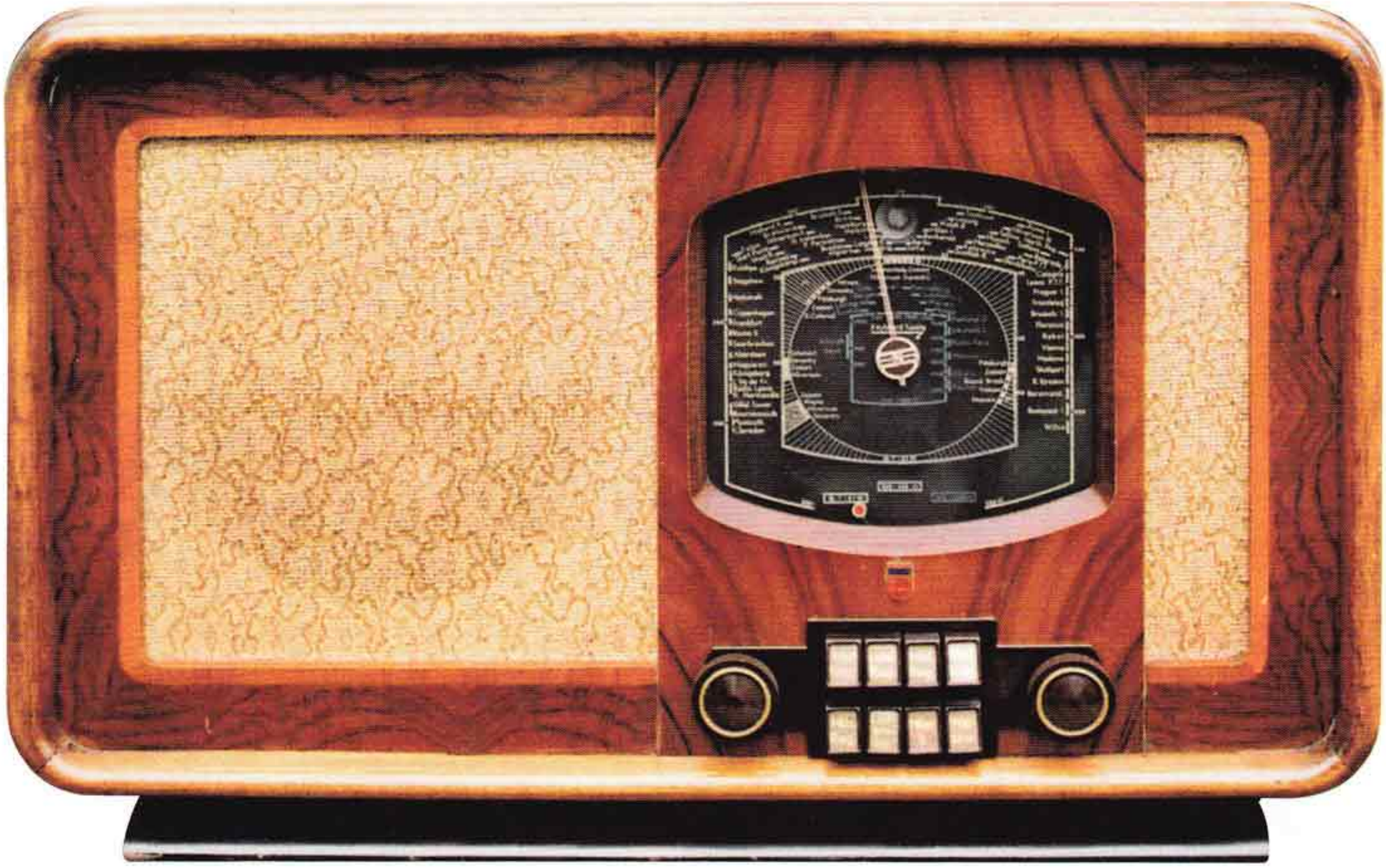
The Philips 660A by Peter Nash

The Philips 660A of 1938 has all the features that one can expect a good Philips from the era to have. It has the quirky but efficient chassis, a notorious drive cord system coupled with a unique tuning device, audio feedback loops and handsome good looks with a sparkling performance. It even manages to incorporate a Bowden cable. 1938 was generally a big year for press button tuning, it became the latest fad. Many different systems were evolved, but the special type of tuning capacitor used by Philips in the 660A meant that it was particularly suited to this type of operation as we shall see. Eight press buttons were provided for preset tuning in addition to there being normal manual tuning across the long, medium and short wavebands. Receiver operation was from AC mains with the familiar carousel type selector catering for a wide range of supply voltages.



