'TRADER' SERVICE SHEET 221

INVICTA 390

3-BAND BATTERY SUPERHET

A SHORT-WAVE range of 16.5-52 metres is covered by the Invicta 390 5-valve 3-band battery operated receiver. It has a Q.P.P. output stage employing two separate pentodes, while a hexode is used in the I.F. stage.

There is provision for both a gramophone pick-up and an extension speaker.

CIRCUIT DESCRIPTION

Aerial input via series condenser **C1** to coupling coils **L2** (S.W.), **L4** (M.W.) and (via choke coil **L1**) **L6** (L.W.) to single tuned circuits **L3, C21** (S.W.), **L5, C21** (M.W.) and **L7, C21** (L.W.).

First valve (**V1, Mullard metallised FC2A**) is an octode operating as frequency changer with electron coupling. Oscillator grid coils **L8** (S.W.), **L10** (M.W.) and **L12** (L.W.) are tuned by **C22**; parallel trimming by **C23** (S.W.), **C24** (M.W.) and **C25** (L.W.); series tracking by fixed condensers **C7** (S.W.), **C8** (M.W.) and **C9** (L.W.). Anode reaction coils **L9** (S.W.), **L11** (M.W.) and **L13** (L.W.).

Second valve, a variable-mu hexode (**V2, Mullard metallised VP2B**), operates as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings **C26, L14, L15, C27** and **C28, L16, L17, C29.**

Intermediate frequency 465 KC/S.

Diode second detector is part of double diode triode valve (**V3, Mullard metallised TDD2A**). Audio frequency component in rectified output is developed across load resistance **R7** and passed via coupling condenser **C14,** compensator **C16** and manual volume control **R8** to C.G. of triode section. Provision for connection of gramophone pick-up across **R8.** I.F. filtering by **R6, C12, C13.**

Second diode of **V3,** coupled by **C15,** provides D.C. potential which is developed across load resistance **R11** and fed back through decoupling circuit as G.B. to F.C. and I.F. valves, giving automatic volume control. Delay voltage is obtained from tapping on G.B. battery.

Parallel-fed transformer coupling by **R9, C17** and **T1** to quiescent push-pull output stage comprising two matched pentodes (**V4, V5, Mullard PM22A's**). Variable tone control by R.C. filter **C18, R13.** Provision for connection of low-impedance external speaker across secondary of **T2.**

DISMANTLING THE SET

Removing Chassis.—To remove the chassis from the cabinet, first remove the four control knobs (recessed grub screws) and then the four bolts (with rubber and metal washers) holding the chassis to the platform. The chassis can now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

When replacing, do not forget to replace the rubber washers between the chassis and its platform, and the felt washers between the knobs and the cabinet front. Also note that although there is a flat on the spindle of the wave-change switch, the grub screw in the knob should not be fixed against this. The knob should be placed so that on the various bands the dot is in the positions indicated on the tuning scale.

