AVOMETER TEST SET

MODEL 12

INSTRUCTION MANUAL

AVO LTD

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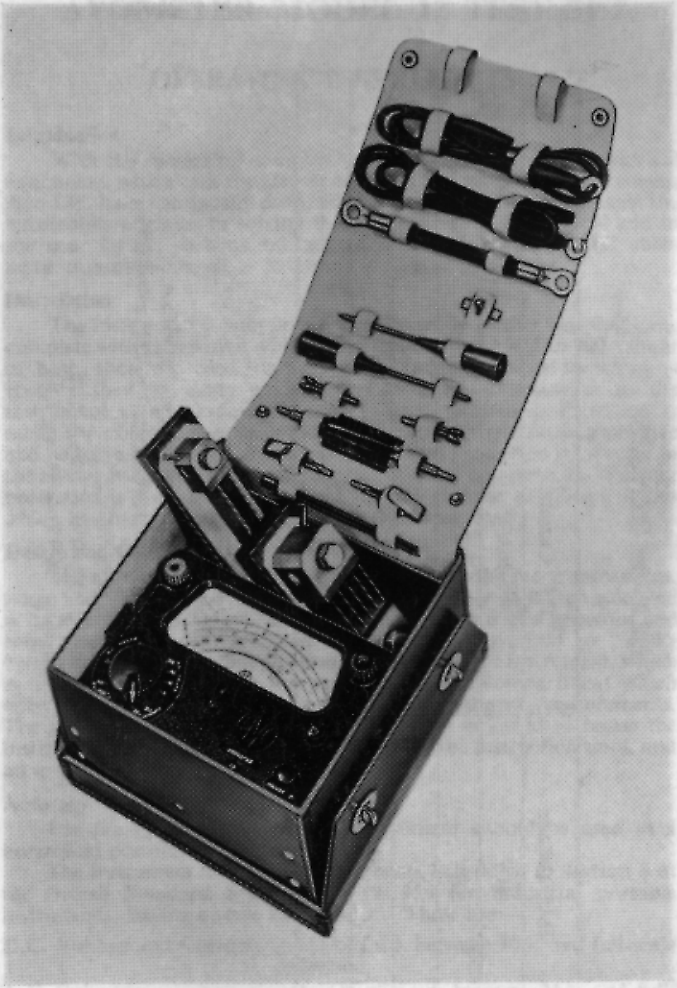


Model 12 Avometer Test Set

TABLE OF RANGES

D.C. Voltage	D.C. Current	A.C. Voltage
36V	36A	360V
18V	3·6A	90V
9V		18V
3·6V	External Shunt (90A)	9V
External Shunt*	External Shunt (900A)	

RESISTANCE

0–1000 Ω (25 Ω mid scale)
0–10000 Ω (250 Ω mid scale)

* The " Ext. Shunt " position corresponds to 90mV f.s.d.
90A or 900A external shunts are available as optional accessories.

SENSITIVITY

D.C. Voltage Ranges 200Ω/V = 5 mA f.s.d.
A.C. Voltage Ranges 90Ω/V = 11 mA f.s.d.

AVOMETER MODEL 12 TEST SET

OPERATING INSTRUCTIONS

Introduction

With the increasing complexity of modern automobile electrical equipment, which calls for greater accuracy and scope of measurement, Avo Ltd. have specifically designed the Model 12 in order to assist the automobile engineer in solving the new problems arising now and in the near future, such as a.c. generation, electrically operated automatic transmissions, etc.

Description

The instrument is supplied in an ever-ready leather carrying case, complete with accessories, which may include either a 90A or 900A shunt or both, these are used for heavy d.c. current. Range switching is accomplished by using a single switch knob, connections to the instrument being made by means of two terminals. Provision is made for polarity reversal without the need for transposing positive and negative leads. A high degree of overload protection is inherent in the circuit itself by the use of generously rated components. Further protection is provided for the movement by the use of silicon diodes which by-pass current during a period of over-load.

Design and Construction

The moulded front panel is used to support the meter movement, range and " reverse moving coil " switches together with the associated voltage multipliers, shunts, etc. The range switch is of a generous and robust design, the silver-plated contacts being arranged to " make before break " on adjacent positions. The case of the instrument, which is of a similar material to the panel, includes a compartment which houses the 1·5V cell used for continuity and resistance measurements. The " ever-ready " type leather case has been designed to house the instrument, and its accessories together with the instruction book and an applications manual.

Accuracy

For the greatest accuracy the instrument should be used in a horizontal position.

The instrument meets the requirements laid down in Section 6 of the British Standard Specification 89/1954 for industrial portable instruments, having a scale length of 5". These are:—

D.C. Voltage and Current: ±1% of f.s.d. between 10% and full-scale deflection.

A.C. Voltage: ±2·25% of f.s.d. between 25% and full-scale deflection.