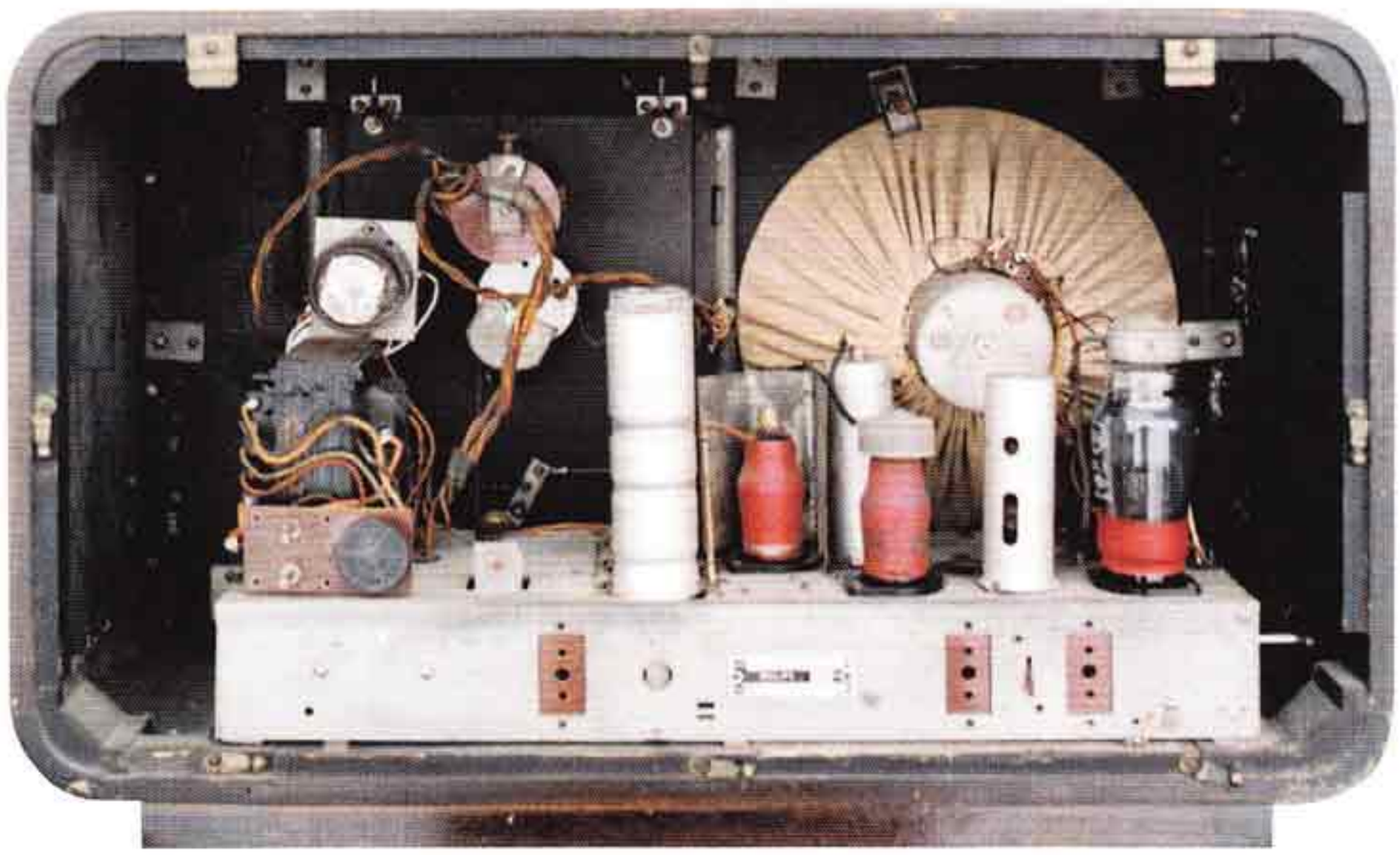
Much thought has gone into the cabinet design. It is neat and uncluttered whilst remaining very pleasing to the eye. All of the tuning controls are situated at the front and all of the sound controls are at the side. The lavish veneers , curves, rounded dial and brass inserts to the knobs give it a fresh, continental aura. It was probably designed in Eindhoven. By contrast to the rest of the set, the dial is very busy indeed; in fact no less than 105 stations are marked if one includes the aircraft band! This gives a clue to its capabilities. All manner of stations are marked here. The Scottish region rubs shoulders with Katowice and London becomes neighbours with Linz. At the top centre of the dial, the crowded stations respectfully part to allow the emerald glow of the magic eye to shine through. At the bottom of the dial is a waveband indicator driven by bowden cable.

