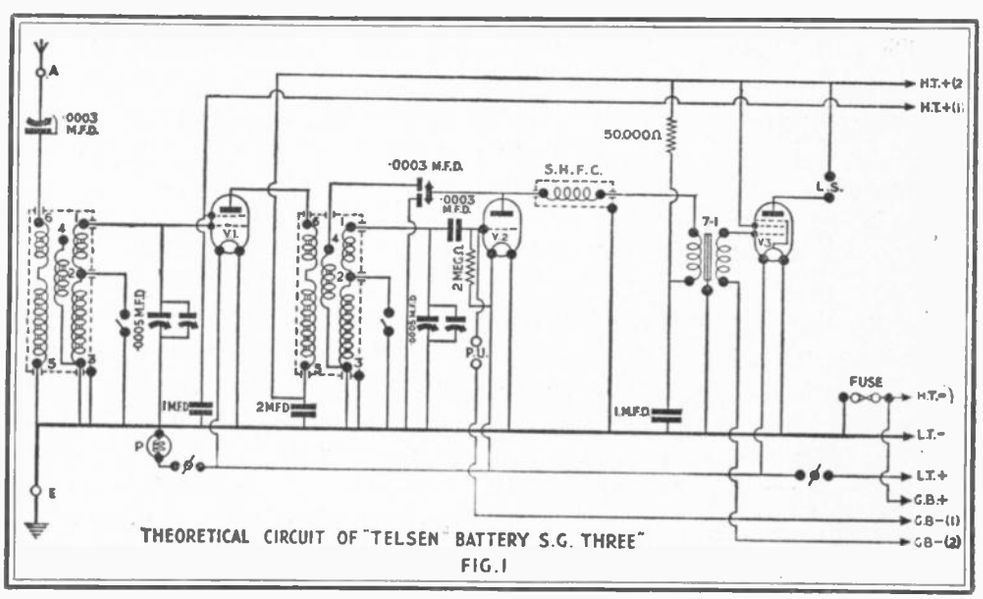
A SUPER S.G. 3 RECEIVER FOR DISTANT STATION RECEPTION THIS SET IS THE LAST WORD IN MODERN BATTERY SETS, EMPLOYING IRON CORED COILS, SINGLE KNOB TUNING AND PENTODE OUTPUT.

THERE is little doubt that sets using a screened grid H.F. valve, detector and pentode output valve are among the most popular general purpose receivers being produced to-day, and when properly designed and constructed so that optimum conditions are attained throughout the circuit they leave very little to be desired in the matter of range, selectivity, volume, quality of reproduction and economy.

The last named is particularly important to the battery user, and the Telsen Battery S.G. Three, which is a fine example of up-to-the-minute radio design, has been produced with the object of obtaining the very best value for money, both in first cost and running expenses. At the same time every worth-while improvement has been incorporated, and the owner of this receiver will not be slow to realise that he has a set of which he can be justly proud.

A notable feature of this set is the use of the new Telsen Iron-Cored Screened Coils which have such a small magnetic field, and are so well screened, that a metal chassis is unnecessary, and the inexpensive wooden baseboard can be employed. At the same time these coils are very compact, and this improves the layout, while their high efficiency enhances both the selectivity and the sensitivity of the receiver. From an examination of the theoretical diagram it will be seen that the aerial is loosely coupled to the tuned circuit preceding the screened grid H.F. valve, a series condenser being inserted in the aerial circuit. The latter is a valuable control of selectivity and volume as it enables aerial coupling to be adjusted to an optimum value. A shorting switch, fitted to the spindle, enables this condenser to be cut out when not required. The screened grid valve V1 provides amplification at radio frequency, thus enabling distant stations to be received at good volume, and it is coupled by means of the iron-cored H.F. transformer to the grid circuit of the detector.

The two iron-cored screened coils are tuned by a Telsen twin gang condenser, so that tuning is effected with great ease by means of a single control. The dial is illuminated by a pilot lamp which, however, can be switched off when not required so as to economise in L.T. current. The coils and reaction circuits have been carefully designed so that reaction is smooth and consistent over both wavebands and forms a very useful control of volume and selectivity. The detector anode circuit is adequately decoupled, and all metal screening cans, etc., are connected to earth to secure perfect stability.



THEORETICAL CIRCUIT OF "TELSEN" BATTERY S.G. THREE"
FIG. 1

THE TELSEN BATTERY S.G. THREE—*continued*

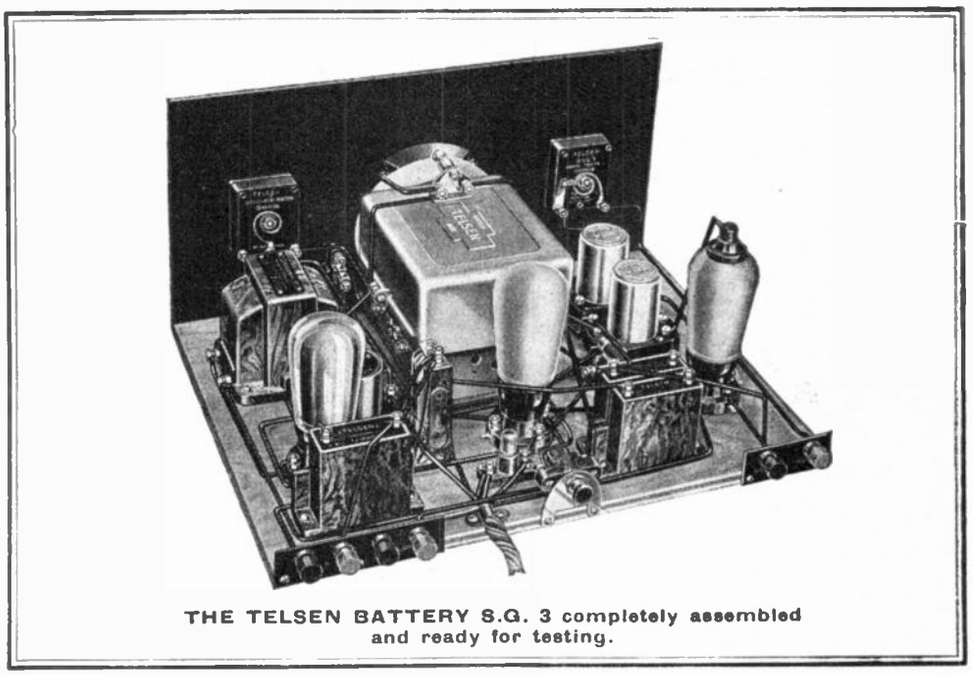
From the detector valve V2, audio frequency signals pass through the new screened H.F. choke and 7:1 " Radiogrand " transformer to the pentode output valve, a high degree of magnification being obtained. The pentode valve may be chosen to give 1,000 milliwatts undistorted output (which is sufficient to operate a moving coil loudspeaker) or half this value, with reduced anode current, according to individual requirements. Reproduction is of excellent quality, and the connection of a pick-up to the terminals " P.U." will enable gramophone records to be reproduced with wonderful fidelity. A Black Print showing the complete assembly and wiring of the Telsen Battery S.G. Three is given, and with the help of this article it enables the set to be constructed easily and rapidly.

Owing to the unprecedented demand, the No. 5 issue of the " *Telsen Radiomag* " is now out of print. A limited number of the 1/- Blue Prints which were issued with this magazine are, however, still available. In order to assist those constructors who prefer a full size Blue Print and who were unable to secure the No. 5 " Radiomag," a copy of the 1/- full size Blue Print, also building instructions and detailed point to point wiring of the Battery S.G. Three, will be supplied on application to Telsen, at the price of 1/- post free.

A complete list of the components required for constructing this set will be found at the end of this article. Constructors who already possess some of the components can complete the set by buying the remainder, but in any case the Constructor's Outfit W.445 should be obtained, as it contains the baseboard, panel, tools, wire, insulated sleeving and other small articles required for building this receiver. The remainder of this article deals with the construction of the Telsen Battery S.G. Three, and though simple and easy to follow, it will be found so detailed and explicit that it is almost impossible to go wrong.

ASSEMBLY

The first operation is to mount the components on the panel. The escutcheon plate supplied with the ganged condenser should be placed in position on the front of the panel, and the fixing screws inserted. The nuts may then be screwed on at the back and tightened. Next mount the aerial series condenser (with switch) in the hole on the extreme left of the panel, taking care to see that the spindle is insulated. To do this special insulating washers are provided, and the method of fixing them is illustrated in Fig. 2. First, fit over the screwed fixing bush, one of the cupped washers supplied with the kit, so that the cupped portion faces away from the condenser body, follow this by a large flat insulating washer, then by a small insulating washer. Next, from the back of the panel, insert the fixing bush and spindle of the condenser into the appropriate hole. The condenser should be disposed so that the terminals are in the positions shown in the Black Print. See that the cupped washer and the large flat insulating washer lie flat against the back of the panel; the small insulating washer should fit into the hole in the panel and should project at the front a little, as it is slightly thicker. Over this projecting portion the appropriate escutcheon plate (" volume" or " separator " as the case may be) is fitted, and after this, another large flat washer, and the condenser fixing nut. Rotate the escutcheon plate so that its indication is at the top, and holding the whole assembly firmly, screw up the fixing nut tightly by means of the special spanner provided. After this, the knob may be fitted.



THE TELSEN BATTERY S.G. 3 completely assembled and ready for testing.

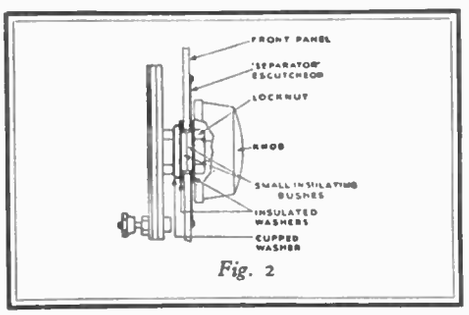


Fig. 2

The differential reaction condenser may now be fitted to the hole on the extreme right, and must be secured in the same manner as the aerial condenser.

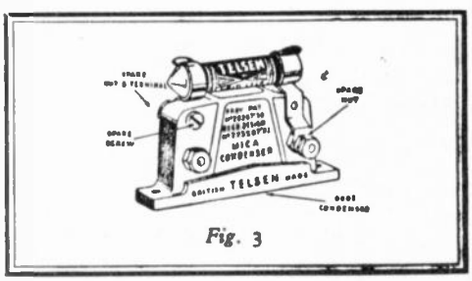


Fig. 3

Next fit the two switches to their respective holes as shown in the Black Print. This completes the panel assembly.

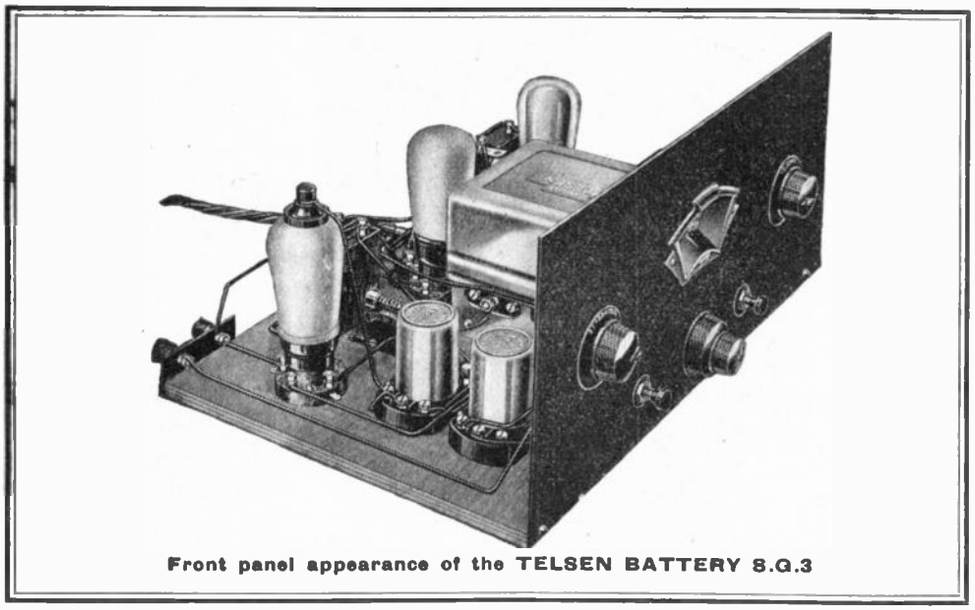
THE TELSEN BATTERY S.G. THREE—*continued*

The mounting of the components on the baseboard may now be proceeded with.

Particular care should be taken to see that the valve holders are placed correctly, "V3." being mounted the opposite way to "V1" and "V2." The ganged condenser should be fixed as per instructions supplied with same.

WIRING

For those who do not wish to solder connections the "special" wire supplied may be taken to each individual terminal as shown in the Black Print. On looking at the Print it will be seen that all terminals are numbered; in the case of the tuning coils A and B, these should be mounted so that the terminals 1, 2 and 3 (the numbers actually on the coil bases) are facing the ganged condenser. The wiring should then be carried out as follows: —



Front panel appearance of the TELSEN BATTERY S.G.3

The terminal strips should now be fixed up and mounted as shown. The colours of the various terminals from left to right looking at the back of the receiver are black, red, black, red, black, red.

The two-point switch controlling the pilot lamp should be mounted on the switch bracket contained in the Constructor's Outfit, and this assembly screwed to the back edge of the baseboard. The object of this switch is to enable the pilot lamp to be switched off after the desired station has been tuned in. In this way economy in low tension current is effected.

The grid condenser and leak connected to the detector valve-holder "V1" should be fitted up as shown in the accompanying diagram, Fig. 3.

Having completed the mounting of the components on both panel and baseboard, the panel may be secured to the baseboard. The set is then ready for wiring.

Terminal

1 on aerial-earth terminal strip to 2 on V1.

1 on aerial-earth terminal strip to 3 on 1 mfd. condenser to 4 on 1 mfd. condenser to 5 on coil B to 7 on coil A to 9 on wavechange switch to 10 on coil A.

5 on coil B to 6 on coil B (fixing down screw).

7 on coil A to 8 on coil A (fixing down screw).

4 on 1mfd. condenser to 11 on V2 to 12 on fuse holder to 13 on V3, to 15 on H.F. choke to 16 on gang condenser to 17 on pilot lamp to 18 (nut and bolt holding escutcheon, to earth panel).

13 on V3 to 14 on 2 mfd. condenser.

19 on V1 to 20 on grid leak to 21 on V2 to 22 on V3 to 23 on L.T. switch.

24 on aerial earth terminal strip to 25 on aerial series condenser.

26 on aerial series condenser to 27 on coil A.

28 on coil A to 29 on wavechange switch.

30 on gang condenser to 31 on coil A to 32 on V1.

33 on wavechange switch to 34 on coil B.

35 on gang condenser to 36 on grid condenser to 37 on coil B.

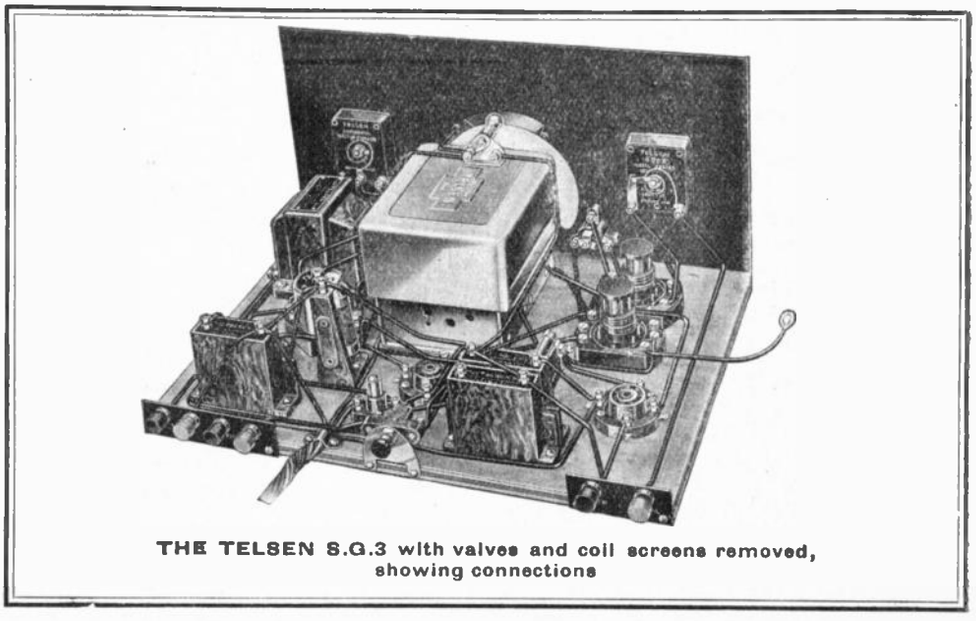
38 on V1 to 39 on 1 mfd. condenser.

40 on 1 mfd. to 41 on resistance holder to 42 on Radiogrand transformer.

43 on coil B to 44 on differential condenser.

45 on pilot lamp to 46 on pilot lamp switch.

47 on grid leak and condenser to 48 on V2.



THE TELSEN S.G.3 with valves and coil screens removed, showing connections

THE TELSEN BATTERY S.G. THREE—*continued*

49 on V2 to 50 on H.F. choke to 51 on differential condenser.

52 on H.F. choke to 53 on Radiogrand transformer.

16 on gang condenser to 54 on Radiogrand transformer to 55 on differential condenser.

56 on Radiogrand transformer to 57 on V3.

58 on coil B to 59 on resistance holder to 60 on 2 mfd. condenser to 61 on terminal strip.

62 on coil B, a 6" length of wire, to be connected to top of S.G. valve later.

59 on resistance holder to 63 on V3.

64 on V3 to 65 on terminal strip.

21 on V2 to 66 on pilot lamp switch.

48 on V2 to 67 on terminal strip.

The 8-way battery cord must now be fitted, the colours for the different battery connections and wander plugs being as follows :—

Red wire ..	L.T.+
Black wire ..	L.T.—
Blue wire ..	H.T.+1
Maroon wire ..	H.T.+2
White wire ..	H.T.—
Speckled wire..	G.B.+
Yellow wire ..	G.B.—1
Green wire ..	G.B.—2

The wires should be joined as follows :—

Red wire ..	to 71 on switch.
Black wire ..	to 12 on fuse holder.
Blue wire ..	to 38 on V1.
Maroon wire.	to 60 on 2 mfd. condenser
White wire ..	to 68 on fuse holder.
Speckled wire	to 68 on fuse holder
Yellow wire .	to 69 on terminal switch.
Green wire ..	to 70 on Radiogrand transformer.

This now completes the wiring.

OPERATING INSTRUCTIONS

Two Telsen pilot lamps W.417 are included in the kit. One of these should be screwed in the pilot lampholder on the twin gang condenser and the other into the fuseholder. Insert suitable valves as indicated at the end of this article. Connect aerial, earth and a good loudspeaker to the appropriate terminals and the L.T.+ and L.T.— leads to the + and — terminals respectively of the accumulator.

G.B.+ should be plugged in to the + socket, and G.B.—1 and G.B.—2 into the 1½ and 9 volt tappings of the grid bias battery. H.T.— should go into the — socket of the H.T. battery, H.T.+1 being plugged into a socket of about 90 volts and H.T.+2 into the socket giving the maximum voltage available. The receiver should now be switched on by means of the right hand switch, and the pilot lamp switch should be pulled "on" at the rear of the set.

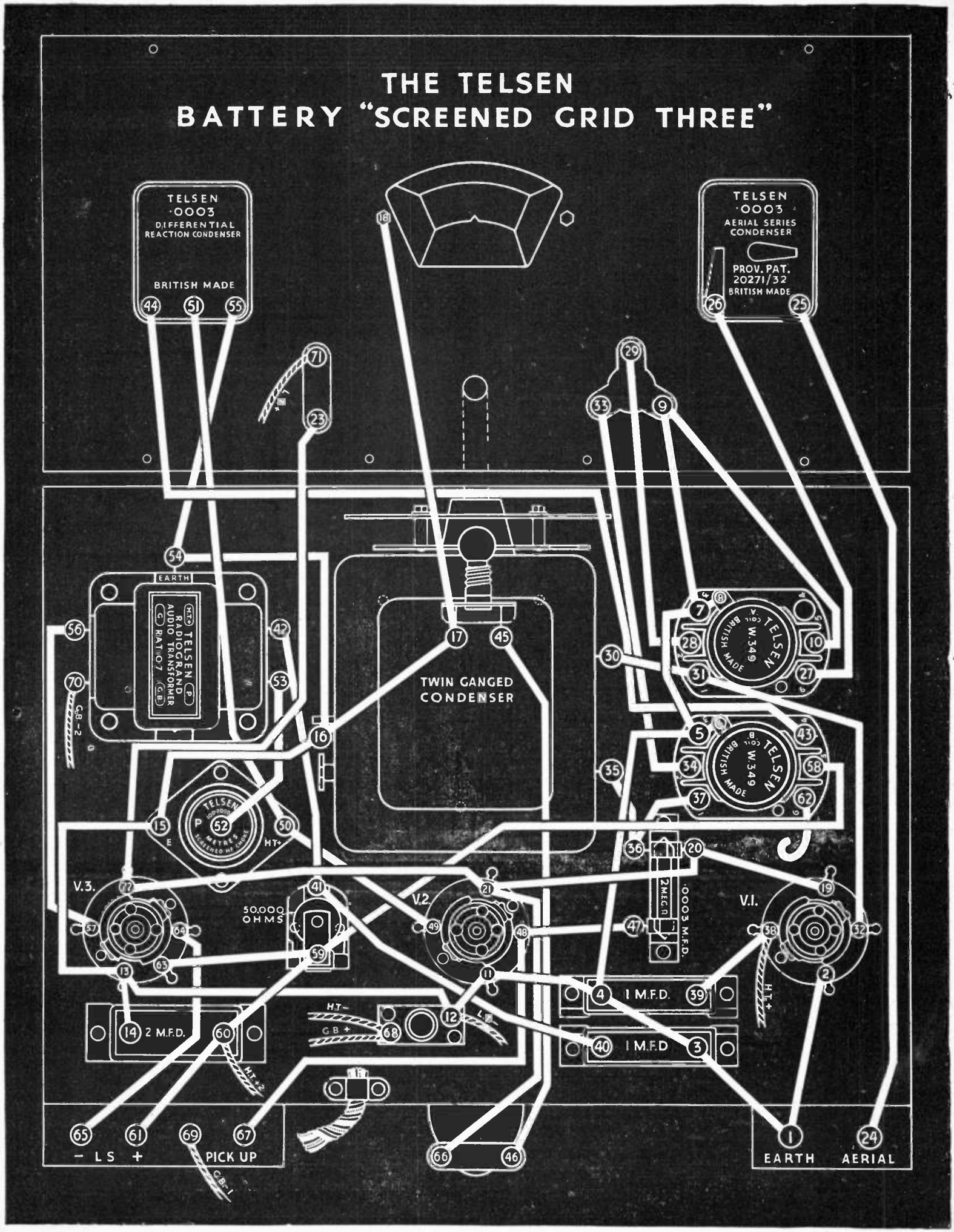
A preliminary test has revealed that the receiver is working normally, and receiving signals. The wavechange switch should be set to the "medium" position and the separator about half-way over. The volume control should be set so that the receiver is in a sensitive position, i.e., almost at the oscillation point, and a fairly weak station at the lower end of the waveband should be tuned in. Any station lying between 200/250 metres is suitable, and it should be tuned in with the trimmer on the front panel concentric with the main tuning dial, left approximately half-way between the limits of its travel. The trimmer operated by the "star wheel" on the right hand side of the tuning condenser should now be adjusted for maximum signal strength, adjusting the main tuning condenser, when necessary, to keep the station tuned in. Having set this trimmer to the position giving maximum signal strength, it should not again be touched. Following adjustments of the separator control, which are made from time to time, to suit reception conditions, adjustments to ganging will be necessary, but these are performed by a slight movement, one way or the other, of the control knob operating the trimmer on the front panel. This control enables the most efficient performance to be obtained at any setting of the separator or main tuning control, and is of value when tuning in weak stations. Although ganging is carried out on the short waves, it will hold good on changing over to long waves—this is taken care of in the matching of coils. If preferred, the wavelength calibrated scale can be used and adjusted to read correctly as follows :—Set the separator condenser about half-way in, and tune in a station of known identity and wavelength, preferably on the medium waveband. The scale may indicate the correct wavelength for the particular station being received, but, if not, the nuts securing the scale to the driving disc should be slackened off, and the scale, which has elongated fixing holes, should be shifted relative to the condenser, until the correct figure is indicated against the index on the escutcheon plate. The scale should then be clamped firmly on the driving disc by re-tightening the fixing nuts.

RECOMMENDED VALVES

Make	V1	V2	V3
Mazda	S215A	HL2	PEN220A

THE TELSEN BATTERY S.G. THREE
List of Components

Quantity	*Description*	*Cat. No.*	*Price*
2	Telsen 4-pin Anti-Microphonic Valve Holders	W.222	1/4
1	,, 5-pin Anti-Microphonic Valve Holder	W.223	10d.
1	,, 7 : 1 "Radiogrand" Transformer	W. 60	10/6
1	,, .0003 Mica Condenser	W.242	1/-
1	,, 2 meg. Grid Leak	W.251	1/-
1	,, Cartridge Resistance Holder	W.286	9d.
1	,, 50,000 ohm Cartridge Resistance	W.279	1/-
1	,, 2 mfd. Paper Condenser	W.226	3/-
2	,, 1 mfd. Paper Condensers	W.227	4/6
1	,, Battery Type Fuse Holder	W.146	6d.
1	,, Standard Screened H.F. Choke	W.341	3/6
1	,, Twin Ganged Condenser	W.427	16/6
2	,, 2-point Push-Pull Switches	W.107	2/-
1	,, 3-point Push-Pull Switch	W.108	1/3
1	,, Aerial Series Condenser .0003	W.350	2/6
1	,, Differential Reaction Condenser .0003	W.351	2/6
2	,, Matched Iron Cored Coils	W.349	17/-
2	,, 2.5 volt Pilot Lamps	W.417	1/-
1	,, Modern Radio Engineer's Constructor's Outfit ..	W.445	5/6



How to MAKE YOUR OWN LOUDSPEAKER

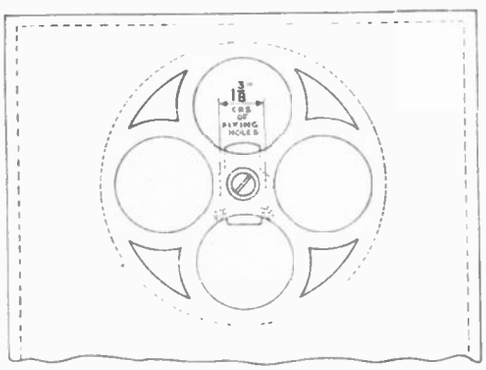
AN ARTICLE OF PARTICULAR INTEREST TO ALL RADIO BEGINNERS WHO WISH TO MAKE THEIR OWN LOUDSPEAKER—OR REQUIRE AN EXTRA SPEAKER FOR USE IN ANOTHER PART OF THE HOME

ALTHOUGH when home constructed a loudspeaker is both inexpensive and simple to build, it is surprising what remarkable results are obtainable if care is exercised in the construction.

If the following instructions are strictly adhered to your loudspeaker will give you the same volume and quality as that obtainable from comparatively costly commercial instruments. The parts required are :—

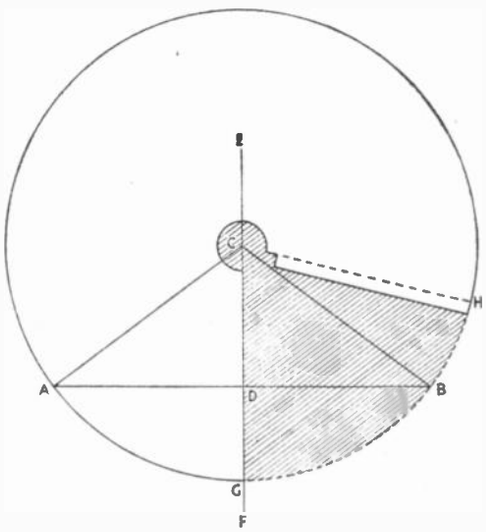
- 1 Telsen loudspeaker unit W.54
- 1 Telsen terminal block W.204
- 1 Baffle board 2 feet square or a suitable cabinet.
- 1 Piece of cartridge paper.

The basis of the instrument is the Telsen loudspeaker unit W.54. This unit is of the high impedance type and is suitable for connecting directly in the plate circuit of the output valve. Scientifically designed, it is robustly built round a powerful magnet, and is free from objectionable resonances. The unit is housed in a handsome bakelite case and supplied with all necessary fixing screws,



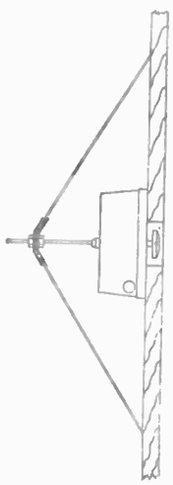
reed stylus and cone washers. Procure a suitable piece of cartridge paper from your stationer. It should be about 18" square and 8 to 12 mils. thick.

To make the cone you will require a pair of compasses and a foot rule. When marking out and cutting the cone, care should be taken to avoid cracking the cartridge paper, as this would completely spoil the finished job. First draw a triangle representing the exact height and base of the cone required. Assuming that a 9" cone 1½" high



is needed, draw the line AB 9" long and bisect it as shown at D by drawing the perpendicular EDF. Now mark off the point C exactly 1½" above the base line. Join C to A and B and you have a triangle exactly representing a section of the required cone. With the compasses taking point C as centre and CA as radius describe a circle. This circle will, of course, just touch the points AB. Now from the same centre, describe a small circle ¼" radius. If the perpendicular line EF does not cut the circumference, extend it so that it passes through the point G. Now adjust the compasses to the length AD and commencing at G mark six times round the circumference and you will find the point H. Draw the line CH. The segment CGH is the area which has to be cut out after allowing sufficient for a fixing flange, which should first be drawn in along CH. The small circle in the centre should also be cut out and the cone is ready to be formed. Smear the flanges with a little Croid or Seccotine. Now bring the edges together so that the flange overlaps, and hold or conveniently support them together until the glue has dried. You will then have a perfect cone of exactly the right texture.

