WESTON
ELECTRICAL INSTRUMENTS
FOR AIRCRAFT

Weston Aircraft Instruments are supplied to the Air Ministry and to leading military and civil aircraft manufacturers throughout the world.

Sangamo Weston Ltd. are Design Approved by the Ministry of Supply, and the engineers at our Works and at our Branches are always available to discuss any problems or to give any assistance which may be required in connection with these instruments. Enquiries at any of our addresses will receive immediate attention.

HIGH ACCURACY AIRBORNE TACHOMETER

Information contained in this manual affecting safe operation and maintenance has been verified and approved by the Air Registration Board in accordance with Chapter A6-2 of British Civil Airworthiness Requirements. 9. 8. 54.

SANGAMO WESTON LIMITED.

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SANGAMO WESTON LIMITED

MODEL No.

AMENDMENT RECORD SHEET

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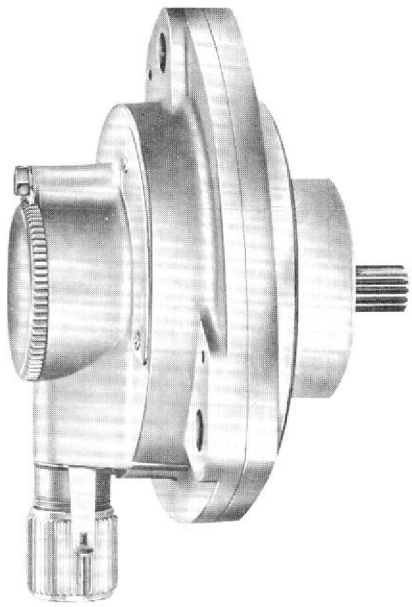
TACHOMETER GENERATOR MODEL S.168.
Form 1.



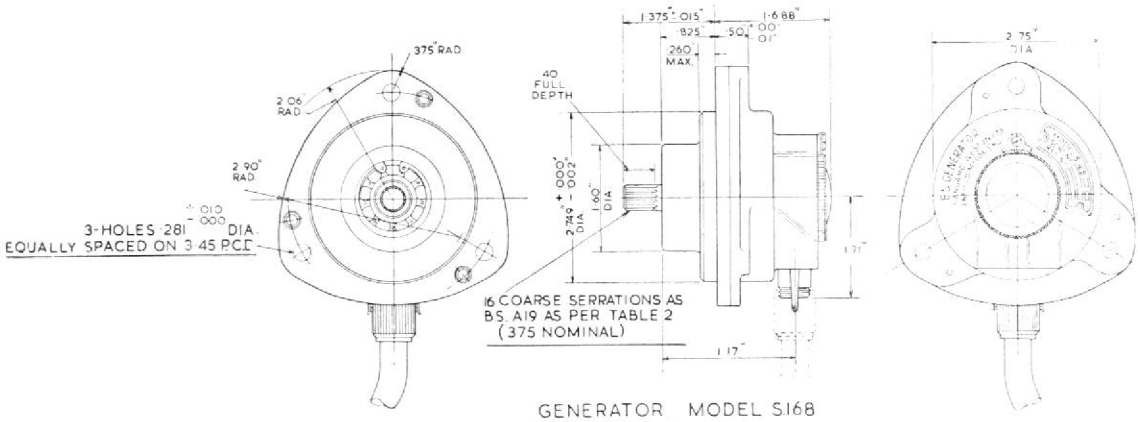
This is a single phase 24 pole alternator type generator with a permanent magnet rotor. It is contained in an oil-sealed diecast casing, and is designed to run at half engine speed for indicated speeds up to 10,000 r.p.m., and quarter engine speed for indicated speeds over 10,000 r.p.m.

The fixing dimensions conform to B.S.I. Drawing No. 1677, and the shaft terminates in a 16 tooth spline.

The stator winding is fully impregnated and insulated from the frame, electrical connection being via a 2-pin plug.

The generator has an output of 10 volts and 200 c.p.s. per 1,000 r.p.m. The wave form approximates to a sine wave, and the generator resistance is about 25 ohms. It is designed to operate over a temperature range of −70° C. to +125° C., the temperature coefficient approximating to −·0001 volts per volt per degree centigrade rise over this range.

Accuracy : Initial adjustment of output voltage ±1% at 20° C.



Fixing Diagram

GENERATOR (ELECTRICAL)

The output of this unit is 10 volts per 1,000 r.p.m. as measured by a rectifier type permanent magnet moving coil voltmeter. The voltmeter should have a sensitivity of 1,000 ohms per volt, and should be accurate up to at least 1,200 cycles. The instrument used should be similar to SANGAMO WESTON TYPE S.82.

Failure to give correct output may be caused by either, or both, of the following :

(*a*) Aged or damaged rotor.

(*b*) Short circuited or open circuited windings.

A resistance test on the windings should give 25 ohms approximately when measured at 20° C.

If the rotor is aged or damaged, the complete generator should be returned to the manufacturers.

Short circuited windings may be caused by a breakdown of the insulation between the windings and the frame. The insulation resistance obtained by the application of 500 volts d.c. between the frame and windings should not be less than 50 megohms.

It should also be noted that the presence of foreign matter across the pins of the 2-pin plug may give rise to symptoms similar to a short circuit.

GENERATOR (MECHANICAL)

The rotor should be easy to turn manually. Stickiness, or erratic action may be the result of damage to the bearings caused by (*a*) impact, (*b*) excessive wear, or (*c*) foreign matter in the bearings causing a seizure. The only cure is a complete bearing renewal.

The front bearing runs in an oil mist from the engine, but if it appears dry may be lightly coated with engine oil. The rear bearing is lubricated with grease to Specification D.T.D. 825.

STRIPPING THE GENERATOR

Remove the hexagon headed 6 B.A. locking screw and the locking pawl. Then unscrew sealing cap. Take out the three 6 B.A. screws and shakeproof washers. Fold back 2 B.A. tab washer, and, holding the shaft in a mandrel or suitable fixture, remove 2 B.A. full nut, tab washer, and plain washer. When carrying out this last operation, care must be taken not to damage the splines.

Gently tap the rear end of the shaft with some soft material, for example, wood, lead, copper, or a similar substance, holding the rear half of the housing whilst doing so. The front and back housings will then separate.

At this stage the rotor may be slid off the shaft. Take care not to lose the squared key which aligns these two components. The rotor must not be laid on any magnetic surface, or its performance may be affected.

The circlip may now be taken out. This will allow the shaft and the front bearing to be separated from the front housing. When removing the bearings, note that the front race is a drive fit on the shaft, whilst the rear is a push fit in the rear housing.

To assist in the identifying and replacing of the front bearing, front housing or rotor shaft, the letter on the inner race of the front bearing should match the letter on the rotor shaft, whilst the letter on the outer race should match the letter on the housing.

If the stator or the plug needs replacement, the rear housing must be returned to the manufacturers.

When re-assembling, make sure that the gaskets, lock washers, tab washer, and locking pawl, are all replaced in their correct positions.

It should be stressed that the components which make up a generator are not interchangeable with those from other generators. Therefore, when two or more of these units are being serviced, individual parts should be carefully marked.

INSPECTION

(*a*) GENERATOR

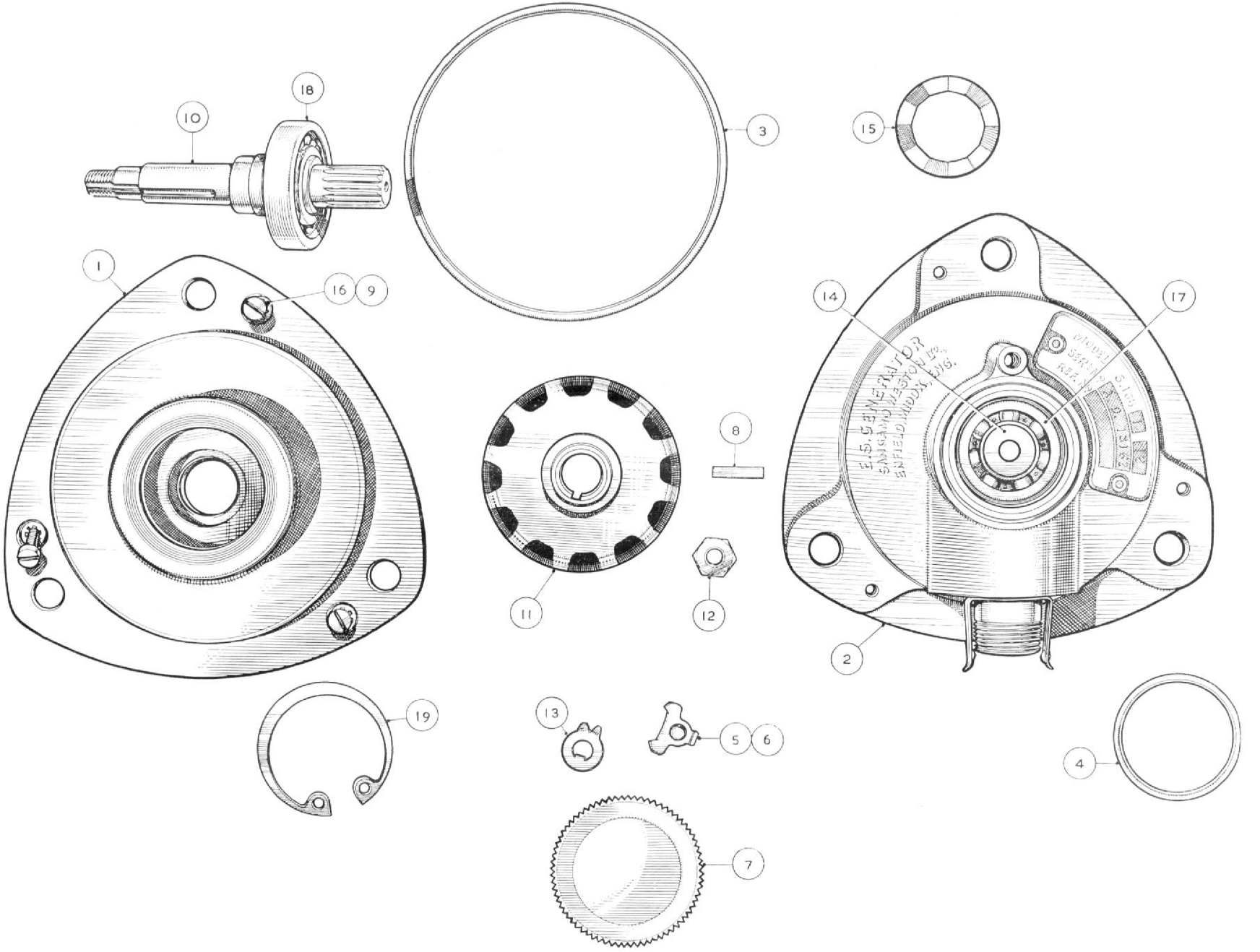
Check the Generator after every 1,000 flying hours in accordance with the method previously described. The rear bearing must be examined, and, if necessary, lubricated with grease to Specification D.T.D.825.

