TECHNICAL INFORMATION

BULLETIN NO149

(TYPE)

TECHNICAL DESCRIPTION AND ADJUSTMENT PROCEDURE

OF 9-VALVE BAND SPREAD RECEIVERS.

CROMWELL MODEL NO.C.951-A

Series 1.

RECEIVER

COLLIER & BEALE LTD.

WELLINGTON

TECHNICAL DESCRIPTION AND ADJUSTMENT PROCEDURE

OF 9-VALVE BAND SPREAD RECEIVERS

CROMWELL MODEL NO.C.951-A.

Series 1.

Model No.C.951-A Receiver is of the Superheterodyne type and employs a total of nine valves used in the following arrangement :-

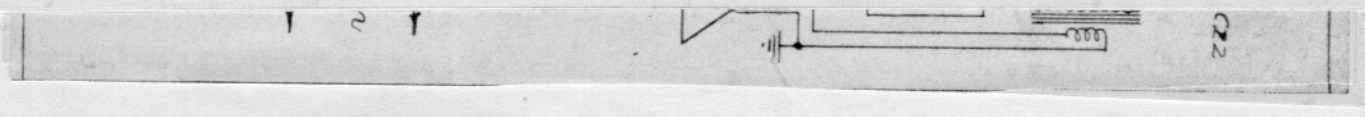
1	type	6U7G	signal frequency amplifier (all bands)
1	"	6K8/6K8G	mixer oscillator
1	"	6U7G	intermediate frequency amplifier (465-kc/s)
1	"	6B6G	diode rectifier and first audio amplifier
1	"	6J7G	phase inverter
2	"	6F6G	power amplifiers
1	"	6U5G	visual tuning indicator
1	"	5Y3G	power supply rectifier

This receiver, although conventional insofar as the basic receiver circuit is concerned, embodies a number of circuit innovations that have a material bearing on the performance achieved.

Five frequency ranges are covered by a unit coil assembly, the particular range desired being selected and brought into circuit by a band-operated switch.

As previously stated, the basic circuit is entirely conventional, and, other than the provision of "High Q" intermediate frequency transformers with consequent limited band width and reduction of receiver background noise, the major modifications occur in the audio frequency portion of the circuit and in the manner of sectionalising a single short-wave tuning circuit to obtain the three spread bands covering the principal International short-wave ranges.

The departures from standard in the audio frequency portion of the circuit are the inclusion of high frequency tone correcting circuit in the first audio amplifier stage (6U7G), and made up of resistor R-12 shunted by capacitor C-26, and the push-pull output stage. The push-pull stage is excited by a "phase inverter" valve (type 6J7G) with equal loads in its cathode and anode circuits. This stage being highly degenerative does not contribute materially to the audio gain of the receiver, the principal amplification being obtained from the triode section of the demodulator valve (type 6B6G) and the valves comprising the output stage. The output stage comprises two Pentodes (type 6F6G) in a push-pull arrangement, the output circuit being somewhat unconventional in that a portion of the voice coil potential is injected in the cathode circuit of the demodulating valve (type 6B6G) to obtain approximately 15% overall inverse feed-back in the output stage. The benefits from such a system are the reduction of output valve plate impedance and harmonic distortion. The high frequency corrective network, previously mentioned, is for the purpose of counteracting "side-band cutting" by the sharply selective I.F. transformers fitted.



The method of sectionalising the single short-wave circuit to provide for the three spread bands 19, 25 and 31 meters is, in general, conventional and is achieved by the insertion of small capacitors of 25 and 12½ mmfds in series with the tuned circuits and by the use of suitable values of shunt capacities. The two series capacitor values, just mentioned, are obtained by the use of either one or two identical capacity condensers singley, or in series respectively. These condensers are shown as B1 and B2 in attached print. Fixed capacitors designated F.1, F.2 and F.3 of 130, 50 and 25 mmfds respectively, together with associated trimmer condensers T.1, T.2 and T.3 are automatically shunted across the short-wave range inductors in the spread band positions by a section of the wave change switch and for the bands 31, 25 and 19 meters respectively.