If you do not wish to mount your speaker in a cabinet procure a plywood baffle board, not less than 2 feet square and about ⅜" thick. Cut a fret 1" less in diameter than that of the cone. It is important that the fret be of such a design as provides a member of a size suitable for mounting the unit. See sketch. Now drill a ¾" hole in the centre of the fret to clear the loudspeaker adjusting screw, and two ⅛" holes to carry the fixing screws. The dimensions are given on the sketch. The unit should now be tightly bolted to the fret with the nuts and bolts provided. Now fix the terminal block in a convenient position at the back of the baffle about 9" from the centre of the fret. Connect two pieces of flex between the terminal block and the terminals on the unit. Fix the leads so that they are taut and flush with the baffle, as the edge of the cone will have to rest on them.

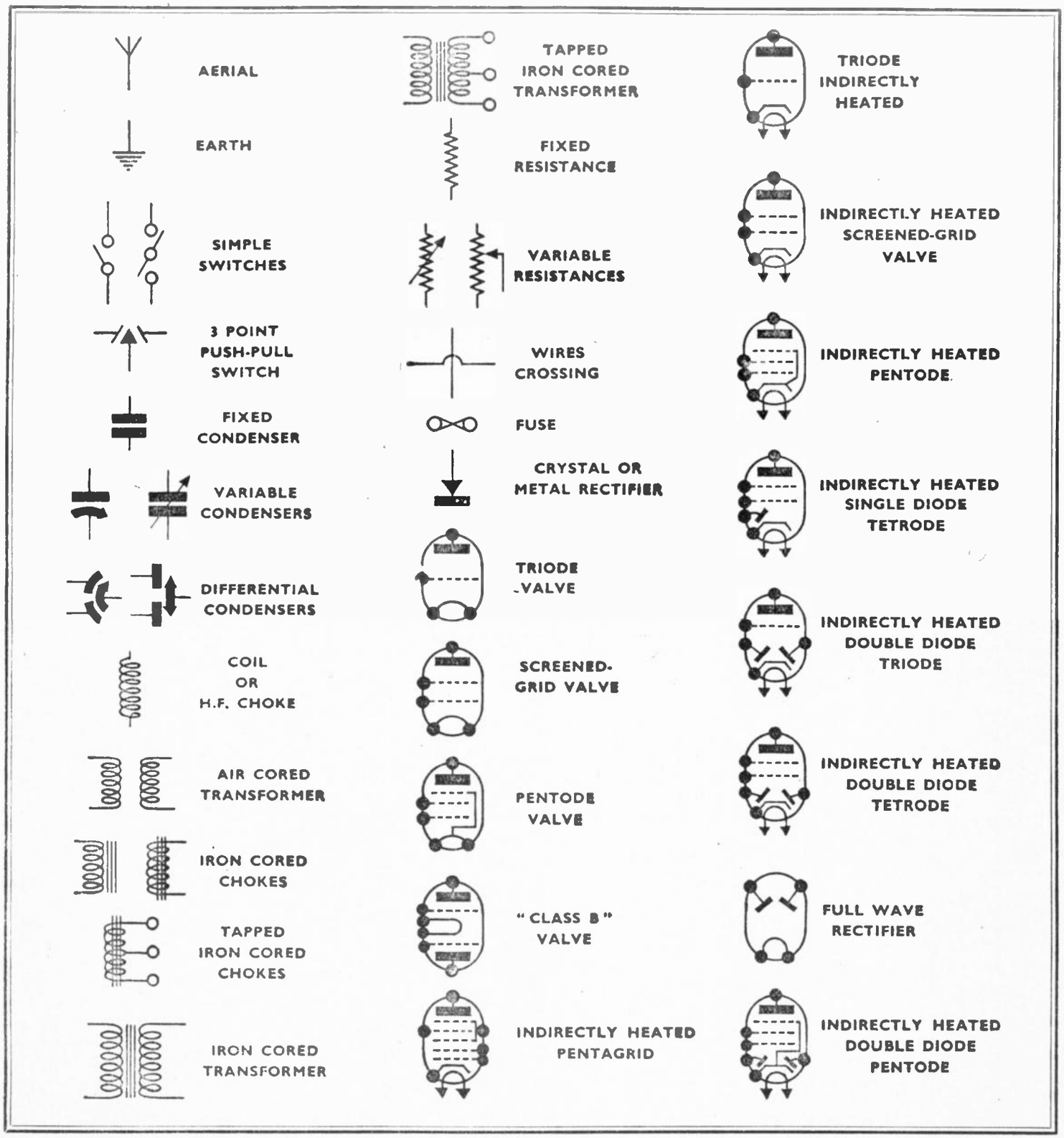


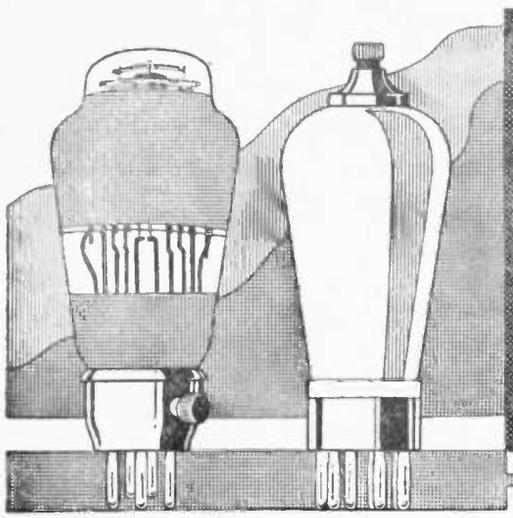
Now fix the cone washers to the apex of the cone, placing one on either side and locking them in position on to the chuck with the nut provided—see sketch.

Fix the stylus into the chuck on the unit and slide the cone on to the stylus until the edge is just touching the baffle. A small "U" piece may be cut in the edge of the cone to clear the leads which run to the terminal block. Tighten the chuck at the apex of the cone, locking it securely into position, and your loudspeaker is complete.

MODERN DIAGRAMMATIC SYMBOLS

Beginners are recommended to study the following list of diagrams, as a knowledge of them will enable constructors to follow the theoretical circuits given in this and other publications.





LATEST TYPES of VALVES

By **T. D. HUMPHREYS,**

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155, Charing Cross Road, W.C.2.

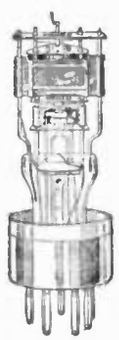
THE past year has marked a very real advance in valve design, and the purpose of this article is to introduce readers to some of the latest developments in this sphere.

The battery user in particular has been well served, and for the first time those who are compelled to use this source of H.T. supply are able to obtain a large peak output without incurring heavy running expenses.

Several economical methods of output stage operation are available. Firstly there is the quiescent push-pull operation of either a matched pair of triodes or pentodes. As an alternative to Q.P.P. a Class B or positive drive output stage can be employed. The latter generally necessitates more alteration to an existing receiver, as a special driver transformer is essential.

The Mazda battery range includes valves suitable for both the above-mentioned circuit arrangements, and there are now two types of Class B valves available, one operating at zero bias and the other requiring a negative grid bias of between $4\frac{1}{2}$ and $7\frac{1}{2}$ volts. The output obtainable from these valves is of the order of $2\frac{1}{2}$ watts, and at once puts the battery set on an equal footing with a mains receiver from the point of view of power output.

As a result of the greater power which can be handled without distortion, the detector stage is frequently expected to handle a larger high frequency input than can be dealt with by a leaky grid detector. The use of a diode detector in such a case is always to be recommended as an almost unlimited input can be handled without distortion and a diode detector is capable



AC/HL.DD

L2/DD

of being more linear than a leaky grid detector under most conditions.

The reason this form of detection has not previously come greatly into favour in battery receivers is that its inclusion has necessitated the use of an additional valve which has no effect on the overall amplification of the receiver. With the introduction, however, of the Mazda L.2/DD, the advantages of diode detection are obtainable while the inclusion of a triode enables the stage gain of the receiver to be maintained without increasing the overall number of valves. Not only does the L.2/DD offer these advantages, but, being a double-diode triode, one of the diodes can be used to provide automatic volume control for the H.F. stages.

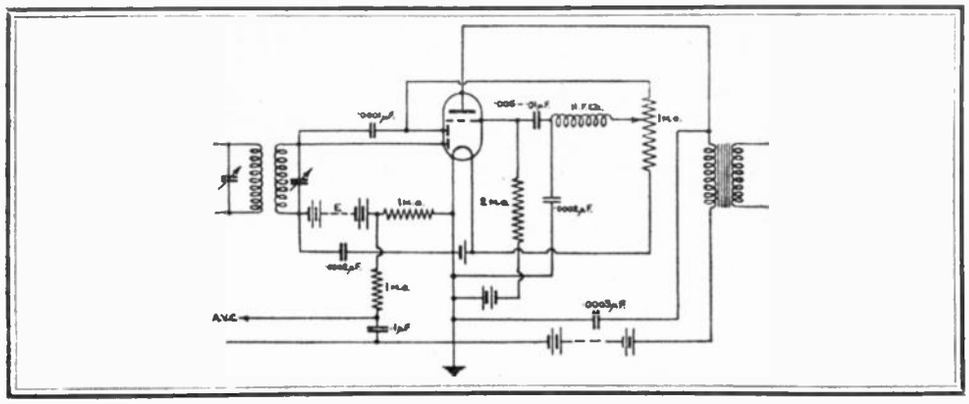
PD220A

In view of the ease with which this valve can be incorporated in many types of existing sets to give greatly improved results, a few notes on its use are not out of place. The basic principle of "automatic volume control" is very simple. A portion of the high frequency input to the detector is rectified by means of one of the diodes of the L.2/DD, and the D.C. voltage developed across the external load used to provide bias for the high frequency valves. As will be seen, the D.C. voltage increases with strength of carrier, and in consequence, magnification of the high frequency stages is reduced, thus bringing the output signal to approximately the same volume as on a weaker station.

This valve is adaptable to a great number of circuits providing both automatic volume control and straight detection, and a typical

SOME NEW VALVES—*continued*

circuit arrangement is shown in the accompanying diagram. It will be seen that the battery " E " puts negative bias on the diode anode providing automatic volume control, and in consequence no current will flow through the one megohm load resistance



until the incoming signal exceeds the bias in value. Since no voltage is set up across the load resistance unless this predetermined delay voltage is exceeded by the carrier amplitude, the high frequency stages are running at maximum efficiency on very weak signals. Such a system of delayed automatic volume control is much to be preferred to a simpler system in which no delay voltage is employed.

One of the advantages of this type of detector valve is that the properties of detection and low frequency amplification are divided, with the result that low frequency amplification can be obtained with a minimum of distortion due to overloading produced by incorrect operating conditions of the triode portion of the valve. Those users of triode detectors of either the leaky grid or anode bend types may, however, feel loath to discard their existing arrangements in view of the increased range obtained with an ordinary detector by using reaction. Provided that they are prepared to sacrifice a certain amount of power handling capacity, it is quite simple to apply reaction to a diode detector. All that is necessary, is to remove the high frequency choke normally fitted to the grid circuit of the L.2/DD, and insert it in the anode circuit. As will be seen, by removing this choke, the high frequency input to the diode anode is also transferred to the grid of the L.2/DD, which consequently amplifies this signal as well as the low frequency signal. Reaction is then applied from the anode of the triode section in the ordinary way, by means of a variable condenser and coil to earth.

With the exception of the heater and bias connections, the AC/HL.DD circuits are in every way the same as those designed for the use of the L.2/DD, though, of course, it is very rarely necessary to include reaction in a mains receiver. Owing to the long grid base of mains variable mu valves " amplified automatic volume control " is frequently necessary in order to obtain sufficient control of amplification.

The method of obtaining this is to feed one diode for detection in the ordinary way, and omit the high frequency choke from the grid lead of the triode section. The high frequency input for the diode providing the amplified automatic volume control, is then obtained through a small capacity condenser connected to the triode anode. The high frequency component of the incoming signal is thus amplified by the triode section before being rectified to provide the bias for the variable mu valves.

In spite of the outstanding improvements which can be effected in battery set design as a result of the recent valve developments in the battery range, the mains user has by no means been neglected and many new types of valves both H.F. and L.F. have made their appearance.

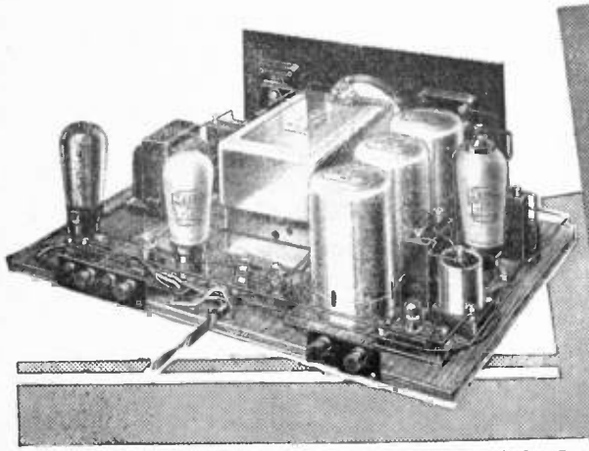
In view of the exceptional popularity of the super-heterodyne receiver brought about by the present requirements for selectivity, particular interest is attached to the Mazda AC/S2 Pen. H.F. Pentode. This valve has a very wide application in both straight sets and super-hets., though being a non-variable-mu type, its main use is as a frequency changer using either cathode or suppressor grid injection in a set of the latter type. When so used, its conversion efficiency is higher than that of any type of valve previously introduced. This fact, combined with its high mutual conductance of 6 milliamps. per volt, renders the highest possible gain per valve to be obtained.

The difficulty of designing a triode detector stage capable of handling very large inputs, while less than in the case of battery work, is nevertheless considerable, and in consequence the Mazda AC/HL.DD double-diode-triode is of great importance to the enthusiast wishing to obtain the highest stage gain consistent with good quality. This valve consists essentially of a triode of the AC/HL type, constructed in the same bulb as a double diode valve, and enables the same results to be obtained as with the L.2/DD, namely the capacity to handle large inputs, the provision of A.V.C. and high stage gain accompanied by very high quality.

Turning our attention to the L.F. side of the receiver, the most outstanding addition to the Mazda range takes the form of a high efficiency output pentode type AC.2/Pen. This valve has a mutual conductance of 8 milliamps. per volt, and requires only a little over 2½ volts grid swing to give its maximum undistorted output of 3.4 watts. For those wishing to obtain a large power output without employing high voltage output valves, the AC.2/Pen is worthy of very serious consideration, as only 250 volts are required for screen and anode in order to obtain maximum output, while the anode dissipation does not exceed 8 watts.

The introduction of this valve opens up a new sphere in single valve loudspeaker receivers and amplifiers. It is quite a practical possibility to construct a single valve receiver utilising the AC.2 Pen. as a power grid detector and amplifier, to give a power output of well over 1 watt on a local station. In the case of gramophone amplification, it is desirable when using a fairly low impedance pick-up such as the B.T.H., to feed it into the valve through a 3.5 or 5: 1 low frequency transformer when it will be found that the valve can be almost fully loaded on average records without the use of any intermediate low frequency stage.

With the advent of so many new types of valves during the last few months, the valve manufacturers have provided almost boundless scope for receiver developments, and though it is not possible in this article to give more detailed information on their applications, no doubt the reader will be able to adapt these types to his own requirements to the best advantage.



THE TELSEN BANDPASS 3

A SUPER SELECTIVE "S.G.3" BATTERY RECEIVER—USING "BANDPASS" TUNING TO MEET PRESENT DAY SELECTIVITY PROBLEMS

NO matter how efficient coils may be, the resonance curve of a single tuned circuit is far from ideal for the reception of music or speech. The audible frequencies extend over more than 9,000 cycles so that to ensure good quality the circuit should respond equally to the carrier frequency of the transmitter and frequencies up to 9,000 cycles each side of the carrier frequency. In actual practice, it is desirable to limit the response to about 5,000 cycles owing to the necessity of eliminating interference from neighbouring transmitters. The response curve, therefore, should be flat topped covering a band of frequencies up to 5 k.c. either side of the carrier frequency, where it should fall very steeply in order to ensure the complete elimination of unwanted signals. Curve "a" of Fig. 1 is the response curve of an efficient-tuned circuit, but an examination shows that this curve while selective does not fulfil the conditions required. The sharp peak shows

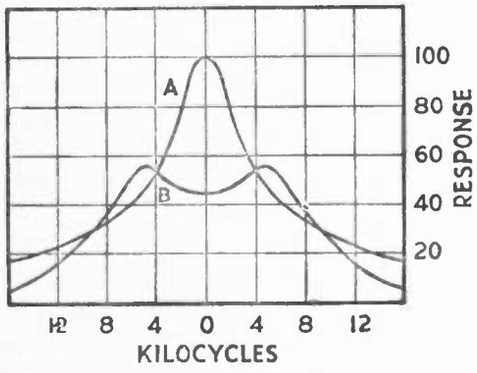
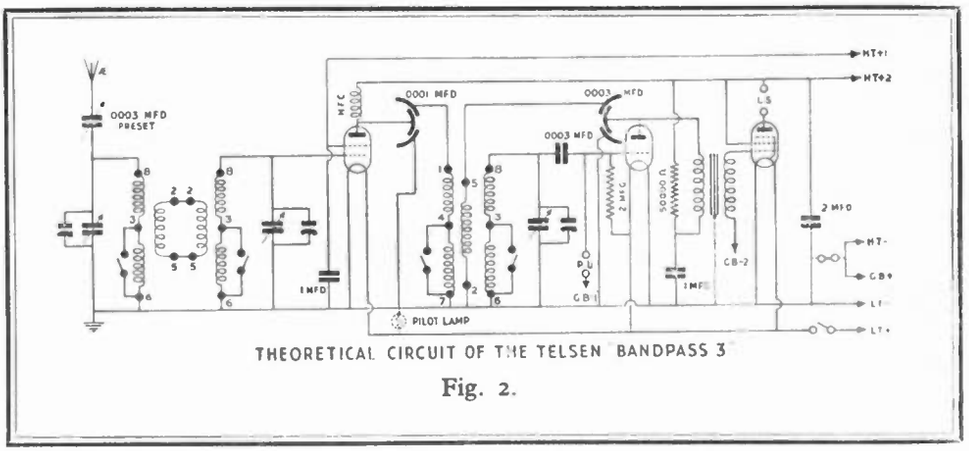


Fig. 1.

an excellent response to the carrier frequency but gives a very poor response to the higher audio frequencies. At 5,000 k.c. above and below the carrier frequency, the response has fallen nearly 50 per cent.

In order that good quality may be obtained, use is made of the properties of coupled circuits. If the coils of two circuits are coupled together a transfer of energy takes place between the coils owing to their mutual inductance. Should the coupling be very close the two circuits will respond as one, but by adjusting the coupling, two resonant peaks can be produced. The combined response curves, although of smaller amplitude, produce a substantially flat topped characteristic, as shown by curve "b" of Fig. 1. Such an arrangement is known as a band pass filter, and is incorporated in the receiver about to be described.

Referring to the circuit diagram given in Fig. 2, it will be observed that the circuit is substantially the same as that of the S.G.3, described elsewhere in the *Modern Radio Engineer*, with the exception that an extra tuned circuit is incorporated. This involves the use of three coils and a triple gang condenser. The aerial is coupled through a pre-set condenser to the Telsen band pass coil unit, W.290. This gives an enormous increase in selectivity without any loss of quality. A stage of high frequency amplification follows. This employs a screen grid valve choke coupled through a differential condenser to the tuned grid circuit of the detector. A Telsen screen coil is used as this is designed to match the band pass coils, thus enabling a triple ganged condenser to be employed. The differential coupling to the tuned grid coil is of especial interest. The amplification of a receiver of this type is considerable and some form of volume control is essential. The .0001 differential condenser performs this function in an exceptionally efficient manner by varying the amount of energy passed on from the H.F.



THEORETICAL CIRCUIT OF THE TELSEN BANDPASS 3

Fig. 2.

THE TELSEN "BANDPASS S.G.3"—*continued*

valve. Unlike systems that employ wire-wound potentiometers, the control is absolutely silent in operation. Furthermore, by varying the input to the detector stage, a valuable additional control of selectivity is provided. In operation, this condenser is used in a similar manner to the aerial series or separator condenser used on other receivers described in this magazine.

The Band Pass 3 employs cumulative or leaky grid detection, while a .0003 differential reaction condenser feeds back energy from the plate to the grid circuit. Finally, the audiofrequency output of the detector is stepped up by a 7 : 1 Radiogrand transformer and coupled to a pentode output valve. It will be observed that generous decoupling is provided throughout the receiver so that it is absolutely stable in operation over all wavebands. The construction does not call for any special comment as it will be found as straightforward as the building of the receivers so far described.

Those constructors who already possess a *Modern Radio Engineer's* Constructor's Outfit will have all the necessary non-standard parts not shown in the list of components. The only exceptions are the baseboard and panel. A special panel is required, dimensions and drilling instructions for which are

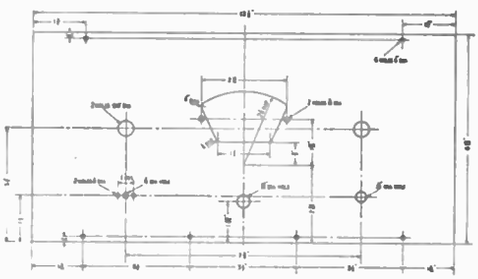


Fig. 3.

given in Fig. 3. The baseboard should be $\frac{3}{8}$" plywood, $17\frac{1}{2}$"×$11\frac{1}{2}$". The wavechange switches are incorporated in the coils. By arranging the coils in line, all switches can be operated simultaneously by one knob. The operating rods supplied with the coils are not long enough for this purpose, but constructors can obtain a suitable $10\frac{1}{2}$" rod for 6d., post free, on application to Telsen Electric Co., Ltd., Aston, Birmingham.

Assembly

Having prepared the panel as shown in Fig. 3, the panel components should be assembled. If a metal panel is used care should be taken to insulate the differential condensers. The mounting of these condensers is illustrated in Fig. 4. The procedure is as follows :—

Remove the knob, and take off all the loose assembly pieces on the condenser shank,

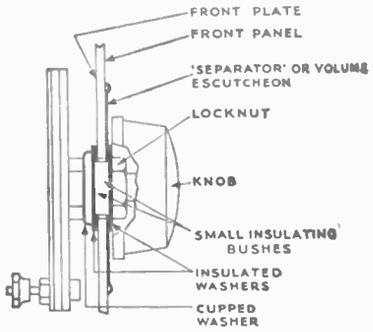


Fig. 4.

namely the lock nut, spare lock nut, two large insulating washers and one insulating bush. Now place on the condenser shank the cupped washer contained in the Constructor's Outfit, then a large insulating washer, and then the two thick insulating bushes that are also contained in the Constructor's Outfit.

The cupped washer should be so fitted that the cupped portion (see Fig. 4) faces away from the bakelite condenser. Insert from the back through the lower left hand hole, the condenser being disposed as shown in the Blue Print. See that the washer lies flat against the back of the front plate and the front edge of one thick bush therefore just projects at the front. Place the escutcheon on the projecting bush, then the second large insulating washer and finally screw loosely to the shank the locking nut.

Rotate the escutcheon plate into its correct position, and holding the whole assembly firmly, screw up the lock nut tightly. Now fix the knob on to the condenser spindle. Details for fixing the escutcheon of the tuning condenser will be found enclosed with the condenser.

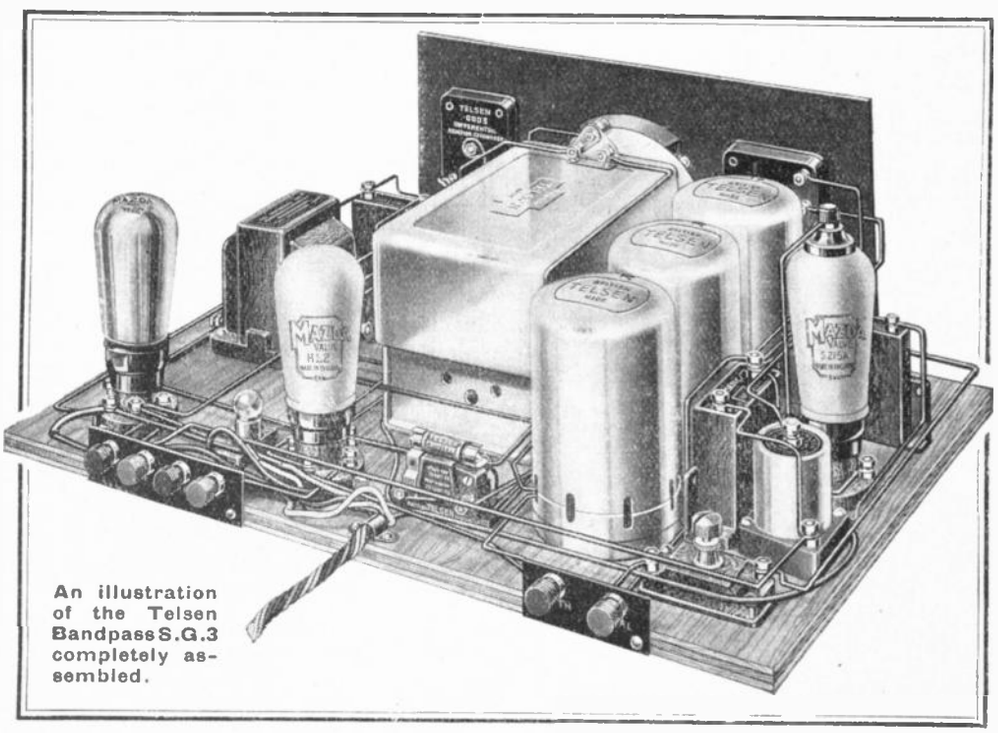
The two-point push-pull switch should now be fitted in the position shown in the black print.

This completes the panel assembly.

The baseboard should now be assembled.

Fig. 5.

The position of the various components is clearly indicated in the black print which is drawn to scale.



An illustration of the Telsen Bandpass S.G.3 completely assembled.

WIRING INSTRUCTIONS FOR THE "BANDPASS S.G.3"

The variable condenser should be fixed first in accordance with the instructions supplied with it. The panel should then be screwed to the baseboard and the other components fitted. Before fixing the 1 mfd. condenser " B," a spare terminal should be assembled to the long fixing flange (see Fig. 5). This terminal provides an anchorage for the 50,000 ohm resistor. The grid leak and .0003 condenser should be assembled as

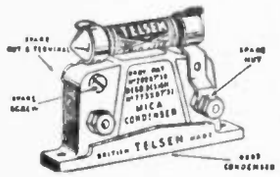


Fig. 6.

shown in Fig. 6. The metal plinth supplied with the band pass coils should be removed as it is not required. Note that the band pass coils are those marked " A " and " B " on the black print and should be fitted as shown. The screen coil " C " occupies the rear position. The coils should be placed in position and the 10½" switch rod should be inserted to pass through all the coil switch holes, placing the switch stop and the loose collar in the positions indicated in the black print. Place the knob on the switch rod where it projects through the panel and slide the rod backwards or forwards until the knob has the same spacing from the front panel as that of the differential condensers. The switch stop should be located very close to the screen base of the rear coil and then screwed up tightly. The coils should then be screwed down to the baseboard.

Having assembled all the components and the two terminal strips, the receiver is ready for wiring.

Wiring

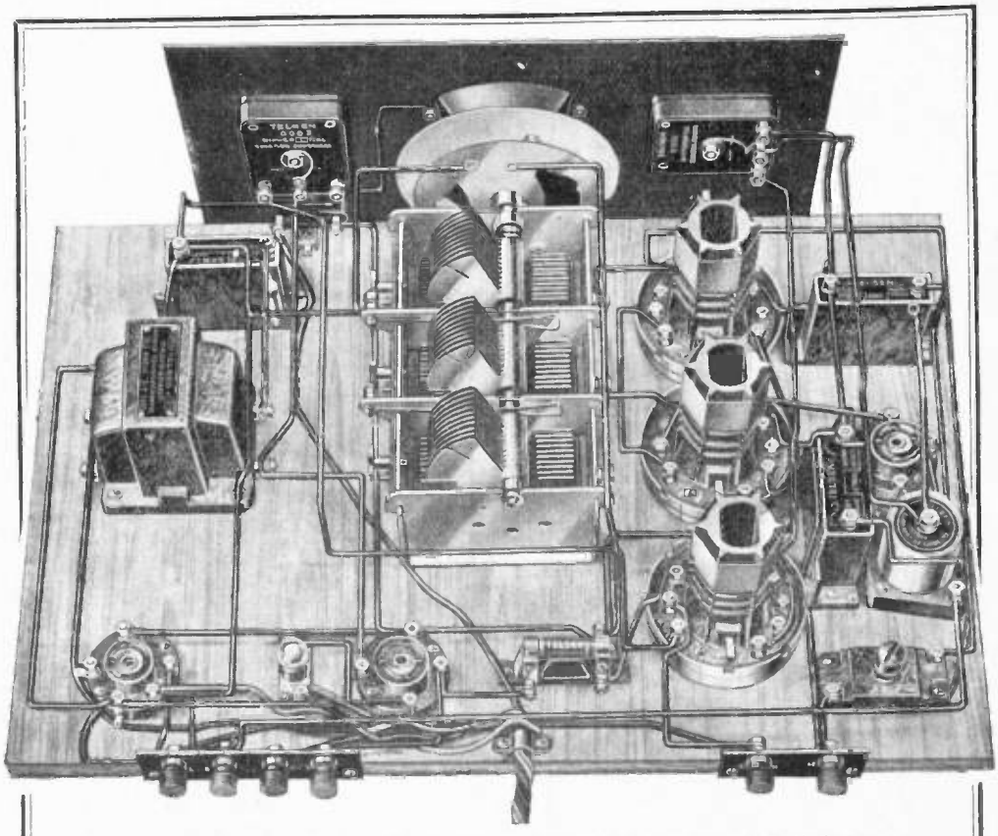
The special insulated connecting wire is to be used in accordance with the instructions given on page 8.