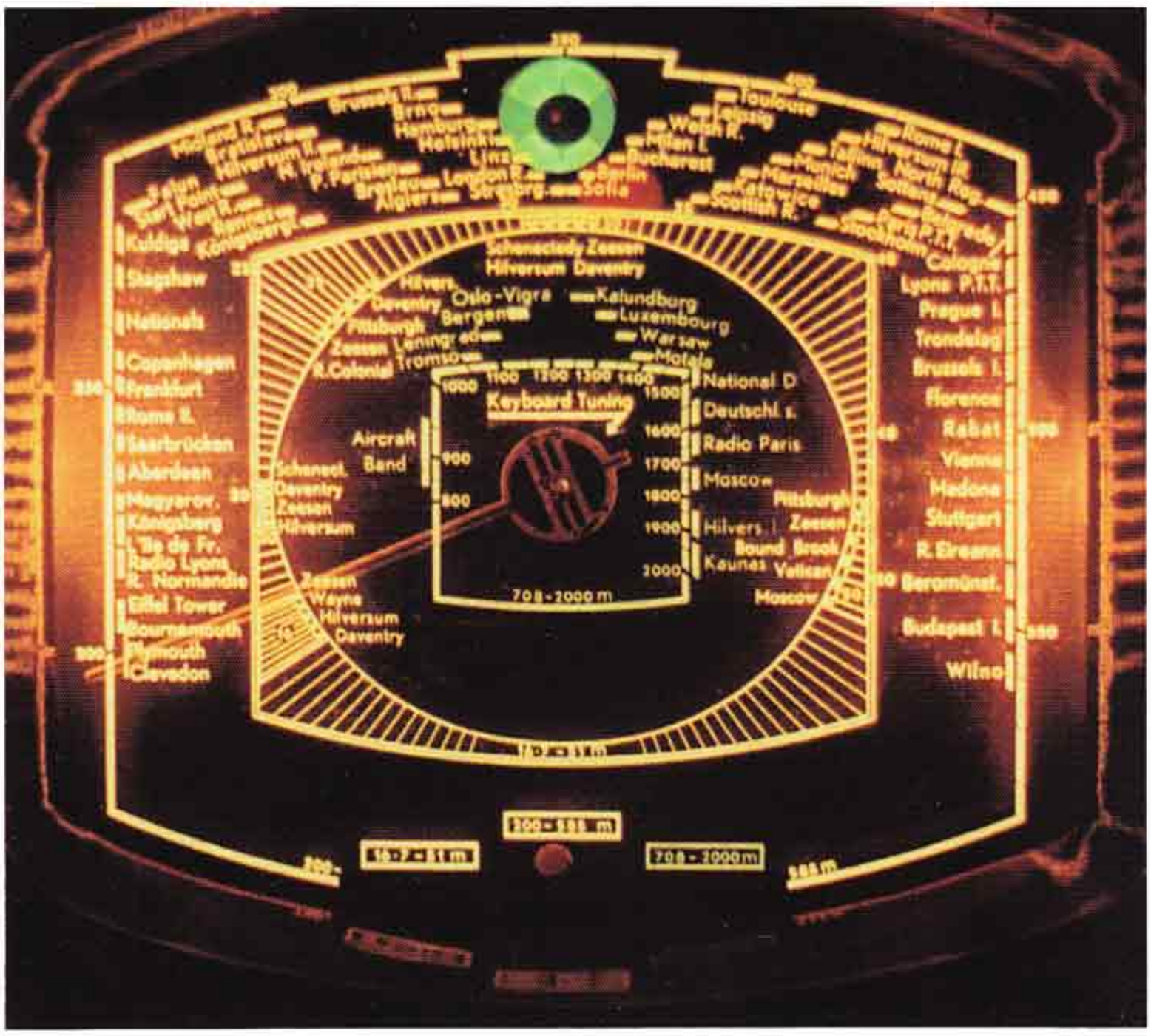
The circuit

The receiver employs six side–contact valves in a 'short' superhet arrangement. The lineup is EF8, EK2, EF9, EBL1, EMI, and AZI. The dial lamps are two MES types rated at 6.3v 0.3A. The special type of tuning capacitor, which we will examine shortly, is a 3 gang unit allowing the use of an RF amplifier to preced the frequency changer. The EF8 is used as the RF amplifier with stage gain controlled by the AVC line. Frequency conversion is performed by RF octode EK2 with AVC only applied to this stage on MW and LW. IF amplification is by RF pentode EF9, which operates with a fixed bias despite it being a vari–mu valve. The EBL1 is a double diode pentode and handles signal detection, AVC derivation, audio amplification and output. EMI is the magic eye tuning indicator which takes its controlling voltage from the signal diode for greater sensitivity, not the AVC line which is delayed. AZI, a full wave rectifier, supplies HT.