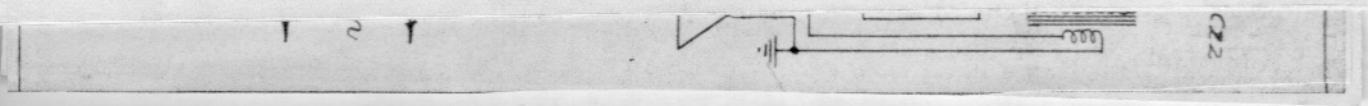
The usual general coverage short-wave range 16-6.5/mc/s has been retained in this receiver and when in use the series or shunt band spreading condensers are entirely disconnected. The high frequency alignment capacitors for the adjustment of this master range, designated T.4 in schematic diagram being located in the unit coil assembly in the manner customary to standard 2 and 3 band receivers of conventional design.

The broadcast portion of the circuit is entirely conventional, the high frequency trimmer condensers for this band being also located in the top section of the unit coil assembly.

In general, the receiver should not be subject to any greater difficulties due to misalignment, than a standard broadcast and short-wave receiver, but it is to be noted that, due to the much restricted frequency spread of the short-wave ranges, the usual variations encountered in the standard receiver will become more evident in this particular case and may be indicated by fair discrepancies in calibration. Caution, however, is required to be observed in this particular model in that any adjustments made to the fixed range trimmer condensers (T-4) although not greatly affecting the calibration of the general coverage band which, due to the fact that they are permanently connected across the inductors that are also used in the band spreading circuits, will have a material bearing on the calibration accuracy of these latter bands. Discrepancies in calibration, therefore, may be due to a shift of general coverage adjustment trimmers (T-4) or the shunt trimmers associated with the band spreading circuits (T.1,T.2,T.3) and before attempting the realignment of the receiver on the spread bands, it is desirable that the calibration accuracy of the general coverage band be carefully checked.

In the event of adjustment being required the following notes, which should be used in conjunction with the location plan, drawing No. 721-A attached, are supplied.

<u>Intermediate Frequency Amplifier Alignment.</u> The intermedate frequency used in Model C.951-A is 465-kc/s and both transformers should be adjusted for maximum output, and under no circumstances should a "staggered" adjustment be used as the "gain" of the whole receiver will be materially affected. Adjustment of these two transformers should be undertaken by first aligning the diode transformer alone, this being accomplished by clipping the signal generator lead on to the grid of the intermediate frequency



amplifier tube (6U7G) and adjusting for maximum output. The generator unit should then be transferred to the grid of the mixer tube (6K8G) and the first transformer treated in a similar manner. In this latter adjustment it is desirable to make certain that the wave-band switch is in the "broadcast" position, otherwise the comparatively low impedance of the short-wave tuned circuits at this test frequency will place the equivalent of a short-circuit across the generator terminals and so make the obtaining of an adequate test voltage difficult. An alternative arrangement - to avoid any possibility of loss in the detector input circuits - is to entirely remove the grid lead from this valve, and to complete the grid circuit temporarily with a fixed resistor of approximately 50,000 ohms resistance.

Signal Frequency Circuits Alignment. Adjustment of the signal frequency circuits, although not difficult, should be undertaken with a fair amount of care, particularly in the setting of the oscillator trimmer condensers, and in no case - unless the performance of the receiver is in question, regardless of minor errors in dial reading - should any attempt be made to disturb the factory adjustments. In all cases the broadcast band should be treated first. The order of adjustment is as follows.

With an accurate signal generator set at some convient high frequency, say 1,500-kc/s or 1,600-kc/s, and with the gang condenser set at the correct position, as indicated by the dial scale, the oscillator trimmer should be adjusted for maximum output. With this adjustment made both the mixer and R.F. trimmers may be adjusted, it being noted that all of the broadcast band trimmers are located in the top section of the unit coil assembly. Neither of these two latter adjustments is critical or difficult to perform, and very rarely, unless the receiver has been tampered with, will any major variation be required to be made.

With these adjustments satisfactorily made, the receiver should be aligned or "padded" at the low frequency end of the band, this adjustment taking place at approximately 600-kc/s. The most satisfactory way of adjusting the padding condenser is to use a highly damped signal source, rather than the signal generator, to avoid the necessity of constantly "rocking" the tuning mechanism, to ensure the optimum adjustment that provides maximum output. The most suitable highly damped source is generally available in the variety of electrical disturbances that constitute the usual background of a radio receiver when connected to an antenna. The receiver, therefore, should preferably be tuned to a frequency of 600-kc/s, making sure that no station carrier-wave is present, and the padding condenser adjusted for maximum noise output. After satisfactory adjustment of the padding condenser it is wise again to recheck the high frequency oscillator trimmer condenser, this latter adjustment only being necessitated if a considerable movement of the padding condenser has occured.