Connect terminal :—

1 on aerial-earth strip to 2 on V2.
2 on V2 to 3 on fuse holder.
2 on V2 to 4 on V3.
4 on V3 to 5 on transformer.
5 on transformer to 6 on 1 mfd. condenser " B."
6 on 1 mfd. condenser " B " to 7 on .0003 mfd. differential reaction condenser.
7 on reaction condenser to 8 on metal panel.
6 on 1 mfd. condenser " B " to 9 on ganged condenser.
1 on aerial-earth strip to 10 on coil " C."
10 on coil " C " to 11 on coil " C."
11 on coil " C " to 12 (the fixing screw) on coil " C."
12 on coil " C " to 13 on coil " C."
1 on aerial-earth strip to 14 on 2 mfd. condenser.
14 on 2 mfd. condenser to 15 on H.F. choke.
15 on H.F. choke to 16 on V1.
14 on 2 mfd. condenser to 17 (the fixing screw) on coil " B."
17 on coil " B " to 18 on coil " B."
14 on 2 mfd. condenser to 19 on 1 mfd. condenser " A."
19 on 1 mfd. condenser " A " to 20 (the fixing screw) on coil " A."
20 on coil " A " to 21 on coil " A "
19 on 1 mfd. condenser " A " to 22 on .0001 mfd. differential condenser.
23 on aerial-earth strip to 24 on .0003 mfd. pre-set condenser.
25 on .0003 mfd. pre-set condenser to 26 on coil " A "
26 on coil " A " to 27 on ganged condenser.
28 on coil " A " to 29 on coil " B."
30 on coil " A " to 31 on coil " B."
32 on coil " B " to 33 on ganged condenser.
32 on coil " B " to 34 on V1.
35 on V1 to 36 on 1 mfd. condenser " A."

From 37 on H.F. choke a lead is taken to the terminal at the top of valve V1.

37 on H.F. choke to 38 on .0001 mfd. differential condenser.
39 on .0001 mfd. differential condenser to 40 on coil " C."
41 on coil " C " to 42 on .0003 mfd. fixed condenser.
42 on .0003 mfd. fixed condenser to 43 on ganged condenser.
44 on coil "C" to 45 on .0003 mfd. differential reaction condenser.
46 on V1 to 47 on .0003 mfd. fixed condenser.
47 on .0003 mfd. fixed condenser to 48 on V2.
48 on V2 to 49 on V3.
48 on V2 to 50 on switch.
51 on .0003 mfd. fixed condenser to 52 on V2.
52 on V2 to 53 on pick-up strip.
54 on V2 to 55 on transformer.
55 on transformer to 56 on .0003 mfd. differential reaction condenser.



Plan View of the Telsen Bandpass S.G.3 with Valves and Coil Screens removed showing connections.

MAKING FINAL ADJUSTMENTS TO THE "BANDPASS S.G.3"

57 on transformer to 58 on 1 mfd. condenser "B."

59 on transformer to 60 on V3.

61 on V3 to 62 on loudspeaker strip.

63 on V3 to 64 on 1 mfd. condenser "B." (This terminal is formed by passing a bolt through the fixing hole and securing with a lock nut, the wire being held by a terminal head.)

63 on V3 to 65 on loudspeaker strip.

65 on loudspeaker strip to 66 on H.F. choke.

66 on H.F. choke to 67 on 2 mfd. condenser.

If it is intended to use a pilot lamp, two wires should now be connected as follows, these wires being shown dotted in the Blue Print :-

68 on pilot lamp holder to 47 on .0003 mfd. fixed condenser.

69 on pilot lamp holder to 9 on ganged condenser.

Connect a 50,000 ohm resistor between 58 and 64 on 1 mfd. condenser "B."

Now prepare the battery cord in accordance with the instructions on page 8.

The battery cord should now be connected to the receiver as follows :—

The white lead H.T.— to 70 on fuse holder.

The red and white lead G.B.+ to 70 on fuse holder.

The black lead L.T.— to 4 on V3.

The red lead L.T.+ to 71 on switch.

The yellow lead G.B.—1 to 72 on pick-up strip.

The green lead G.B.—2 to 73 on transformer.

The blue lead H.T.+1 to 35 on V1.

The maroon lead H.T.+2 to 63 on V3.

This completes the wiring.

Connecting-up and Adjusting The Telsen "Bandpass 3"

Place in valve holder V1 a screened grid valve, connecting the long lead issuing from terminal 37 to the top terminal of the valve in V1. Insert the detector valve in V2 and the pentode valve in V3. The pentode valve should be of the 5-pin type, but if it has four valve pins only, a small length of wire should be joined between terminals 63 of V3 and the terminal on the side of the pentode valve. Next connect up the aerial and earth leads and attach the loudspeaker to the correct terminals.

If it is desired to illuminate the tuning dial, a 2.5 volt .2 ampere flashlamp bulb should be inserted in the holder mounted on the condenser cover. This component may be purchased from your local dealer. A Telsen fuse bulb W.318 is then placed in the fuse holder.

Insert G.B.+ wander plug into + tapping of grid bias battery.

Insert G.B.—1 wander plug into —1½ volt tapping of grid bias battery.

Insert G.B.—2 wander plug into —7½ volt tapping of grid bias battery.

Insert H.T.— wander plug into — tapping of H.T. battery.

Insert H.T.+1 wander plug into +102 volts H.T.

Insert H.T.+2 wander plug into +120 volts H.T.

Connect spade of black lead to — terminal of accumulator.

Connect spade of red lead to + terminal of accumulator.

It should be noted that the value of voltage of G.B.—2 depends on the type of pentode valve used in the output stage. It is here advisable to consult the makers' valve instructions as to the value of grid bias to be used.

The volume and reaction controls should now be turned fully clockwise and anti-clockwise respectively, the wavelength switch set to the medium range, finally switching on the L.T. current by means of the on-off switch. On rotating the tuning control knob, stations will be received, and the receiver should be similarly tested on the long wavelength range.

The set is now ready for ganging. This is carried out as follows.

On the side of the variable condenser will be found three small star shaped wheels which when rotated in a clockwise direction increase the capacity of the trimming condensers which are in parallel with the main tuning condenser. These trimming condensers should be adjusted about half-way. Now set the pre-set condenser about half in and adjust the reaction near to oscillating point. Then tune in a fairly weak station at the bottom end of the medium wavelength band. Now adjust the trimming condensers by means of the star wheels until maximum signal strength is obtained. Each trimmer should be set separately and while this operation is taking place the main tuning control should not be moved under any circumstances. A much weaker station at a lower wavelength than before should now be tuned in, and the above procedure repeated until the receiver is ganged up to a very high degree of precision. Then, on tuning in a station at the top end of the medium wavelength band, it will be found that the ganging still holds and no further adjustment is required.

Recommended Valves and Batteries

Mazda S.G.215A ; H.L.2 ; Pen.220A or Pen. 220.

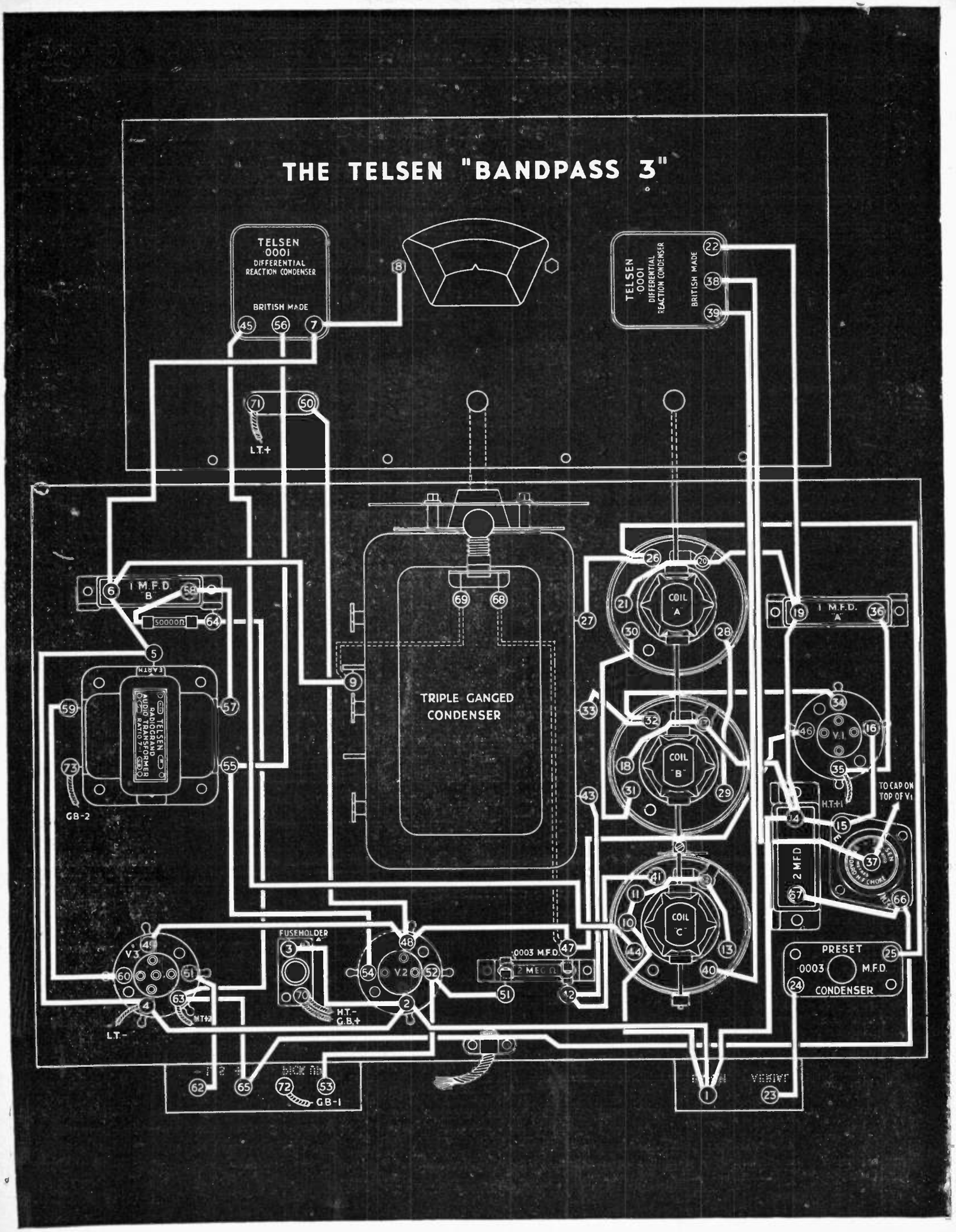
H.T. Battery : 2 of Ediswan 60 volt 20 mA. Cat. No. 69724 ; or 1 Ediswan 120 volt 20 mA. Cat. No. 69728.

G.B. Battery : 1 Ediswan 9 volt. Cat No. 69804.

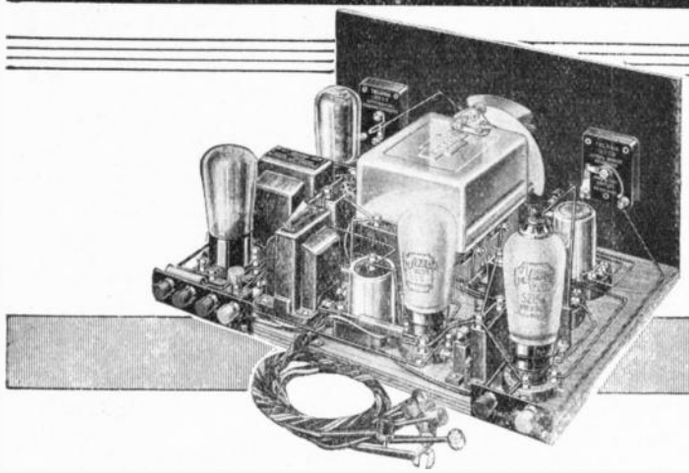
L.T. Battery : 1 Ediswan 2 volt 45 a.h. Type E.L.M.4.

THE TELSEN "BANDPASS 3" List of Components

Quantity	*Description*	*Cat No.*	*Price*
1	Telsen .0001 Differential Reaction Condenser	W.353	2/6
1	,, .0003 Differential Reaction Condenser	W 351	2/6
1	,, .0005 Triple Ganged Condenser	W 428	22/6
1	,, 2-point Switch	W.107	1 –
1	,, Band Pass Coil Unit	W 290	14 6
1	,, Screened Coil	W.216	7 –
2	,, 4-pin Anti-microphonic Valve Holders	W.222	1/4
1	,, 5-pin Anti-microphonic Valve Holder	W 223	10d.
2	,, 1 mfd. Paper Condensers	W 227	4 6
1	,, 2 mfd. Paper Condenser	W 226	3 –
1	,, Screened H.F. Choke	W.341	3 6
1	,, .0003 Mica Condenser	W.242	1 –
1	,, 2 meg. Grid Leak	W.251	1 –
1	,, 50,000 ohm resistor	W.420	1 –
1	,, Fuse Holder	W.146	6d.
2	,, 2.5 volt Pilot Lamps	W 417	1 –
1	,, 7 : 1 Radiogrand Transformer	W.60	10 6
1	,, .0003 Pre-set Condenser	W.151	1 6



THE TELSEN CLASS B·4



AN OUTSTANDING FOUR VALVE "CLASS B" RECEIVER—EMPLOYING THE LATEST "IRON CORED" COILS — SINGLE KNOB TUNING — AND GIVING "MAINS QUALITY" OUTPUT WITH LOW BATTERY CONSUMPTION !

THOSE who have constructed the Class B Three described earlier in this journal will have become acquainted with the enormous output obtainable and the extremely economical running costs of the Class B system.

If, however, constructors are so situated that reception from distant stations is poor they will want a similar receiver, but with the addition of a high frequency stage of amplification. This desirable combination is found in the receiver now to be described.

Although the receiver incorporates two of the very latest developments in radio, the construction is extremely simple. The combination of iron cored coils and Class B system produces a receiver of outstanding performance, giving great output with exceptional selectivity and sensitivity. The practically fieldless coils and careful circuit design ensure stability without the necessity of using the inconvenient metal baseboard. Too little attention has been given to this factor by designers.

The wooden baseboard is unsurpassed for home construction, as it allows great latitude to the constructor when making modifications arising out of new developments. For this reason all the receivers described in this magazine make use of the wooden baseboard.

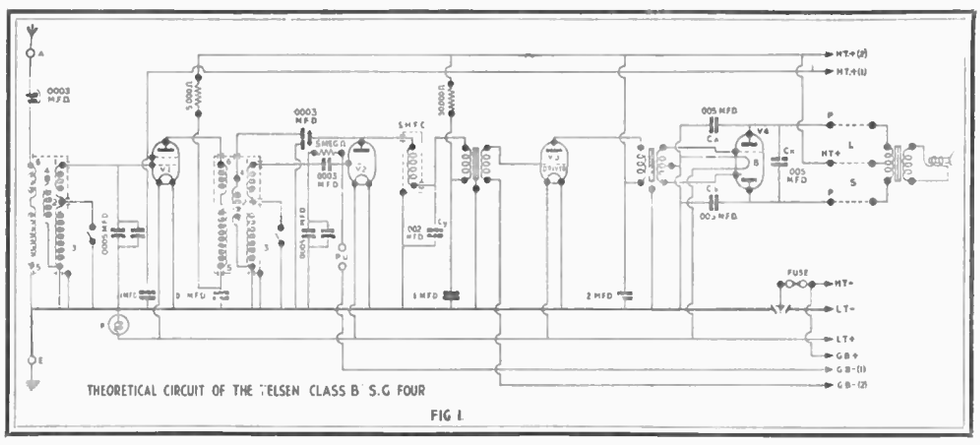
An example of the latitude allowed and the great economy effected is shown by the fact that all the receivers up to, and including, the "Class B" S.G.4 are built on baseboards of identical dimensions, with the exception of the Band Pass 3.

Constructors who have, therefore, built the Battery S.G.3 will only be called upon to re-arrange the components on the baseboard to convert the receiver to the instrument now being described. Practically all the components employed in the S.G.3 can be used as the only alteration is the conversion of the low frequency stage.

The receiver is built round the Modern Radio Engineer's Constructor's Outfit, which contains all the specialised parts, such as baseboard, panel, battery cord, terminals, screws, connecting wire, and all parts not obtainable as standard components.

The receiver employs four valves, screen grid H.F. amplifier, detector, driver, and Class B output valves.

The Telsen patented aerial series condenser in the aerial circuit provides a variable aerial coupling giving a wide control of selectivity and sensitivity. As in the case of the S.G.3, a Telsen iron cored coil is employed as a high frequency transformer, but an "Ace" low frequency transformer couples the



THEORETICAL CIRCUIT OF THE TELSEN CLASS B S.G FOUR

FIG 1

At the end of this article is given a complete list of the components required to build the set so that constructors who have not built any of the receivers so far described in this magazine may ascertain the number of components required, and on purchasing them, together with the Constructor's Outfit, may build the receiver without trouble, or unnecessary expense.

Readers who are familiar with theoretical circuit diagrams are referred to the diagram given in Fig. 1. It will be observed that detector to the driver valve. Generous decoupling is provided to both detector and H.F. valves, precautions which are particularly essential to ensure stability where "Class B" amplification is employed. Smooth reaction control is ensured by the incorporation of a differential reaction condenser, which provides the necessary "feed back" to the H.F. transformer coil.

The driver valve is coupled to the "Class B" output valve by the special Telsen 1.5 : 1 driver transformer, the ratio of which is

THE "CLASS B" FOUR RECEIVER—*continued.*

found to be the most efficient with the "Class B" valve specified.

"Class B" is a form of "push-pull," a system of amplification which is subject to self oscillation unless special precautions are taken. Two condensers are, therefore, connected between the plates of the "Class B" valve and earth, thus ensuring complete stability. A further condenser is connected between both plates of the Class B valve, to prevent the load impedance rising with frequency to an unduly high value and introducing distortion.

As in the case of the Battery S.G.3, five controls, including switches, appear on the panel, viz., wave change switch, on-off switch, tuning control, separator and reaction or volume control.

Constructors should note that the loudspeaker to be used with the receiver should be fitted with a special "Class B" output transformer. It will be found that this transformer has a centre tap, and requires three connections instead of the usual two. The two loudspeaker terminals provided on

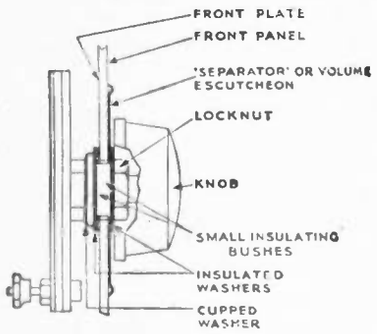


Fig. 2.

the terminal panel should be connected to the outside terminals on the loudspeaker transformer. The centre tap on the transformer should be connected to the half terminal block which is mounted on the baseboard near the terminal strip.

Constructors who desire to use a loudspeaker with a high resistance speech coil or one that is already fitted with a transformer, that is unsuited for "Class B" can overcome the difficulty by employing a Telsen "Class B" output choke W.345. The choke has three terminals which connect to the output of the receiver, and two terminals for connecting to the loudspeaker. Full instructions for use are supplied with the component.

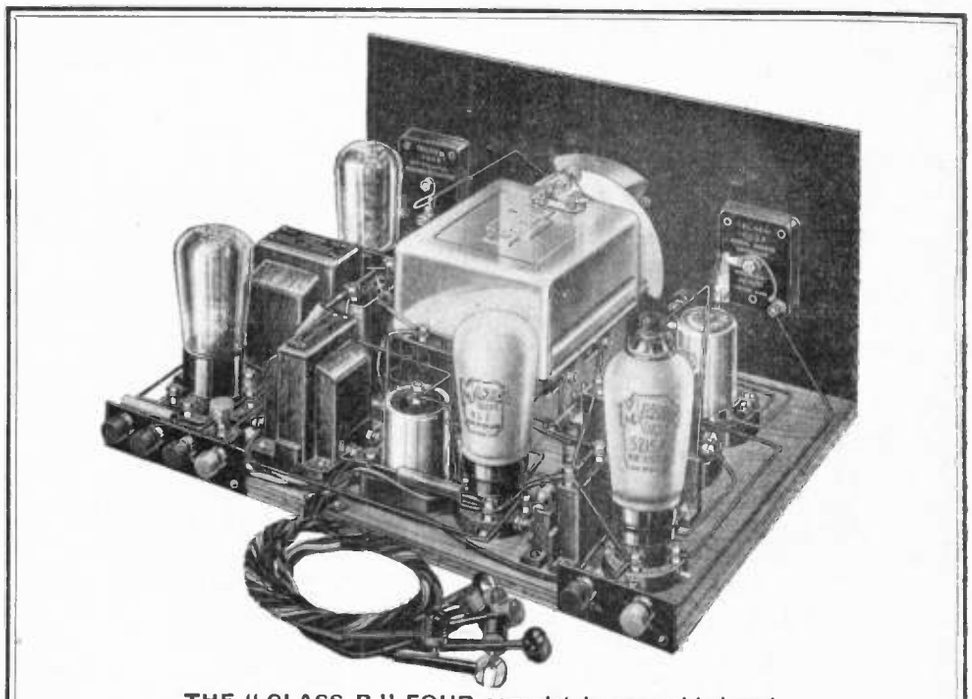
A black print of the wiring is given and constructors who follow this in conjunction with the point to point wiring will find construction extremely simple.

Assembling the Panel

This follows the procedure given for the Battery S.G.3, and constructors who have built that receiver will find that the control panel need not be dismantled as it is identical to the panel used in the receiver now being described. Constructors who have not built any of the other receivers described in this magazine should commence by mounting the components on the panel. The escutcheon plate supplied with the ganged condenser should be placed in position on the front of the panel, and the fixing screws inserted. The nuts may then be screwed on at the back and tightened. Next mount the aerial series condenser (with switch) in the hole on the extreme left of the panel, taking care to see that the spindle is insulated. To do this special insulating washers are provided, and the method of fixing them is illustrated in Fig. 2. First, fit over the screwed fixing bush, one of the cupped washers supplied with the kit, so that the cupped portion faces away from the condenser body, follow this by a large flat insulating washer, then by a small insulating washer. Next, from the back of the panel, insert the fixing bush and spindle of the condenser into the appropriate hole. The condenser should be disposed so that the terminals are in the positions shown in the black print. See that the cupped washer and the large flat insulating washer lie flat against the back of the panel; the small insulating washer should fit into the hole in the panel and should project at the front a little, as it is slightly thicker. Over this projecting portion the appropriate escutcheon plate ("volume" or "separator" as the case may be) is fitted, and after this, another large flat washer, and the condenser fixing nut. Rotate the escutcheon plate so that its indication is at the top, and holding the whole assembly firmly, screw up the fixing nut tightly by means of the special spanner provided. After this, the knob may be fitted.

The differential reaction condenser may now be fitted to the hole on the extreme right, and must be secured in the same manner as the aerial condenser.

Next fit the two switches to their respective holes as shown in the black print. This completes the panel assembly.



THE "CLASS B" FOUR completely assembled and ready for testing.

Assembling the Baseboard

The mounting of the components on the baseboard may now be proceeded with.

First fix the variable condenser in accordance with the instructions supplied with it. Pay particular attention to the mounting of the valve holders, making certain that they are disposed in exactly the same positions as shown in the black print. The positions occupied by the components can be clearly ascertained from the black print, but constructors who prefer, can obtain a full-size Blue Print, price 1/-, on application to Telsen Electric Co., Ltd.

After mounting the components the aerial and loudspeaker terminal panels should be assembled and mounted on the back edge of the baseboard in the position shown. The colours of the various terminals from left to right looking at the back of the receiver are

THE "CLASS B" FOUR WIRING INSTRUCTIONS

black red, black red, black red. As mentioned above the loudspeaker transformer has three connections. Only two are provided on the terminal strip. The third, or centre connection, is taken to the half terminal block, which should now be fitted in

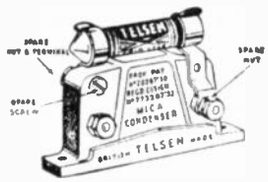


Fig. 3.

the position shown on the black print. A Telsen terminal block W.204, can be easily sawn in half by holding a hacksaw upside down in a vice, and drawing the terminal block up and down the edge.

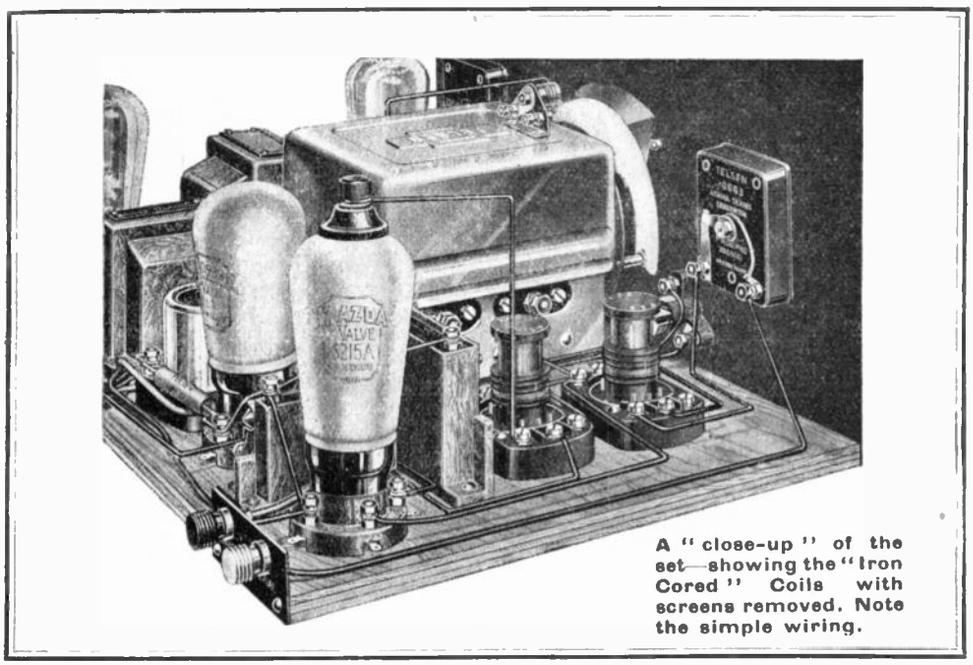
Instructions for using this wire are given on page 8.

For the convenience of constructors all terminal wiring points are numbered. It should be noted, however, that these figures exist only on the black print and bear no relationship to any markings that appear on the actual components.

The complete wiring list which follows has been arranged to facilitate wiring and the instructions should, therefore, be followed in the order given. It is a good plan to cross off the wires on the list as and when they are completed in the receiver.

Wire terminal :—

1 on aerial-earth strip to 2 on V1.
2 on V1 to 3 on .1 mfd. condenser.
3 on .1 mfd. condenser to 4 on V2.
4 on V2 to 5 on H.F. choke.
5 on H.F. choke to 6 on " Ace " transformer.



A " close-up " of the set—showing the " Iron Cored " Coils with screens removed. Note the simple wiring.

The grid condenser and leak which connects to valve holder V2 should be mounted as shown in Fig. 3.

Having completed the mounting of the components on panel and baseboard, the panel should be secured to the baseboard. The set is then ready for wiring.

Wiring

Constructors should note that instructions for fixing the wire-end resistors and tubular grid leaks are given in the following point to point wiring instructions.

Although connections can be soldered, this is not essential. The *Modern Radio Engineer* Constructor's Outfit includes special insulated connecting wire, which is designed to enable constructors to wire their receivers without recourse to soldering.

6 on " Ace " transformer to 7 on 2 mfd. condenser.
7 on 2 mfd. condenser to 8 on ganged condenser.
(*Note.*—This is the upper terminal, connected to the frame of the condenser, not either of the lower ones, mounted on insulating panels.)
8 on ganged condenser to 9 on metal panel.
7 on 2 mfd. condenser to 10 on driver transformer.
10 on driver transformer to 11 on V4.
11 on V4 to 12 on driver transformer.
12 on driver transformer to 13 on V3.
13 on V3 to 14 on differential reaction condenser.
14 on differential reaction condenser to 15 on S2.
5 on H.F. choke to 16 on 1 mfd. condenser " B."
3 on .1 mfd. condenser to 17 on 1 mfd. condenser " A."
17 on 1 mfd. condenser " A " to 18 on Coil " B."
18 on Coil " B " to 19 on Coil " A."
19 on coil " A " to 20 on S1.
19 on coil " A " to 21 on coil " A."

Nos. 22 and 23 are the fixing screws which secure coils " A " and " B " respectively and wires should be connected to these as follows :—

19 on Coil " A " to 22 on Coil " A."
18 on coil " B " to 23 on coil " B."
24 on V1 to 25 on V2.
25 on V2 to 26 on V4.
26 on V4 to 27 on V3.

If a pilot lamp is to be used, the holder should now be wired up as follows (dotted lines are used to indicate these wires in the Blue Print) :—

27 on V3 to 28 on pilot lamp holder, and
29 on pilot lamp holder to 8 on ganged condenser.
30 on aerial-earth strip to 31 on aerial series condenser.
32 on aerial series condenser to 33 on coil " A."
34 on coil " A " to 35 on S1.
36 on coil " A " to 37 on ganged condenser.
36 on coil " A " to 38 on V1.
39 on coil " B " to 40 on S1.
41 on coil " B " to 42 on ganged condenser.
43 on coil " B " to 44 on differential reaction condenser.
45 on coil " B " to 46 on .1 mfd. condenser.
48 on V1 to 49 on 1 mfd. condenser " A."
42 on ganged condenser to 50 on .0003 mfd. condenser.
51 on .0003 mfd. condenser to 52 on V2.
52 on V2 to 53 on pick-up strip.
54 on V2 to 55 on H.F. choke.
55 on H.F. choke to 56 on differential reaction condenser.
57 on H.F. choke to 58 on " Ace " transformer.
59 on " Ace " transformer to 60 on V3.
61 on V3 to 62 on driver transformer.
63 on driver transformer to 64 on V4.
65 on driver transformer to 66 on V4.
67 on V4 to 68 on loudspeaker strip.
69 on V4 to 70 on loudspeaker strip.
71 on terminal block to 72 on 2 mfd. condenser.
72 on 2 mfd. condenser to 73 on driver transformer.
73 on driver transformer to 74 on 1 mfd. condenser " A."

This terminal 74 on 1 mfd. condenser " B " requires some explanation. The terminal is not normally provided on this component ; it is supplied loose in the Constructor's Outfit, and is fitted by the constructor to a hole in the fixing lug of the condenser, indicated on the black print. It is intended to provide a fixed anchorage for the end of the 5,000 ohm resistance to which convenient connection can be made. To fit the terminal, it is only necessary to insert the cheese-headed stem of the terminal into the hole in the condenser fixing lug and to tighten down on it the flat hexagon nut, after which the connecting wires are secured under the large hexagon-headed terminal nut provided.

Wire terminal :—

75 on fuse-holder to 76 on S2.
77 on " Ace " transformer to 78 on 1 mfd. condenser " B."