Subject to this check, the life may be regarded as indefinite.

GENERATOR MODEL S.168

PARTS LIST

Reference No.	Part No.	Description	Number Off
1	168963	Housing (Front).	1
2	168966	Housing Assembly (Back).	1
3	168990	Rubber Gasket (Front).	1
4	168991	Rubber Gasket (Back).	1
5	168995	Locking Pawl.	1
6	168996	Screw 6 B.A. Hex. Slotted.	1
7	168986	Sealing Cap.	1
8	168997	Key.	1
9	150376	Lock Washer 6 B.A.	3
10	168984	Shaft.	1
11	168979	Rotor.	1
12	92211	Full Nut 2 B.A.	1
13	168998	Tab Washer 2 B.A.	1
14	150192	Washer 2 B.A.	1
15	168992	Crimped Washer.	1
16	168999	Screw 6 B.A. x $\frac{3}{8}$" Ch. Hd.	3
17	168987	Ball Journal 22 mm. (Rear).	1
18	168985	Ball Journal 1·125" (Front).	1
19	168989	Circlip.	1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INTRODUCTION

Up to the present, tachometry conforming to a reasonable degree of accuracy has involved the careful selection, matching, and maintenance of instruments. This process has proved costly and inconvenient. Even with the utmost care, it has not been possible to guarantee results up to the high standards required.

The equipment described in the following pages has been designed to overcome these difficulties, and to give an accuracy in the order of $\pm\frac{1}{4}\%$. All units are freely interchangeable with other similar units, and maintenance procedure has been reduced to a minimum.

It should be noted that the indicators may be supplied in two versions, (*a*) in one large S.A.E. case, or (*b*) as two separate instruments. The instructions given apply equally to both types of presentation.

FUNCTIONING

The tachometer consists of three units, the Generator, the Computer Box, and the Indicators.

The total range indicator is operated by the voltage parameter of the generator, and covers the full speed range of the engine. The expanded scale instrument is acted upon by a frequency parameter fed to it through the computer box, and covers only an expanded or critical portion of the total speed range.

A conventional rectifier type permanent magnet moving coil voltmeter forms the voltage sensitive indicator. The frequency sensitive indicator operates in conjunction with a specially developed electronic circuit designed to provide the required high accuracy.

As the output frequency of the generator is a direct function of engine speed, the frequency ratio available for the indicator over the expanded or critical portion of the total engine speed is reduced as the speed range to be indicated is reduced. It is therefore necessary to increase the frequency ratio supplied to the indicator, and this is done in the following manner. The figures quoted are only by way of an example.

Assume the required range of the frequency sensitive indicator to be from 7,000 to 8,000 r.p.m. Then with a 24-pole generator running at half engine speed, the frequency range of the generator output will be 700–800 c.p.s., which is a ratio of 1 : 1·14. This must be raised to at least 1 : 2·5 to give a good circular scale instrument, and is accomplished as follows.

The generator output of 700 to 800 cycles is made to beat with the output of a 650 cycle tuning fork oscillator. This gives a beat frequency of 700 minus 650, to 800 minus 650 cycles, that is, 50 to 150 cycles. By this method, the ratio is increased to 1 : 3. A high-pass input filter is connected in the input to the modulator to eliminate all frequencies below 650 cycles, as, at generated frequencies of 500 to 600 cycles, beat frequencies of 150 to 50 cycles are produced, which, unless removed, would give false indications.

After passing through a low pass filter which takes out any unwanted higher frequencies, the beat frequency is amplified and applied to the coil of a high speed polarised relay. This is a vibrating reed type, and has single pole changeover contacts which operate at the applied frequencies of 50 to 150 cycles per second. These contacts are used to transfer a condenser charge from a 28 volt d.c. supply to one coil of the expanded scale indicator. The time constant of the condenser circuit is made to such a value that the condenser is fully charged and fully discharged at each cycle. Therefore, the average d.c. current flowing in the indicator coil is directly proportional to the frequency. This is given by the equation :—

$$I_{AV} = CEn$$

where I_{AV} = average d.c. current in amperes.
C = value of condenser in farads
E = voltage of supply
n = number of pulses per second.

The other indicator coil is energised from the same 28 volt supply through a suitable series resistance. The current flowing in this coil is thus also proportional to E, and the combined effect is that the indication is independent of E, and proportional only to Cn. Accuracy and stability depend upon C, which is a high stability 0·6 mf. silvered mica condenser.

It should be noted that the equation for I_{AV} contains no function of resistance. Consequently the indication is independent of lead resistance over a wide range.

It may be required to reduce the engine to generator gear ratio from 2 : 1 to 4 : 1, so that the generator runs at $\frac{1}{4}$-engine speed. This would reduce the generator frequency output by one-half, and a way must be found to restore the frequency range to its original value.

This is done by using a frequency doubler after the input filter.

The frequency doubler takes the form of a full wave bridge rectifier which produces a d.c. output with a superimposed ripple of twice the input frequency. This ripple is used to modulate the fork frequency in the usual way.

When using this system, it becomes necessary to eliminate a second harmonic in the frequency doubler output which reacts with another second harmonic in the cathode of the modulator to produce a spurious output. To this end, a parallel tuned condenser/choke circuit is placed between the frequency doubler rectifiers and the cathode resistor of the modulator.

INSTALLATION NOTES

Details of the fixing centres may be obtained by reference to the fixing diagrams.

The computer box must be anti-vibration mounted and should be installed in an upright position at a location where temperature variations do not exceed −40° C. to +55° C. Where possible, provision should be made to allow adequate ventilation round the box.

The indicators are to be fitted to a vibration-proof instrument panel.

POWER SUPPLIES

Power supplies required are :—

(*a*) 115 volts, 400 c.p.s., 3-phase.
Consumption 30 VA. at ·9 power factor approximately with substantially balanced loading.

(*b*) 28 volts d.c. at 50 mA. approximately. This supply, including the wiring to the computer box, must be of low impedance, i.e., not greater than 10 ohms.
In order to eliminate possible pointer oscillation on the expanded scale indicator, the 28 V. d.c. supply must be reasonably free from ripple.
The above ratings apply to a two-engine equipment.

CHECKING

OVERALL CHECK

With the equipment wired to specification, run the generator up to the required speeds. If output is low or non-existent, inspect the 2-pin socket on the connecting cable to the generator plug for open circuit or faulty internal cable connections. Note that the pointer on the expanded scale does not appear until the minimum r.p.m. applicable to that scale is reached, and that it emerges smoothly from behind the shield. The accuracy of the two scales should be as previously stated, and the expanded scale pointer should remain deflected over the end of the scale for at least 300 r.p.m. beyond full scale value. Check both channels in this manner.

RECOMMENDED TEST RIG

In order to simulate flight conditions, and to check the complete equipment, it is recommended that a simple test rig be constructed to the following specification.

Components:

(*a*) One variable speed motor to which the generator may be directly coupled. The motor should be capable of 1,000–6,000 r.p.m., and should preferably be fitted with a heavy flywheel.

(*b*) A means of determining motor speed, e.g., stroboscope, or CINTEL frequency monitor. The last mentioned is the most accurate.

Power Supplies:

28 volts d.c.
115 volts 400 cycles a.c.