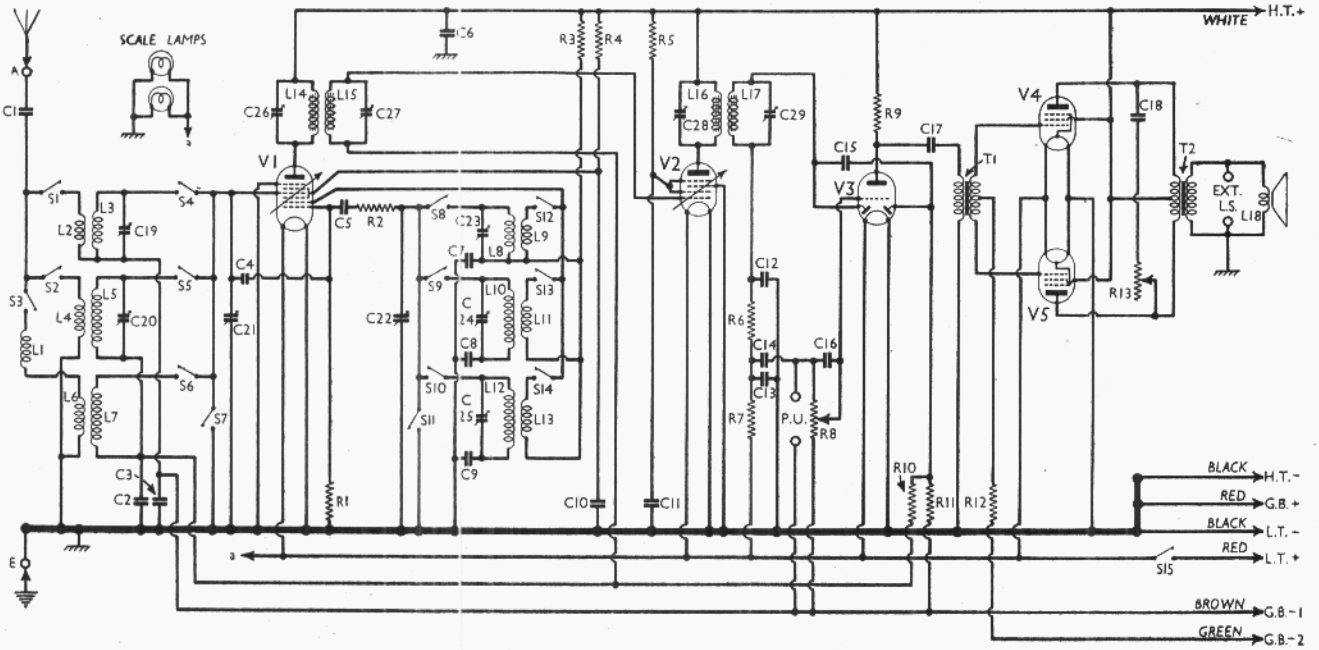
To free the chassis entirely, unsolder the speaker leads.

Removing Speaker.—If it is desired to remove the speaker from the cabinet, remove the nuts from the four screws holding it to the sub-baffle and *when replacing,* see that the terminal panel is at the top.