The adjustment of the general coverage short-wave range and the three associated band spread ranges should be undertaken generally in the manner to that described above, the actual requirement being the exercise of greater care in the adjustment of the oscillator trimmer condensers, which

in all cases will be found quite critical, and to observe the caution mentioned in an earlier paragraph of this Bulletin, in respect to the connection existing between the adjustment of the general coverage band and its effect on the calibration accuracy of the spread ranges. The general coverage short-wave range should be aligned first and for which test frequencies of approximately 16-mc/s and 6.5-mc/s are required. With the high frequency and padding condenser adjustments made the spread ranges adjustments may now be undertaken using test frequencies of 15,200, 11,800 and 9,600-kc/s for the bands 19, 25 and 31 respectively. The accuracy of calibration of these bands will depend on the accuracy of the test signal source, it being desired that a unit capable of being set to an accuracy of ± 10/15-kc/s be used.

The same remarks - in regard to the avoidance of altering trimmer adjustments if the performance of the receiver is satisfactory - apply in the above bands as well and, in the event of dial readings being appreciably out, movement of the pointer should be suspected and adjustment made accordingly. In certain cases unequal stretching of the dial operating cord can produce fair discrepancies in dial reading, and in shuch cases the remedy is quite simple and necessitates only the repositioning of the cursor on the dial operating cord.

As an aid in servicing the receiver, in the event of failure in any of the components fitted, a component schedule is appended which is to be used in conjunction with the schematic diagram attached.

COLLIER & BEALE LIMITED,
66, GHUZNEE STREET,
WELLINGTON, C.2.

21st January, 1942.

COMPONENT SCHEDULE FOR MODEL C.951-A.

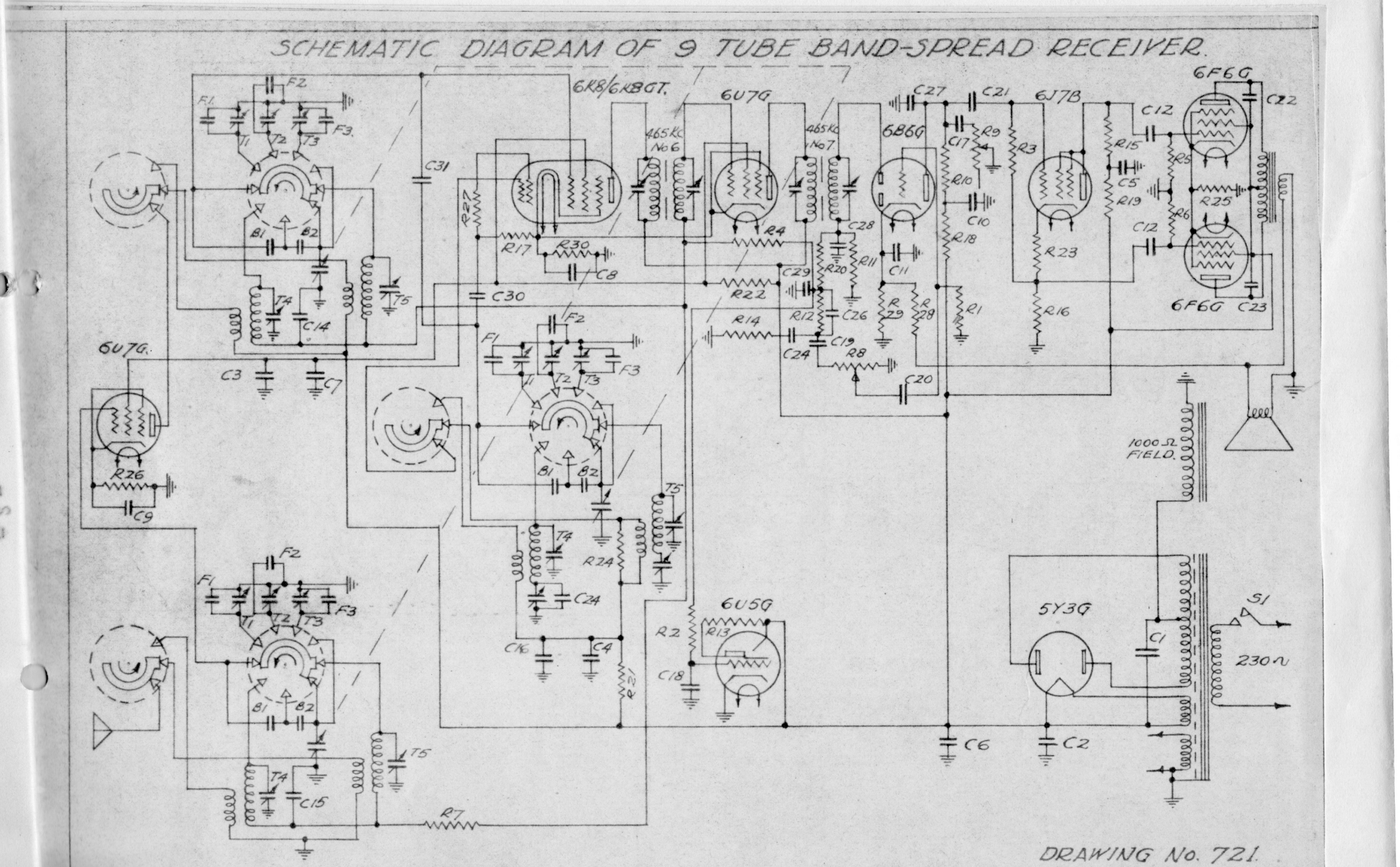
RECEIVER.