The tubular condensers and wire end resistors should now be fitted as follows :

Connect a 5,000 ohms resistor (green body, black tip, *red* band) between 46 on .1 mfd. condenser and 74 on 1 mfd. condenser " A." (*Note.*—Use only the resistor with the *RED* band.)

OPERATING THE "CLASS B" FOUR

Connect a 50,000 ohms resistor (green body, black tip, *orange* band) between 78 and 1 mfd. condenser " B " and 72 on 2 mfd. condenser. (*Note.*—Use only the resistor with the *ORANGE* band.)

Connect a .002 mfd. tubular condenser between 4 on V2 and 57 on H.F. choke.

Connect a .005 mfd. tubular condenser between 7 on 2 mfd. condenser and 67 on V4.

Connect a .005 mfd. tubular condenser between 69 on V4 and 12 on driver transformer.

Connect a .005 mfd. tubular condenser between 68 and 70 on loudspeaker strip.

At this stage the various battery leads can be connected; these are comprised in a multi-way cord, in which the various leads can be traced through by the fact that they are given distinctive colours. The Constructor's Outfit, which contains this cord, also contains a number of suitable wander plugs and a pair of spade terminals, for connection to the various leads in the cord. These should be connected as follows :—

Black	L.T.—
Red	L.T.+
Red-White (Speckled) ..	G.B.+
Yellow	G.B.—1
Green	G.B.—2
White	H.T.—
Blue	H.T.+1
Maroon	H.T.+2

Before attaching the wander plugs and spade tags, the battery cords should be separated out for a length of about 18 in.; they can, if desired, be retwisted or plaited into groups for the various batteries—a group of three H.T. leads, a group of three leads for the G.B. battery, and a pair of leads for the L.T. battery. This results in a neat appearance. When fitting the plugs and spades, and also when connecting the cords into the set, the ends should be finished off with a short length of sleeving, which will serve to conceal the frayed ends of the coloured braiding. Push back the braiding on the cord for about one quarter of an inch and cut off the wire to the same length, then slide the braiding forward again over the wire, moisten it and screw it to a point between finger and thumb, after which a short length of the sleeving can be threaded easily over the braiding and pushed forward to the wander plug or spade tag when fitted.

To fit a wander plug, the wire is bared and bent into a loop which is gripped between the screwed collar and the insulating head on the plug.

When fitting the spade terminals a larger size of sleeving is used, which can be pushed forward over the shank of the spade tag after the latter has been fitted. To fit the spade tags, a short length of sleeving is slipped over the wire, and about one and a half inches of the wire is bared and doubled back on itself so as to form a thick wire end giving a good grip for the spade tag. After the wire end is placed in the shank of the tag, the teeth are closed over one by one, using a pair of pliers so that the wire is gripped firmly, after which the finishing piece of sleeving is slid forward over the shank.

Having fitted the plugs and spades in the manner described, the free end of the battery cord should be secured under the cord clip which is fastened to the baseboard. This cord clip will be found in the Constructor's Outfit. The free end of the cord should then be untwisted and the various leads connected to the points indicated in the Blue Print, viz. :—

Connect :—

L.T.— (Black to terminal 82 on S2.

L.T.+ (Red) to terminal 25 on valve holder V2.

G.B.—1 (Yellow) to 79 on " Pick-up " strip.

G.B.—2 (Green) to terminal 80 on " Ace " transformer.

H.T.+1 (Blue) to terminal 48 on valve holder V1.

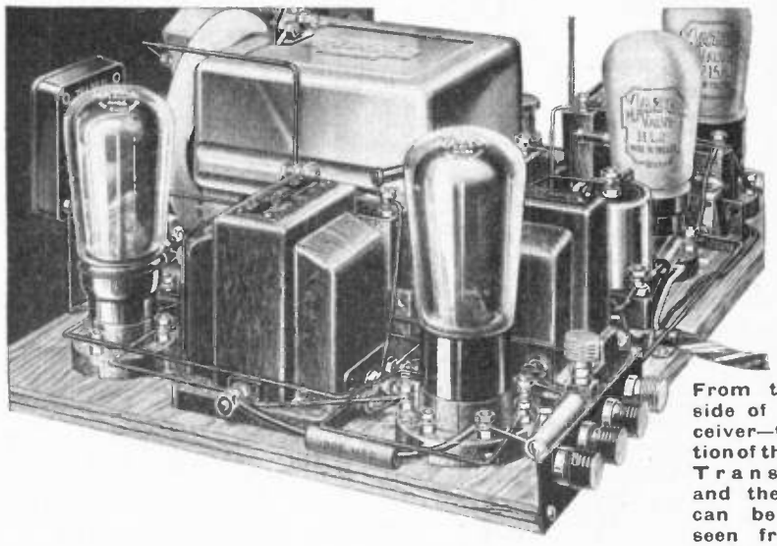
H.T.+2 (Maroon) to terminal 72 on 2 mfd. condenser " A."

Insert in valve holder " V1 " the screen grid valve Mazda S.215A; in " V2," the Mazda H.L.2; in " V3," the Mazda P220; and in " V4 " plug the " Class B " valve (Mazda " PD220 "). Connect aerial and earth to the appropriate terminals and the special " Class B " speaker to the three speaker terminals. In general, the central one of the three terminals on a " Class B " speaker will go to the terminal block on the set, whilst the two outer terminals go to the loudspeaker terminals on the set. (These can be connected either way round. Whatever the mechanical arrangement of terminals adopted by the manufacturer, it should be remembered that the centre tap on the speaker input transformer will invariably be connected to the terminal block on the set, although it may not necessarily be the central one of the three terminals on the speaker.

In cases where the constructor has a moving coil speaker not designed for " Class B " operation, but fitted with an input transformer or a high resistance speech coil he may, as previously mentioned, adapt it for use with this receiver by using a Telsen W.345 " Class B " output choke.

With some speakers it may be found that the capacity of the condenser which is connected across the output circuit, may require some modification to produce the best tonal balance. The value chosen (.005 mfd.) will, however, be the most suitable in the majority of cases. Next connect L.T.— (black lead with spade tag) to the " — " terminal of the accumulator, and L.T.+ (red lead with spade tag) to the " + " terminal. Insert the G.B.+ wander plug into the " + " tapping of a 9 v. grid bias battery and insert G.B.—1 and G.B.—2 into the —1½ and —6 volt tappings respectively. Now insert the H.T.— plug into the " — " tapping of a 120 volt H.T. battery, plugging H.T.+1 into a socket giving about 72 volts and H.T.+2 into the 120 volt socket.

With the separator control set full over in a clockwise direction and the reaction (volume) control full over in an anti-clockwise direction, switch the receiver on by means of the on-off switch " S2 " and with the wave change switch " S3 " pulled out to the medium wave position, rotate the main tuning dial when a number of transmissions should be heard. On pushing in the wave change switch long wave stations should be received if everything is in order.



From the L.F. side of the Receiver—the position of the Driver Transformer and the wiring can be clearly seen from this photograph.

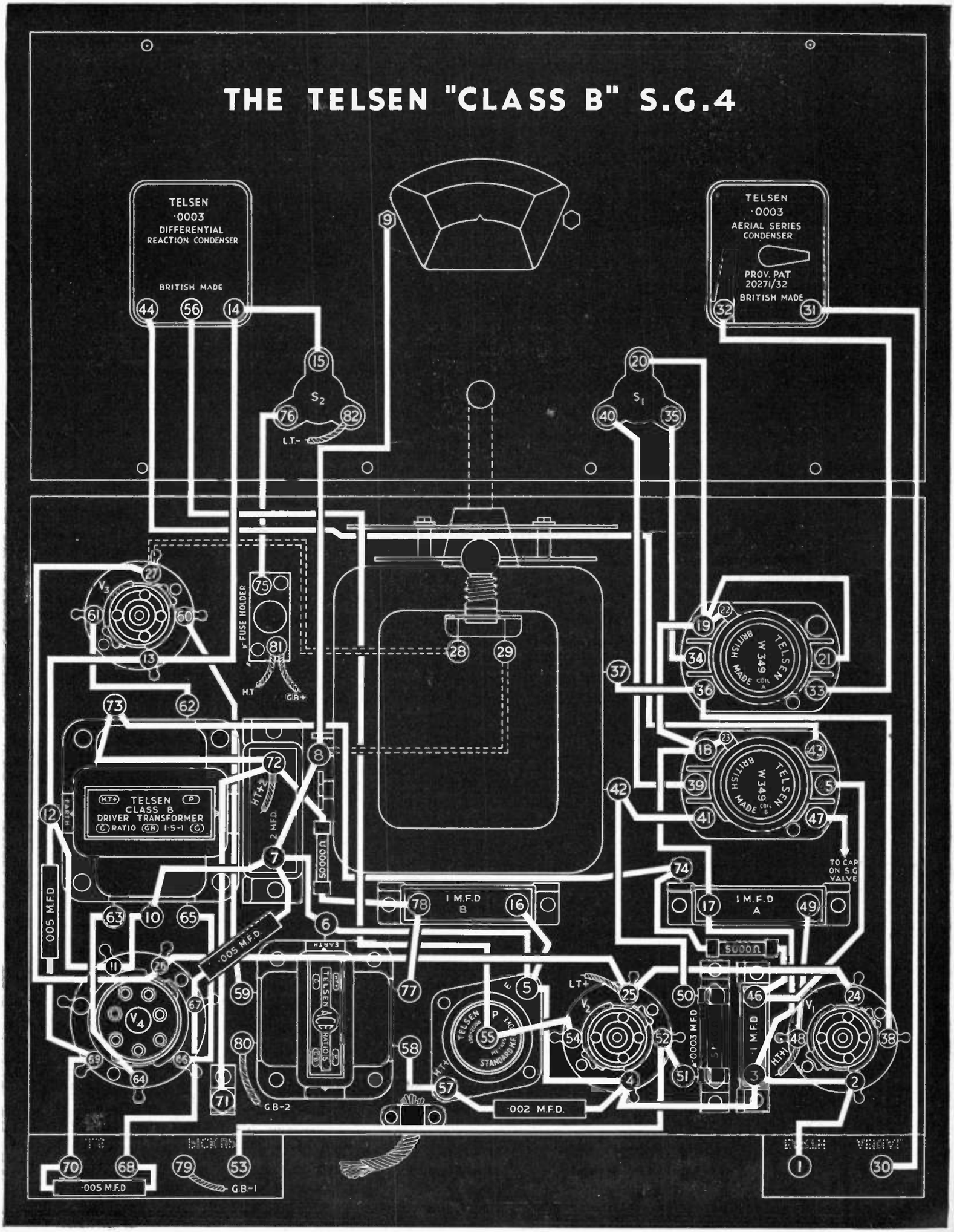
H.T.— (White) and G.B.+ (Red-White) are connected to terminal 81 on fuseholder.

To avoid undue slack, these leads should be cut off to suitable lengths when connecting them up, and the ends should be finished off with sleeving as described.

The battery cord having been connected, attach a nine inch length of insulated wire to terminal 47 of coil " B " and bend the free end into a neat loop, for connection to the anode of the screen grid valve, V1, after which the receiver is ready for test.

Connecting up and Operating the "Class B" S.G.4.

Two Telsen Pilot Lamps W.417 are required. One of these should be screwed in the pilot lamp-holder on the twin gang condenser, and the other in the fuseholder. The same type of lamp should be used if replacement is required at any time.



GANGING INSTRUCTIONS FOR THE "CLASS B" FOUR

To attain maximum sensitivity, however, correct use should be made of the reaction control, and the tuned circuits should be " ganged " properly.

The twin gang tuning condenser carries two " trimming " condensers, as they are called, for ganging or balancing the tuning circuits. One of these trimmers is operated by a star wheel at the side of the condenser and is of the pre-set type, whilst the other trimmer is operated by a knob concentric with the main tuning control. These should be adjusted as follows :—Set the wave-change switch to the " medium " position and the separator control about half way over, then with the volume control set near the point where oscillation commences, so that the receiver is in a sensitive condition, tune in a station near the bottom end of the medium wave band, i.e., with the condenser vanes nearly " all out." The small knob concentric with the main tuning control should be set half way between the limits of its travel, and the trimmer operated by the star wheel should be then adjusted for maximum signal strength, adjusting the main tuning con denser if necessary to keep the station tuned in. Having set the star wheel to the position giving maximum signal strength it should not again be touched.

Slight adjustments to ganging will be necessary from time to time, following adjustment to the " separator " condenser, but these are performed by means of the small concentric knob on the main tuning control. This concentric control knob enables the most efficient performance to be obtained at any setting of the main tuning condenser or the separator. On changing over to long waves ganging carried out on short waves will still be found to hold good.

If the wavelength calibrated scale is fitted it should be adjusted to read correctly in the following way. Set the separator condenser about half way in, and tune in a station of known identity and wavelength preferably on the medium wave-band, then if the scale does not indicate the correct wavelength for the particular station being received, slacken off the nuts securing the scale to the driving disc and move the scale round relative to the condenser, until the correct wavelength figure is indicated against the index on the escutcheon plate. The scale has elongated fixing holes so that this correction can readily be made. The scale should then be clamped firmly on the driving disc by re-tightening the fixing nuts.

Gramophone.

The Telsen " Class B " Four can be used for the electrical reproduction of gramophone records with excellent results, by connecting a pick-up to the terminals provided. A potentiometer volume control should be shunted across the output from pick-up to provide the necessary volume control. With most pick-ups the 10,000 ohm type will be most suitable, this value provides in addition to volume control, a certain degree of scratch filtration.

With some types of pick-ups, considerably improved results will be obtained by connecting a resistance of 25,000 to 50,000 ohms in value, across the primary winding of the " Ace " transformer. Telsen wire end resistances are suitable, type W.380 (25,000 ohms) or W.420 (50,000 ohms) should be used and should be floated between terminals 90 and 122 on the " Ace " transformer. This, whilst having little effect on the quality of radio reproduction, produces in some cases a considerable improvement in the quality of reproduction from records. The value of grid bias applied to the " G.B.—1 " tapping affects considerably the results obtainable when using a pick-up. The most suitable value will usually be found to be —1½ v.

Recommended Valves

" V_1 "	Mazda S.215A
" V_2 "	,, H.L.2
" V_3 "	,, P.220
" V_4 "	,, P.D.220

Recommended Batteries

Any 120 volt Ediswan battery of standard capacity may be used for the H.T. supply, a larger power output can be obtained if desired by the use of a 150 volt standard capacity battery, although the output obtainable with 120 volts H.T. supply should be adequate for all normal requirements. A 9 volt grid bias battery and a 2 volt 45 ampere hour (slow discharge rate) accumulator are the other batteries required. This receiver is not suitable for operation from a mains unit.

Loudspeakers for the "Class B S.G.4"

This receiver is, of course, intended to operate a moving coil loudspeaker—a moving iron (reed) type of loudspeaker is not suitable for operation from a " Class B " receiver. Experience has indicated that some types of moving coil speakers give very much better results than others, therefore, the constructor is advised to choose a " Class B " moving coil speaker manufactured by a maker of repute. A moving coil speaker not designed for use on " Class B " may be made to give very good results, providing that careful matching is achieved by the use of a Telsen " Class B " output choke or transformer, as described previously.

The Telsen "Class B" Four List of Components

Quantity	*Description*	*Cat. No.*	*Price*
2	Telsen Iron Cored Coils	W.349	17/–
1	,, Twin Gang Condenser	W.427	16/6
3	,, 4-pin Anti-Microphonic Valve Holders	W.222	2/–
1	,, 7-pin Anti-Microphonic Valve Holder	W.338	1/9
1	,, " Ace " Transformer, 5 : 1 ratio	W. 65	5/6
1	,, Driver Transformer, 1.5 : 1 overall ratio	W.359	10/6
1	,, Standard Screened H.F. Choke	W.341	3/6
1	,, ·0003 Mica Condenser	W.242	1/–
1	,, ·5 megohm Grid Leak	W.249	1/–
1	,, Fuseholder	W.146	6d.
1	,, .0003 Aerial Series Condenser	W.350	2/6
1	,, .0003 Differential Reaction Condenser	W.351	2/6
2	,, 3-point Push-Pull Switches	W.108	2/6
1	,, 2 mfd. Paper Condenser (500 v. test)	W.226	3/–
2	,, Pilot Lamp Bulbs	W.417	1/–
2	,, 1 mfd. Paper Condensers (500 v. test)	W.227	4/6
1	,, .1 mfd. Paper Condenser (500 v. test)	W.231	1/9
1	,, 5,000 ohm Wired End Resistance, 1 watt type ..	W.377	1/–
1	,, 50,000 ohm Wired End Resistance, 1 watt type ..	W.420	1/–
1	,, .002 mfd. Tubular Condenser	W.407	1/–
3	,, .005 mfd. Tubular Condensers	W.408	3/–
1	,, Terminal Block	W.204	6d.
1	,, *Modern Radio Engineer's* Constructor's Outfit ..	W.445	5/6

SIMPLE OPERATING INSTRUCTIONS—*continued from page 17*

Small dots should now be made on the chart in positions corresponding to the wavelength and dial reading of each station. A similar set of readings on the long waves should also be taken, and the results plotted on the chart. It will be found that the points that indicate the tuning and the wavelength of the stations, when joined together give a diagonal line, slightly curved, from which the approximate position of stations which have not previously been logged can be estimated. By utilising a similar graph you will be able to tune immediately to any station that is within range of your aerial, and by increasing the reaction slightly and making a small adjustment to the main tuning condenser the station should be brought in loud and clear, unless it is being heterodyned by another transmitter. In this case a whistle will be heard which does not vary with a slight change of tuning. This is interference between two transmitters as distinct from the howl which is heard when the receiver reaction control is misused.

INTERFERENCE

Should two stations come in together, the separator control must be brought into action. Interference usually comes from the local station, when trying to tune a more distant signal that is on a nearby wavelength. The separator should be rotated in an anti-clockwise direction, and it will be noticed that the interference will be reduced. At the same time the station desired will not be so loud. It will be found that delicate readjustment of the tuning and reaction controls will bring up the volume of the wanted station. Of course, reception of distant stations, especially those on a wavelength near to that of the locals will be much louder and clearer when the local stations are not working. When such is the case the separator can usually be left at the " maximum " position and this will still further improve the sensitivity of the receiver. The reception of distant stations is beset with many difficulties, the most important of which are heterodyning and fading. Only very expensive and elaborate apparatus can deal with these problems. When it is found a station is being heterodyned or is badly fading the listener is advised to proceed to some other station for that evening. Heterodyning is caused by a station departing from its allotted wavelength, and its transmission thereby coming too close to that of another station. Fading is caused by a fluctuating condition of the ionised layers of air many miles above the earth's surface.

COILS

THE KEY TO RANGE AND SELECTIVITY

THE coils employed in a radio receiver are vital components in that their efficiency contributes very largely to the efficiency of the receiver. The constructor will doubtless welcome some notes on coils, and it is hoped that the following article will not only add to the constructor's knowledge, but also be of assistance by drawing attention to those features for which he should look when purchasing coils for future experiments.

If an alternating current is passed along a wire a fluctuating electro-magnetic field is created which extends inside and outside the wire. This magnetic field which is alternately increasing and decreasing will, if it comes into contact with another conductor, induce a current in that conductor. The current will, however, flow in an opposite direction to that which is creating the magnetic field. Similarly, as some of the lines of force are penetrating the wire which is carrying the current, an opposing current will also be created in the original conductor. The greatest part of the magnetic field lies outside the conductor, and therefore only a small reverse current will be induced in the conductor itself. If, however, the wire is wound in a helix to form a coil, the turns of which are close together, the effect of the induced current will be greatly increased.

The magnetic field of each turn will cross all the adjoining turns, and a considerable amount of interaction will take place between the applied current in each turn, and all the induced currents created by the magnetic field.

The total effect will be that a rise or fall of the applied current will be impeded. This property of a coil is known as its inductance, and the coils used in wireless receivers are known as high frequency inductances. The unit of inductance is the henry. As the inductance of coils used in radio circuits is quite small, it is, for convenience, expressed in microhenries, that is, in 1-millionth parts of a henry.

Although the only property for which a coil is required is its inductance, in practice no coil can be obtained which does not possess other properties, which unfortunately introduce losses. These are resistance and distributed capacity.

The resistance of a conductor to high frequency currents such as are employed in radio, is considerably greater than that offered to direct currents, such as are supplied by a battery or accumulator. This is largely due to what is known as the "skin effect."

When a high frequency current flows along a wire, eddy currents are induced in the centre of the conductor which compel the H.F. current to keep to the surface. Consequently the effective size of the conductor is greatly reduced, and the resistance thereby increased. This resistance is further increased by what is known as the proximity factor, and the combination forms what is known as "Copper Losses."

As already stated, a coil also possesses a distributed capacity. Each turn of wire is insulated from, but adjacent to, the next turn. Consequently each pair of turns behave exactly like a small condenser, and we, therefore, have a large number of small condensers in series. The dielectric of these condensers consists of the former on which the coil is wound, and the insulation on the wire. At the best these materials form a poor dielectric which results in the introduction of further resistance that comes under the heading of capacity losses.

The total of copper losses and capacity losses are expressed as the high frequency resistance of the coil.

This high frequency resistance is expressed in ohms, and it varies with the frequency. The higher the frequency the greater the H.F. resistance. It will be evident that it is an undesirable property that should be kept as small as possible, and that the efficiency of a coil depends upon as great a ratio of inductance to H.F. resistance as possible.

The coil efficiency also depends upon the capacity in circuit. It would not be practicable to use a separate coil for each frequency that it was desired to receive, and a variable condenser is, therefore, connected in circuit with the coil. By varying the capacity of the condenser it is possible to use the coil over a fairly wide range of frequencies, but the added capacity reduces the efficiency of the coil in a similar manner to resistance. In order to express the overall efficiency of an inductance both the high frequency resistance and the capacity in circuit must be taken into account.

The overall efficiency of a coil is given as the inductance divided by the product of the resistance and capacity, i.e., $\frac{L}{Cr}$ where L = inductance C = capacity and r = H.F. resistance. This formula gives the impedance at resonance. It is known as the dynamic resistance, and is expressed in ohms. As both the capacity and H.F. resistance vary with the frequency it is necessary to state the exact frequency at which the measurements are taken. Usually, unless otherwise stated, the dynamic resistance in the case of coils used for the medium waveband, is calculated at 1,000 kilocycles, i.e., 300 metres.

Constructors will observe from the foregoing that the higher the dynamic resistance the greater the efficiency of the coil. A good commercial coil unscreened, such as the Telsen H.F. transformer coil, should have a dynamic resistance of about 120,000 ohms. This is achieved by designing the coil so that it has a low distributed capacity. and a very low high frequency resistance. An examination of the coil will show that it is wound on a ribbed former, and uses heavy gauge silk covered wire. The silk insulation and large air spacing provided by the ribbed former, are responsible for the reduction of the distributed capacity to an absolute minimum, while the heavy gauge high conductivity copper wire ensures a low high frequency resistance. The importance of

THE COIL—*continued*

reducing the losses to an absolute minimum cannot be over-estimated, and research is constantly going on with a view to still further improving the efficiency of coils. The lower the coil losses the greater the sensitivity and selectivity of the receiver, as will be shown.

COIL MAGNIFICATION

If a swinging pendulum has a very small but correctly timed impulse applied to it, the movement of the pendulum will increase, and continue to increase so long as the impulses are applied. When a circuit consisting of a coil and condenser is coupled to an aerial, and tuned to an incoming signal, the circuit will oscillate at the frequency of the received signal. Each impulse received from the aerial is added to the previous one, and the oscillations in the circuit are increased in the same way as in the analogy the added impulses increased the swing of the pendulum. A voltage (Vg) is developed across the condenser, which is applied to the grid of the valve (see Fig. 1).

If the circuit has no resistance an infinitely great voltage would be developed. Unfortunately this condition cannot be obtained in practice, as some high frequency resistance is always present, and damps down the oscillations. The degree of voltage increase obtained is known as the coil magnification. It is expressed as a ratio and is the reactance of the coil divided by the H.F. resistance, $\frac{2\pi fL}{r}$. Thus the magnification of the coil depends upon its high frequency resistance.

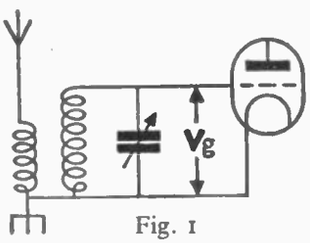


Fig. 1

It will, therefore, be seen what a great contribution to sensitivity a really efficient coil can be. The lower its H.F. resistance the greater its magnification, and the greater the sensitivity of the receiver.

SELECTIVITY

Not only does an efficient coil, by reason of its greater magnification, bring in more stations, it also enables them to be tuned in with less interference. That is to say, the selectivity of the circuit is greater when the coil losses are low.

The selectivity of a circuit depends upon the ratio of its response at the frequency to which it is tuned to the ratio at other frequencies. The greater the ratio the greater the selectivity. This ratio depends upon the high frequency resistance of the coil, and its associated components, as well as the reactance of the coil and tuning condenser. Take the case of a series circuit. When the circuit is tuned to resonance the reactances of the coil and condenser cancel each other out, so that the impedance at the frequency to which the circuit is tuned, is the high frequency resistance only. At other frequencies the reactances of coil and condenser come into evidence, and it will, therefore, be seen that if the H.F. resistance is kept low the ratio of the impedance at the resonant frequency to the impedance at any other frequency will be high. As previously pointed out the greater this ratio the greater the selectivity. This is clearly shown by the typical response curves (Fig. 2).

Curve "A" is the response curve of a circuit of low H.F. resistance, and it will be noticed that at 10 K.C. off tune the response has fallen to nearly 40%.

Curve "B" is plotted from a circuit employing a coil of high H.F. resistance, and in this case the response at 10 K.C. off tune is practically 80%.

high frequency resistance. Take the case of the Telsen H.F. transformer coil: this has an inductance of 156 μh on the medium waveband. If a capacity of .000163 mfd. is introduced the circuit will be tuned to 1000 K.C. or 300 metres, and the response at this frequency will only be limited by the resistance. The coil in question has been scientifically designed to have as low a high frequency resistance as is commercially practicable, and at 1000 K.C. this approximates to 8 ohms. Assuming that the remaining part of the circuit introduces a further 4 ohms, the total impedance at resonance will be 12 ohms.

The impedance at other frequencies will increase as the frequency departs from that to which the circuit is tuned as the reactances of the coil and condenser will no longer cancel out.

Take, for example, a signal that is only 10 K.C. off tune, that is a frequency of 1010 K.C. The sum of the reactances ta this frequency will be approximately 20 ohms. As the high frequency resistance at this frequency will be practically the same

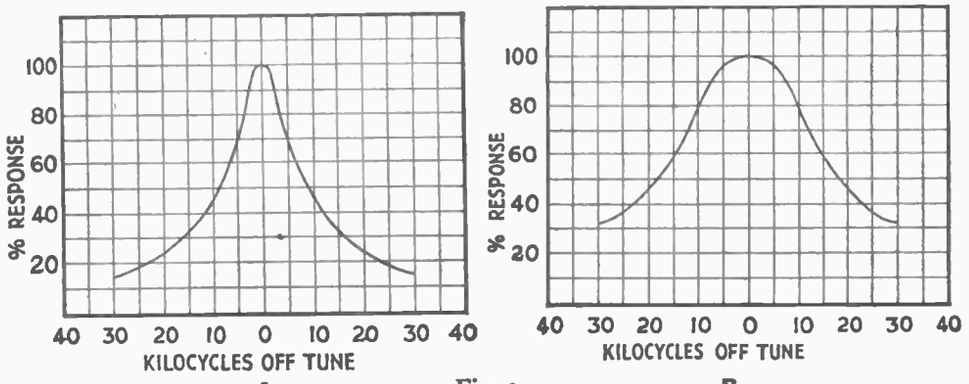


Fig. 2

The Response Curves shown are for Parallel Tuned Circuits. The Curves for the Series Circuits discussed in the text are similar, except that they are inverted, the peaks being at zero.

A low resistance coil gives a sharp tuning curve, while a badly designed coil has a very flat curve. Those readers who care to follow the simple figures in the following example will obtain practical evidence of the great gain in selectivity obtained when substituting a coil of high efficiency for one of bad design.

The total impedance of a series circuit consisting of a coil and condenser, is the square root of the sum of the squares of the resistance and reactances. The formula is:

$$Z = \sqrt{r^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

where: Z = Impedance.
r = High frequency resistance.
ω = Angular velocity.
L = Inductance of coil.
C = Capacity of condenser.

At resonance the reactances of the coil and condenser are equal and therefore cancel out. Consequently the impedance of a series circuit at resonance is equal to the

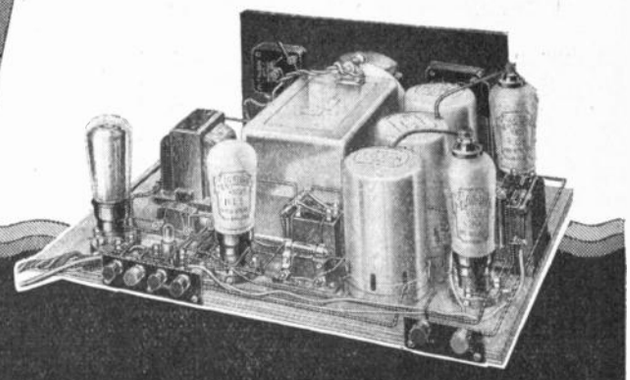
as at the resonant frequency the total impedance will be $\sqrt{12^2+20^2}$, or approximately 23.4 ohms. This is nearly twice the impedance at the resonant frequency, although the change in frequency has been extremely small.

Many coils are available which have a high frequency resistance as much as 45 ohms at these frequencies, and it will, therefore, be profitable to examine the effect of this increased resistance.

At resonance the impedance will now be 49 ohms, while at 1010 K.C. the impedance will be $\sqrt{49^2+20^2} = 53$ ohms. The ratio now is only 1.08 to 1.

If the field strength of the signals were the same, much less interference would be audible where the low resistance coil was used, but in the case of the inferior coil the interference would be practically as loud as the wanted signal.

The TELSEN Super SELECTIVE FOUR



A HIGHLY SELECTIVE "TWO H.F. FOUR VALVE" RECEIVER FOR LONG DISTANCE RECEPTION—BATTERY OPERATED.