Method of Use:

Connect up as appropriate. Note that for an engine/generator gear ratio of 2 : 1, the generator speed will be half the indicated speed, and that for a gear ratio of 4 : 1, the generator speed will be one-quarter of the indicated speed.

A check should be made at each 1,000 r.p.m. division on the total range scale, and at each 100 r.p.m. division on the expanded scale. The resultant accuracy should be ±3% full scale deflection on the total range scale, and ±20 r.p.m. on the expanded scale. Errors greater than these require that individual checks shall be carried out as detailed under the relevant headings.

COMPUTER BOX MODEL S.169. Form 1.

This is of splashproof metal construction, and all connections are made via Plessey Mark IV 6-pin plugs. There are three sub-chassis, of which one is a combined power supply and tuning fork oscillator, the remaining two being identical tachometer channels.

These separate sub-chassis have been designed for easy removal, the only connections between them consisting of six soldered " bus-bar " type leads.

All components are fully tropicalised, and the complete unit is satisfactory for use in the range −40° C. to +55° C., the upper limit of which is determined by the metal rectifiers used on the power supply chassis.

The valves used are type 13D2 (Brimar Trustworthy Range). These are double triodes and may in extreme circumstances be replaced by type 6SN7. The Carpenter relay is a Telephone Manufacturing Co. type 5HA34A with a 20,000 turn winding. It has been specially stabilised for aircraft use.

The computer box is not affected by changes in pressure, the error introduced by a change in altitude of 40,000 ft. being less than 0·02%.

The unit is insensitive to slight vibration conditions, but, for the protection of the valves and relays, should always be anti-vibration mounted.

The connection to the tachometer channels is arranged so that generators and indicators cannot be cross connected, although the channel used for a generator and indicator is immaterial.

COMPUTER BOX (ELECTRICAL)

The following chart gives details in tabular form of faults that may occur in the computer box. It should be read in conjunction with the system circuit diagram. These checks should be carried out using a generator and indicator of known accuracy.

Before proceeding, it is advisable to examine the equipment for any minor faults that may arise due to service conditions, such as pulled connections, frayed or otherwise damaged insulation, improperly seating plugs, and so on. Should there be combinations of the symptoms tabulated, classify them under their respective headings and check accordingly.

BOTH CHANNELS INOPERATIVE (SECTION 1)

Symptom	What to Check	Remedy or Further Check	Remarks
No audible response from fork.	(1) Continuity of exciter coils L1 and L2. Foreign matter in gaps. (2) Output voltage from fork.	Replace defective coil, or remove foreign matter. Check at points 1 and 5 on interconnections. Should be 10 volts R.M.S. for 2 : 1 ; 5 volts R.M.S. for 4 : 1.	This measurement may be made only with a high impedance voltmeter or suitably calibrated oscilloscope. Adjust coils L1 and L2 as necessary.
As above and no H.T.	(3) Valve V1.	Replace with similar type.	
	(4) Power supply at primary and secondary of T1 and T2.	Replace defective transformers, or check back on power supply.	
	(5) Output H.T. across C1.	Disconnect R1 at point A. This will indicate whether C1 and/or rectifiers are at fault.	Disconnect and recheck H.T.
	(6) C1.	If satisfactory replace rectifiers.	Reconnect R1.
	(7)	If disconnection of R1 at A restores H.T. across C1, then fault lies on C2 or the following circuit.	
	(8)	Disconnect jumper No. 6 from both channels. If this restores H.T., then the fault lies in one of the channels.	
	(9)	Disconnect C2, C3 and point B in sequence, replacing defective components as necessary.	Any of these operations should restore H.T. If not, suspect component being checked.
	(10)	Check R2, R3, R4, R5, R6 and C4. Check exciter coils L1 and L2 for insulation breakdown.	

ONE CHANNEL INOPERATIVE (SECTION 2)

Symptom	What to Check	Remedy or further Check	Remarks
No output to expanded scale.	(1) Interconnections 1, 2, 3, 4, 5, and 6.	—	
	(2) Voltage across C4.	If C4 is satisfactory, check R7.	
	(3) Valve V2.	Check if heaters are glowing. Replace with similar type if faulty.	
	(4) Potentials at C and D.	—	
	(5) R8, L3 and C5.	—	
	These measures should restore H.T.		
H.T. satisfactory but no signal present.	(6) Relay S1 should be audible.	If suspicious, change relay.	
	(7) C9.	If open, or short, circuited would render charge/discharge circuit inoperative.	
	(8) L.T. to V2.	Heater should be glowing. If suspicious, replace. Check as at (5), Section 2.	
	(9) R9, R10, R11, R12, R13, R14, R15, C6, C7, C8.	Replace where necessary.	
	(10) Run generator at speed corresponding to any portion of expanded scale.	With power supplies off, check across R11. Reading should be approx. 2 to 3 volts. If not, check C10, C11, C12, L4, R16.	

ONE OR BOTH CHANNELS GIVING SPURIOUS READINGS (SECTION 3)

Symptom	What to Check	Remedy or further Check	Remarks
Expanded scale pointer appears before appropriate reading is reached.	(1) Input filter.	As at (9), Section 2.	
	(2) Polarised Relay.	Badly adjusted. Replace.	
Erratic indicator behaviour.	(3) Polarised Relay.	As above.	
	(4) Intermittent fault leading to breakdown as noted in previous sections.	Classify symptoms and check as previously described.	

FREQUENCY DOUBLER

Where the engine/generator gear ratio is 4 : 1, a frequency doubler is fitted in the computer box. Note that R.11 is changed to 1,000 ohms. All the previous servicing information applies in addition to that given below.

Symptom	What to Check	Remedy or further Check	Remarks
Expanded scale pointer appears immediately before correct speed is reached, and behaves in an erratic manner.	L5 and C13.	If satisfactory, suspect rectifier B1. If not satisfactory check as (10), Section 2.	Replace B1.

COMPUTER BOX (MECHANICAL)

Replacement of Channels

To remove any one of the channels, the following sequence of operations should be carried out.

Remove cover. Disconnect the six jumper leads. Unscrew the nut which holds the plug in position, and remove the four screws on the appropriate channel to be taken out. The assembly will then be free.

RELAY CONTACT RE-ADJUSTMENT

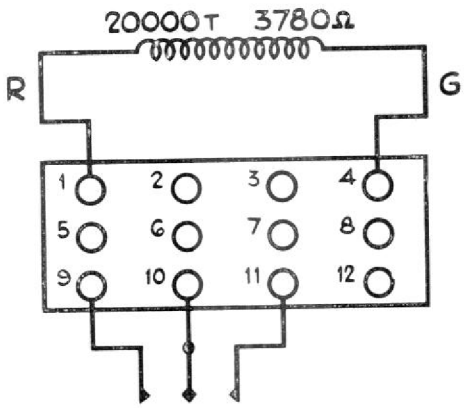
Should any maintenance to a polarised relay other than a contact re-adjustment become necessary, the relay should be returned to the manufacturers.

Inspect the contacts for signs of wear, such as pitting, or the formation of a black powdery deposit. If wear is discernible, the contacts should be burnished by gently rubbing a 0·002″ steel feeler gauge over their surfaces. If the contacts are badly burnt, it may be necessary to remove the side contact assemblies so that the contacts are accessible for careful filing. This operation should not be attempted except in an emergency.

The side contacts are positioned by two capstan-headed adjusting screws on the pole-piece extensions. Each screw is secured in position by the locking screws provided, which may be loosened by a non-magnetic tommy-bar.

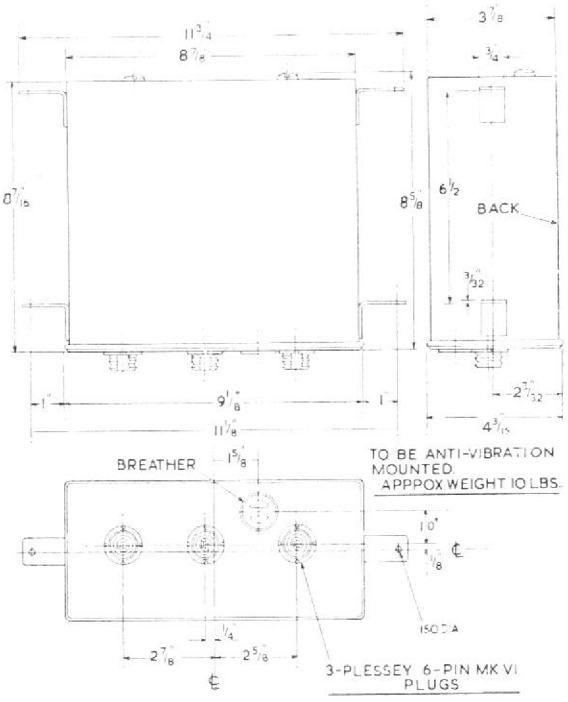
A current of 0·13 mA. is passed through the coil winding after a " saturate " current of 2·5 mA. has first been passed in the reverse direction. If the relay operates, the adjusting screw governing the position of the contact on which the armature rests at zero current, is advanced until the relay no longer operates on the application of 0·13 mA. Whilst this current is still applied, the adjusting screw is slowly retracted until the relay just operates. The adjusting screw is locked in this position. The currents are reversed, and the same procedure is then repeated for the opposite contact.