Owing to the nature of resistance scales, it is not possible to quote percentage accuracy for the whole range. As a guide, however, readings will be within ±3% of indication around mid-scale, increasing to ±10% of indication at deflections corresponding to 10% and 90% of the arc traversed by the pointer.

Scaling

Three basic scales are provided, each approximately 5" (12·7 cm) in length, the outer one (90 divisions), being for voltage and current measurements and is marked 0–9 and 0–18. The centre scale is also for use on voltage and current, but is scaled with 72 divisions and marked 0–36. The inner scale is for resistance and continuity only, and is scaled 0–1000 Ω, with the first indication being 0·5 Ω.

Reading the Scale Plate

Due to limited space availability on the scale plate, it is not possible on a multi-range instrument to provide individual scales for every switch position. It is, therefore, necessary for the operator on the 90V a.c. and 360V a.c. ranges to use a basic scale, i.e. 0–9 or 0–36, and multiply his readings by a factor of 10. With the 3·6V d.c. range, the scale marked 0–36 should be used and readings this time divided by a factor of 10. It follows that the remaining ranges (except with the external shunt) may be read directly on the scale appropriate to the range chosen. The ohms range position chosen (× 1 or × 100) indicates the multiplication factor required to the reading indicated on the ohms scale.

Operation of the Instrument

The instrument can be used in the leather case after removal of the lid, the latter being so designed that it can be unobtrusively attached to the underside of the case if so desired.

For greatest accuracy use the instrument face upward. If necessary, set the pointer to the left-hand zero by means of the screw marked " Z " which is situated on the front panel of the instrument.

The red lead should be attached to the positive (red) terminal, and the black lead to the negative (black) terminal.

Set the range switch to the correct position for the type of measurement to be made before connecting the leads to the circuit. If in doubt as to the magnitude of current or voltage to be measured, switch to the highest range, and then to a lower range, until a suitable meter deflection is obtained. Under these conditions, it is not necessary to break the circuit when switching ranges.

Exercise care before connecting the meter to a circuit or switching on a supply, for although a high degree of protection is inherent in the design, a prolonged heavy overload could cause damage. Severe momentary overloads can be accepted without damage, but care should be taken to avoid such misuse. Should the pointer swing very hard across the scale, remove leads IMMEDIATELY. Never disconnect

by turning the range switch to a blank position to disconnect the circuit.

For d.c. measurement, the red terminal is normally positive. Some tests may involve reversing the input polarity, in which case the indication can still be obtained without transposing leads, merely by depressing the reverse moving coil button marked " Rev. M.C."

WARNING

Except in the case of low-voltage circuits, it is dangerous to make connections to live apparatus. The user is advised wherever possible to make a habit of connecting the instrument whilst the circuit is dead.

Current Measurements

Current measurements up to 36A d.c. are accomplished by connecting the instrument (set to a suitable range) in series with the circuit, i.e. in such a way that the entire current passes through the instrument. For currents in excess of 36A d.c., having first connected a suitable external shunt in series with the circuit under test (with the lead provided if required), connect the instrument (set to the range marked EXT. SHUNT) to the small studs situated at each end of the shunt. The instrument will then take a small fixed proportion of the current flowing in the circuit under test and thus indicate the total current. The 900A shunt is used in exactly the same way as described above, but is not rated for continuous operation at maximum current, and should therefore not be used for periods longer than one minute at maximum current.

NOTE

Since the external shunt setting corresponds to 90mV, certain other shunts not made specifically for this instrument can also be used; for example, a 400A–100mV type could be used as a 360A shunt, readings being taken on the scale marked 0–36.

Resistance and Continuity

Before carrying out resistance or continuity measurements, the ohms zero must be checked and adjusted if necessary. This is carried out by setting the range switch to a resistance range and joining the leads together, after which the pointer can be brought to the ohms zero (i.e. full scale), by means of the " ADJUST OHMS " knob.

When the cell voltage has fallen, due to use or age, it may not be possible to adjust the pointer to zero, or even if this can be accomplished the pointer indication may gradually fall. In such a case the 1·5V (U2) (Part No. 12379–9) cell which is housed in a compartment on the under-side of the meter should be removed and replaced by a similar cell inserted in the same direction. After insertion, adjust ohms zero as described above.

To measure resistance the two leads should be connected across the component under test. It is important that anything being tested is not already carrying current, nor should the leads be connected across any source of voltage, e.g. the battery or dynamo when running.

Although most components are substantially constant as regards resistance, some vary considerably with temperature, e.g. lamps, etc., so that resistance tests only indicate continuity, and the readings obtained cannot be used to calculate wattage. The resistance of other devices, such as rectifiers, varies according to the voltage applied and the direction of current. When such tests have to be made using the resistance ranges, it should be noted that the polarity which appears at the terminals of the meter will be reversed from that shown on the panel (i.e., the positive terminal has a negative potential).