RESISTORS:

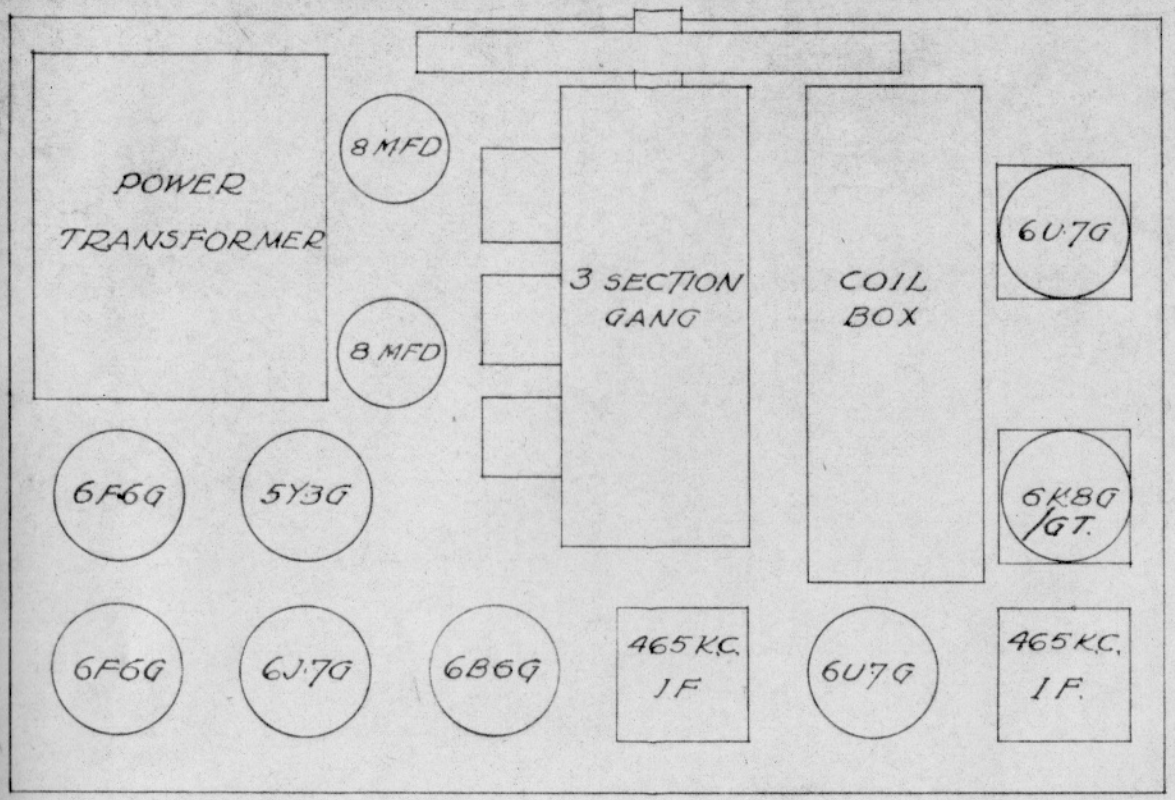
R - 1	10-megohm		Grid-leak bias resistor
2	2	"	Grid resistor tuning-indicator
3	1	"	Grid-leak phase-inverter
4	½	"	A.V.C. filter
5	¼	"	Grid-leak, output stage
6	¼	"	" " " "
7	½	"	A.V.C. filter
8	½	" pot.	Volume control
9	½	" pot.	Tone control
10	¼	"	Plate-load, 1st A.F. tube
11	¼	"	Diode load
12	¼	"	Audio corrector H.F.
13	1	"	Plate-load, tuning indicator
14	.1	"	Audio corrector L.F.
15	60,000-ohm		Plate-load "phase inverter"
16	60,000	"	Cathode-load "phase inverter"
17	50,000	"	Grid-leak, oscillator
18	50,000	"	Plate-decoupler 1st A.F. stage
19	25,000	"	Plate-decoupler "phase inverter"
20	20,000	"	R.F. suppressor
21	20,000	"	H.T. dropper oscillator stage
22	15,000	"	Screen-dropper
23	5,000	"	Cathode-bias "phase inverter"
24	1,000	"	Feed-back equaliser (B.C. band)
25	300	"	Cathode-bias output stage
26	300	"	Cathode-bias R.F. stage
27	200	"	R.F. suppressor oscillator stage
28	200	")	Inverse feed-back potentiometer
29	25	")	
30	150	"	Cathode-bias (1st det. & I.F. stages)