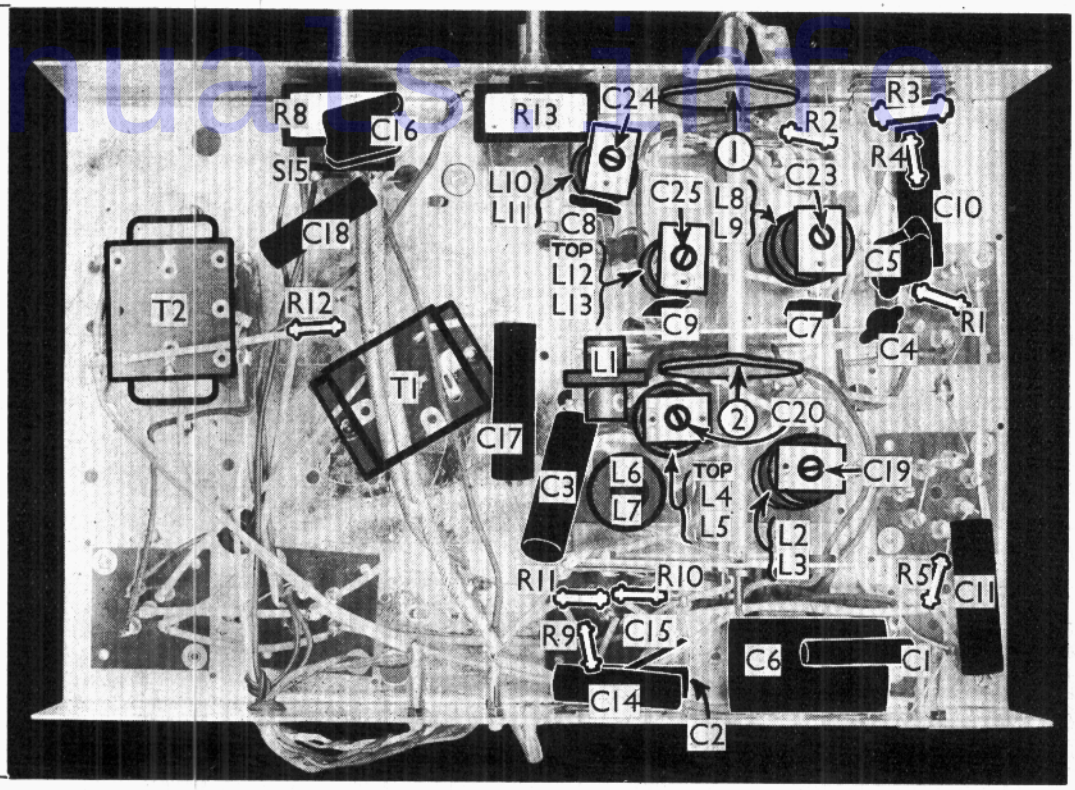
COMPONENTS AND VALUES

	CONDENSERS	Values (μF)
C1	Aerial series condenser ..	0·0003
C2	V1 pentode and V2 C.G. decoupling	0·05
C3	V1 pentode C.G. decoupling (S.W.)	0·1
C4	Small coupling	0·0000018
C5	V1 osc. C.G. condenser ..	0·00015
C6	H.T. reservoir condenser ..	1·0
C7	Osc. circuit S.W. fixed tracker	0·005
C8	Osc. circuit M.W. fixed tracker	0·000657
C9	Osc. circuit L.W. fixed tracker	0·00023
C10	V1 S.G. decoupling	0·1
C11	V2 S.G. decoupling	0·1
C12	I.F. filter condensers ..	0·00015
C13		0·00015
C14	A.F. coupling to V3 triode ..	0·01
C15	Coupling to V3 A.V.C. diode..	0·00015
C16	Bass compensator	0·0003
C17	A.F. coupling to T1	0·1
C18	Part of tone control filter ..	0·01
C19‡	Aerial circuit S.W. trimmer	0·00004
C20‡	Aerial circuit M.W. trimmer	0·00004
C21†	Aerial circuit tuning	0·000553
C22†	Osc. circuit tuning	0·000553
C23‡	Osc. circuit S.W. trimmer ..	0·00004
C24‡	Osc. circuit M.W. trimmer ..	0·00004
C25‡	Osc. circuit L.W trimmer ..	0·00008
C26‡	1st I.F. trans. pri. tuning ..	0·00009
C27‡	1st I.F. trans. sec. tuning ..	0·00009
C28‡	2nd I.F. trans. pri. tuning ..	0·00014
C29‡	2nd I.F. trans. sec. tuning ..	0·00014

† Variable. ‡ Pre-set.



Circuit diagram of the Invicta 390 3-band battery superhet. An extra trimmer may be found across **L7.**



Under-chassis view. Note the various coil units and their trimmers. In our chassis there was no trimmer at the top of the **L6, L7** unit. Details of the two switch units are on page IV.

RESISTANCES		Values (ohms)
R1	V1 osc. C.G. resistance	40,000
R2	V1 osc. C.G. stabiliser	50
R3	V1 osc. anode H.T. feed	1,000
R4	V1 S.G. H.T. feed	40,000
R5	V2 S.G. H.T. feed	100,000
R6	I.F. stopper	100,000
R7	V3 signal diode load	500,000
R8	Manual volume control	500,000
R9	V3 triode anode load	40,000
R10	A.V.C. line decoupling	250,000
R11	V3 A.V.C. diode load	1,000,000
R12	V4, V5 C.G. circuit stabiliser	100,000
R13	Variable tone control	50,000