After re-positioning the contacts and re-locking the adjusting screws, check that the operating current is 0·13 mA. The relay should not operate at 0·12 mA. Check also that the contacts are " making ". This can be done under quiet conditions by listening, when, if the relay is working, the contacts will be heard to " click " over. Alternatively, and as a more positive method, a check for electrical continuity may be made. Note that if, after re-adjustment, the gap between the contacts falls outside the range 0·0015″ to 0·003″, the relay is unserviceable.



With + on Tag 1 10 makes contact with 11.

Diagram of Relay Plug Pins.



Fixing Diagram

INSPECTION

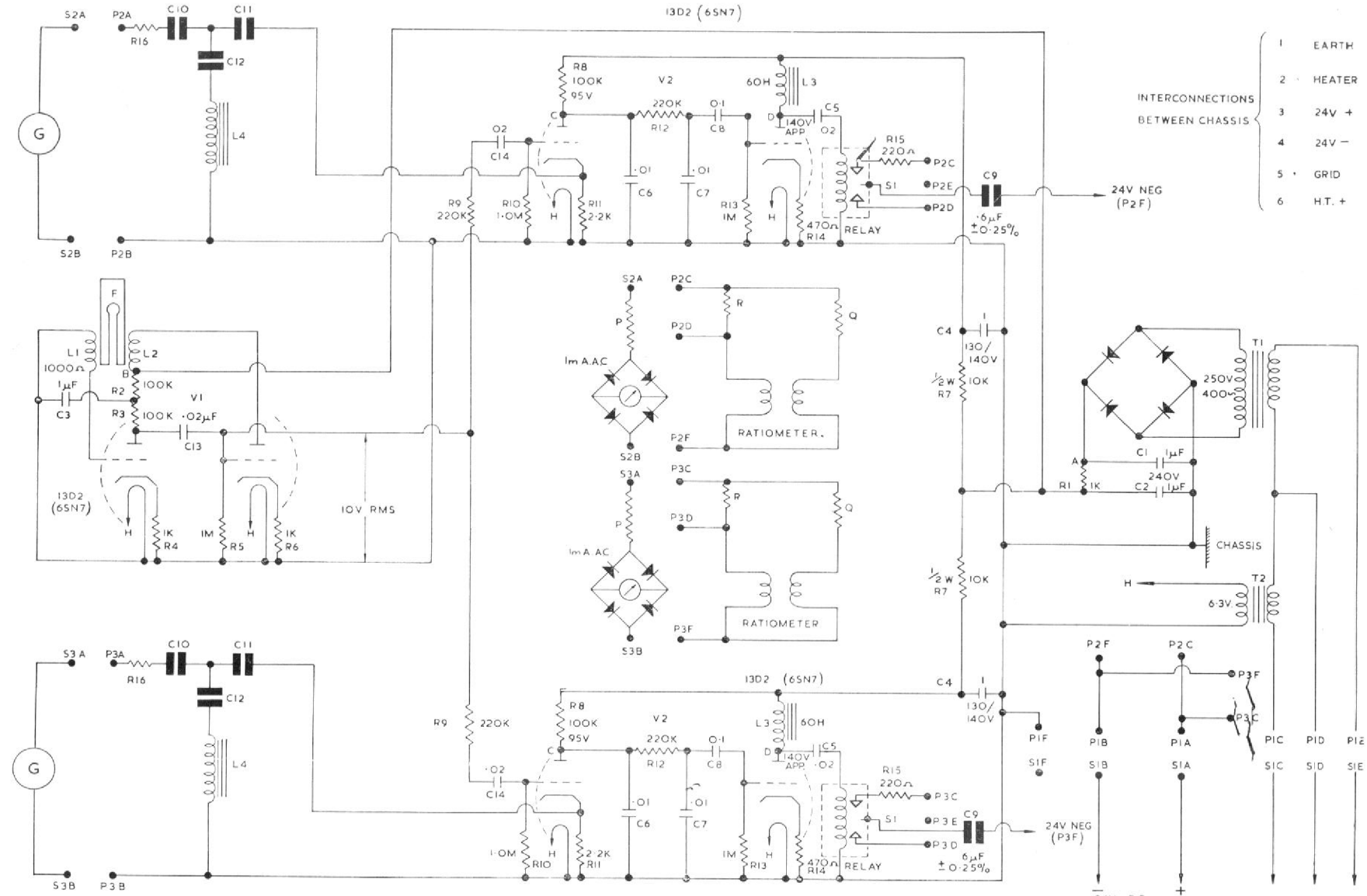
(*b*) COMPUTER BOX

The Computer Box should be checked, preferably " in situ " after every 500 flying hours. A separate check on the sensitivity of the relay must be made in accordance with the method laid down in this manual, and, if necessary, the relay must be re-adjusted to conform to the prescribed limits.

The valves must be checked and replaced in accordance with the established procedure of the operator.

At the time of the 500 hour check, a new or dried-out silica-gel breather should be fitted.

Provided that the Computer Box functions satisfactorily subject to these adjustments, the life may be regarded as indefinite.



CONNECTIONS VIA PLESSEY PLUGS & SOCKETS (6 PIN) MK IV

PLUGS ARE DENOTED BY P
Nº OF PLUG " " 1,2, OR 3
PIN IN PLUG " " A,B,C,D,E, OR F
} eg P1A

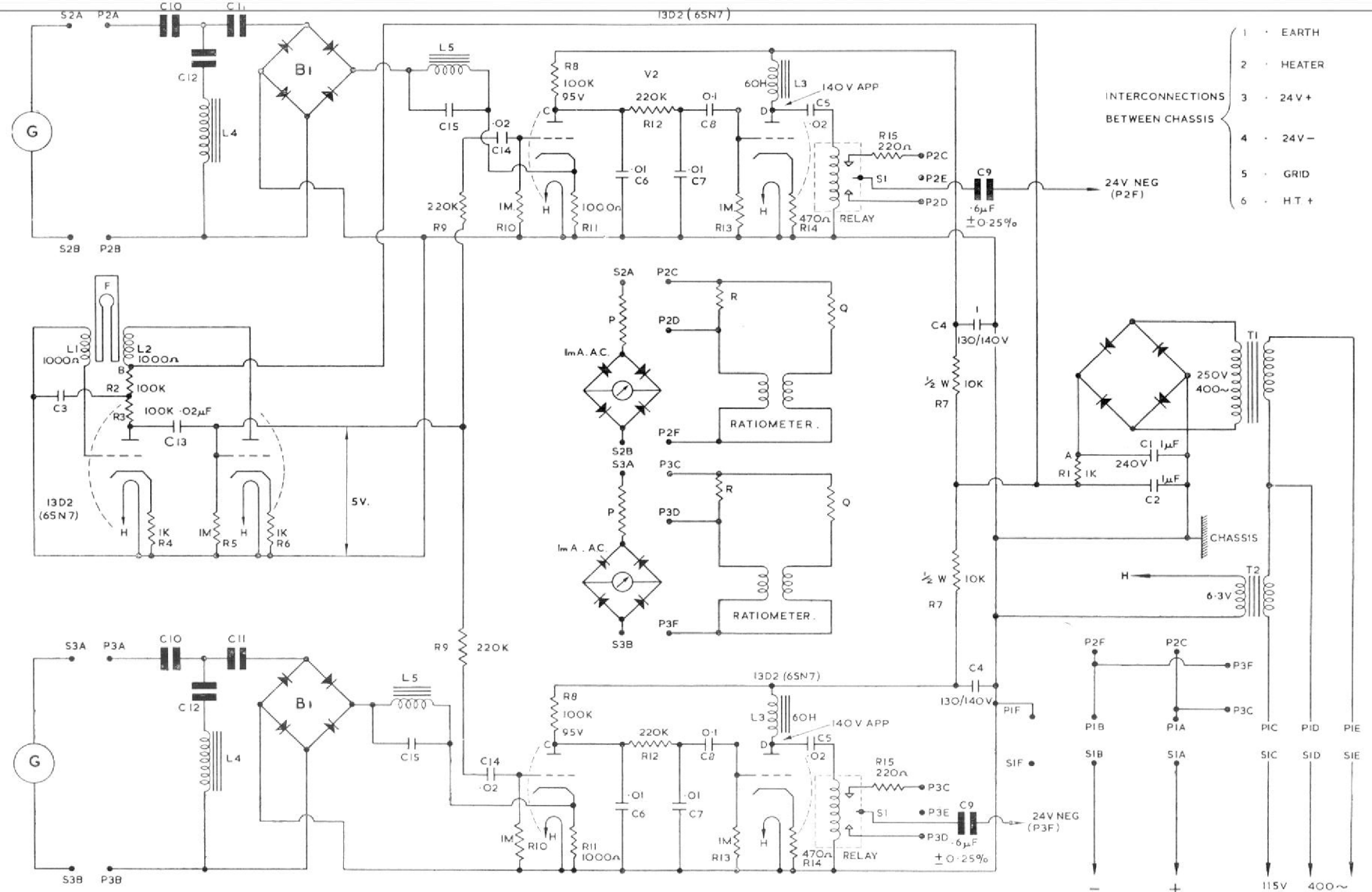
SOCKETS ARE DENOTED BY S
Nº OF SOCKET " " 1,2, OR 3
PINS IN SOCKET " " A,B,C,D,E, OR F
} eg S1A

WIRING DIAGRAM.