THIS set has been designed to meet the demand of a large body of wireless enthusiasts who required a highly selective receiver capable of long distance reception, which will still maintain the maximum purity of reproduction. Now it is important that such a set should be highly sensitive so as to magnify the feeble signals from far off stations to the extent necessary for proper reception. However, great sensitivity is of little value unless accompanied by selectivity, for the number of stations which a sensitive set can receive under modern conditions is so large that without a high degree of selectivity, nearly every programme would be spoilt by interference from stations working on adjacent wave-lengths. As will be seen from the accompanying circuit diagram great sensitivity is obtained in the Telsen "Super Selective S.G.4" by the use of two carefully designed stages of screened grid valve high frequency amplification, followed by a 7 : 1 Radiogrand low frequency transformer and high efficiency pentode output valve. Ample selectivity is also provided by means of three tuned circuits operated by a single tuning control. The aerial is loosely coupled to the tuned grid circuit of the first valve and a variable series aerial condenser is incorporated, which is used as a selectivity and volume control. The first valve is coupled by a high frequency transformer to the tuned grid circuit of the second valve, and this is coupled by another high frequency transformer to the tuned circuit preceding the leaky grid detector. Reaction is introduced here and is very smooth and even in operation.

The purity of reproduction is remarkably good for such a selective set, the bass response being excellent while the annoying mush usually found on long distance reception is reduced to a minimum. Provision is made for playing gramophone records by connecting a gramophone pick-up to the terminals marked "Pick-up."

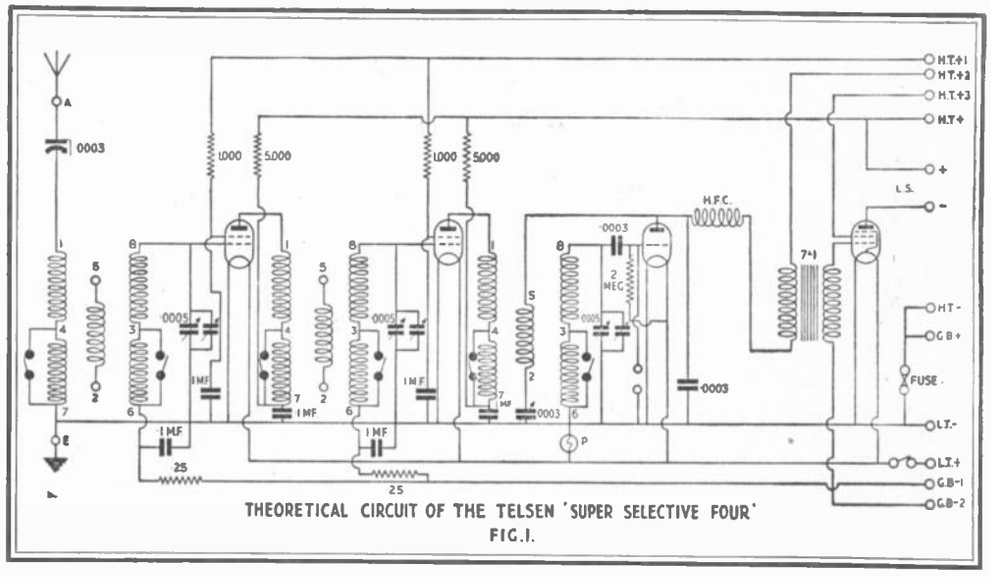
As is well known, modern receivers having high magnification are very apt to become unstable unless care is taken to prevent "feed-back" by decoupling various high and low frequency circuits. Due to the extensive decoupling in the Telsen "Super Selective S.G.4," this receiver has a great margin of safety against instability.

The translucent tuning dial, which is calibrated directly in wavelengths, is illuminated from behind, and this feature, besides facilitating tuning, also serves as an indication that the set is switched on. There are four other controls arranged symmetrically on the panel: the wavechange switch, the selectivity control or separator, the reaction or volume control, and the on-off switch for low tension supply. These are needed for occasional adjustment only, the tuning control being normally the only one used.

A full size Blue Print can be obtained from Telsen price 1/- post free. Most constructors will find the accompanying black print and detailed instructions for building this set so clear that it is almost impossible to make a mistake.

The detailed list of components is given on page 49. Constructors who already have some of the components may complete the kit by buying the remaining parts singly.

A special constructor's outfit is not provided for this receiver, as it is felt that constructors of the more ambitious sets will want to build them with special cabinets, where the front of the cabinet forms the control panel. It is assumed that constructors will already have in their possession the *Modern Radio Engineer's* Constructor's Outfit, and will therefore have the necessary terminals, terminal panels, screws, etc. The outfit must be supplemented with a ⅛ in. plywood baseboard 17 in. x 11½ in., and those constructors who wish to have a control panel apart from the cabinet should procure a metal panel similar to that shown in the photographs. Fig. 4 gives the dimension of the panel, position and sizes of holes.



THEORETICAL CIRCUIT OF THE TELSEN 'SUPER SELECTIVE FOUR'
FIG. I.

THE TELSEN "SUPER SELECTIVE FOUR"—*continued*

The panel should be assembled first, constructors who use a metal panel should pay particular attention to the insulating of both reaction and aerial series condensers. Full instructions for mounting the panel will be found on page 7. Having completed the panel the baseboard should receive attention. First mount the variable condenser. Special instructions together with a template will be found in the carton containing the condenser. The position of the remaining components can be easily ascertained from the black print.

The coils should be placed in position and the switch rod provided with this range of coils should be inserted to pass through all the coil switch holes, placing the switch stop and the loose collar in the positions indicated in the black print. Place the knob on the switch rod where it projects through the front panel, and slide the rod backwards or forwards until the knob has the same spacing from the front panel as that of the separator and volume control knobs.

The switch stop should be located very close to the screen base of the rear coil and then screwed up tightly. The coils should then be screwed firmly to the baseboard.

Special attention should be directed towards the fixing of the .1 and 1 mfd. paper condensers. The two 1 mfd. condensers should be placed together so that the vertical fixing flanges are together.

A $\frac{3}{16}$ in. x 4 B.A. cheese-headed screw should be passed through the holes of one pair of flanges and locked in position with a 4 B.A. nut. This screw forms the terminal No. 76 shown on the black print, and serves as an anchorage for the resistors.

Two pairs of .1 mfd. condensers should be treated in a similar manner. An additional 4 B.A. nut will be required for each terminal affixed to the sides of the condensers, so that the connecting wires can be held in position. Fig. 2 shows the method of fixing a terminal to a pair of condensers. The grid leak should be mounted on the grid condenser as shown in Fig. 3. Those constructors who have the constructor's outfit above referred to will find that the loudspeaker and aerial terminal panels are quite suitable for this receiver. Those constructors who do not possess the outfit can use three Telsen terminal blocks W.204. Having mounted all the components in the positions shown, the control panel should be screwed to the baseboard and the wiring commenced. The following detailed point to point wiring instructions should be carried out in the order given. The resistors should be fixed in position after the main wiring has been completed.

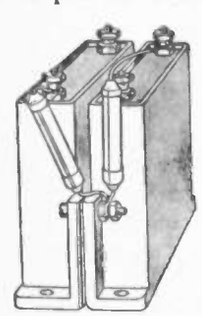


Fig. 2

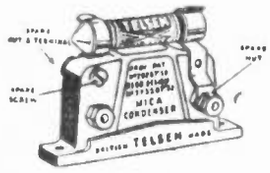
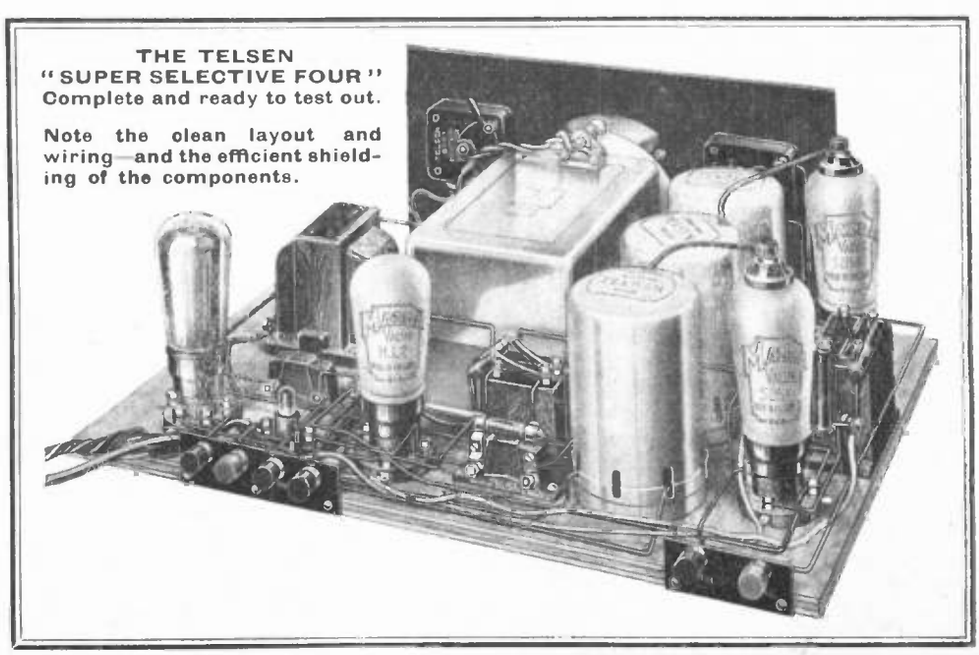


Fig. 3

The special Telsen insulated connecting wire is to be used in accordance with the instructions given on page 8.

Connect :—

1 on aerial-earth strip to 2 on V2.
2 on V2 to 3 on V1.
3 on V1 to 4 (the fixing-screw) on coil "A."
4 on coil "A" to 5 on coil "A."
2 on V2 to 6 on .1 mfd. condenser "B."
6 on .1 mfd. condenser "B" to 7 on .1 mfd. condenser "A."
7 on .1 mfd. condenser "A" to 8 on 1 mfd. condenser "A."
8 on .1 mfd. condenser "A" to 9 on .1 mfd. condenser "B."
6 on .1 mfd. condenser "B" to 10 on coil "B."
11 on .1 mfd. condenser "B" to 12 on coil "B."
2 on V2 to 13 on .1 mfd. condenser "D."
13 on .1 mfd. condenser "D" to 14 on ganged condenser.
13 on .1 mfd. condenser "D" to 15 on .1 mfd. condenser "C."
15 on .1 mfd. condenser "C" to 16 on coil "C."
16 on coil "C" to 17 on coil "C" (the fixing bolt).
15 on .1 mfd. condenser "C" to 18 on V3.
18 on V3 to 19 on V4.
19 on V4 to 20 on .0003 mfd. condenser "B."
19 on V4 to 21 on fuse holder.
21 on fuse holder to 22 on pick-up strip.
23 on ganged condenser to 24 on reaction condenser.
23 on ganged condenser to 25 on transformer.
23 on ganged condenser to 26 on pilot-lamp holder.
27 on pilot-lamp holder to 28 on switch. (The above two wires can be omitted if it is not intended to use a pilot-lamp.)
28 on switch to 29 on V3.
29 on V3 to 30 on V4.
29 on V3 to 31 on V2.
29 on V3 to 32 on .0003 mfd. condenser "A."
31 on V2 to 33 on V1.
34 on aerial-earth strip to 35 on aerial series condenser.
36 on aerial series condenser to 37 on coil "A."
38 on coil "A" to 39 on ganged condenser.
38 on coil "A" to 40 on V1.
41 on coil "A" to 42 on .1 mfd. condenser "A."
43 on V1 to 44 on 1 mfd. condenser "A."



THE TELSEN "SUPER SELECTIVE FOUR" Complete and ready to test out.

Note the clean layout and wiring—and the efficient shielding of the components.

THE TELSEN "SUPER SELECTIVE FOUR"—*continued*

45 on coil "B," through hole in screening-can to cap on top of V1.
46 on coil "B" to 47 on ganged condenser.
46 on coil "B" to 48 on V2.
49 on coil "B" to 50 on .1 mfd. condenser "D."
51 on V2 to 52 on .1 mfd. condenser "B"
53 on coil "C" to cap on top of V2.
54 on coil "C" to 55 on reaction condenser.
56 on coil "C" to 57 on V3.
58 on coil "C" to 59 on .1 mfd. condenser "C."
60 on coil "C" to 61 on ganged condenser.
60 on coil "C" to 62 on .0003 mfd. condenser "A"
63 on .0003 mfd. condenser "A" to 64 on V3.
64 on V3 to 65 on pick-up strip.
57 on V3 to 66 on H.F. choke.
66 on H.F. choke to 67 on .0003 mfd. condenser "B."
68 on H.F. choke to 69 on transformer.
70 on transformer to 71 on V4.
72 on V4 to 73 on loudspeaker strip.
74 on loudspeaker strip to 75 (this terminal is made by passing a bolt through the fixing holes of the .1 mfd. condensers "C" and "D"—see assembly instructions).

(This completes the main wiring.)

Connect :—

A 5,000 ohm resistor (green body, black tip, orange band) between 50 on .1 mfd. condenser "D" and 75.

A 5,000 ohm resistor between 59 on .1 mfd. condenser "C" and 75.

A 1,000 ohm resistor between 44 on .1 mfd. condenser "A" and terminal 76, which, like 75, is formed by passing a bolt through the fixing holes of the two condensers, securing this with a lock-nut and securing the wire with a terminal-head (see assembly instructions).

A 1,000 ohm resistor (brown body, black tip, red band) between 52 on 1 mfd. condenser "B" and 76.

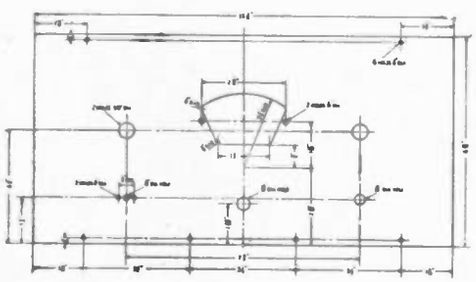
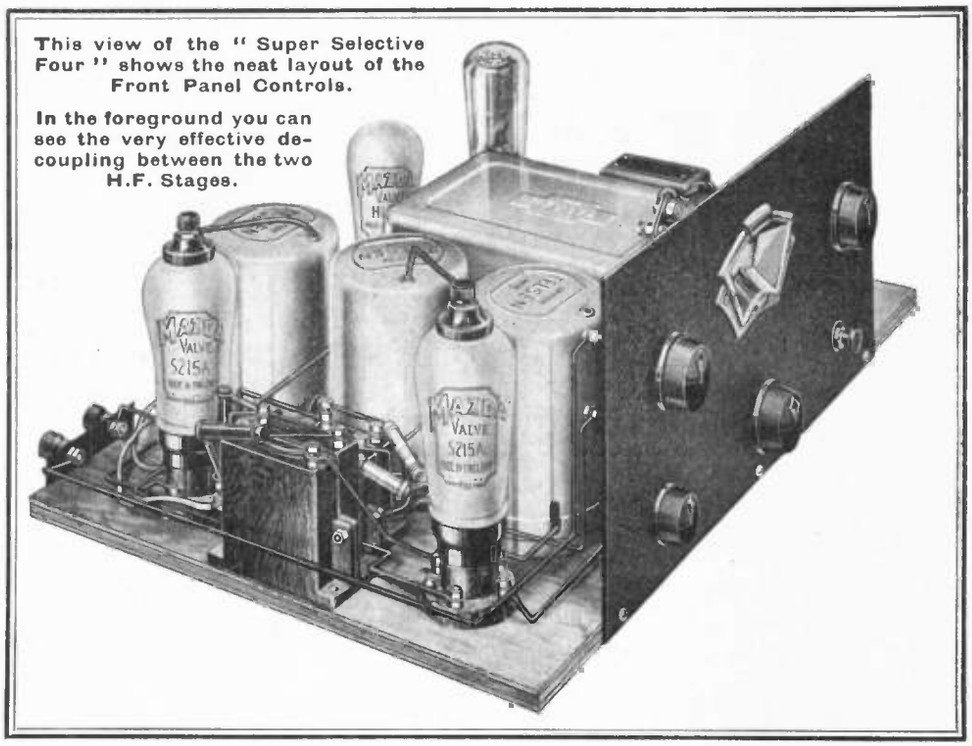


Fig. 4



This view of the "Super Selective Four" shows the neat layout of the Front Panel Controls.

In the foreground you can see the very effective decoupling between the two H.F. Stages.

A 250,000 ohm resistor (red body, green tip, yellow band) between 77 (which is similar to 67 and 68) and 11 on .1 mfd. condenser "B."

A 250,000 ohm resistor between 77 and 42 on .1 mfd. condenser "A."

A ten-way battery cord is required for this receiver.

After preparing the battery cord as instructed on page 8, connect it as follows :—

H.T.+1 to 76 on 1 mfd. condenser.
H.T.+2 to terminal 78 on transformer.
H.T.+ to 75 on .1 mfd. condensers C and D.
H.T.+3 to 79 on V4.
H.T.— to 80 on fuse holder.
G.B.+ to 80 on fuse holder.
G.B.—1 to 77 on .1 mfd. condensers A and B.
G.B.—2 to 81 on transformer.
L.T.+ to 82 on switch.
L.T.— to 19 on V4.

Connecting up and adjusting the "Super Selective S.G.4."

Place in each of valve holders V1 and V2 a screened grid valve, connecting the long lead issuing from the screen of coil B to the top of terminal of the valve in V1 and that from the screen of coil C to the valve in V2. Insert the detector valve in V3 and the pentode valve in V4. The pentode valve should be of the 5-pin type, but if it has four valve pins only, a small length of wire should be joined between terminals 159 of V4 and the terminal on the side of the pentode valve. Next connect up the aerial and earth leads and attach the loudspeaker to the correct terminals.

If it is desired to illuminate the tuning dial, a 2.5 volt .2 ampere flashlamp bulb should be inserted in the holder mounted on the condenser cover. This component may be purchased from your local dealer. A Telsen fuse bulb W.318 is then placed in the fuse-holder.

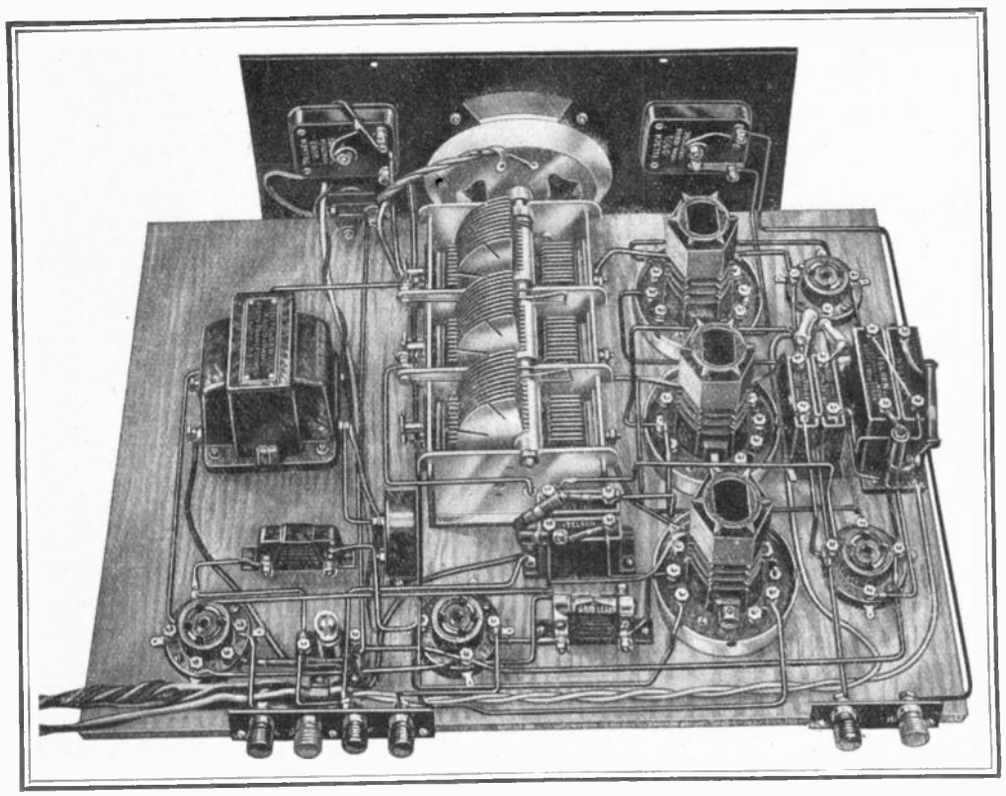
Insert :—

G.B.+ wander plug into + tapping of grid bias battery.
G.B.—1 wander plug into —1½ volt tapping of grid bias battery.
G.B.—2 wander plug into —7½ volt tapping of grid bias battery.
H.T.— wander plug into — tapping of H.T. battery.
H.T.+1 wander plug into +78 volts H.T.
H.T.+2 wander plug into +102 volts H.T.
H.T.+3 wander plug into +114 volts H.T.
H.T.+ wander plug into 120 volts H.T.

Connect :—

Spade of black lead to — terminal of accumulator.
Spade of red lead to + terminal of accumulator.

THE TELSEN "SUPER SELECTIVE FOUR"—*continued*



It should be noted that the value of voltage of G.B.—2 depends on the type of pentode valve used in the output stage. It is here advisable to consult the makers' valve instructions as to the value of grid bias to be used.

The separator and volume controls should now be turned fully clockwise and anti-clockwise respectively, the wavelength switch set to the medium range, finally switching on the L.T. current by means of the on-off switch. On rotating the tuning control knob, stations will be received, and the receiver should be similarly tested on the long wavelength range.

The set is now ready for ganging. This is carried out as follows :—

On the side of the variable condenser will be found three small star shaped wheels which when rotated in a clockwise direction increase the capacity of the trimming condensers which are in parallel with the main tuning condenser.

These trimming condensers should be adjusted about half-way. Now set the aerial series condenser about half in and adjust the reaction near to oscillating point. Then tune in a fairly weak station at the bottom end of the medium wavelength band. Now adjust the trimming condensers by means of the star wheels until maximum signal strength is obtained. Each trimmer should be set separately and while this operation is taking place the main tuning control should not be moved under any circumstances. A much weaker station at a lower wavelength than before should now be tuned in, and the above procedure repeated until the receiver is ganged up to a very high degree of precision. Then, on tuning in a station at the top end of the medium wavelength band, it will be found that the ganging still holds, and no further adjustment is required.

Gramophone Pickup.

It should be noted that arrangements have been made in the receiver for the necessary grid bias voltage, this being controlled by the battery lead marked G.B.—1.

Recommended Valves and Batteries.

	Mazda
1	S.G.215A
2	S.G.215A
3	H.L.2
4	Pen. 220A or Pen. 220

H.T. Battery : 2 of Ediswan 60 volt 20 mA. Cat. No. 69724 ; or
1 Ediswan 120 volt 20mA. Cat. No. 69728.

G.B. Battery : 1 Ediswan 9 volt. Cat No. 69804.

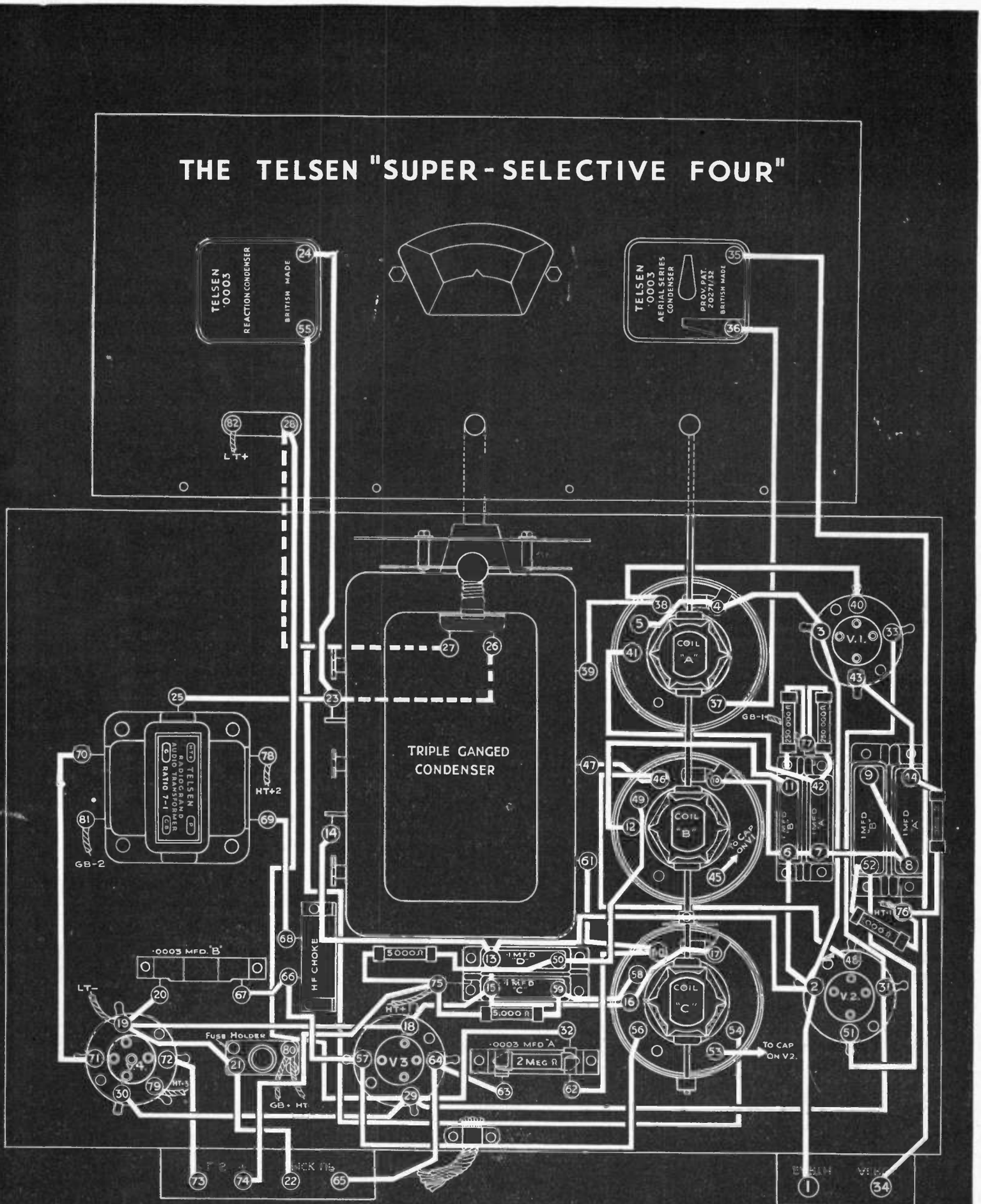
L.T. Battery : 1 Ediswan 2 volt 45 a.h. Type E.L.M.4.

THE TELSEN "SUPER SELECTIVE FOUR"

List of Components

Quantity	*Description*	*Cat. No.*	*Price*
2	Telsen 1,000 ohm Resistors	W.375	2/–
2	,, 5,000 ohm Resistors	W.377	2/–
1	,, Standard H.F. Choke	W. 75	2/6
2	,, .0003 mfd. Mica Condensers	W.242	2/–
4	,, .1 mfd. Paper Condensers 500 v. type	W.231	7/–
1	,, 2 megohm Grid Leak	W.251	1/–
2	,, 250,000 ohm Resistors	W.382	2 –
2	,, 1 mfd. Paper Condensers, 500 v. type	W.227	4 6
1	,, .0003 mfd. Aerial Series Condenser with Switch ..	W.350	2/6
1	,, .0003 mfd. Bakelite Reaction Condenser	W.354	2/6
1	,, 2-pt. Push-Pull Switch	W.107	1/–
3	,, 4-pin Anti-Microphonic Valve Holders	W.222	2/–
1	,, 5-pin Anti-Microphonic Valve Holder	W.223	10d.
1	,, 7 : 1 Radiogrand Transformer	W. 60	10/6
1	,, Fuse Holder	W.145	6d.
2	,, Pilot Lamps—2.5v.	W.417	1/–
1	,, Set of Triple Matched Screened Coils	W.288	21/6
1	,, Triple Ganged Condenser	W.428	22/6

THE TELSEN "SUPER-SELECTIVE FOUR"



How to CHOOSE A MAINS UNIT

CONSTRUCTORS who have built battery operated receivers and who have the electric supply mains available, are in a position to secure high tension current at a cost which is purely nominal. This is achieved by substituting one or another of the Telsen Mains Units for the high tension battery.

These Units can be used with any of the battery receivers described in this journal except those employing " Class B " amplification. The high tension battery, compared with the electric mains, is really a very inefficient device, in that it is not only very costly but also never allows the receiver to operate at its best except when the battery is new. An examination of the discharge curves of dry batteries will show that during the first few hours of their life the voltage rapidly drops about 10% and thereafter steadily declines. Usually a replacement is necessary about every three months. The voltage of the electric supply mains is always constant, so that when the high tension supply is taken from this source the receiver can always be operated at maximum efficiency, and the inconvenience, to say nothing of the cost, of constantly replacing batteries is eliminated.

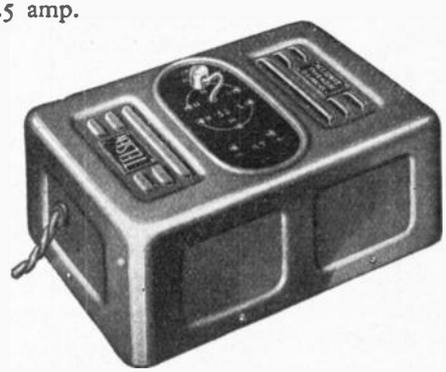
The high tension current taken by even a large wireless receiver is measured in milliamps, that is in 1000th parts of an ampere. It is so extremely small that the cost, when taken from the supply mains, is difficult to calculate. It has been estimated that the amount of current, when taken from the mains, required to supply high tension for a battery operated receiver, costs approximately one shilling for a whole year.

As a mains unit lasts indefinitely, it contains nothing that should go wrong or wear out, it will be realised that the first cost is virtually the last.