Let us now look at one or two finer points of the circuit. The RF amplifier, EF8, is described in the receiver literature as a 'noiseless RF pentode' but according to Mullard (who manufactured the valve) it is a 'low noise hexode'. Either way, it is an excellent choice of valve. Withdraw the aerial plug and certainly the background becomes very quiet. Pop the aerial back in and it springs to life, everything that you hear being from the aerial and not internally generated. The stage introduces a very worthwhile level of gain across all three wavebands. Discrete RF inductors dedicated to each band with separate switching, trimming and padding where necessary contribute towards low loss. The second IF transformer has tapped primary and secondary windings to mitigate the effects of loading.

The audio stage is interesting. In a very clever and effective system, it uses both negative and positive feedback, the volume control setting determining which has the greater effect. The key component used in the system is the output transformer, which





has a centre tapped tertiary winding. The centre tap is decoupled to chassis, one leg then providing a negative feedback voltage which is coupled to a tapping low down on the volume control track. The other leg provides positive feedback and is connected to the top of the volume control. Both feedback lines are subjected to frequency tailoring. So, for lower volume settings, say for local station listening, negative feedback is applied resulting in a high quality of reproduction. For higher volume settings used on weaker signals, positive feedback nullifies the negative feedback and the maximum gain becomes available. A generously proportioned loudspeaker referred to as having an anti directional cone is fitted in the spacious cabinet and protected by enclosure in a dust bag.

In the power supply, HT smoothing is thorough, being by a 28 + 32 µF electrolytic unit in conjunction with a smoothing choke. The RF amplifier has its own privately decoupled anode supply and an anti–modulation hum capacitor is fitted between one of the rectifier anodes and chassis.

The Tuning Capacitor

Nestled among the switch wafers and wiring beneath the chassis is that marvel of Philips' fine engineering, the direct action tuning capacitor. To the casual observer, this would not be immediately recognisable because it does not have the usual sets of intermeshing vanes. The 'plates' of this capacitor are formed from two cylindrical brass foils of slightly differing diameters, one of which is arranged to slide inside the other in telescopic fashion. Almost incredibly, a linear movement of just under half an inch produces a capacity charge of about 480 pF. The manufacturing tolerances and assembly procedures to the component parts of the capacitor would have been most exacting. The air gap which is maintained between the foils is extremely narrow. It will take the thickness of a human hair but possibly not much more. I certainly would never encourage measuring the gap or disturbing the foils in any way, it would be all too easy to ruin the unit. One can begin to appreciate the degree of precision and rigidity that has gone into the unit's production, in triplicate and with eight preset push–buttons added on!

It is the linear movement needed to tune the capacitor which simplifies its adaptability to press–button tuning. The moving foils are essentially coupled to a spring–loaded thrust plate which tends to throw open the capacitor. Each press–button selected is arranged to act against the thrust plate by an amount depending upon a screw setting for each button. It is a delightfully simple system.

Manual tuning, on the other hand, is less straightforward. The rotary action of the tuning control is converted into linear motion by similar means to a nut being driven along a turning screw thread. The rotary dial cursor is driven in an unusual manner. There is only one end of a drive cord which issues from the tuning mechanism, the amount of cord played out corresponding to the tuning position. It follows that any kind of indicator driven by the cord must be under its own tension in order to keep the drive cord taut and allow back and forth operation. This is achieved by using a spring–loaded cursor which is firstly wound up three turns like a clock and then the cord is attached to the cursor drum. Things start to become more complicated because the linear law of the capacitor does not equate to evenly spaced stations around the dial, so some deliberate non linearity is introduced to the cursor motion to make this so. The aforementioned cursor drum is eccentrically mounted to give a quicker pull towards one end of the scale. Add to this a small counterbalance to compenates for variations in loading caused by the eccentric drum and one can see the amount of engineering that has gone into making everything just right.

For further reading on the Philips direct action tuning capacitor, I recommend the article by Geoffrey Dixon–Nuttall, found in the Summer 1997 Bulletin (see page 27).

The Chassis

Once the back and underneath panels are removed, accesibility to the chassis is quite good and it ought to be possible to carry out most checks and repairs without any further dismantling. However, from time to time, it will be necessary to remove the chassis from the cabinet, say to inspect the wiring or to restring the tuning dial. It must be remembered that in this receiver the whole dial and cursor assembly remains fixed to the cabinet. Therefore it is imperative to detach the cursor drive cord and the waveband indicator cable as well as the more usual

items before the chassis is withdrawn. Reassembly entails a logical reversal of the removal procedure, but the trickiest part is the reattachment of the cursor drive cord. Pointer accuracy depends upon fairly exact placement of the cord upon the drum, hopefully the part that alters the non–linearity would not have been disturbed. The drum must also be held to stop it unwinding until the cord is properly attached. I have found that it helps to treat the cord attachment lug more like a clamp, gradually pulling the cord through until it is possible to secure good calibration, then tighten the screw up. This procedure can take some time to complete accurately.