ENGINE / GENERATOR RATIO 2 : 1

ALL CONDENSERS SHOWN THUS ‖ ARE SILVERED MICA 164599.

FOR COMPONENT VALUES NOT SHOWN SEE RANGE SHEET.



CONNECTIONS VIA PLESSEY PLUGS & SOCKETS (6PIN) MK IV

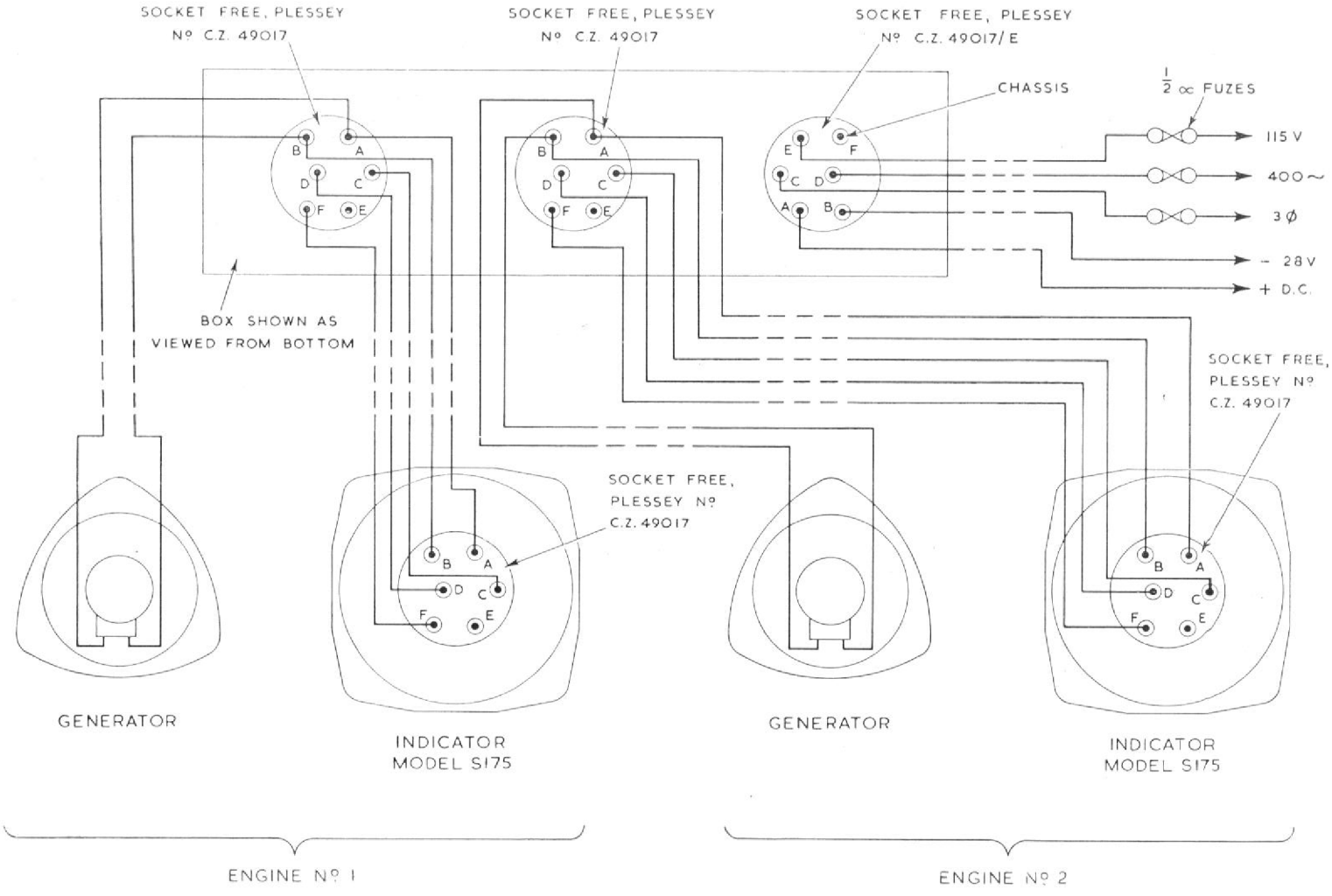
PLUGS ARE DENOTED BY P
Nº OF PLUG " " 1,2 OR 3
PIN IN PLUG " " ABCDE OR F
} eg P1A

SOCKETS ARE DENOTED BY S
Nº OF SOCKET " " 1,2 OR 3
PINS IN SOCKET " " ABCDE OR F
} eg S1A

WIRING DIAGRAM
ENGINE/GENERATOR RATIO 4:1

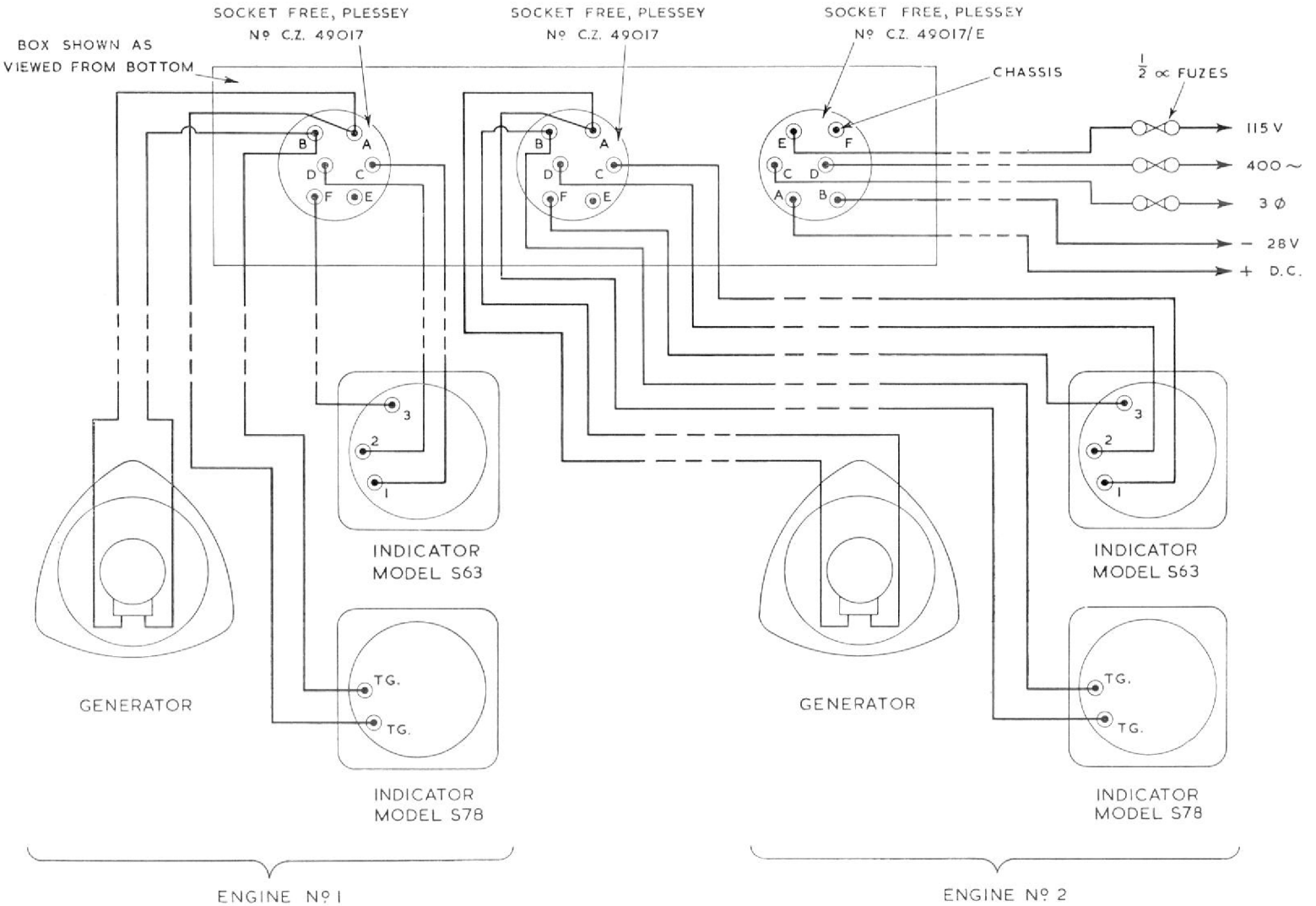
ALL CONDENSERS SHOWN THUS ▮▮ ARE SILVERED MICA 164599.

FOR COMPONENT VALUES NOT SHOWN — SEE RANGE SHEET.



GENERATORS & INDICATORS
SHOWN AS VIEWED FROM BACK

EXTERNAL WIRING DIAGRAM
DUAL INDICATORS



GENERATORS & INDICATORS
SHOWN AS VIEWED FROM BACK

EXTERNAL WIRING DIAGRAM
SMALL S.A.E. INDICATORS

RANGE SHEET "A"

ENGINE/GENERATOR RATIO 2 : 1

The list below gives range details of complete equipment available at the present. Our engineers will be pleased to collaborate with customers requiring other speed range measurements. Enquiries should be addressed to the Contracts Department.