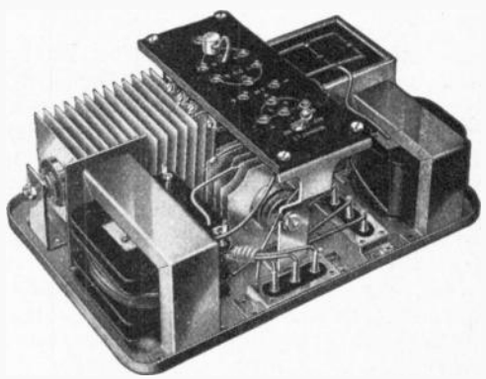
The Telsen Mains Units are of robust construction, and like all Telsen Mains Apparatus, have a large margin of safety. Up to 28 milliamps at 150 volts is delivered by these units, more than sufficient for any ordinary receiver. Special potential dividers provide separate tappings for screened grid and detector valves in addition to the maximum of 150 volts, and on all the tappings a choice of high, medium and low voltages are available. The alternating current models employ the Westinghouse Patent Metal Rectifiers, and all models are constructed and finished in accordance with the I.E.E. regulations.

Those constructors whose electric supply is 200-250 volts alternating current can use either of the following models :—

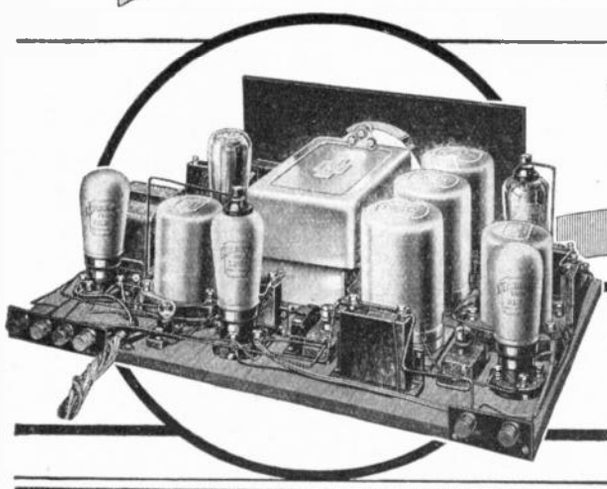
W.346 H.T. Unit and L.T. charger suitable for 200-250 volts 40-100 cycles. This unit has provision made for the charging of 2, 4 or 6 volt accumulators at .5 amp.



W.347 H.T. Unit. This is similar to the 346 unit but does not include the L.T. charger. A low voltage A.C. output is available enabling constructors to make use of indirectly heated A.C. valves. Where battery valves are used the A.C. output can be neglected, and the accumulator employed as usual.



Where Direct Current mains are available, the **W.348 Mains Unit** should be used. This provides high tension current only, and is designed for D.C. inputs of from 200-250 volts.



The TELSEN SUPER 5

A HIGHLY EFFICIENT "FIVE VALVE SUPERHET" OF OUTSTANDING QUALITY—FOR THE CONNOISSEUR.

THE recent increase in the number of high power broadcasting stations in Europe has produced a condition of overcrowding in the ether which necessitates the use of a highly selective set by all who wish to receive all possible programmes without interference. No type of receiver offers such possibilities in this direction as the superheterodyne, and a great deal of intensive research work has been carried out in the Telsen laboratories in order to evolve the very best superheterodyne circuit for the modern constructor.

It is impossible to here outline the principles of the superheterodyne as space does not permit, but in order that the needs of the advanced constructor can be filled, full building instructions are given of a first-class battery operated superheterodyne.

The receiver about to be described has been designed to meet the needs of present-day conditions, yet while being remarkably sensitive and selective, gives a high quality output that will not offend the most fastidious ear.

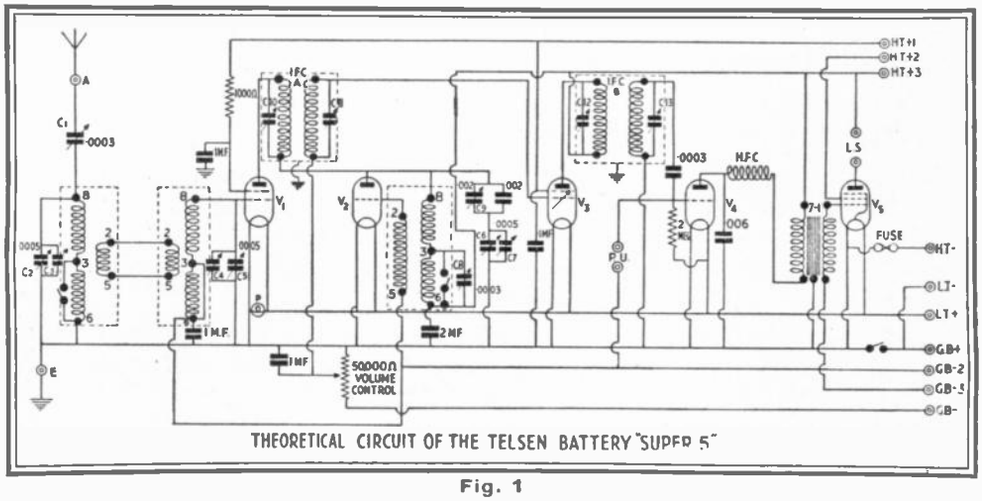
The expert constructor has only to glance at the circuit diagram to note that the incorporation of band pass filters throughout ensures selectivity without high note loss. The circuit has been the subject of very careful deliberation and while performance has been given every consideration, other equally important factors have not been neglected. These are initial cost and running costs. The latter are particularly important to the battery user, and the receiver will be found to be extremely economical for an instrument of its type.

The receiver, like all those described in the *Modern Radio Engineer*, is built on a wooden baseboard, thereby allowing the constructor all possible latitude for the introduction of any modifications he may wish to make at a later date.

Careful selection of values and disposition of components results in the receiver being perfectly stable although extremely sensitive. Considering the receiver has five valves and five tuned circuits, it is remarkable to note the small amount of wiring necessary. Construction will be found extremely simple as the amount of wiring is no more than that required for a much less ambitious instrument.

In the Telsen Battery Super 5, the theoretical circuit of which is given in Fig. 1, there are two tuned circuits preceding the first detector.

The initial tuned circuits comprise a band-pass filter employing a system of inductive coupling. When choosing a band-pass filter one would be inclined to select the mixed filter with its constant selectivity. This type of filter is, however, unsuitable, due to the fact that the common coupling condenser offers a high impedance to signals of the frequency of the intermediate stage. Signals of this frequency would therefore cause voltages to be applied across the grid of the first detector valve V1, which are then amplified by the intermediate amplifiers. As a pure capacity filter produces the same effect, an inductive method has been developed to obviate this defect. Also included in the aerial circuit is a pre-set condenser C1, which can be adjusted to obtain the maximum efficiency from any type of aerial system, and to suit the conditions peculiar to the district in which the set is operated. Following the first detector we have a separate oscillator V2 which generates oscillations and feeds them into the plate circuit of V1, where they "beat" with the signal frequency oscillations to produce the intermediate frequency (110 k.c.). The signals are then fed through the intermediate frequency transformer (I.F. coil "A"), which is comprised of two tuned circuits band-pass coupled to the grid of the intermediate frequency valve V3, a variable-mu valve being used in this stage. The signals are then applied to the primary of the second intermediate frequency transformer (I.F. coil "B"), which again is



THEORETICAL CIRCUIT OF THE TELSEN BATTERY "SUPER 5"

Fig. 1

WIRING INSTRUCTIONS FOR THE TELSEN "SUPER 5"

comprised of two tuned circuits band-pass coupled to the second detector valve V4. The signals are rectified at this stage, then passed on through a 7 : 1 step-up L.F. transformer to the output valve V5. A pentode valve giving one watt of undistorted power output is used here.

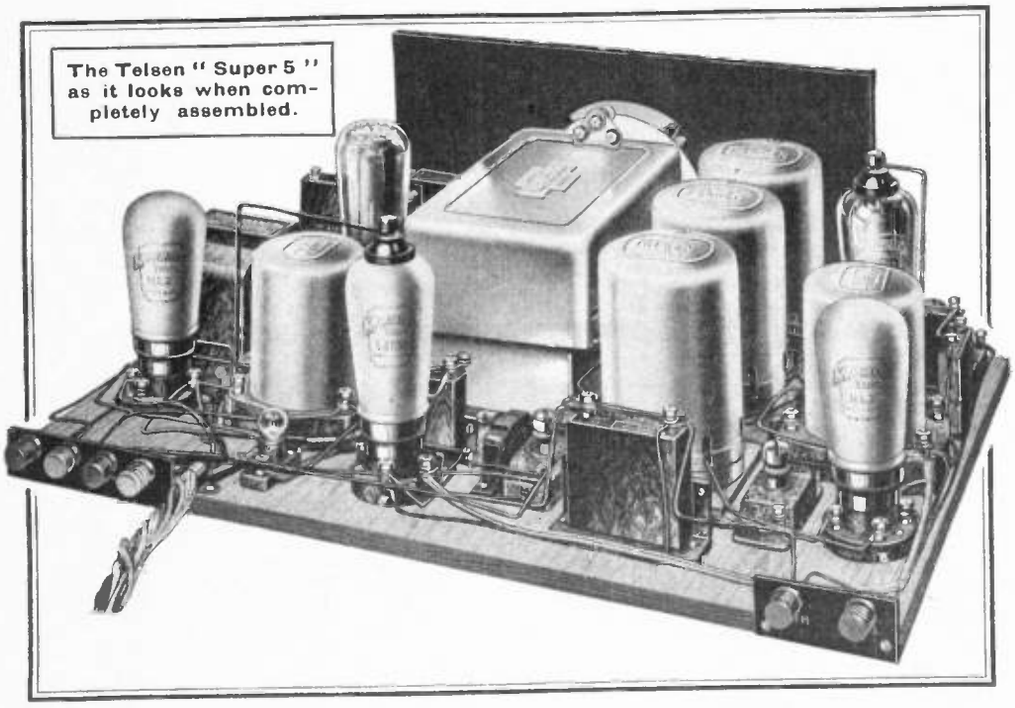
A most important control on the modern receiver is the volume control. The Telsen "Super Five" incorporates a variable-mu screened grid valve, as the intermediate frequency amplifier V3. This type of valve is one of the latest advances in the world of battery valves; it possesses the unique property that whilst its efficiency is lowered as the grid bias voltage is increased, it still retains the power to handle strong signals without distortion. It, therefore, can be seen that this is an ideal method by which signals can be controlled from a roar to a whisper. On this volume control is also incorporated an on-off switch, which controls the filament current for the valves. So far we have a control for the tuning circuits, and one for the volume and on-off switching. There is another control which is for switching from the long to the medium wavelength ranges.

Therefore, it will be observed that the Telsen Battery "Super Five" is a highly efficient 5-valve receiver of superlative qualities with but three controls—tuning, wave-change and volume.

A black print showing the complete assembly and wiring of the Telsen "Super Five" is given in this issue of the *Modern Radio Engineer* which, with the help of this article, enables the set to be quickly constructed and adjusted for the most efficient working. A complete list of components required for building this receiver is given elsewhere.

In addition to the components listed, a panel (dimensions and drilling instructions for which are given in Fig. 2) and a plywood baseboard 17½×12" are required. There are ten battery leads and it is advisable to secure a ten-way battery cord if possible. The only other non-standard components are the terminal panels shown in the photograph. These have been taken from a *Modern Radio Engineer's* Constructor's Outfit. Constructors who do not possess this outfit will find the Telsen terminal blocks W.204 equally suitable.

With the triple gang variable condenser is supplied a special template which enables constructors to cut a hole in the panel correctly for the dial escutcheon.



The Telsen "Super 5" as it looks when completely assembled.

Assembling the Panel

Having prepared the panel as shown in Fig. 2, the condenser escutcheon should be affixed in accordance with the instructions supplied with it. The wave-change and volume escutcheons should then be attached. The only other component to fix on the panel is a potentiometer with ganged switch. This is fixed in the right-hand hole and should be arranged so that all terminals are easily accessible.

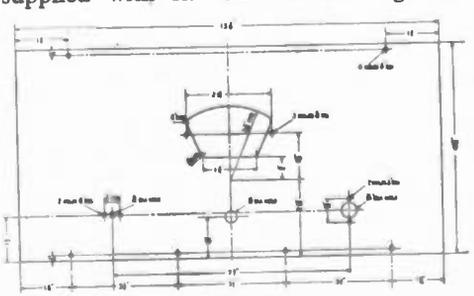


Fig. 2

Assembling the Baseboard

The position of the components is clearly shown in the accompanying black print. The variable condenser should first be mounted in accordance with the instructions supplied with the condenser. The band pass and oscillator coil unit, which are already mounted on a plinth, should next be fixed into position. The screens should be removed and it will be found that the oscillator coil is specially marked. The plinth should be fixed so that the oscillator coil is furthest from the control panel. All other components are then to be screwed down in the positions shown on the black print. Special attention should be given to the mounting of the grid leak clips on the .0003 fixed condenser. One clip is fixed to the terminal side of the condenser and connects to one of the terminals. The other clip is fixed to the reverse side, see Fig. 3.

A spare terminal should be fixed to the flange of the .1 mfd. condenser C.

The terminal consists of a 4/16" cheese-headed screw and two lock nuts. Having completed the assembly, the receiver is ready to be wired, first fixing the panel to the baseboard. Special insulating connecting wire is supplied for those constructors who do not wish to solder the connections. The wire is supplied in cartons containing 10 feet coils, Catalogue No. W.441. Instructions for using this wire will be found on page 8.

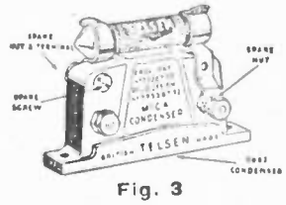


Fig. 3

Wiring

It will be observed that all terminals are numbered on the black print and the following point to point wiring instructions refer to those numbers. Constructors should note that the numbers given do not refer to any numbers or markings which appear on the components themselves. The wiring should be carried out in the order given, and it will be found helpful if the instructions are crossed through as each wire is fixed.

Connect terminal :—

1 on aerial-earth strip to 2 on 2 mfd. condenser.
2 on 2 mfd. condenser to 3 on V3.
3 on V3 to 4 on fuse holder.
4 on fuse holder to 5 on V5.
5 on V5 to 6 (the fixing screw) on I.F. coil "B."
6 on I.F. coil "B" to 7 on V4.
7 on V4 to 8 on transformer.
7 on V4 to 9 on 1 mfd. condenser.
9 on 1 mfd. condenser to 10 on on-off switch.
10 on on-off switch to 11 on ganged condenser.

FINAL ADJUSTMENTS AND GANGING UP THE "SUPER 5"

11 on ganged condenser to 12 on ganged condenser.
(11 and 12 are the terminals attached to the metal frame, not those on ebonite panels.)
12 on ganged condenser to 13 on .006 mfd. condenser.
13 on .006 mfd. condenser to 14 on I.F. coil "B."
14 on I.F. coil "B" to 15 on .1 mfd. condenser "C."
15 on .1 mfd. condenser "C" to 3 on V3.
1 on aerial-earth strip to 16 on V2.
16 on V2 to 17 on I.F. coil "A" (the fixing screw).
17 on I.F. coil "A" to 17 on .1 mfd. condenser "B."
18 on .1 mfd. condenser "B" to 19 on .1 mfd. condenser "A."
19 on .1 mfd. condenser "A" to 20 on V1.
20 on V1 to 21 on coil A.
22 on aerial-earth strip to 23 on .0003 mfd. pre-set condenser "B."
24 on .0003 mfd. pre-set condenser "B" to 25 on coil "A."
25 on coil "A" to 26 on ganged condenser.
27 on coil "A" to 28 on coil "B."
29 on coil "A" to 30 on coil "B."
31 on coil "B" to 32 on coil "C."
31 on coil "B" to 33 on .1 mfd. condenser "A."
34 on V1 to 35 on coil "B."
35 on coil "B" to 36 on ganged condenser.
37 on coil "C" to 38 on .002 mfd. pre-set condenser.
38 on .002 mfd. pre-set condenser to 39 on .002 mfd. fixed condenser.
37 on coil "C" to 40 on I.F. coil "A."
41 on coil "C" to 42 on 2 mfd. condenser.
43 on coil "C" to 44 on .0003 mfd. pre-set condenser "A."
45 on coil "C" to 46 on V2.
47 on .002 mfd. fixed condenser to 48 on .002 mfd. pre-set condenser.
48 on .002 mfd. pre-set condenser to 49 on ganged condenser.
50 on V1 to 51 on V2.
51 on V2 to 52 on V3.
52 on V3 to 53 on V5.
53 on V5 to 54 on V4.
54 on V4 to 55 on .0003 mfd. condenser.
(The wires to the pilot-lamp holder, which are shown dotted, may be left out if it is not desired to use a pilot-lamp. These connections are as follows):—
56 on pilot-lamp holder to 54 on V4.
57 on pilot-lamp holder to 11 on ganged condenser.

Proceeding with the other wiring:—
58 on V1 to 59 on .1 mfd. condenser "B."
58 on V1 to 97 on .1 mfd. condenser "C."
(Note.—Terminal 97 is a spare terminal which should be fixed to the flange of the .1 condenser.)

Now connect a 1,000 ohm resistor between terminals 60 and 97 on .1 mfd. condenser "C."
61 on I.F. coil "A" to cap on top of V1.
62 on I.F. coil "A" to 63 (the sliding contact) on potentiometer.

Connect a length of screened wire between 64 on I.F. coil "A" and 65 on V3.

Now connect a wire from the screening on the lead to 16 on valve holder V2.
40 on I.F. coil "A" to 66 on V2.
67 on .0003 mfd. pre-set condenser "A" to 42 on 2 mfd. condenser.
42 on 2 mfd. condenser to 68 on I.F. coil "B."
68 on I.F. coil "B" to 69 on loudspeaker strip.
70 on V3 to 60 on .1 mfd. condenser "C."
71 on I.F. coil "B" to cap on top of V3.
72 on I.F. coil "B" to 73 on .0003 mfd. condenser.
74 on .0003 mfd. condenser to 75 on V4.
74 on .0003 mfd. condenser to 76 on pick-up strip.
(This lead should be omitted if it is not intended to use a gramophone pick-up.)
77 on V4 to 78 on .006 mfd. condenser.
77 on V4 to 79 on H.F. choke.
80 on H.F. choke to 81 on transformer.
82 on transformer to 69 on loudspeaker strip.
83 on transformer to 84 on V5.
85 on V5 to 86 on loudspeaker strip.
87 on loudspeaker strip to 32 on coil "C."
88 on 1 mfd. condenser to 63 on potentiometer.
9 on 1 mfd. condenser to 89 on potentiometer.
10 on switch to 90 on panel.
2 on 2 mfd. condenser to 96 (the fixing screw) on coil plinth.

This completes the main wiring.

A ten-way battery cord is required; this should now be connected as follows:—
H.T.— lead to 91 on fuse holder.
G.B.+ lead to 92 on switch.
L.T.— lead (with spade-tag) to 92 on switch.
L.T.+ lead (with spade-tag) to 52 on V3.
G.B.—1 lead to 93 on potentiometer.
G.B.—2 lead to 87 on pick-up strip.
G.B.—3 lead to 94 on transformer.
H.T.+1 lead to 60 on .1 mfd. condenser "C."
H.T.+2 lead to 95 on V5.
H.T.+3 lead to 69 on loudspeaker strip.

This completes the wiring.

In Valve-Holder			*Insert Mazda Valve*
V1	..	..	215 S.G.
V2	..	..	H.L.2.
V3	..	..	S.215.V.M.
V4	..	..	H.L.2.
V5	..	..	Pen. 220.A.

Join the loose lead from 61 to the terminal on top of V1.

Join the loose lead from 71 to the terminal on top of V3.

The Pen. 220A valve should be of the 5-pin type. If it should have four pins only the terminal on the side of the base should be joined by a length of insulated wire to the terminal 95 of valve holder V5.

Now connect up the loudspeaker, aerial and earth to their respective terminals.

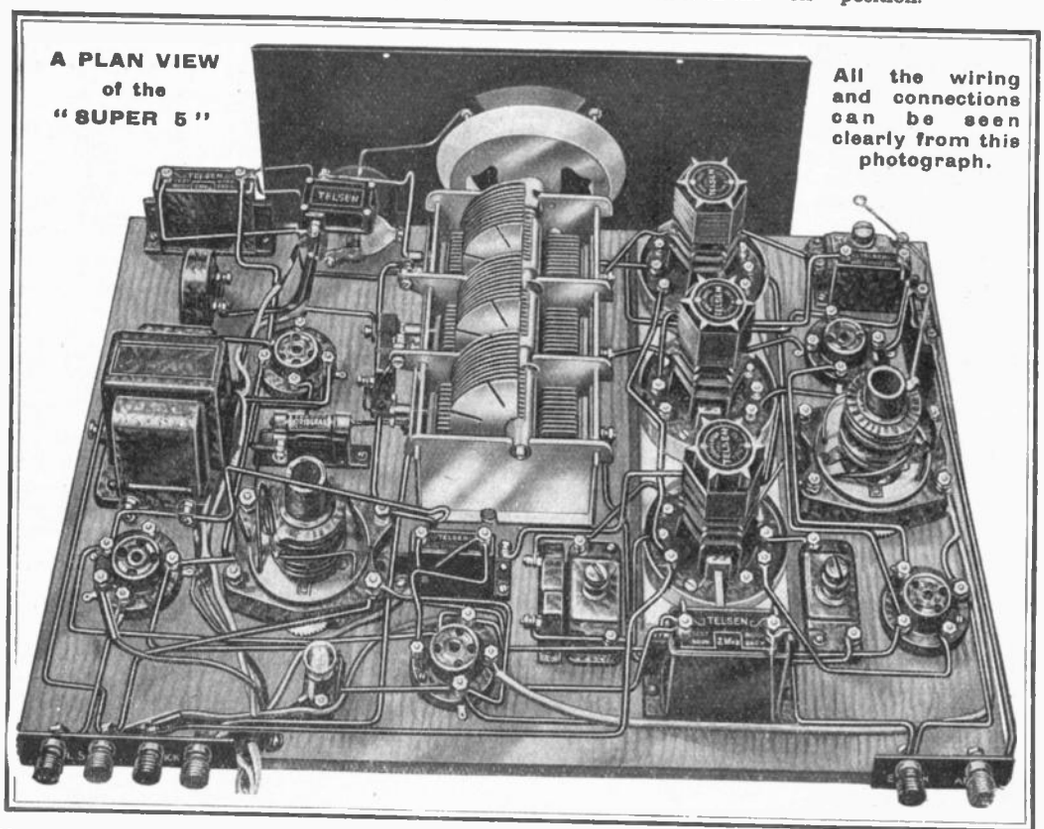
Screw the fuse into the fuse holder. This should be of the .15 ampere type and may be purchased from your local dealer, as may the 3 volt pilot lamp for illuminating the dial.

Now connect up the L.T., G.B. and H.T. batteries as follows:—

Connect spade of L.T.— lead to — terminal of accumulator.

Connect spade of L.T.+ lead to + terminal of accumulator.

See switch is in the "off" position.

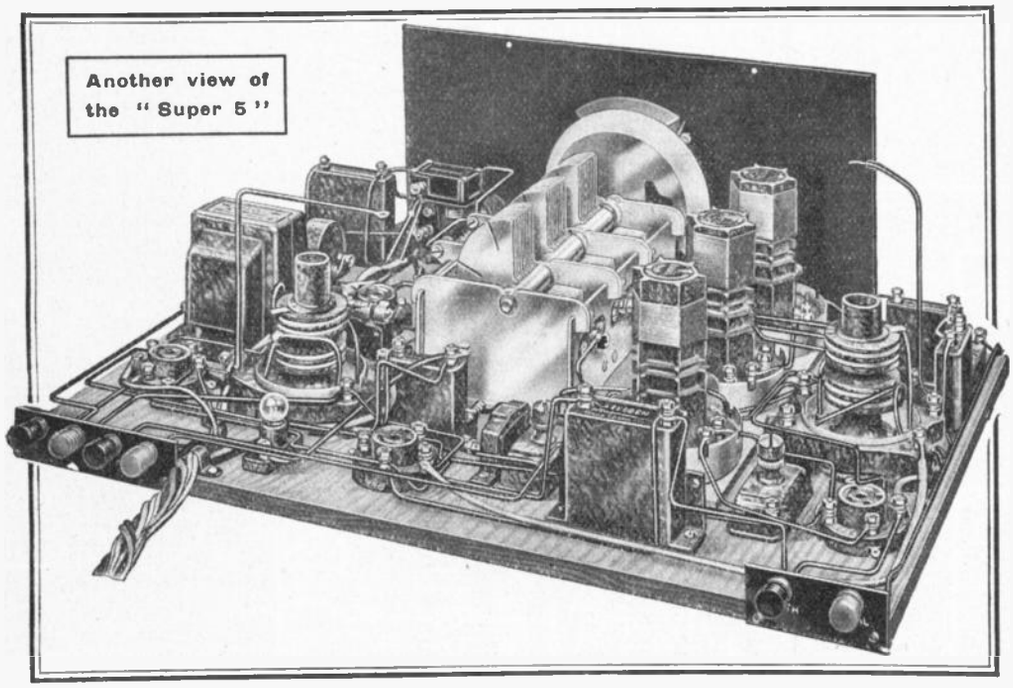


Setting up and Adjusting the Battery Super Five

The set is now ready for setting up for the reception of broadcasting.

Insert:—
G.B.—1 plug into —16 volt tapping of G.B. battery.
G.B.—2 plug into —1½ volt tapping of G.B. battery.
G.B.—3 plug into —9 volt tapping of G.B. battery.
H.T.+1 plug into 72-84 volt tapping of H.T. battery.
H.T.+2 plug into 108 volt tapping of H.T. battery.
H.T.+3 plug into 120 volt tapping of H.T. battery.

THE TELSEN "SUPER 5"—*continued.*



Another view of the "Super 5"

Insert :—

H.T. – plug into – tapping of H.T. battery.

G.B. + plug into + tapping of G.B. battery.

The trimming condensers may be screwed down temporarily as follows :—

C4.—Screw in the "star wheel" until about one half of a complete turn from being fully screwed in.

C1 and C9.—Screw down until about three complete turns from the full in position.

Now switch on.

Should the receiver become unstable and oscillate before the volume control reaches its maximum position, this is due to the voltage of H.T. +2 being of too high a value; it should accordingly be tried in the lower H.T. tappings until a progressive increase in volume with perfect stability is obtained as the volume control is turned.

After switching on the receiver, first rotate the wavechange switch to the medium wavelength position. At no time during ganging is it necessary to adjust the tuning condenser C3 and C7, which are mounted on the ganged tuning condenser. They should therefore be set at a minimum capacity by unscrewing the star wheels which operate them, to a position such that the plates of the trimmer are well separated. In adjusting the trimming condensers of the "pre-set" type, namely C1, C8 and C9, use an insulated screwdriver; this will avoid any disturbing effects due to the proximity of the hand.

The adjustments fall into three categories, and are best carried out in the following order :—

1.—The tuning of the I.F. circuits.

2.—The ganging.

3.—The balancing of the selectivity and quality.

The first two processes are carried out by tuning for maximum signal strength. The coils inside the I.F. Transformers should be set at nearly their maximum distance apart and a station tuned in as accurately as possible. The strength of this station should be adjusted to a conveniently low level by means of the volume control, so that differences of strength are easily perceptible.

The trimming condensers C10, C11, C12 and C13 are varied by rotating the thumb wheels situated at the sides of the bottom of each coil. Adjustment of these trimmers must now be carried out. Starting from C10, rotate the "thumb wheel" backwards and forwards for the maximum response; repeat the same operation on C11, C12 and C13. If it is found that maximum signal strength occurs with any one of the thumb wheels rotated to the full extent of its travel then all the other three thumb wheels should be rotated slightly in the opposite direction and the station retuned by the ganged condenser.

Tune in a station near the bottom of the scale, making sure that the signals are constant and are not from a station susceptible to serious fading. The station as in the last operation must be tuned in accurately, and kept at a low volume level by means of the volume control. Adjust the trimming condenser C4 for maximum response and finally the aerial trimming condenser C1. The set is now temporarily ganged at the bottom of medium band. The next step is to rotate the triple ganged tuning condenser and tune in to a station near the top end of the medium wavelength band. An adjustment is now made with the "padding" condenser C9; each time C9 is turned, the triple ganged condenser must be rotated in the opposite direction to receive this same station. Therefore when C9 is turned in a clockwise direction, the triple ganged condenser must be rotated in an anti-clockwise direction. This adjustment should be carried out slowly and if a decrease in the strength of the signals is observed when, say, C9 is rotated in a clockwise direction, C9 must therefore be rotated in the opposite direction, rocking the triple ganged condenser each time an adjustment is made to C9 until the position is found for maximum response. The top end of the medium wavelength band is now in gang and a final ganging must be made at the bottom end. To readjust, rotate the triple ganged condenser to a station as near as possible to the minimum position of the tuning dial and rotate the trimming condenser C4 for maximum response.

The last adjustment to be made on the medium wavelength band is the aerial trimming condenser C1. It has been found that this should be adjusted when the set is tuned to a station of about 400 metres. The medium wavelength band is now in gang. To gang up the long wavelength band, rotate the wave-change switch to the long wavelength position, and with the triple gang condenser tune in a station at about 1,400 metres —preferably a long distance station. Gang up by means of rotating the long wavelength trimming condenser C8. Like C9, the triple ganged condenser has to be "rocked" in an opposite direction for each movement of C8 in order to keep the station in tune.

The last operation is the adjustment of the coils on the I.F. transformers and these should be adjusted to give a compromise between maximum selectivity and quality so as to suit individual tastes. This is achieved by varying the coupling between the coils.

Finally it may be found that an adjustment of the I.F. transformer trimming condenser C10, C11, C12 and C13 is necessary to give the maximum sensitivity.

Recommended Valves and Batteries

Mazda 215S.G., H.L.2, S.215V.M., H.L.2 and Pen. 220A.