CONDENSERS:

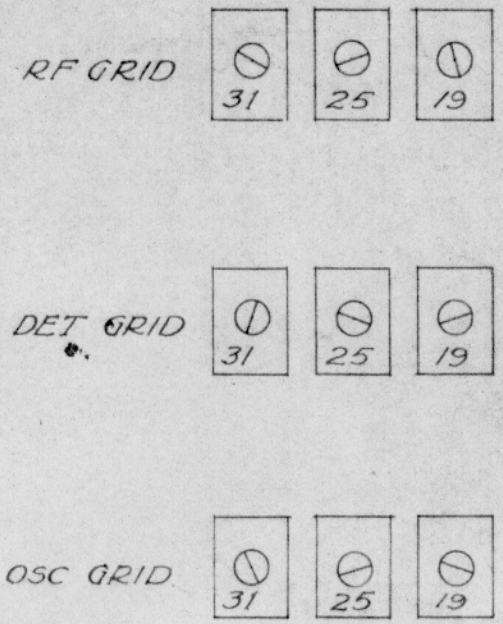
C - 1	16-mfd		H.T. filter
2	8	"	H.T. filter
3	8	"	Screen filter
4	8	"	Oscillator-plate supply filter
5	8	"	Plate decoupler "phase inverter"
6	.25	"	H.T. R.F. by-pass
7	.25	"	Screen R.F. by-pass
8	.25	"	Cathode R.F. by-pass (1st det. & Osc. stages)
9	.1	"	Cathode R.F. by-pass (R.F. stage)
10	.1	"	Plate decoupler (1st A.F. stage)

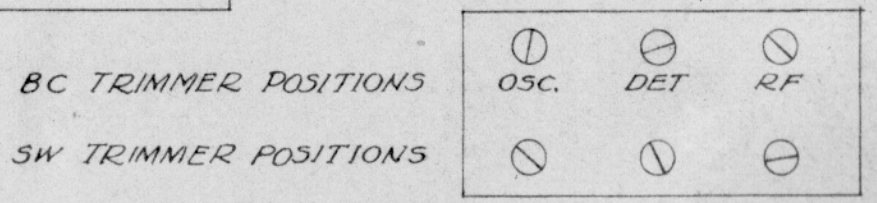

SCHEMATIC DIAGRAM OF 9 TUBE BAND-SPREAD RECEIVER.
6K8/6K8GT.
6U7G
6B6G
6J7B
6F6G
6F6G
6U7G.
6U5G
5Y3G
465 KC No 6
465 KC No 7
1000 Ω FIELD.
230 Ω
S1
F1
F2
F3
T1
T2
T3
T4
T5
B1
B2
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C26
C27
C28
C29
C30
C31
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30
DRAWING No. 721.

TUBE POSITIONS FOR TYPE C-951 A



S.W. TRIMMER POSITIONS.





DRAWING No 721 A