For anyone that owns the receiver, it is well worthwhile to try to obtain the service manual. If the Philips manual is not available, try for the Mullard MAS24, for this receiver has an identical chassis. Some Philips receivers were badged up as Mullard. The manual is generally very good and explicit on most points but it can be annoyingly remiss on most basic items. For instance, it gives the part reference for the dial lamps, but not the ratings, or it describes the setting up procedure for the cursor in detail, but it does not tell you how to run the cord from scratch!

Repairs

My own example of the 660A had already received some attention prior to acquisition but more work was needed to complete repairs. Some capacitors including all electrolytics had been replaced with good quality components and the cabinet and chassis were clean. The tuning drive had been restrung in nice new nylon cord but unfortunately the indications ran in reverse. The magic eye was dim to the point of extinction and some of the rubber insulated wiring was in dangerous condition.

Once the cursor was correctly set up, trials brought forth some encouraging results on short and medium wave. Half of the long wave was missing from about 1550 metres upwards, there would be an abrupt silence. Thinking that this was a classic case of a tired local oscillator, a new EK2 was tried, but this did not make a scrap of difference. Checking a little deeper, it became apparent that the local oscillator was being disabled by a standing voltage on the AVC line. This proved to be from one of the diodes in the EBL1, maybe internal leakage or an ionistaion effect being to blame. A new EBL1 put matters right with the original EK2 now able to be refitted. An unusual fault: one does not often cure a local oscillator by replacing the output valve!

A search for a replacement magic eye EM1 was originally unsuccesful because of its scarcity, but an EM4, which is a little more common was found to be a good substitute. The valves are nearly compatible. The data books say that the EM4 requires a different load resistor and also an additional resistor, both of which can be accomodated on the indicator socket. In practice, I found the existing load resistor to be near enough in value, leaving just the additional resistor to be wired across the relevant base connections. The beauty of doing it this way is it gives forward and reverse compatibility. Should the correct EM1 become available, it can just be fitted and the extra resistor ignored (this going to an unused pin on the EM1). The EM4 worked well, the shadow display being of the dual sensitivity type, it could even be considered to be an enhancement over the original.

Finally, some rubber insulated wiring was replaced, in particular the rectifier anode cabling had crumbling insulation exposing the inner conductor at a point where it was drawn tightly around a metal edge!

At this point, the radio was working well even without any need to disturb the alignment. It was time to put everything back together properly and cruise the bands.

In use

The first thing that one notices when searching the ether with this set is how effortlessly it draws in weaker signals even if the aerial is not overly efficient. A two speed tuning system is used to promote accurate tuning; turning the control in the opposite direction for a short distance will result in a lower