OTHER COMPONENTS			Approx. Values (ohms)
L1	Aerial circuit choke (L.W.)		60·0
L2	Aerial S.W. coupling coil		0·55
L3	Aerial S.W. tuning coil		Very low
L4	Aerial M.W. coupling coil		75·0
L5	Aerial M.W. tuning coil		1·5
L6	Aerial L.W. coupling coil		1·8
L7	Aerial L.W. tuning coil		12·5
L8	Oscillator S.W. tuning coil		Very low
L9	Oscillator S.W. reaction		0·6
L10	Oscillator M.W. tuning coil		1·4
L11	Oscillator M.W. reaction		17·0
L12	Oscillator L.W. tuning coil		3·9
L13	Oscillator L.W. reaction		33·0
L14	1st I.F. trans.	Pri.	6·5
L15		Sec.	6·5
L16	2nd I.F. trans.	Pri.	4·15
L17		Sec.	3·6
L18	Speaker speech coil		2·0
T1	Intervalve trans.	Pri.	1,000·0
		Sec. total	8,000·0
T2	Output trans.	Pri. total	800·0
		Sec.	0·1
S1-S14	Waveband and gramophone switches		—
S15	L.T. switch		—

VALVE ANALYSIS

Valve voltages and currents given in the table (col. 2) are those measured in our receiver when it was operating with a new 120 V H.T. battery reading 128 V, on load, and the green plug inserted into the 6 V socket of a G.B. battery. The receiver was tuned to the lowest wavelength on the medium band and the volume control was at maximum, but there was no signal input, the receiver being in the quiescent state.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 FC2A*	128	1·2	70	1·5
V2 VP2B	128	2·0	60	7·0
V3 TDD2A	90	0·6	—	—
V4 PM22A	125	1·2	128	0·2
V5 PM22A	125	1·3	128	0·2

* Oscillator anode (G2) 122 V, 3·4 mA.

Voltages were measured on the 1,200 V scale of an Avometer, chassis being negative.

GENERAL NOTES

Switches.—S1-S14 are the waveband and radio muting (on gram.) switches, in two ganged rotary units beneath the chassis. These are indicated by numbers in circles and arrows in our under-chassis view, and are shown in detail in separate diagrams on p. IV., where they are seen

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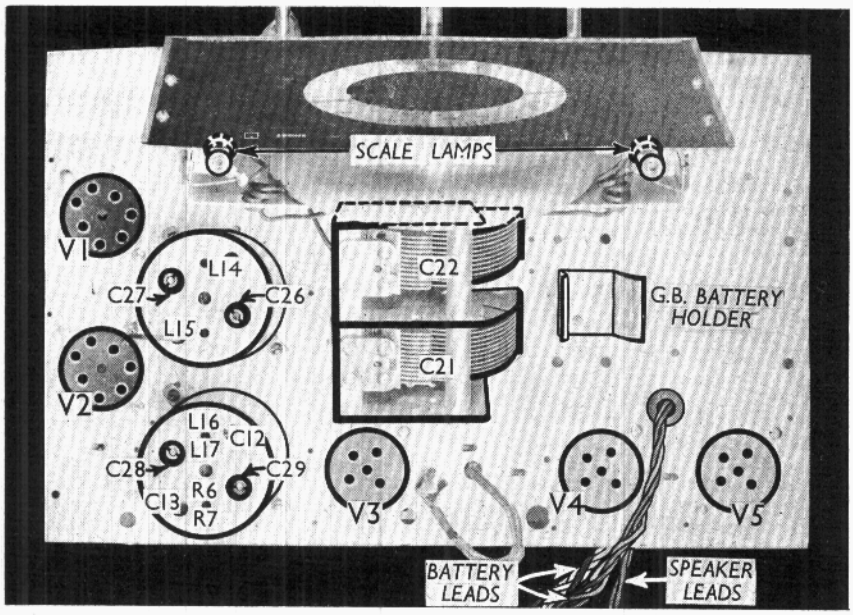


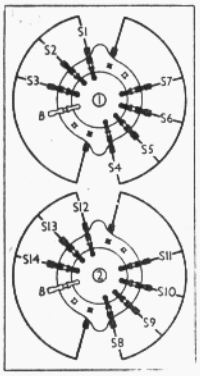
Plan view of the chassis. Note the extra components in the **L16, L17** unit.