Range R.P.M.	Sub-Specification No.		C10	C11	C12	F	L4	R16
	Computer Box	Indicators						
0—8000 and 7000—8000	S.169.1.11	S.175.8.12	·041 mf.	·041 mf.	·046 mf.	650~	2·03H (150Ω)	33KΩ
0—8400 and 7300—8300	S.169.1.17	S.175.8.14	·007 mf.	·0669 mf.	·0187 mf.	680~	3·34H (150Ω)	Not reqd.
0—9000 and 7700—8700	S.169.1.13	S.175.8.13	·007 mf.	·0632 mf.	·0176 mf.	720~	3·16H (150Ω)	Not reqd.
0—10400 and 9400—10400	S.169.1.4	S.175.8.11	·0298 mf.	·0298 mf.	·0335 mf.	890~	1·49H (150Ω)	82KΩ

Alternative two-instrument indicator presentations catering for the above ranges are also available.

COMPUTER BOX PARTS LIST

Illustration Reference	Circuit Diagram Reference	Component	RANGES A 7000 — 8000	B 7700 — 8700	C 9400 — 10400	D 7300 — 8300	E 11300 — 12300	F 11000 — 12000	G 10900 — 11900	No. Off
1 Not Shown	—	Case Assembly	169232	169232	169232	169232	169232	169232	169232	1
2 Not Shown	—	Sealing Screw, 0 B.A.	169235	169235	169235	169235	169235	169235	169235	2
3 Not Shown	—	Rubber Gasket	169236	169236	169236	169236	169236	169236	169236	2
4	—	Front and Chassis Assy.	169237	169237	169237	169237	169237	169237	169237	1
5	—	Breather Assembly	169294	169294	169294	169294	169294	169294	169294	1
6	—	Spring Clip for Breather	169299	169299	169299	169299	169299	169299	169299	1
7 Not Shown	—	Name Plate	169313	169313	169313	169313	169313	169313	169313	2
8 Not Shown	—	Rivet for Name Plate, ·09″ lg.	169315	169315	169315	169315	169315	169315	169315	2
9 Not Shown	—	Rivet for Name Plate, ·17″ lg.	169316	169316	169316	169316	169316	169316	169316	2
10	—	Mtg. Plate (H.T. & Osc. Chnl)	169245	169245	169245	169245	169245	169245	169245	1
11	—	6-Pin Plug Mk. IV	164766/3	164766/3	164766/3	164766/3	164766/3	164766/3	164766/3	1
12	—	Filament Transformer	169262	169262	169262	169262	169262	169262	169262	1
13	—	Selenium Rectifier	169305	169305	169305	169305	169305	169305	169305	4
14	—	Lock Nut, 2 B.A.	96452	96452	96452	96452	96452	96452	96452	4
15	—	H.T. Transformer	169268	169268	169268	169268	169268	169268	169268	1
16	—	Terminal Tag, 2 B.A.	157637	157637	157637	157637	157637	157637	157637	2
17	—	Valve, 13D2	169303	169303	169303	169303	169303	169303	169303	3
18	—	Valve Holder	169304	169304	169304	169304	169304	169304	169304	3
19	—	Screw, 4 B.A. × $\frac{5}{16}$″ Rd. Hd.	150044	150044	150044	150044	150044	150044	150044	26
20	—	Shakeproof Washer, 4 B.A.	150404	150404	150404	150404	150404	150404	150404	42
21	—	Nut, 4 B.A.	150164	150164	150164	150164	150164	150164	150164	20
22	—	Terminal Tag, 4 B.A.	156746	156746	156746	156746	156746	156746	156746	5
23	—	Resistor Panel Assembly	169283	169283	169283	169283	169283	169283	169283	1
24	R1, R4, R6	Resistor 1,000 ohms ±10%	169306	169306	169306	169306	169306	169306	169306	3
25	R5	Resistor 1 M.ohm ±10%	169305	169306	169306	169306	169306	169306	169306	1
26	R2, R3	Resister 100 K.ohms ±10%	169306	169306	169306	169306	169306	169306	169306	2
27	C13	Condenser ·02 mf.	169308	169308	169308	169308	—	—	—	1
28	—	Insulating Washer ·45″	169249	169249	169249	169249	169249	169249	169249	10
29	—	Inter-conn. Panel Assembly	169281	169281	169281	169281	169281	169281	169281	3
30	C1, C2, C3	Condenser 1·0 mf./350 V.	164967	164967	164967	164967	164967	164967	164967	3
31	—	Condenser Clip	169301	169301	169301	169301	169301	169301	169301	5
32	—	Screw, 8 B.A. × $\frac{1}{4}$″ Ch. Hd.	95391	95391	95391	95391	95391	95391	95391	10
33	—	Nut, 8 B.A.	150168	150168	150168	150168	150168	150168	150168	12
34	—	Shakeproof Washer, 8 B.A.	94469	94469	94469	94469	94469	94469	94469	16
35	—	Terminal Tag, 6 B.A. D.E.	160198	160198	160198	160198	160198	160198	160198	1
36	—	Terminal Tag, 6 B.A. S.E.	156456	156456	156456	156456	156456	156456	156456	5
37	—	Nut, 6 B.A.	150166	150166	150166	150166	150166	150166	150166	14
38	—	Shakeproof Washer, 6 B.A.	150376	150376	150376	150376	150376	150376	150376	22
39	—	Oscillator Coil Assembly	169285	169285	169285	169285	169285	169285	169285	2
40	—	4 B.A. Slotted Hex. Nut	106698	106698	106698	106698	106698	106698	106698	8
41	—	Tuning Fork 650 cy./sec.	169290/650	—	—	—	—	—	—	1
41	—	Tuning Fork 720 cy./sec.	—	169290/720	—	—	—	—	—	1
41	—	Tuning Fork 890 cy./sec.	—	—	169290/890	—	—	—	—	1
41	—	Tuning Fork 680 cy./sec.	—	—	—	169290/680	—	—	—	1
41	—	Tuning Fork 1040 cy./sec.	—	—	—	—	—	—	169290/1040	1
41	—	Tuning Fork 1080 cy./sec.	—	—	—	—	169290/1080	—	—	1
41	—	Tuning Fork 1050 cy./sec.	—	—	—	—	—	169290/1050	—	1
42	—	Nut, 2 B.A.	92211	92211	92211	92211	92211	92211	92211	2
43	—	Shakeproof Washer, 2 B.A.	150402	150402	150402	150402	150402	150402	150402	2
44	—	Mounting Plate Assembly	169257	169257	169257	169257	169257	169257	169257	2
45	—	6-Pin Plug Mk. IV	164766	—	—	—	—	—	—	2
46	L4	Filter Choke 650 cy.	169272/650	—	—	—	—	—	—	2
46	L4	Filter Choke 720 cy.	—	169272/720	—	—	—	—	—	2
46	L4	Filter Choke 890 cy.	—	—	169272/890	—	—	—	—	2

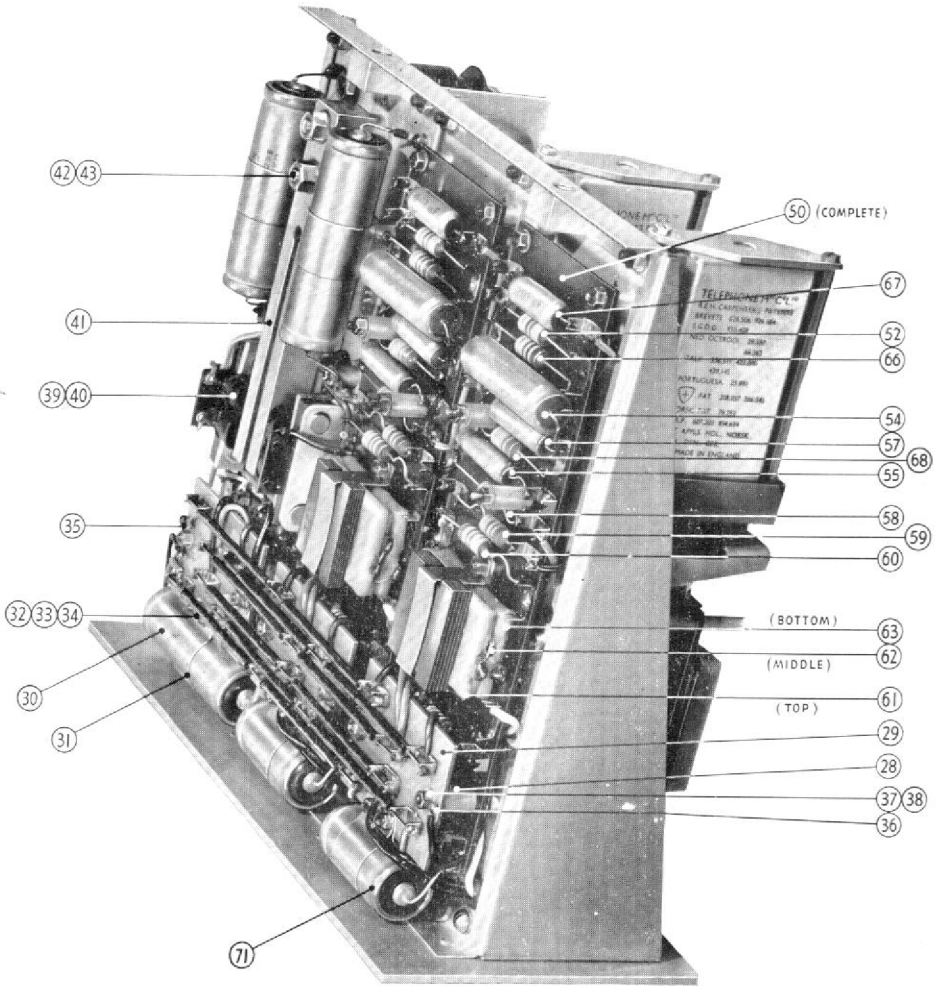
COMPUTER BOX PARTS LIST—contd.