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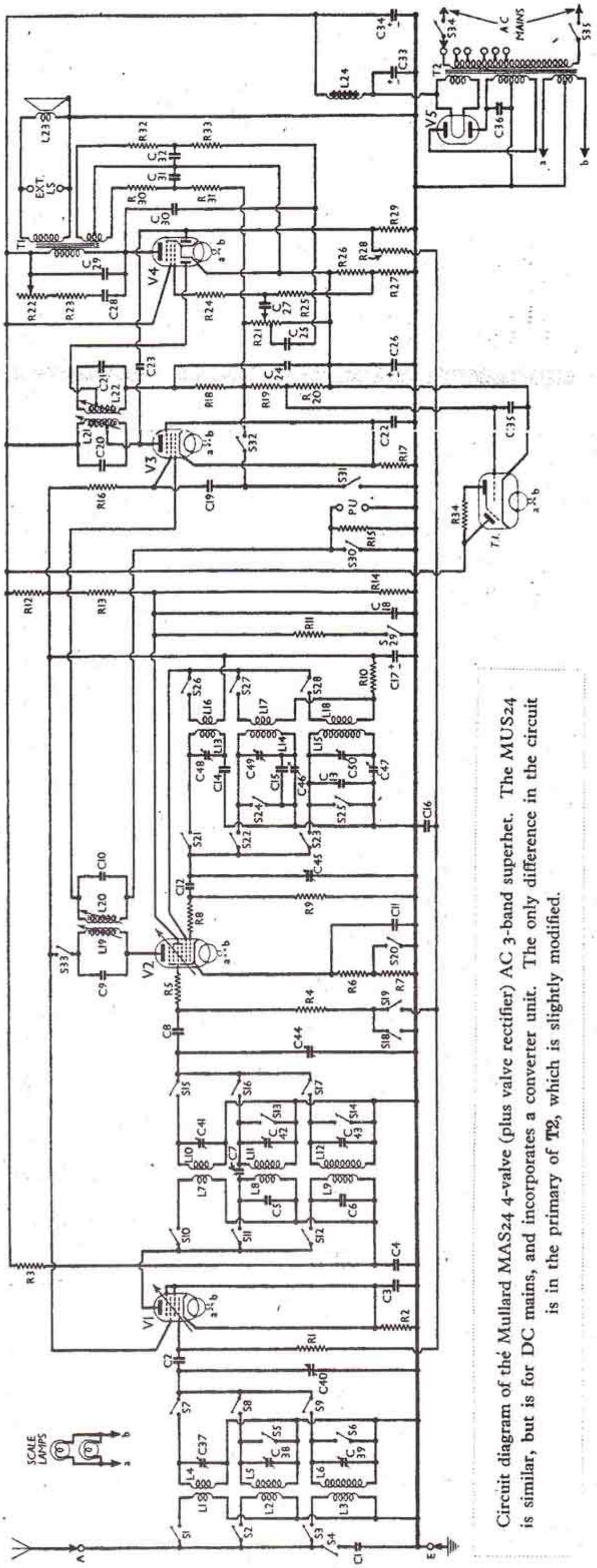
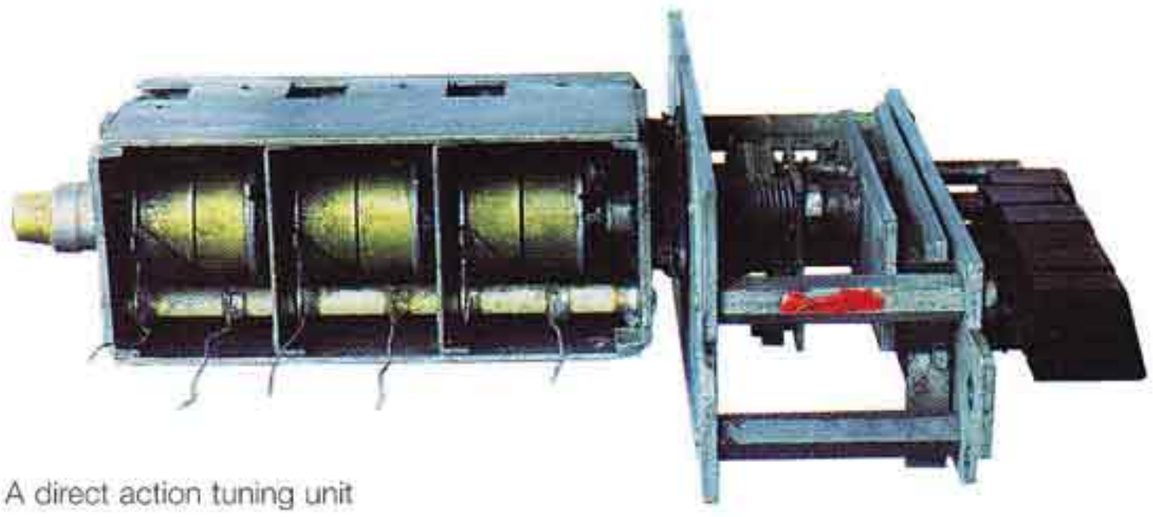


Circuit diagram of the Mullard MAS24 4-valve (plus valve rectifier) AC 3-band superhet. The MUS24 is similar, but is for DC mains, and incorporates a converter unit. The only difference in the circuit is in the primary of T2, which is slightly modified.