INVICTA 390—*Continued*

looking from the rear of the underside of the chassis.

The table below gives the switch positions for the three control settings, starting from fully anti-clockwise. O indicates open, and **C**, closed.

Switch	S.W.	M.W.	L.W.	Gram.
S1	**C**	O	O	O
S2	O	**C**	O	O
S3	O	O	**C**	O
S4	**C**	O	O	O
S5	O	**C**	O	O
S6	O	O	**C**	O
S7	O	O	O	**C**
S8	**C**	O	O	O
S9	O	**C**	O	O
S10	O	O	**C**	O
S11	O	O	O	**C**
S12	**C**	O	O	O
S13	O	**C**	O	O
S14	O	O	**C**	O



Switch diagrams, as seen looking from the rear of the underside of the chassis.

S15 is the Q.M.B. L.T. circuit switch, ganged with the volume control **R8.**

Coils.—The R.F. and oscillator coils are in pairs on six tubular unscreened formers beneath the chassis. Each former (except one in our chassis) carries a trimmer at its end. **L1** is on a separate small former. The I.F. transformers **L14, L15** and **L16, L17** are in two screened units on the chassis deck, with their associated trimmers. Note that the second unit also contains **R6, R7, C12** and **C13.**

Scale Lamps.—These are two Ever Ready M.E.S. types, rated at 2·0 V, 0.1 A.

External Speaker.—Two sockets are provided at the rear of the chassis for a low resistance (2 O) external speaker.

Batteries.—A 2 V, 30-50 AH cell is recommended for L.T. Types suggested are Ever Ready GS60, Exide DXG. Space available, 6¾ in. by 4¼ in. by 6¾ in. high. For H.T., a 144 or 150 V type is suggested (e.g. G.E.C. BB 365 or Every Ready 51 P). For economy a 120 V unit may be used (Every Ready 120 L Super). Space available, 10½ in. by 3⅜ in. by 6¾ in. For G.B. a 9 V unit is necessary, and this is held in the clip on the chassis deck.

Battery Leads and Voltages.—Black lead, spade tag, L.T. negative; red lead, spade tag, L.T. positive 2 V; black lead and plug, H.T. negative; white lead and plug, H.T. positive (in maximum socket of battery); red lead and plug, G.B. positive; brown lead and plug, G.B. negative 1, —1·5 V; green lead and plug, G.B. negative 2, —7·5 V with 150 V H.T., or —6 V with 120 V H.T.

Matching V4 and V5.—The pair of valves supplied are matched. When fitting replacements, rough matching should be carried out. Insert a milliammeter in the negative H.T. lead. Remove all valves, but leave batteries connected. Insert one PM22A in **V5** socket, note meter reading and remove valve. Insert another PM22A in same socket and again note reading. Select a pair of valves which give readings with a ratio less than 2 to 1.

Valve V2.—The VP2B is a hexode, used in this set as an I.F. pentode amplifier, by connecting the two screening grids together. A diagram of the base connections, looking at the underside of the valve, is given on this page.

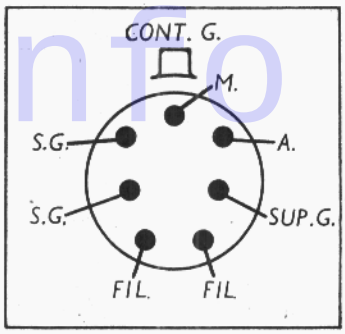
Chassis Divergencies.—In the makers' diagram there is an aerial circuit L.W. trimmer, in parallel with **L7,** and mounted on the **L6, L7** coil unit. This does not occur in our chassis.