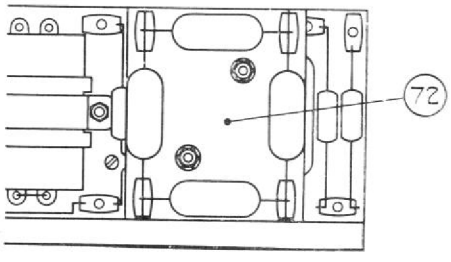
Illustration Reference	Circuit Diagram Reference	Component	RANGES A	B	C	D	E	F	G	No. Off
			7000 — 8000	7700 — 8700	9400 — 10400	7300 — 8300	11300 — 12300	11000 — 12000	10900 — 11900	
46	L4	Filter Choke 680 cy... ..	—	—	—	169272 /680	—	—	—	2
46	L4	Filter Choke 1040 cy. ..	—	—	—	—	—	—	169272 /1040	2
46	L4	Filter Choke 1080 cy. ..	—	—	—	—	169272 /1080	—	—	2
46	L4	Filter Choke 1050 cy. ..	—	—	—	—	—	169272 /1050	—	2
47	L3	Output Choke	169270	169270	169270	169270	169270	169270	169270	2
48	S1	Polarised Relay and Socket ..	169309	169309	169309	169309	169309	169309	169309	2
49	—	Screw, 8 B.A. $\times \frac{9}{16}$" C'sunk..	150348	150348	150348	150348	150348	150348	150348	6
50	—	Resistor Panel	169275	169321	169276	169649	169277	169606	170005	2
51	C14	Condenser ·02 mf.	169308	169308	169308	169308	169308	169308	169308	2
52	R14	Resistor 470 ohms ±10% ..	169306	169306	169306	169306	169306	169306	169306	2
53	R10	Resistor 1 M.ohm ±10% ..	169306	169306	169306	169306	169306	169306	169306	2
54	C8	Condenser ·1 mf.	169308	169308	169308	169308	169308	169308	169308	2
55	C6	Condenser ·01 mf.	169308	169308	169308	169308	169308	169308	169308	2
56	R9	Resistor 220 K.ohm ±10%	169306	169306	169306	169306	169306	169306	169306	2
57	C7	Condenser ·01 mf.	169308	169308	169308	169308	169308	169308	169308	2
58	R8	Resistor 100 K.ohms ±10%	169306	169306	169306	169306	169306	169306	169306	2
59	R15	Resistor 220 ohms ±10% ..	169306	169306	169306	169306	169306	169306	169306	2
60	R11	Resistor 2·2 K.ohms ±10%	169306	169306	169306	169306	—	—	—	2
60	R11	Resistor 1000 ohms ±10%	—	—	—	—	169306	169306	169306	2
61	C12	Condenser ·046 mf. ±1% ..	164599	—	—	—	—	—	—	2
61	C12	Condenser ·0176 mf ±1% ..	—	164599	—	—	—	—	—	2
61	C12	Condenser ·0335 mf. ±1%	—	—	164599	—	—	—	—	2
61	C12	Condenser ·0187 mf. ±1%	—	—	—	164599	—	—	—	2
61	C12	Condenser ·0553 mf. ±1%	—	—	—	—	164599	—	—	2
61	C12	Condenser ·0568 mf. ±1%	—	—	—	—	—	164599	164599	2
62	C10	Condenser ·041 mf. ±1% ..	164599	—	—	—	—	—	—	2
62	C10	Condenser ·007 mf. ±1% ..	—	164599	—	—	—	—	—	2
62	C10	Condenser ·0298 mf. ±1%	—	—	164599	—	—	—	—	2
62	C10	Condenser ·007 mf. ±1% ..	—	—	—	164599	—	—	—	2
62	C10	Condenser ·0142 mf. ±1%	—	—	—	—	164599	—	—	2
62	C10	Condenser ·0176 mf. ±1%	—	—	—	—	—	—	164599	2
62	C10	Condenser ·0143 mf. ±1%	—	—	—	—	—	164599	—	2
63	C11	Condenser ·041 mf. ±1% ..	164599	—	—	—	—	—	—	2
63	C11	Condenser ·0632 mf. ±1%	—	164599	—	—	—	—	—	2
63	C11	Condenser ·0298 mf. ±1%	—	—	164599	—	—	—	—	2
63	C11	Condenser ·0669 mf. ±1%	—	—	—	164599	—	—	—	2
63	C11	Condenser ·0491 mf. ±1%	—	—	—	—	164599	—	—	2
63	C11	Condenser ·0505 mf. ±1%	—	—	—	—	—	164599	164599	2
64	C15	Condenser ·01 mf.	—	—	—	—	169303	169308	169308	2
65	R16	Resistor 33 K.ohms ±10%..	169306	—	—	—	—	—	—	2
65	R16	Resistor 82 K.ohms ±10%..	—	—	169306	—	—	—	—	2
66	R13	Resistor 1 M.ohm ±10% ..	169306	169306	169306	169306	169306	169306	169306	2
67	C5	Condenser ·02 mf.	169308	169308	169308	169308	169308	169308	169308	2
68	R12	Resistor 220 K.ohms ±10%	169306	169306	169306	169306	169306	169306	169306	2
69	R7	Resistor 10 K.ohms ±10%..	169307	169307	169307	169307	169307	169307	169307	2
70	—	Condenser Mtg. Plate Assy...	169388	169388	169388	169388	169388	169388	169388	2
71	C4	Condenser 1·0 mf./250 V. ..	164967	164967	164967	164967	164967	164967	164967	2
72	—	Rectifier Panel Assembly ..	—	—	—	—	169311	169311	169311	2
73	Makes up C9	Silver Mica Cond. ·2 mf. ±¼%	164599	164599	164599	164599	164599	164599	164599	6
74	—	Guide Pillar	169310	169310	169310	169310	169310	169310	169310	8
75	—	Washer 4 B.A.	90031	90031	90031	90031	90031	90031	90031	4
76	—	Sub-Mounting Strip	169302	169302	169302	169302	169302	169302	169302	1

NOTE.—The condenser and resistor part numbers given in the preceding columns are SANGAMO WESTON classification numbers only. It is advisable to obtain replacement condensers and resistors direct from the manufacturers, and for identification purposes the following table is appended.