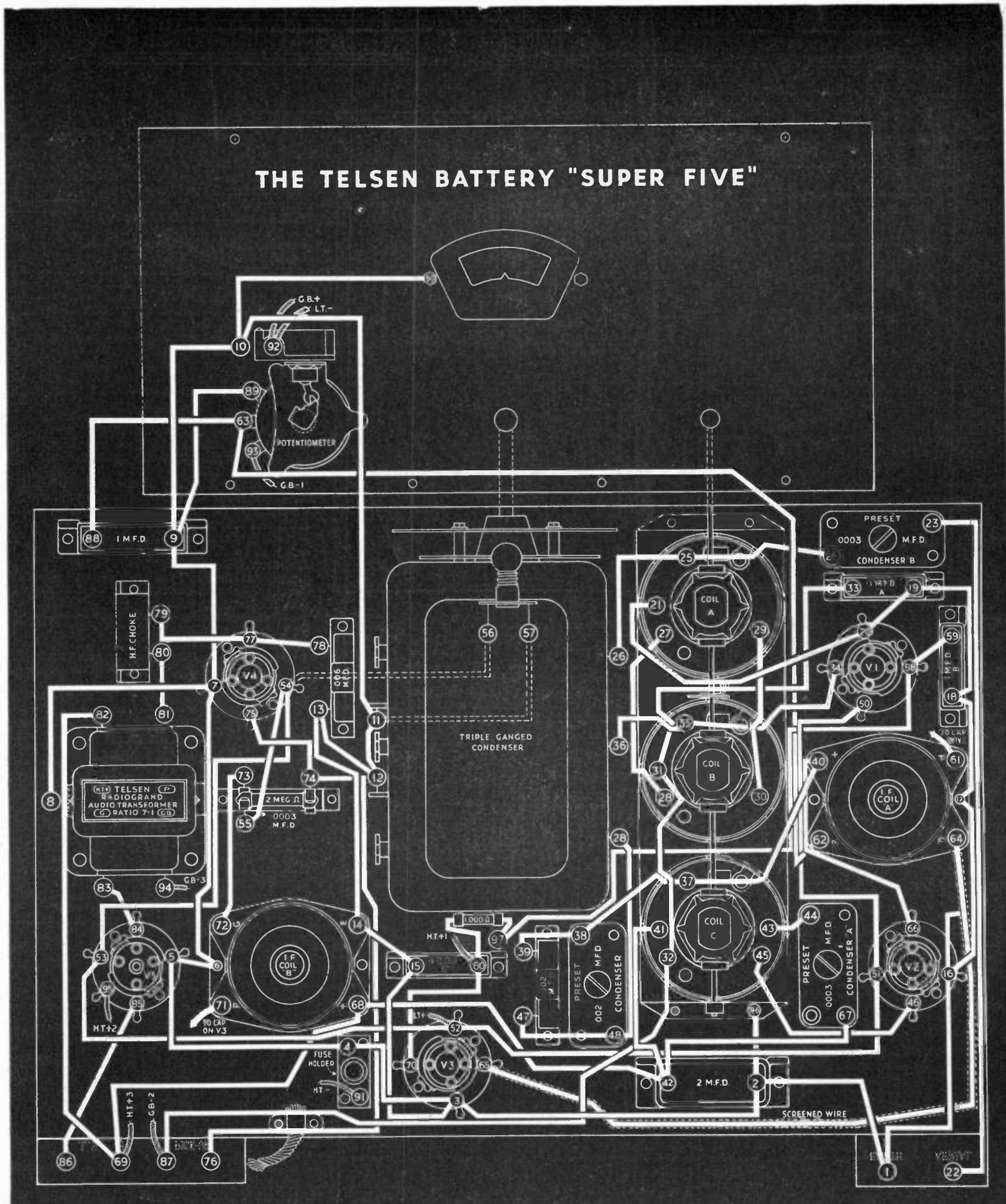
H.T. battery :—2 of Ediswan 60 volt, 20 mA., Cat. No. 69724 or 1 of Ediswan 120 volt, 20 mA., Cat. No. 69728.

G.B. battery :—1 of Ediswan 16 volt, G.B. battery, Cat. No. 69805.

L.T. battery :—1 of Ediswan 16 volt, 45 a.h., Type E.L.M.4.

THE TELSEN "SUPER 5"
List of Components.

Quantity	*Description*	*Cat. No.*	*Price*
4	Telsen Anti-Microphonic Valve Holders, 4-pin	W.222	2/8
1	,, Anti-Microphonic Valve Holder, 5-pin	W.223	10d.
1	,, 2 meg. Grid Leak	W.251	1/-
1	50,000 ohm Volume Control with Mains Switch		4/6
2	,, .0003 Pre-set Condenser	W.151	3/-
1	,, .002 Pre-set Condenser	W.149	1/6
1	, .0003 Fixed Mica Condenser	W.242	1/-
1	,, .002 Fixed Mica Condenser	W.246	1/6
1	,, .006 Fixed Mica Condenser	W.247	1/6
3	,, .1 mfd. Paper Condensers	W.231	5/3
1	,, 1 mfd. Paper Condenser	W.227	2/3
1	,, 2 mfd. Paper Condenser	W.226	3/-
1	,, Triple Ganged Tuning Condenser	W.428	22/6
1	,, Band-Pass and Oscillator Coil Unit	W.292	21/6
2	,, Intermediate Frequency Transformer Coils	W.294	15/-
1	,, Standard H.F. Choke	W.75	2/6
1	,, 7 : 1 "Radiogrand" Transformer	W.60	10/6
1	,, Fuse Holder	W.146	6d.
1	,, 1000 ohm. Resistor	W375	1/-
2	,, Pilot Lamps, 2.5	W.417	1/-



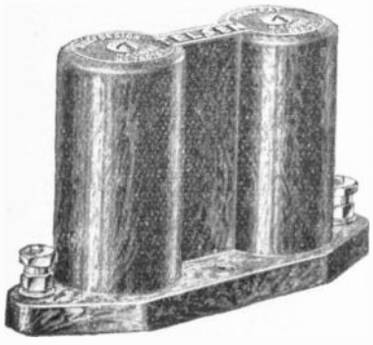
ILLUSTRATED INDEX *of* RADIO COMPONENTS

CHOKES

TELSEN
STANDARD H.F. CHOKE

The Telsen standard H.F. Choke is deservedly popular in view of its remarkable efficiency at a low cost. It is particularly suitable for reaction circuits, has a very low self-capacity for its high inductance and occupies a minimum of space.

No. W.75 **2/6**



TELSEN
BINOCULAR H.F. CHOKE

In high class circuits calling for exceptionally efficient H.F. chokes, the Telsen Binocular Chokes can be relied upon in every respect. Its external field is negligible due to the binocular formation, it has a low self-capacity while its inductance is as high as 180,000 micro-henries. No. W.74 **4/6**

TELSEN
SHORT-WAVE H.F. CHOKE

This choke is specifically designed to cover the complete short wavelength band, usually considered to extend from 150 to 10 metres. "Blind Spots" have been eliminated, and its extremely low self capacity makes it a thoroughly reliable and efficient component for all Short Wave circuits. Enclosed in a neat bakelite moulding it occupies a minimum of space.

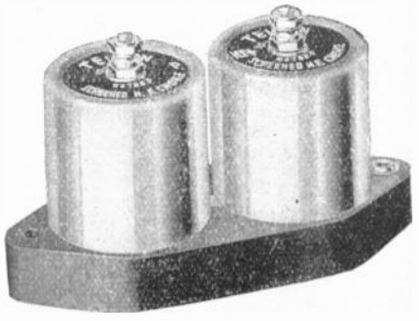
No. W.221 **3/-**

CHOKES—*continued*

TELSEN
SCREENED H.F. CHOKES

These new chokes have been very carefully designed and constructed so that their efficiency is consistently high over the whole of the wave band for which they are intended. They are small and compact, and the metal screen, which is connected to an earthing terminal, entirely prevents interaction with other components.

Three types are available, W.341, which is designed for wavelengths between 100 and 2,000 metres, such as are met with in the ordinary broadcast receiver, W.342, which is a short wave choke for use between 10 and 100 metres, and W.340, a binocular choke suitable for "all-wave" sets working between 10 and 2,000 metres.

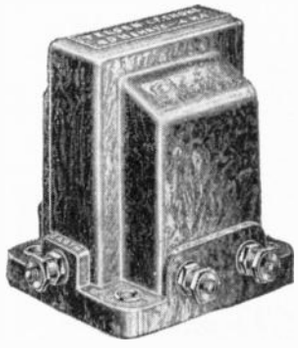


Standard Screened H.F. Choke. No. W.341 **3/6**
All Wave Screened Binocular H.F. Choke. No. W.340 **5/6**
Short Wave Screened H.F. Choke. No. W.342 **3/6**

TELSEN
INTERVALVE
L.F. COUPLING CHOKES

Rating	*Normal Current*	*Max. Current*	*No.*
40 H. at 3 mA	.. 10 mA	..	W.68
100 H. at 2 mA	.. 6 mA	..	W.69

These popular L.F. Chokes are primarily intended for use as coupling chokes in the anode circuits of modern radio receivers, but may be used in any circuit not carrying more than the stipulated maximum current. **5/6**



ILLUSTRATED LIST OF RADIO COMPONENTS—*continued*

CHOKES—*continued*

TELSEN L.F. SMOOTHING CHOKE

The Telsen Smoothing Choke has been designed to fulfil all the requirements of an efficient smoothing component in the rectified mains output circuit of a receiver. Its inductance is 28 henries at 25 mA, the maximum permissible current not exceeding 50 mA D.C. Resistance 1,000 ohms.

No. W.302 **12/6**

TELSEN TAPPED PENTODE OUTPUT CHOKE

This Choke is designed primarily for pentodes taking an anode current of not more than 20 mA. By varying the connections, ratios of 1:1, 1.6:1, and 2.5:1 are attainable, thus providing for matching under widely varying conditions.

No. W.72 **7/6**

TELSEN OUTPUT CHOKE

Designed for use as an output filter in conjunction with a condenser not less than 1 mfd., following any power or super power valve taking up to 40 mA anode current. Gives an ideal response curve under all conditions.

No. W.71 **7/6**

TELSEN HEAVY DUTY SMOOTHING CHOKE

This Choke has the very low D.C. resistance of 420 ohms, and so is particularly useful in smoothing circuits passing comparatively heavy currents where the maximum output voltage is needed. Its inductance is 18 henrys at 50 milliamps., and the maximum permissible current is 75 mA.

No. W.361 **12/6**

TELSEN POWER PENTODE OUTPUT CHOKE

The use of this Power Choke prevents direct current passing through the loudspeaker when the latter is used in conjunction with power pentode output valves carrying up to 40mA. It also enables correct matching and good quality to be obtained through the choice of three ratios, namely, 1:1, 1.3:1 and 1.7:1.

No. W.172 **10/6**

"CLASS B" COMPONENTS

TELSEN "CLASS B" DRIVER TRANSFORMERS

These are made in two ratios, which cover the requirements of all the "Class B" valves available at present and are supplied with comprehensive instructions.

Ratio: (Overall) 1:1; (Primary to half-secondary) 2:1.

No. W.343 **10/6**

Ratio: (Overall) 1.5:1; (Primary to half-secondary) 3:1.

No. W.359 **10/6**

TELSEN "CLASS B" OUTPUT TRANSFORMER

The Telsen "Class B" Output Transformer, which gives ratios of 35:1, 50:1 and 65:1, will provide correct matching to moving coil speakers having low resistance speech coils, and, like the "Class B" Output Choke, has a low primary resistance (200 ohms per half winding) and a very large core section. Supplied with full instructions.

No. W.344 **10/6**

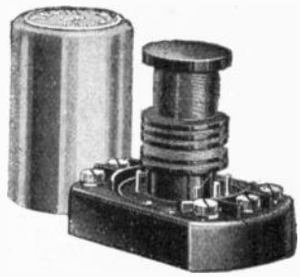
TELSEN "CLASS B" OUTPUT CHOKE

This choke provides ratios of 1:1, 1.3:1, 2:1, 2.6:1, whereby a "Class B" output stage can be matched to any moving coil speaker having either a high resistance speech coil or a low resistance coil and input transformer. The low D.C. resistance of 220 ohms per half winding and generous core section prevent the occurrence of distortion due to voltage drop or magnetic saturation on peak load. The total inductance is 18 henries. Supplied with full instructions.

No. W.345 **10/6**

COILS

TELSEN "349" IRON-CORED SCREENED COILS



The result of extensive research, these coils employ an iron-dust core which has enabled their size to be greatly reduced without sacrifice of efficiency, which is considerably higher than that of the majority of air-cored coils. Magnification and selectivity are correspondingly improved, while the metal screening can prevents the occurrence of unwanted interaction These coils can be used as aerial tuning coils or H.F. transformers, a reaction winding being included.

Single Coil. .. .. No. W.349 **8/6**

Twin Matched Coils. .. .. No. W.422 **17/-**

Triple Matched Coils .. .. No. W.423 **25/6**

TELSEN DUAL RANGE AERIAL COIL

Incorporates a variable selectivity-device, making the coil suitable for widely varying reception conditions. This adjustment also acts as an excellent volume control, and is equally effective on long and short waves. The wave-band change is effected by means of a three-point switch and a reaction winding is included.

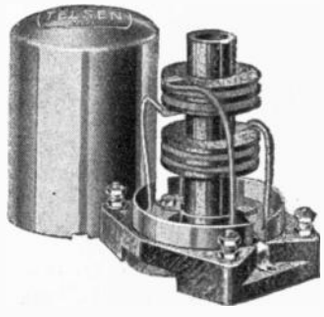
No. W.76 **7/6**

TELSEN H.F. COIL

May be used for H.F. amplification with screen grid valve, either as an H.F. transformer or alternatively as a tuned grid or tuned anode coil. It also makes a highly efficient aerial coil where the adjustable selectivity feature is not required.

No. W.154 **5/6**

TELSEN INTERMEDIATE FREQUENCY TRANSFORMER COIL

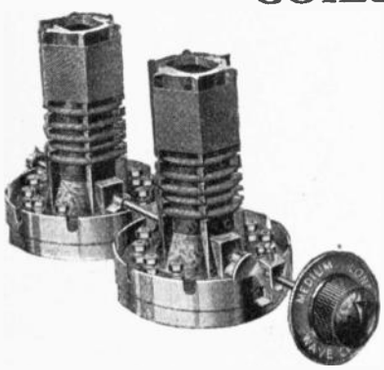


Consists of two tuned circuits comprising a band pass intermediate frequency filter tuned to 110 k.c. by two pre-set balancing condensers fitted in the base of the coil. Small milled wheels projecting from the sides of the base enable these condensers to be adjusted for different values of stray capacities, and the filter coupling is also variable so that optimum conditions for both quality and selectivity may be attained. Totally screened.

No. W.294 **7/6**

ILLUSTRATED INDEX OF RADIO COMPONENTS—*continued*

COILS—*continued*



TELSEN SCREENED TUNING COILS

The result of much research and experiment, these coils embody the ultimate efficiency attainable in a perfectly shielded inductance of moderate dimensions. Provided with separate coupling coils for medium and long waves they are suitable for use as aerial coils or as anode coils following a screen grid valve, giving selectivity comparable only with a well designed band-pass filter. The coils are fitted with cam operated rotary switches with definite contacts and click mechanism, and are supplied complete with aluminium screening cans.

Single Screened Coil	No. W.216	7/-
Twin matched Screened Coils	No. W.287	14/6
Triple matched Screened Coils	No. W.288	21/6

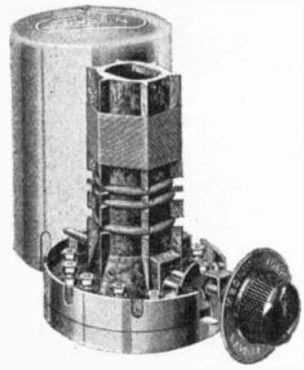
TELSEN COIL SWITCH COUPLING ASSEMBLY

When it is desired to mount two or more of the Telsen Shielded Coils in a line parallel to the panel, and to control the wave change switching by a single knob on the panel, this switch coupling assembly will be found indispensable.

No. W.217 **6d.**

TELSEN COIL SWITCH KNOB ASSEMBLY

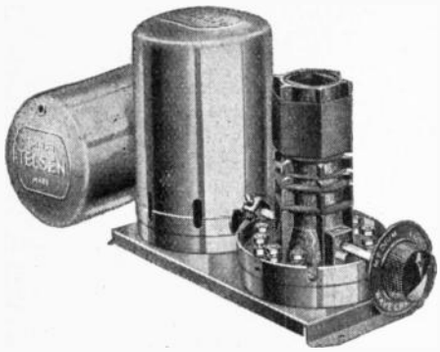
This knob is specially designed for use with the Telsen Shielded coupling coils. The extension on the knob spindle fits over the switch rod supplied with the coils, a firm coupling to the rod being ensured by tightening the small screw provided No. W.218 **1/-**



TELSEN OSCILLATOR COIL

This coil is particularly suited to superheterodyne circuits in conjunction with the Telsen Band Pass Coils, for which it can be obtained separately, or in a combined unit (see W.292). It has been designed to operate at a frequency separation of 110 kilocycles from the band pass tuning range, and with a standard 3-gang tuning condenser and suitable padding condensers will maintain a constant frequency separation over both wave ranges.

No. W.293 **7/6**



TELSEN BAND-PASS COIL UNIT

This unit comprises two accurately matched Screened Band Pass Coils wound on black moulded bakelite formers and mounted together on a single rigid plinth base. The coils are independent of each other and can be wired for any of the three types of band pass filter to give exceptional quality with selectivity. Wave-change switching is incorporated in each coil base, the switches being ganged and controlled by a single knob. Complete with escutcheon plate and knob.

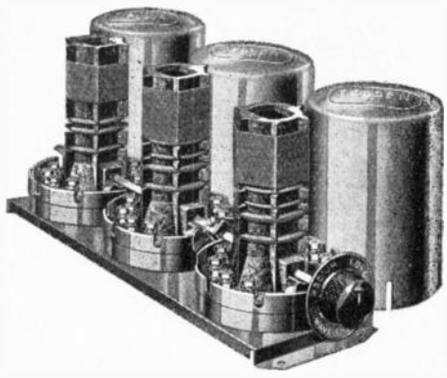
No. W.290 **14/6**

TELSEN BAND-PASS AND OSCILLATOR COIL UNIT

Comprises the Band Pass Coils and Oscillator Coils combined and mounted into a compact unit on a single metal plinth base. All wave change switches are ganged with single knob control. The ideal component for any superheterodyne circuit. No. W.292 **21/6**

COILS—*continued*

TELSEN SUPERHETERODYNE COILS Type No. S.330



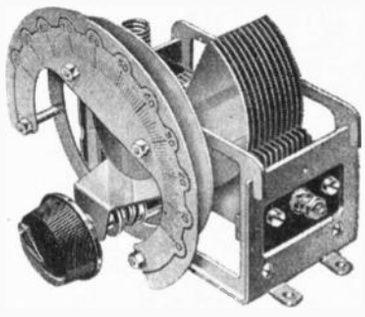
These Telsen Superheterodyne Coils are designed to cater for those constructors who wish to make a Superheterodyne Receiver that does not employ band pass tuning in the pre-detector high frequency stages. They possess the same exceptional features of high efficiency and low losses that have made the Telsen Screened Coils No. W.216 and the Telsen Band Pass Coils No. W.290 so justly famous.

These coils are designed to work in conjunction with a triple ganged variable condenser having specially shaped vanes for maintaining a constant frequency difference of 110 kilocycles between the frequency of the oscillator and that of the aerial and grid tuning coils.

Type No. S.330 **21/6**

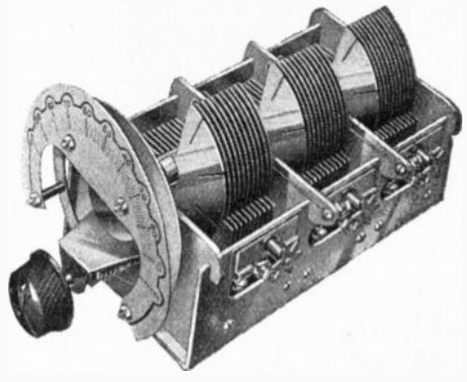
CONDENSERS
(VARIABLE AIR DIELECTRIC)

TELSEN SINGLE CONDENSER UNIT



This is a very high-class air-dielectric condenser with illuminated dial, and is intended for chassis or baseboard mounting. A skeleton framework of nickelplated steel supports the two sets of die-cast vanes, great rigidity and low minimum capacity being achieved in the construction. A stator terminal is provided on each side of the condenser, and positive connection is made to the rotor by means of a flexible pigtail. The maximum capacity of this condenser is .000 53 mfd. Two interchangeable dials are supplied, one of which is graduated in degrees, while the other is specially calibrated to give a direct indication of wave-length when the condenser is used with a Telsen Screened Coil No. W.216. Supplied with knob and escutcheon plate. No. W.339 **8/6**

TELSEN GANGED CONDENSERS



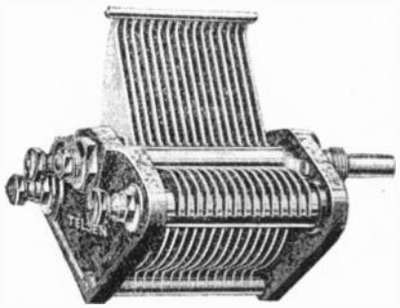
The Telsen Ganged Condenser Units have been designed for use in modern receiver circuits in which accurate and simultaneous tuning of two or three circuits is obtained by the rotation of one dial. A pressed steel frame of great rigidity completely obviates any tendency to distortion, while the rotor and stator vanes are let into one-piece high pressure die castings, ensuring accurate spacing. All sections are very carefully matched by means of split end vanes, and trimmers are provided across each section to compensate for differences in stray capacities. In the twin gang condenser the front section carries a variable trimmer operated by a knob concentric with the main tuning control. Both models have an attractive stove aluminium finish and are complete with disc drive, dust covers, escutcheon plate, pilot light holder, knob and two alternative tuning scales.

Twin Ganged Condenser	No. W.427	.. **16/6**
Triple Gang Condenser	No. W.428	.. **22/6**

ILLUSTRATED INDEX OF RADIO COMPONENTS—*continued*

CONDENSERS—*continued*

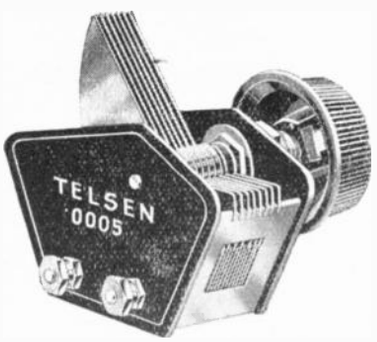
(VARIABLE AIR DIELECTRIC)



TELSEN LOGARITHMIC VARIABLE CONDENSERS

The Telsen Variable Condensers are built to withstand years of service. Rigidity in construction, the effective clamping of both rotor and stator vanes, and freedom from backlash and end play have been the primary features aimed at in their design, and thereby accurate and consistent spacing is assured as long as the condenser is in service.

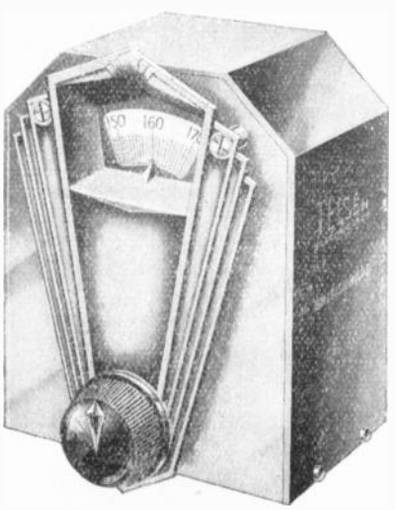
Capacity:
.0005 mfd. No. W.132 .. **3/6** .00025 mfd. No. W.130 .. **2/6**
.00035 mfd. No. W.131 .. **3/6**



TELSEN BAKELITE DIELECTRIC TUNING CONDENSERS

Designed on lines of great rigidity, compactness and high efficiency, these condensers are confidently recommended for use in cases where space is limited. A high grade dielectric is employed, ensuring accuracy of tuning with minimum losses. Complete with knob.

Capacity mfd.		*No.*	
.0005	.. ..	W.193 ..	**2/6**
.0003	.. ..	W.194 ..	



THE TELEXOR

This totally enclosed unit, complete with oxydised silver escutcheon plate and knob, incorporates a special design of tuning condenser, covering the full circle and giving "log law" tuning in both directions. It embodies a new development in radio set construction by which wave range switching or the changing of coils is rendered unnecessary through the automatic switching device provided in the construction of the condenser. Thus both medium and long wave ranges are covered by the operation of turning one knob, while at the same time the illuminated and clearly marked scale facilitates tuning.

No. W.180 **10/6**

(BAKELITE DIELECTRIC)

TELSEN AERIAL SERIES CONDENSER WITH SWITCH

Built on similar lines to the new reaction condensers, this condenser provides an ideal selectivity and volume control. The maximum capacity is .0003 mfd. with an extremely low minimum capacity. A switch arm is keyed to the spindle whereby the condenser is short-circuited at its maximum position, giving a "straight through" aerial connection when desired, which results in a wide range of control. Supplied complete with knob. No. W.350 **2/6**

CONDENSERS—*continued*

(BAKELITE DIELECTRIC)

TELSEN BAKELITE DIELECTRIC REACTION CONDENSERS

These condensers have been entirely re-designed and now incorporate several valuable improvements. They are very rigidly made, and the spindle, to which positive contact is made by means of a flexible pigtail, is so constructed that all end-play, which may alter the capacity, is entirely prevented. The vanes are interleaved with finest quality solid dielectric, and the whole unit is enclosed in a strong dust-proof bakelite case, which, by excluding grit, prevents the occurrence of the annoying "rustling" noises so often found in other makes. Supplied complete with knob.

Cap. mfd.	*No.*	*Cap. mfd.*	*No.*	*Cap. mfd.*	*No.*	*Price*
.0003	W.354	.0001	W.356	.0005	W.358	**2/6**
.00015	W.355	.00075	W.357			

TELSEN DIFFERENTIAL CONDENSERS

These are similar in design and construction to the reaction condensers, and are supplied, complete with knob, in the following capacities.

Capacity mfd.		*No.*	
.0003	.. ..	W.351 ..	**2/6**
.00015	.. ..	W.352 ..	
.0001	.. ..	W.353 ..	

(FIXED MICA)

TELSEN MICA CONDENSERS

The new Telsen "Mica" Condensers represent an important advance in technique by which H.F. losses have been practically eliminated. The re-designed case is of more attractive appearance and can be mounted vertically or flat. Grid leaks, as before, may be mounted in series or shunt, clips being supplied free with capacities .0001, .0002 and .0003 mfd.

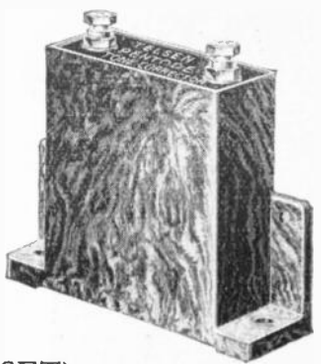
Cap. mfd.	*No.*	*Price*	*Cap. mfd.*	*No.*	*Price*
.00005	W.442	1/-	.0005	W.244	1/-
.0001	W.240	1/-	.001	W.245	1/3
.0002	W.241	1/-	.002	W.246	1/6
.0003	W.242	1/-	.006	W.247	1/6
.0004	W.243	1/-			

The following mica condensers have also been added to the range for special purposes, e.g., band-pass filter circuits, etc., and are supplied in the Self-Sealing type bakelite cases.

Capacity .01 mfd., No. W.310 .. .. **2 6**
" .02 " No. W.311 .. .. **3 6**
" .05 " No. W.316 .. .. **4,6**

(PAPER TYPE)

TELSEN SELF-SEALING CONDENSERS



These condensers are self-sealing, non-inductive and hermetically sealed.

Cap. mfd.		*500 volt test No.*	*Price*
.01	.. ..	W.232	1/6
.04	.. ..	W.230	1/9
.1	.. ..	W.231	1/9
.25	.. ..	W.229	2/-
.5	.. ..	W.228	2/3
1	.. ..	W.227	2/3
2	.. ..	W.226	3/-

(PRE-SET)

PRE-SET CONDENSERS

The very low minimum capacity of the Telsen Pre-set Condensers gives a wide range of selectivity adjustment when used in the aerial circuit. They are substantially made, easily adjusted and provided with a locking ring. Their high insulation and low loss adapts them for a number of uses.

Max. Cap. Mfd.	*Min. Cap. Mfd.*	*No.*	
.00005	.000005	W.446	**1/6**
.002	.00025	W.149	
.001	.000052	W.150	
.0003	.000016	W.151	
.0001	.000005	W.152	

ILLUSTRATED INDEX OF RADIO COMPONENTS—*continued*

CONDENSERS—*continued*

(TUBULAR)

TELSEN SMALL TUBULAR CONDENSERS

This is a new range of very small tubular condensers, which despite their small size, are quite as efficient as the larger types. They are tested up to 1,500 volts, and as they have wired ends are very suitable for suspension in the wiring.

Capacities: .0001, .0002, .0003, .0005, .001, .002, .005, .006 mfd. .. **1/-**
Capacity .01 mfd. **1 3**
Capacity .1 mfd. **1 6**

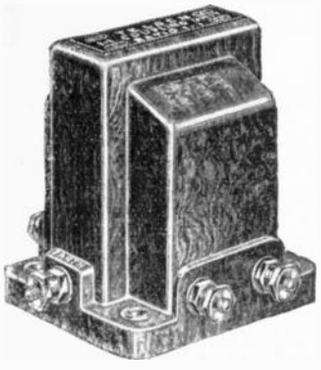
CONSTRUCTOR'S OUTFIT.

THE MODERN RADIO ENGINEER'S CONSTRUCTOR'S OUTFIT

This outfit is supplied to facilitate the building of a Telsen Set by grouping together the panel, baseboard, and all small articles such as screws, wire, wander plugs, spanners, etc., required for the construction of the receiver. Thus, when the standard components for any particular receiver have been obtained, the constructor has only to purchase the corresponding outfit to enable him to complete the entire construction of the receiver with the greatest possible ease.

No. W.445 **5/6**

COUPLING UNITS



TELSEN 1—1 INTERVALVE COUPLING UNIT

This is a modern development of the one time deservedly popular R.C. units. It incorporates a low pass filter feed in its anode circuit, thus effectively preventing "motor-boating," "threshold howl," and other forms of instability. With an H.L. type valve it will give an amplification of about 20, while consuming negligible H.T. current.

No. W.214 **7/6**

TELSEN 10-1 INTERVALVE COUPLING UNIT

A filter-fed Transformer using a high permeability nickel alloy core, and enabling a 10—1 voltage step-up to be attained while preserving an exceptionally good frequency characteristic which is compensated in the higher frequencies for use with a pentode valve. No. W.215 **12/6**

TELSEN "R.C." COUPLING UNIT

No. W.235 .. .. **4 -**

DIALS AND DISC DRIVES

TELSEN SMALL FRICTION DISC DRIVE

A low-priced Disc Drive for auxiliary controls. It is extremely robust and may be usefully employed for main tuning condensers where limitations of space have to be considered.