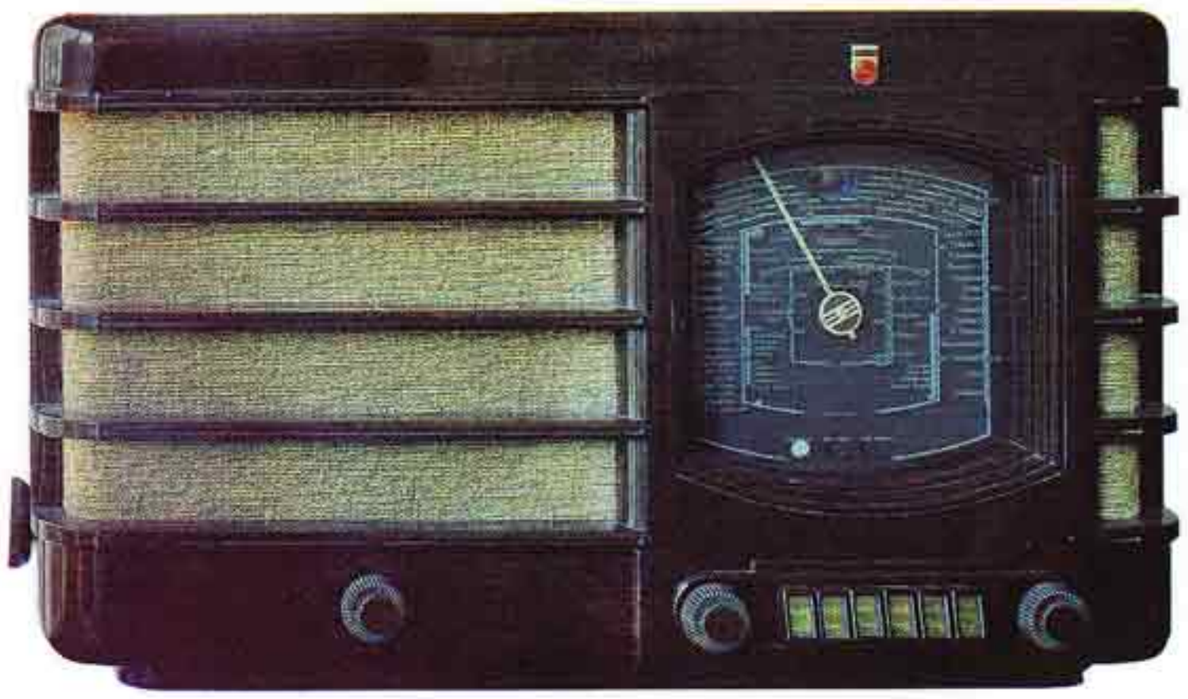
Direct Action Tuning

by Geoffrey Dixon-Nuttall (originally from the Summer 1997 issue of The Bulletin)

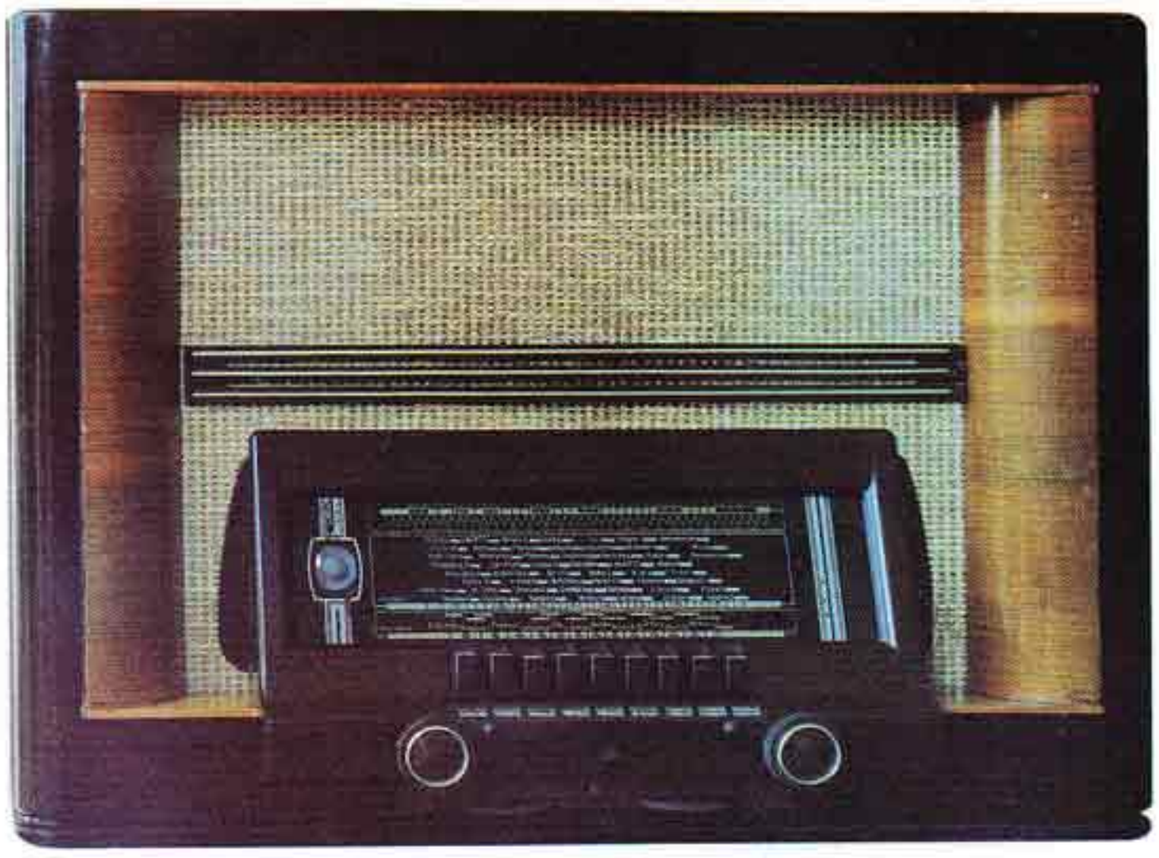
In 1938 there was a sudden outbreak of enthusiasm for press-button tuning. Some manufacturers were taken by surprise, and had to hurriedly add buttons to their usual chassis. Most either added a ready-made mechanical unit (usually from the States) or went in for switched coils and/or trimmers. These tended to drift.