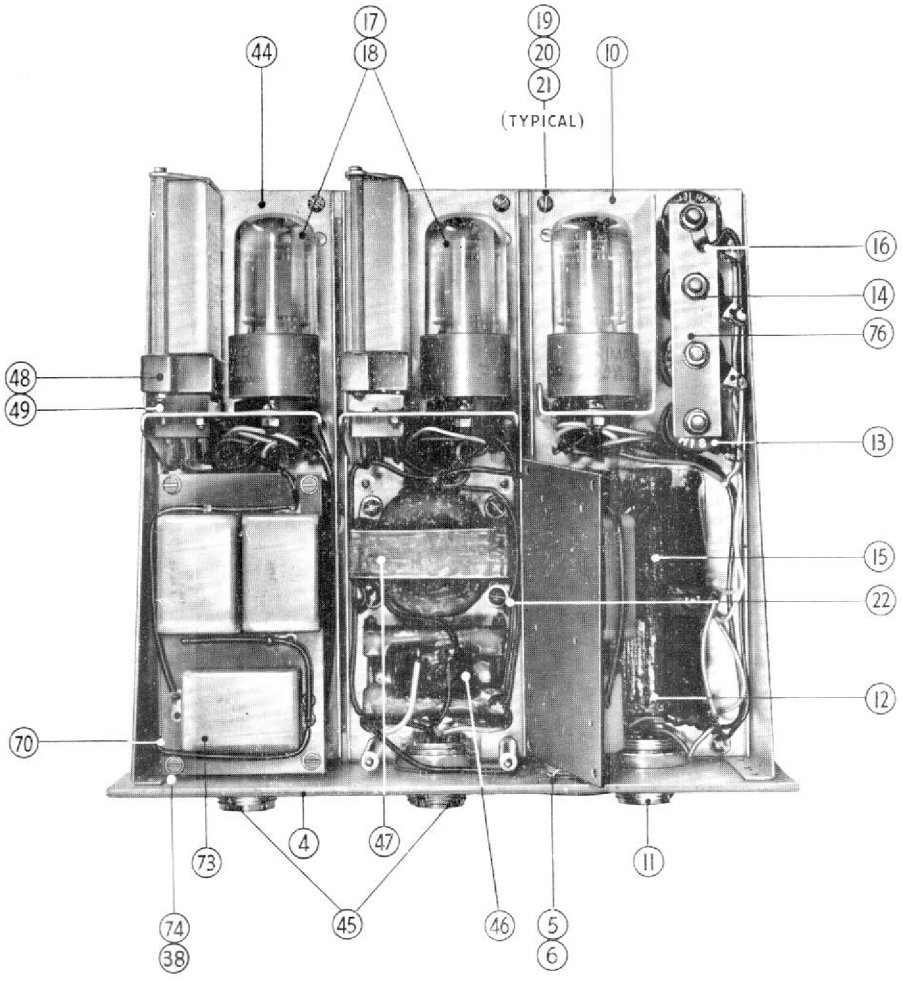
CLASSIFICATION TABLES

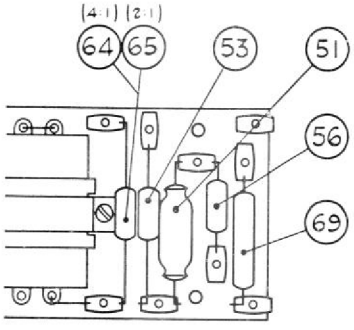
Value	Sangamo Classification Number	Type	Manufacturer
CONDENSERS			
·0669 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·007 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·01 mf.	169308	CP.32N.	Telegraph Condenser Company.
·0142 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0143 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0176 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0187 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·02 mf.	169308	CP.33N.	Telegraph Condenser Company.
·0298 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0335 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·041 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·046 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0491 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0505 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0553 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0568 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·0632 mf. ±1%	164599	F.C.3	Johnson Matthey & Co. Ltd.
·1 mf.	169308	CP.37N.	Telegraph Condenser Company.
·2 mf. ±¼%	164599	F.C.3	Johnson Matthey & Co. Ltd.
1 mf. 250 V.	164967	418	Dubilier Condenser Co. Ltd.
1 mf. 350 V.	164967	418	Dubilier Condenser Co. Ltd.
RESISTORS			
220 ohms	169306	9	Erie Resistor Co.
470 ohms	169306	9	Erie Resistor Co.
1000 ohms	169306	9	Erie Resistor Co.
2·2 K.ohms	169306	9	Erie Resistor Co.
10 K.ohms	169307	8	Erie Resistor Co.
33 K.ohms	169306	9	Erie Resistor Co.
82 K.ohms	169306	9	Erie Resistor Co.
100 K.ohms	169306	9	Erie Resistor Co.
220 K.ohms	169306	9	Erie Resistor Co.
1 M.ohm	169306	9	Erie Resistor Co.



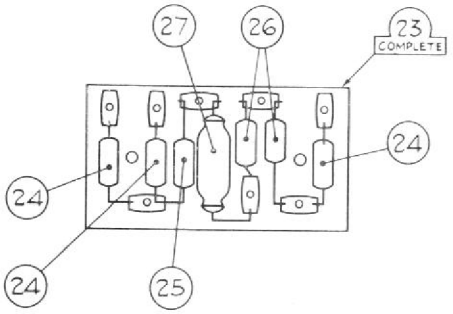


RECTIFIER PANEL ASSEMBLY
4:1 ENGINE/GENERATOR RATIO





RESISTOR PANEL ASSEMBLY
INDICATOR CHANNEL



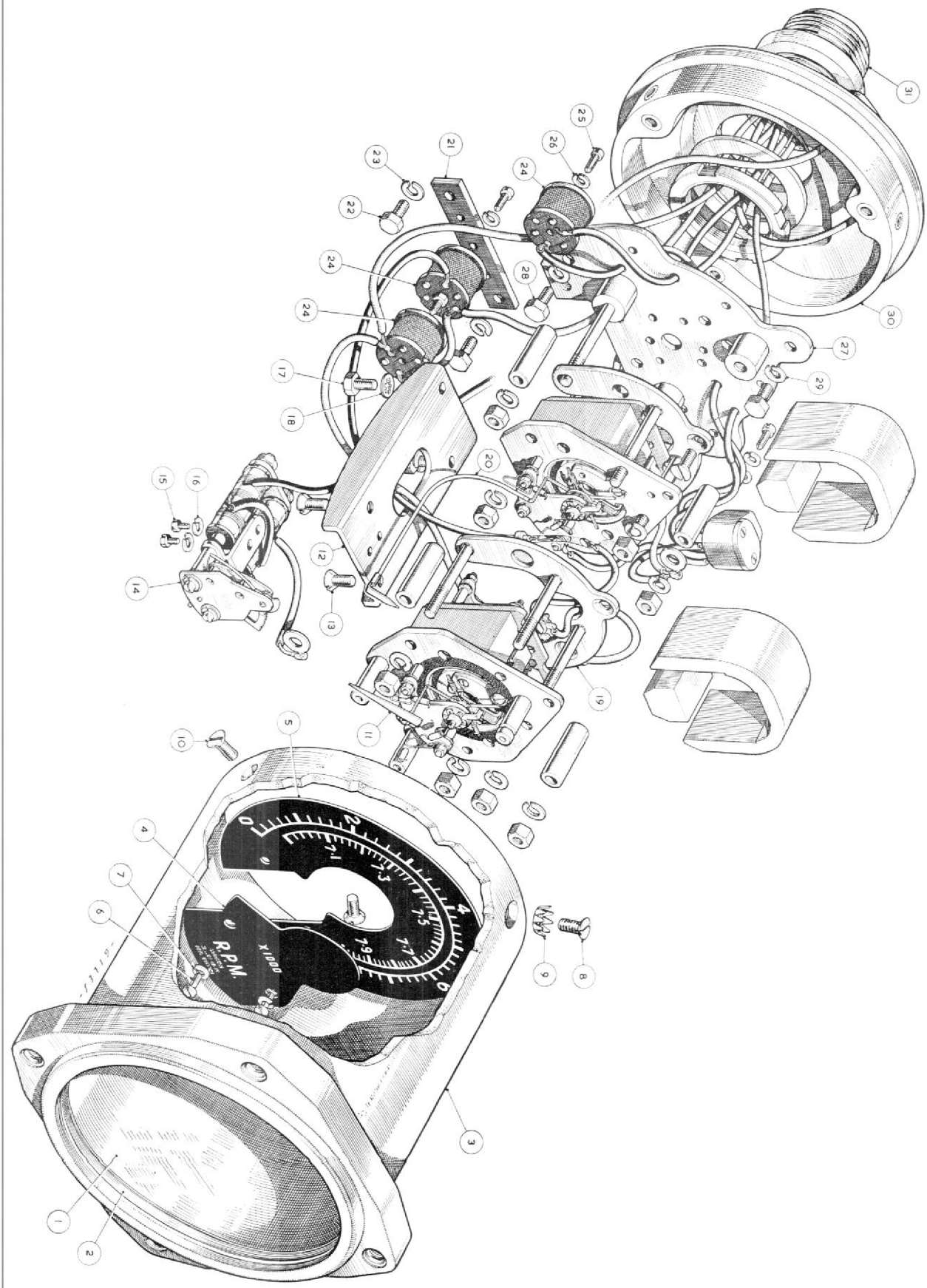
RESISTOR PANEL ASSEMBLY
H.T. CHANNEL

PARTS LIST

MODEL SI75 FORM 8

Reference	Description	Part No.	No. Off per Instrument
1	Glass	166947	1
2	Bezel Ring	166781	1
3	Cover Assembly	169589	1
4	Mask Printed	169627	1
5	Scale	169630	1
6	10 B.A. Screw	156396	2
7	10 B.A. Lockwasher	154825	2
8	Sealing Screw 6 B.A.	168862	1
9	Sealing Cup	168013	1
10	Cover Screw	150146	2
11	Pointer, Inner	169638 Flu. 169617 White	1
12	Bracket	169592	1
13	6 B.A. Countersunk Screw	150146	2
14	Pointer, Return Unit	169620	1
15	Fixing Screw (P.R.U.)	156396	2
16	Lockwasher (P.R.U.)	154825	2
17	6 B.A. Hexagonal Screw	165533	2
18	6 B.A. Shakeproof Washer	150376	2
19	Bottom Plate Assembly	169636	1
20	Pointer, Outer	169593 Flu. 169618 White	1
21	Panel for Spools	169641	1
22	6 B.A. Screw, Hexagonal	165533	2
23	Lockwasher, 6 B.A.	166976	2
24	Spool	Specify Letter and Code No.	As required
25	Spool Fixing Screw, 10 B.A.	150330	3
26	Spool Fixing Lockwasher, 10 B.A.	153367	3
27	Sub-Mounting Plate Assembly	169633	1
28	6 B.A. Hexagonal Fixing Screw	165533	3
29	Lockwasher, 6 B.A.	166976	3
30	Base	167449	1
31	6-Pin Plug	164766	1

Note : Sangamo Weston Code No. appears on front of dial.



Model S175 Form 8