No. W.257 **2/-**

DIALS AND DISC DRIVES

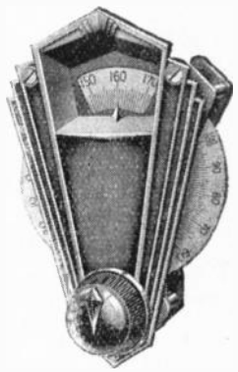
—continued

TELSEN BAKELITE SLOW MOTION DIAL

Made in black or brown moulded bakelite, this elegant little dial has a gear ratio of 8—1, the disc being graduated from 0 to 100 in both directions. It can be fitted to any of the Telsen Tuning and Reaction Condensers, or other standard makes having ¼" spindle and is suitable for all panels up to ⅜" thickness. Mounting instructions are included with every dial.

Black .. No. W.141
Brown .. No. W.141A } **1/6**

TELSEN ILLUMINATED DISC DRIVE

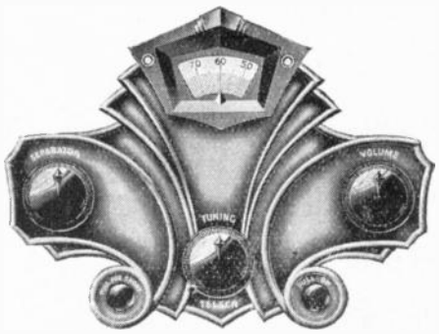


Fitted with a handsome oxydised silver escutcheon of modern design, this drive incorporates an improved movement. The gear ratio of approx. 5—1 and the bold and well-proportioned figures make for delightfully easy tuning. A double-ended spanner to fit all Telsen "one hole fixing" nuts is supplied free with every Disc Drive.

No. W.184 **2/6**

TELSEN "313" DISC DRIVE

This is essentially an illuminated Disc Drive tuning control similar to W.184 and suitable for any standard tuning condenser with ¼" spindle. Although primarily designed for the Telsen "325 Star" receiver, this component, with its exceptionally attractive escutcheon plate, is ideal for use in any receiver employing the usual panel controls indicated. These comprise "Separator," Volume control, and Wave-change and "On-Off" Switches, thus grouping the main essentials of a complete control unit into a compact assembly. Escutcheon plate finished in Oxydised Silver.



No. W.313 **3/6**

FUSES AND HOLDERS

TELSEN POWER FUSE

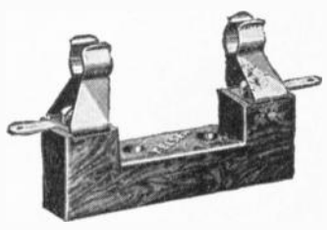
These efficient little power fuses utilise a special fuse wire having a very small "time-lag" when the fusing current has been attained. The wire is mounted in a glass tube hermetically sealed into caps of polished nickel. Made in four values:

Fusing Current: ½ amp., No. W.199; 1 amp. No. W.200; 2 amp., No. W.201; 3 amp., No. W.202 .. .. .. **6d.**

TELSEN POWER FUSE-HOLDER

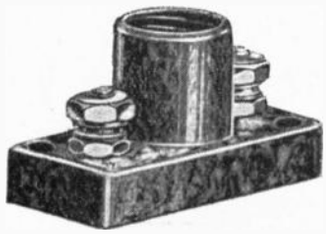
Made for mounting the Telsen Power Fuse. The end clips are securely held and are in one piece with the soldering tag projections. Ordinary wire connections can also be made under the clip screws.

No. W.203 **6d.**



ILLUSTRATED INDEX OF RADIO COMPONENTS—*continued*

FUSES AND HOLDERS—*continued*



TELSEN FUSE-HOLDER

A neat and inexpensive device which should be incorporated in every receiver as a precaution against burnt out valves. The terminals are easily accessible and the standard type fuse bulb is held firmly, giving a perfect contact which cannot become loose.

No. W.146 **6d.**

TELSEN 100 mA. FUSE BULB

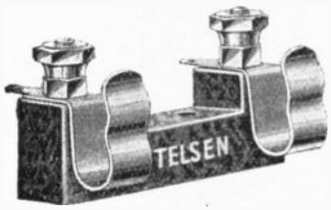
Designed especially for the battery operated receiver where only a small anode current is passing, these fuse bulbs provide adequate protection for the delicate filaments of low consumption valves. That important factor "time-lag" has been given special attention, and these fuses can be relied upon to blow immediately the maximum rated current is passing. Fitted into an hermetically sealed bulb the fuse, in spite of its delicate filament, is extremely robust. This fuse is an essential accessory to every battery operated receiver, and an invaluable insurance against the possibility of burnt out valves.

No. W.318 **6d.**

GRID LEAKS

TELSEN GRID LEAKS

These are absolutely silent and practically unbreakable and do not vary in resistance with application of different voltages. They are non-inductive and produce no capacity effects. Capacities: 5, 4, 3, 2, 1, ½, ¼ megohms. **1/-**



TELSEN GRID LEAK HOLDER

This will hold firmly any standard size or type of grid leak. The spring contacts are extended in one piece to form soldering tags, and the terminals and fixing holes are accessible without removing the grid leak. No. W.148. **6d.**

RESISTANCES

TELSEN SPAGHETTI FLEXIBLE RESISTANCES

These resistances are made from the finest nickel-chrome wire, wound on a pure cotton core, stoved and impregnated so that moisture cannot attack the wire and cause corrosion. The bending of the resistance will not alter its value. Made in the following resistances:

300, 600, 750, 1,000 ohms—42 mA.	6d.
1,500, 2,000, 3,000, 4,000, 5,000 ohms—23 mA. ..	9d.
10,000, 15,000, 20,000, 25,000, 30,000 ohms—6 mA.	1/-
50,000, 60,000, 80,000, 100,000 ohms—3 mA. ..	1/6

RESISTORS

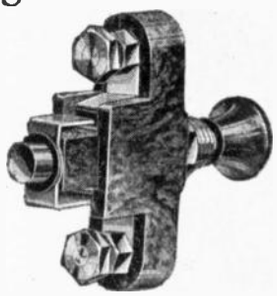
TELSEN RESISTORS WITH WIRED ENDS

The range of these new components is very extensive both as regards resistance value and power rating. They are very small and light and are easily suspended in the wiring of a receiver, where their resistance is quickly identified by the standard colour code. For those unacquainted with the colour code, the resistance value is also printed on the carton. These Resistors have negligible self-capacity and inductance, are noiseless in use, and their value remains unchanged under the most adverse circumstances. They are supplied in the following values:—Power rating of 1 watt: 250, 500, 1,000, 1,250, 5,000, 10,000, 20,000, 25,000, 50,000, 100,000, 250,000, 500,000 ohms resistance. **1/-**

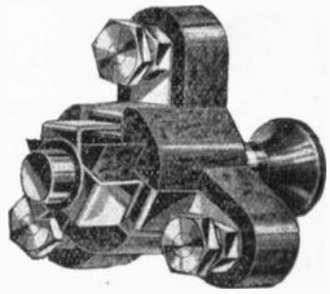
SWITCHES

TELSEN PUSH-PULL SWITCHES

(*Prov. Pat. No.* 14125/31)



The Telsen Push-Pull Switches employ the "knife" type of self-cleaning contact, and a positive snap action. The nickel silver bridge piece is driven between the springy "fixed" contacts, and the wedge-shaped plunger squeezes the inner contacts outwards, closing the jaws in a firm grip. The series gap reduces self-capacity to a minimum and the spindle is insulated from all contacts. They can be usefully applied for several different purposes, e.g., for the switching on and off of the high and low tension and grid bias batteries, for wave change switching where two or three contacts are employed, etc. The shape of the spindle guide prevents any possibility of the contacts becoming out of alignment.



Two-point .. No. W.107 **1/-**

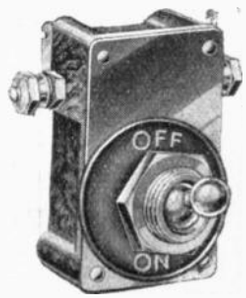
Three-point .. No. W.108 **1/3**

TELSEN FOUR-POINT "TWO-POLE" PUSH-PULL SWITCH

Designed on the same lines as the 2 and 3-point Switches, this model is a two-pole switch highly suitable for use in wave changing on two coils or an H.F. transformer, or for switching pick-up leads or an additional loudspeaker.

No. W.153 **1/3**

TELSEN MAINS SWITCH

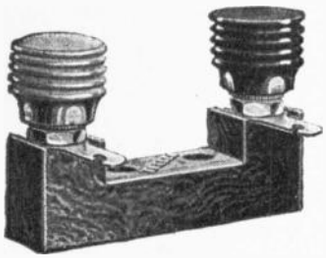


A miniature switch of very robust construction. Its rapid make and break action makes it particularly suitable as a master switch in Mains and Battery operated receivers, for switching Gramophone motors, and numerous other uses. Capable of handling up to 3 amperes at 250 volts with perfect safety. Enclosed in a neat moulded bakelite cover with one hole fixing.

No. W.297 **1/9**

ILLUSTRATED INDEX OF RADIO COMPONENTS—*continued*

TERMINAL BLOCKS



TELSEN
TERMINAL BLOCKS

Two insulated terminals are mounted upon a bakelite moulding as employed in the grid leak holder and power fuse holder. They may conveniently be used for aerial and earth, loudspeaker, pick-up, or extra battery connections, or for independent anchorage points.

No. W.204 **6d.**

INSULATED WIRE

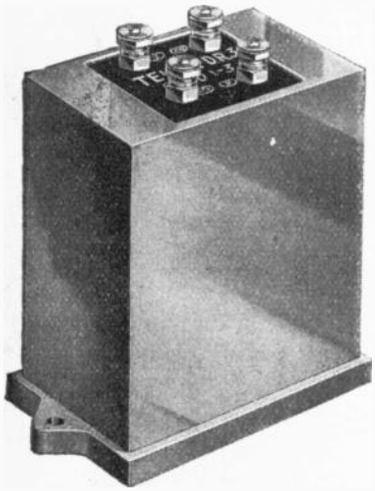
TELSEN INSULATED CONNECTING WIRE

This special connecting wire has been evolved as the result of Telsen's long experience in supplying the wants of the home constructor. The core consists of high conductivity tinned copper wire, and this is provided with a special covering. The highly glazed finish of the covering gives the wiring of the receiver an extremely attractive appearance, and at the same time provides insulation of a very high order. The use of sleeving is eliminated as the snugly fitting covering provides all the insulation necessary. When making connections, the covering should be cut round with a knife, and the piece to be removed will then slide off the end of the wire. Supplied in 10 ft. lengths at the attractive price of 4d. per length.

No. W.441 **4d.**

TRANSFORMERS

(INTERVALVE)



TELSEN
D.R.3 LOW FREQUENCY TRANSFORMER

This transformer stands alone. It is the only L.F. transformer with a completely straight line characteristic, being both theoretically and practically perfect. The amplification of every audible frequency is absolutely uniform. A special nickel alloy core is employed and this transformer should therefore be "parallel fed." Full instructions are supplied with each transformer. Ratio 1 : 3. Primary inductance 150 henries.

No. W.448 **8/6**

A higher ratio, the D.R.5, giving greater amplification and a slight measure of tone compensation is also supplied.
Ratio 1 : 5. Primary inductance 60 henries.

No. W.449 **8/6**

TELSEN "ACE" L.F. TRANSFORMERS

The Telsen "Ace" is eminently suitable for receivers where the highest efficiency is required at a low cost and where space is limited. Its characteristic will bear comparison with that of any other transformer.

Ratio 3—1 No. W.66
Ratio 5—1 No. W.65 } **5/6**

TRANSFORMERS—*continued*

(INTERVALVE)

TELSEN
"RADIOGRAND"
L.F. INTERVALVE TRANSFORMERS

Since their introduction, these Transformers have signified to designers and constructors alike the nearest approach to the ideal in intervalve transformer design. Evolved from the results of extensive research coupled with the soundest engineering principles, every transformer is subjected to rigorous tests to ensure faultless performance and enduring efficiency.

Medium Ratios
3—1 No. W.59
5—1 No. W.58 } **7/6**

TELSEN
"RADIOGRAND" HIGH RATIO 7—1 TRANSFORMER

This Transformer is designed to give extra high amplification on receivers employing only one stage of L.F. amplification. It is not recommended for use in receivers employing two L.F. stages as overloading is likely to occur.

No. W.60 **10/6**

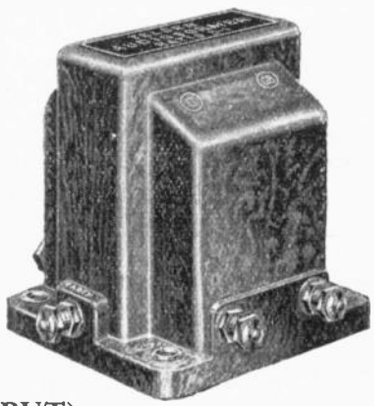
TELSEN "RADIOGRAND"
LOW RATIO 1.75—1 TRANSFORMER

For use in receivers employing two stages of L.F. amplification, where exceptionally good quality is desired. When used following an L.F. stage employing choke or resistance coupling it will be found to give ample volume with remarkable reproduction.

No. W.61 **10/6**

TELSEN "AUDIOFORMER"

The Telsen "Audioformer" solves the problem of tone compensation which has been created by to-day's demand for super-selectivity. Its fixed compensation restores all the high notes which have been lost by the cutting of the sidebands, yet it does so without any loss of amplification or reduction in bass response, and without necessitating either an extra L.F. stage or any additional components.
Absolutely self-contained, this single brilliant component is all you need to achieve that perfect reproduction which your critical ear demands.

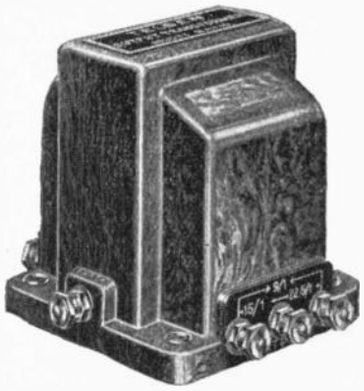


Ratio 5:1.
No. W.327 **11/6**

(OUTPUT)

TELSEN
OUTPUT TRANSFORMER
RATIO 1—1

This Transformer enables a high resistance type speaker to be connected to the output circuit of a receiver using a triode output valve without the necessity of passing direct current through the speaker windings. Saturation of the magnet system is thereby avoided, and the H.T. voltage is kept away from the Speaker. Suitable for anode current up to 40 mA. D.C.



No. W.62 **10/6**

ILLUSTRATED LIST OF RADIO COMPONENTS—*continued.*

TRANSFORMERS—*continued*

(OUTPUT)

TELSEN MULTI RATIO OUTPUT TRANSFORMER

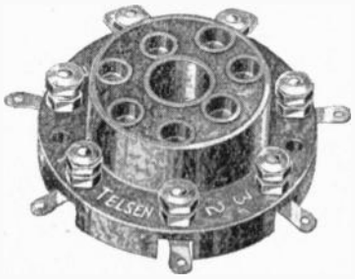
This is designed for use with moving coil loudspeakers having a low impedance speech coil winding. It has three ratios: 9—1, 15—1, and 22.5—1, which allows the correct matching of speakers of widely varying characteristics. Suitable for anode currents up to 40 mA.

No. W.63 **10/6**

VALVEHOLDERS

TELSEN 7-PIN VALVE HOLDERS

These valve-holders are accurately constructed to accommodate several new types of valve, such as the "Class B" valve. They are made in the solid and anti-microphonic types and in both types the contact sockets are extended in one piece to form the soldering tags, thus ensuring perfect connection. The terminals are numbered according to the system standardised by the R.M.A.



7-Pin Solid Type Valve-Holder. No. W.337 **1/6**

7-Pin Anti-Microphonic Type Valve-Holder. No. W.338 **1/9**

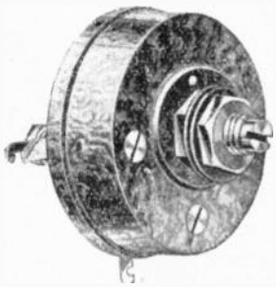
TELSEN VALVE-HOLDERS

The latest models of Telsen Valve-holders have an extremely low self-capacity and are made in both solid and anti-microphonic types. These embody special contact sockets of one-piece design with neat soldering tags and end terminals.

	Solid Type			Anti-microphonic type		
	No.		*Price*	*No.*		*Price*
4-pin	.. W.224	..	**6d.**	4-pin .. W.222	..	**8d.**
5-pin	.. W.225	..	**8d.**	5-pin .. W.223	..	**10d.**

Telsen Uinversal Valve-holder .. W.198 .. **9d.**

VARIABLE RESISTANCES



TELSEN HUM ADJUSTER

Comprises a variable centre tapped resistance designed for hum control in A.C. mains operated receivers and eliminators. Solidly constructed, it occupies very little space, and is extremely silent in operation, both electrically and mechanically. In attractively moulded bakelite case with single hole fixing.

No. W.299 **2/6**

MAINS UNITS

TELSEN H.T. UNIT AND L.T. CHARGER FOR A.C. MAINS

This unit, which is suitable for input voltages between 200 and 250 at 40 to 100 cycles, will be specially welcomed by owners of battery receivers who, while they desire to enjoy the economy of power supply from the mains, do not wish to discard their battery valves in favour of the A.C. variety. The unit is very solidly built and is completely screened by an artistically finished metal case. The H.T. output is 28 milliamps at 150 volts with separate maximum, detector, and screened grid tappings, on each of which a choice of high, medium, or low voltages, is available. Very generous smoothing equipment is provided to eliminate hum. Provision is made for charging 2, 4, or 6 volt accumulators, at 0.5 ampere, and the use of these facilities leads to such a saving of charging costs that the unit soon pays for itself.

No. W.346 **£4-17-6**

MAINS UNITS—*continued*

TELSEN H.T. AND L.T. UNIT FOR A.C. MAINS

As regards input and H.T. output, this is similar to "H.T. unit and L.T. charger" No. W.346, but as it is intended to provide complete power supply for receivers employing A.C. valves, the L.T. charger is replaced by a centre tapped transformer winding capable of supplying 2.5 amps. at 4 volts. It is a very well made component, and will be particularly appreciated by home constructors. No. W.347 **£3-7-6**

TELSEN H.T. UNIT FOR D.C. MAINS

This unit is designed for D.C. inputs of from 200 to 250 volts. Adequate smoothing is provided to remove ripple, and the output is approximately 28 milliamps. at 150 volts. Three tappings are provided, the maximum, screened grid, and detector tappings, at each of which a choice of high, medium, or low voltages is available. The unit is enclosed in a well finished metal case which provides complete screening.

No. W.348 **35/-**

LOUDSPEAKERS

TELSEN LOUDSPEAKER UNIT

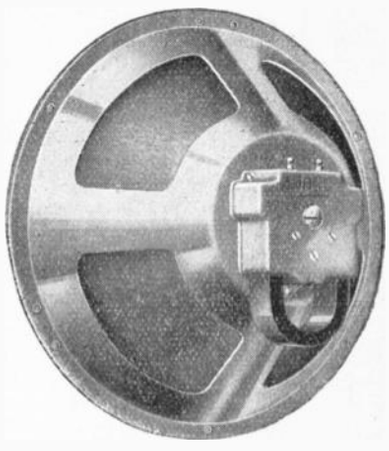
A reliable Loudspeaker Unit capable of giving a very pleasing performance at a low price. The magnets are of cobalt steel and the detachable rod which carries the cone is fitted with cone washers and clutch. The entire unit is enclosed in a beautifully moulded bakelite dust cover. No. W.54 **3/6**

TELSEN LOUDSPEAKER CHASSIS

The fully floating cone of specially prepared damp-resisting material is mounted on a flexible felt surround in a rigidly constructed, light pressed aluminium frame. The material and proportions of the cone give an exceptionally natural balance of tone free from objectionable resonances. With the Telsen Unit W.54, it forms an ideal, inexpensive combination which, for natural reproduction and all-round performance rivals the highest priced units.

Telsen "Popular" Loudspeaker Chassis. Dia. 11". No. W.159 **5/6**

Telsen "Major" Loudspeaker Chassis. Dia. 14½". No. W.170 **7/6**



TELSEN W.181 LOUDSPEAKER

An inexpensive combined Loudspeaker Cone Chassis and Unit, which gives a pleasing and natural balance of tone and will handle all the output necessary for ordinary reception. Fitted with a fully floating cone of damp-resisting material and mounted in a rigid pressed frame of 11" diameter. No. W.181 **8/6**

TELSEN W.182 & W.183 LOUDSPEAKERS

These complete Loudspeaker Chassis incorporate a powerful unit with a high degree of sensitivity and are capable of handling large power outputs. The tonal range is exceptionally fine, combining both depth and brilliance to a remarkable degree. The fully floating cone of special damp-resisting material is mounted in a rigid pressed frame.

No. W.182 (dia. 11") .. **11/6**

No. W.183 (dia. 14½") .. **12/6**

Printed by JAMES COND LTD., at 148-149, Great Charles Street, Birmingham, 3, and Published by the Proprietors TELSEN ELECTRIC CO., LTD., Aston, Birmingham, England.

Purveyors of Electric Lamps By Appointment

EDISWAN

Manufacturers and Purveyors of Electric Lamps By Appointment

The name that means 'EXCELLENCE'

A

B T-H PICK-UP

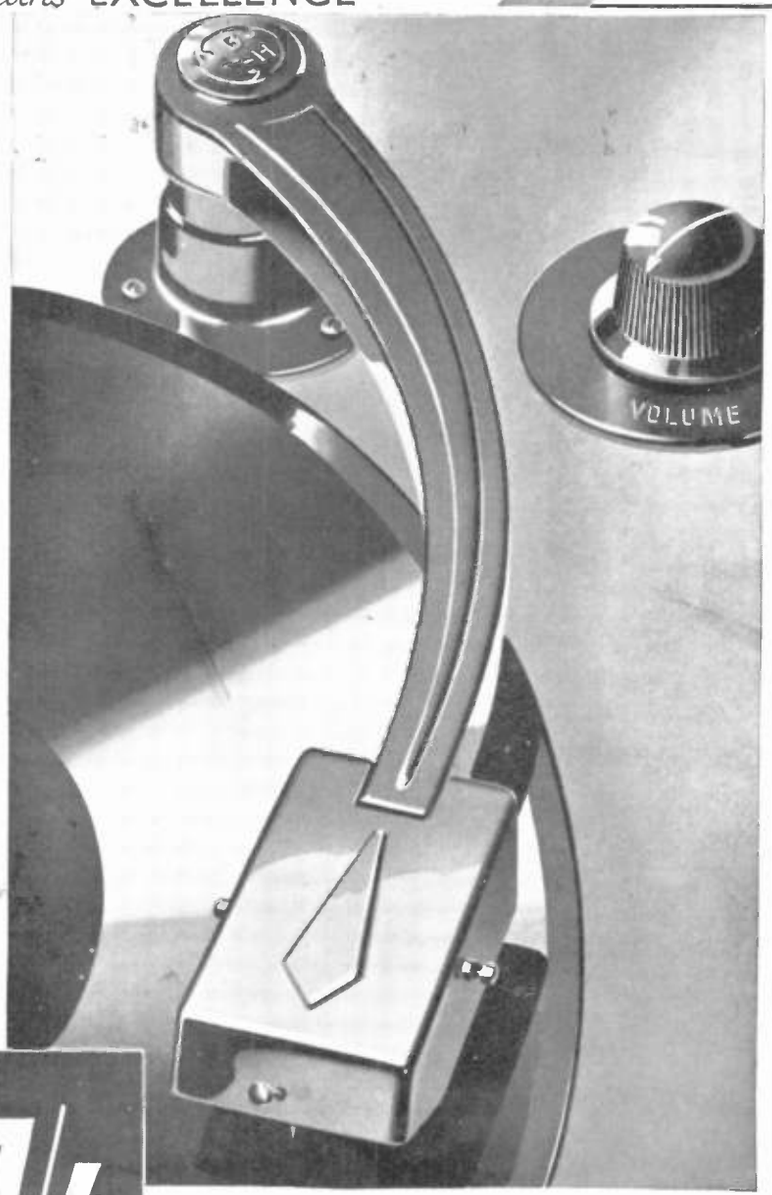
converts your

TELSEN

into the finest

RADIOGRAM

and for only 37/6

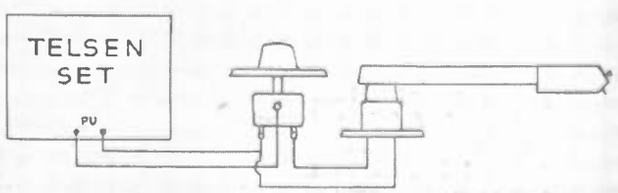


Hear your favourite radio and concert stars by record as well as by radio. Gracie Fields, Peter Dawson, Paul Robeson—you can hear them all, as they were meant to be heard, just by connecting a B.T.H. Pick-up to your Telsen set—the diagram shows you how simple it is.

The B.T.H. Pick-up, exactly the same as your dealer sells, is standardised by most leading manufacturers of luxury radiograms and only the B.T.H. can give you that first-class record reproduction of which your Telsen is capable. Don't be put off with a "just as good." Insist on the B.T.H.

For the man who wants good reproduction at a reasonable cost there is a "Minor" model at 21/- with self-contained volume control and moulded finish.

THIS IS ALL YOU HAVE TO DO



THE EDISON SWAN ELECTRIC CO. LTD. 155 CHARING CROSS RD., LONDON, W.C.2

GOOD RADIO DEALERS RECOM

W.221

Build the new

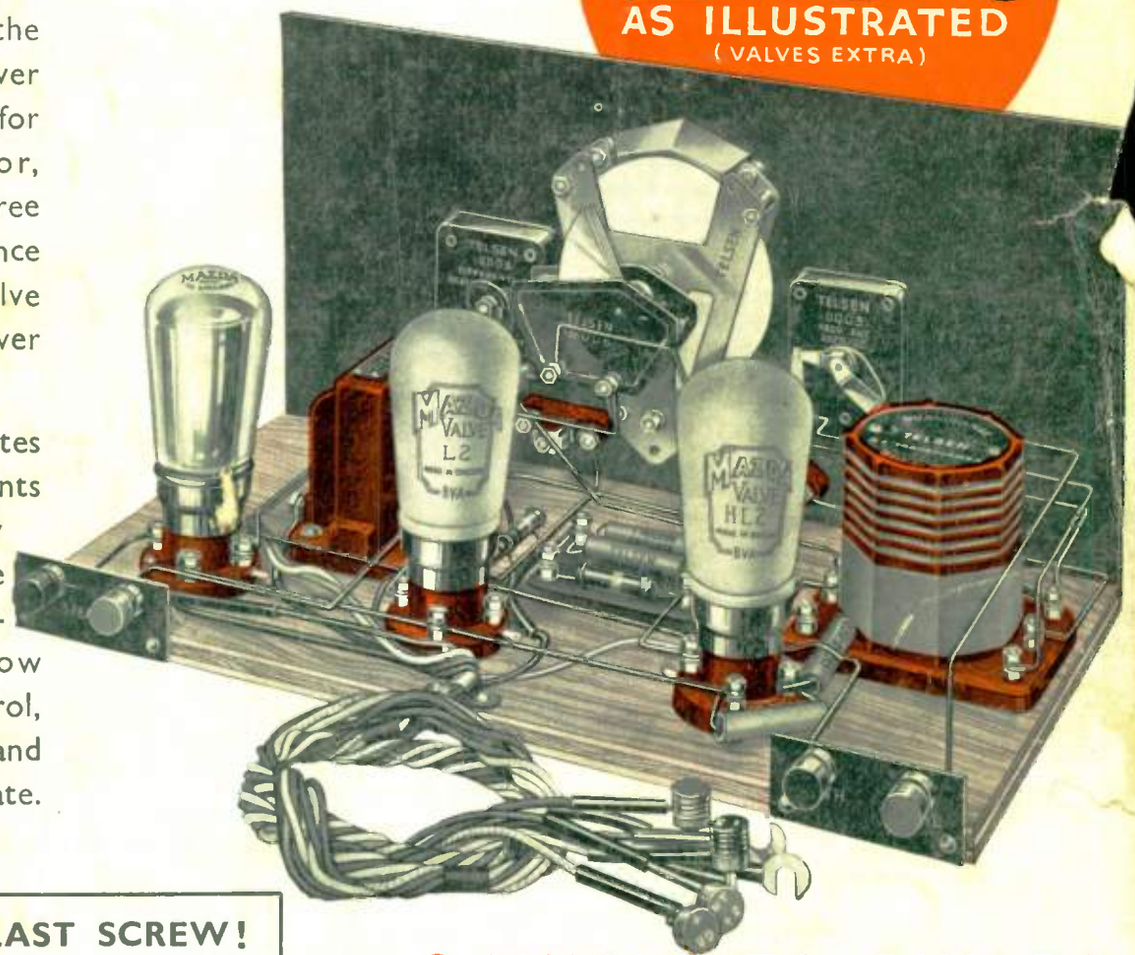
TELSEN '323' KIT SET

A powerful battery-operated 3 valve receiver for only 29/6

AS ILLUSTRATED
(VALVES EXTRA)

THE amazing new Telsen "323" is undoubtedly the most sensational receiver of its type ever designed for the home constructor, for, although it utilises only three valves it gives a performance equal to that of many four valve sets, giving tremendous power and glorious tonal realism!

Its brilliant design incorporates many ultra-modern refinements (such as you would ordinarily expect to find only in the most expensive commercially-built sets) including slow motion disc drive control, special separator control, and silver oxydised escutcheon plate.



COMPLETE TO THE LAST SCREW!

Complete Kit of Component parts, including Panel, Baseboard, and all the necessary sundries, together with full size Blue Print and Stage-by-Stage Building Instructions.

SIMPLE TO BUILD!

Even though you have never handled a screwdriver before you will make a perfect job of building the Telsen "323"; you simply can't go wrong! A full-size blueprint is enclosed with every kit, and stage-by-stage instructions telling you exactly what to do and how to do it! Just follow these instructions and you will build a set of which you will always be proud. A SET WHICH WILL NEVER BE OUT OF DATE OWING TO ITS UNIQUE ADAPTABLE DESIGN. A set which creates a revolution in radio home construction—a set which gives you the maximum of radio enjoyment at the minimum of cost, owing to its amazingly low price and running costs!

GET A T… …M YOUR DEALER TODAY!