A direct action tuning unit



Philips 680A



Philips 555A

Philips had obviously been thinking about this for some time, and when the 1938 models were launched it was seen that they had not one, but two separate systems. One was a clever, and completely original, motor tuning system, which worked very well, but the other was even more unusual. This was christened 'Direct Tuning', and is what we are concerned with.

One of the problems with press-buttons is that they move in a straight line, whereas the tuning capacitor rotates. The obvious answer, they thought, was to make a tuning capacitor that slid.

What they designed is a most amazing device. It consists of a cylindrical coil of brass shim which moves inside another one. The clever thing is the tiny clearances that they achieved; I have never dared to measure them, but it looks like a very few thou. To maintain this in production was quite a feat, and I would like to know how they managed it.

The whole affair is about 30mm in diameter, and the movement is 10mm. In this they managed to get a change of 480 pf, which is very reasonable. An incidental advantage of this construction is that the microphony is very low, as the capacitor is very small and very rigid. In practice the capacitors are three-gang.

This makes the actual mechanism very simple, and the manual tuning arrangements are also quite easy; you just arrange for a screw to push the thing along. There are, however, one or two snags.

The first one is that the capacitor has a straight line capacity law, so that the stations tend to crowd into the high frequency end of the dial. This entails using a non linear dial drive, which is arranged by having a cord pull against a spring-loaded drum, which is offcentre. This means that the press buttons cannot move the pointer round, as it would get left behind and the cord would derail; so the pointer is used on the manual tuning position only. Another snag occurs when changing from manual to buttons, as the cord is still wound, and there is no way of returning the capacitor to zero.

This means that when it is desired to use preset tuning the pointer has to be wound back to the high frequency end of the dial before pressing buttons. Not very user-friendly! To get from press-buttons to manual, the tuning knob is pulled out; this lifts the latch bar and allows all the buttons to return.

Two chassis used this system, the 660 and the 555. The latter was the cheaper one, and the 660 had two rows of buttons and an epicyclic drive on the manual tuning. The buttons on the 555 are too close together for people with thick fingers.

From the customer's point of view, it was all very confusing. Setting the buttons was tricky, as you didn't know where you were on the dial. You had to make sure that the pointer was returned to zero before pressing a button, and you had to select the right waveband. In fact it all worked very well, but you had to know the rules! Setting the buttons, by the way, was accomplished by means of a special key which set the screw inside the buttons. This key is always missing from these sets, in fact I have yet to see one!

Philips obviously took all these objections to heart, and the next range of sets, which came out for the 1939 Show, was much more civilised. What they did was to change the press buttons to piano type keys. These turned a shaft which moved the pointer by means of a crafty arrangement of bell cranks, so that it would work at sufficient speed. This shaft also carried a crank, which pushed the tuning capacitor into position. It was also arranged that this shaft could move the bandswitch if desired. Further, the tuning capacitor foils were tapered, so that the dial drive could be linear.

It will be noticed that they had now gone back to a rotating shaft, so that the whole point of the clever tuning capacitor had been lost! A normal capacitor would, however, have required a much larger movement of the shaft. Surprisingly, the mechanism had no trouble with locating the capacitor with suffficient accuracy, and these systems still work reliably. Even the capacitors never seem to give trouble which considering that they are not dust-proofed, is amazing. This type of mechanism is set by a different type of tool, for which they provided a little hole in the back of the cabinet. They still get lost, though! There is also a provision for setting the first three keys to either medium or long waves by the same tool. Changing from keys to manual is accomplished by pressing in the tuning knob, which releases all buttons except the waveband selectors. Pressing any key will release this.

Apart from the expense of assembling the mechanism, this system seems to be ideal, and one wonders if it would have been used again in the next year's models. Unfortunately, more serious matters intervened, and by the time things were back to normal costs had increased to the point when radios had to lose all their frills to show a profit. So all that clever engineering was never used again.

Apart from the tuning mechanism, these sets were well ahead of their time; if you imagine the buttons in cream instead of brown the styling is very like any of those German sets of the fifties. Except that they got all vulgar and overdid the brass trim!