The makers also show a 10 $\mu\mu$F aerial top coupling condenser between the tops of the aerial coupling and grid coils, which is not in our chassis.

CIRCUIT ALIGNMENT

I.F. Stages.—Connect signal generator to grid (top cap) of **V1** and chassis. Feed in a 465 KC/S signal, and adjust **C29, C28, C27, C26,** in that order, for maximum output. Re-check.

R.F. and Oscillator Stages.—When gang is at maximum, pointer should be vertical.



Base and top cap connections of the VP2B hexode, looking at the underside of the base.

M.W.—Connect signal generator to **A** and **E** sockets and switch set to M.W. Feed in a 250 m. signal, set pointer to 250 m. on scale, and adjust **C24,** then **C20,** for maximum output. Keep input low.

L.W.—Switch set to L.W., feed in a 1,200 m. signal, set pointer to 1,200 m. on scale, and adjust **C25** for maximum output. If a trimmer is fitted to the **L6, L7** unit, adjust this next.

S.W.—Switch set to S.W., feed in a 30 m. signal, set pointer to 30 m. on scale, and adjust **C23,** then **C19,** for maximum output. Check on 16·5 m.

MAINTENANCE PROBLEMS

Insensitive Bush Superhets

INSENSITIVITY on distant stations was the complaint with some Bush battery superhets of the 1935-6 vintage—a tendency which we have noticed on some other new models.

Examination of the valves, valve readings and circuit values revealed no fault, and re-trimming and re-aligning failed to effect an improvement. It was observed, however, that tapping the aerial direct on to the tuning coils after the band-pass filter made an improvement greater than could reasonably be anticipated.

Assuming that the trouble was caused by insufficient coupling of the band-pass coils, we tried capacity coupling by means of a 0·0001 μF condenser at a convenient point on the gang condenser and achieved the desired result.—E. S., CHELTENHAM.

Faults in Lissen 8001 and 8014

TWO or three years ago Lissen put on the market a 2-valve mains set, the 8001, and later another, the 8014. We found these sets very popular and many were sold, but from time to time they have needed service and I give below the cures for faults experienced.

Microphonic howl will usually be found to be due to the detector valve, grid leak or grid condenser, while weak output and no reaction is caused by the reaction coil being O/C due to corrosion, which shows as a small green spot on the winding, adjacent to the soldering tags.

Distorted output may be found to be caused by the grid decoupling resistance being O/C, or the grid decoupling condenser being O/C or S/C. The latter is difficult to spot as the condenser is contained in a block and the wiring cannot be traced unless it is pulled to pieces.—A. E. BANWELL, TADWORTH.

Choke in Portable Burnt Out

IT was only by chance that we found out the cause of the repeated burning out of an R.F. choke in a small Burndept portable. A clue was provided when the customer mentioned that he obtained signals by holding up the screened top connector on the valve to which the choke was connected.

This connector is very shallow and if it should become loose in transit it can, and in this case did, tilt at such an angle that the anode connector touched the metallising of the valve, thus placing the H.T. voltage across the choke winding.—J. H. E. WATTS, SOMERTON.

High Background in Philco 444

A PHILCO 444 A.C. People's Set gave excessive background noise on the L.W. band, especially above 1,800 m., and curiously enough, it seemed that it was functioning as a short-wave set when tuned to this part of the dial, as the sparking plugs of passing cars caused great interference.

After some trouble it was found that the lead from the cathode of the heptode was rather long and passed near the oscillator anode coupling condenser (C4, TRADER *Service Sheet*). On spacing this lead from the condenser the receiver became quite normal, but each time this lead was deliberately misplaced the same symptoms were experienced. — A. L. WHEELER, GREAT MISSENDEN.