WARNING

Under normal conditions the internal cell will operate satisfactory for a very long period but it should, nevertheless, be examined from time to time, since a discharged cell may develop a leak and thus damage the instrument. If it is anticipated that the instrument will not be used for any length of time it is strongly advised that the cell be removed.

ACCESSORIES AND THEIR USE

In order to ensure the maximum versatility of use for the instrument, Avo Ltd have included a range of accessories, some of which are to assist in solving special problems encountered when making measurements on automobiles. The description and use of these accessories follows, and should be used in conjunction with Fig. 1 and the appropriate items.

Item a. **90A Shunt:** The method of using the shunts has already been described under the paragraph headed " Current Measurements " and, when required, the shunt should be used in conjunction with the extension lead provided (Item *g*).

Item b. **900A Shunt:** This is an alternative to the 90A shunt described above and is used in the same manner.

Item c. **Long Reach Safety Clip Mk.2** Supplied in pairs, one black, one red, which can be inserted into the standard test leads (Item *k*) and will be found extremely useful for gaining access to contacts and wires in inaccessible positions. In the closed position 'prod' measurements may be made in the normal manner, a sharp steel point easily pierces varnish on printed circuit boards or soldered joints. By retracting the moulding using thumb and forefinger, a hook end is exposed which may be used as a clip to accommodate conductors up to 0.125 in. (3.2 cm) in diameter.

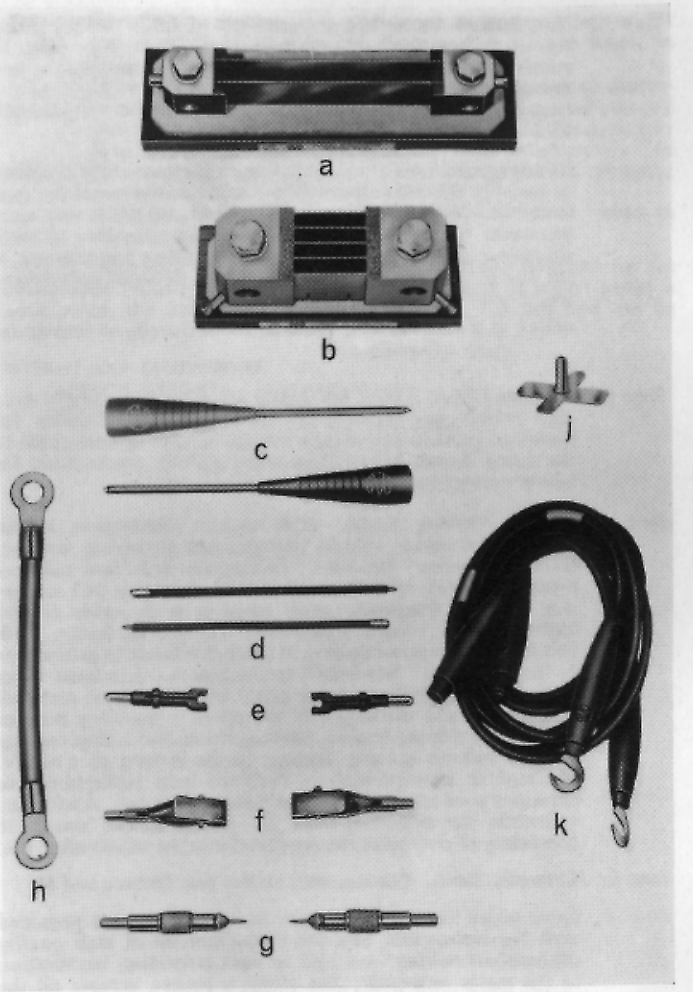


Fig. 1—Accessories

Item d. **Test Prods:** These are included in addition to the Long Reach Safety Clips where quick measurements may be required with a moderately heavy current consumption and are adequately rated when using the internal ranges of the instrument. They should not, however, be used in conjunction with external shunts.

Item e. **Voltage Regulator Clips:** These have been specially designed to assist in making connections to terminal boxes of the type found on voltage regulators, where terminals are in very close proximity to one another and reduce the possibility of leads shorting which could, in some cases, produce burning out of the unit under test. These will, no doubt, be found particularly useful when adjusting voltage regulators.

NOTE: *It is realised that these clips will not fit all makes and types of regulators.*

Item f. **Holdtite Clips:** These are a pair of moderately heavy duty clips which are capable of carrying heavy currents for sustained periods and should always be used in preference to the Long Reach Safety Clips when making connections for heavy current measurements.

Item g. **Battery Piercing Prods:** With current production, manufacturers of motor vehicle batteries are supplying accumulators where the " bus-bars " linking the individual cells are totally enclosed, to reduce the risk of corrosion and sulphation. Cases frequently arise when it is desirable to test individual cells, when it is suspected that they are faulty. With this new type of accumulator, it is often difficult to gain access to the individual " bus-bars " to check each cell in turn. Most batteries do, however, have a small depression over each cell termination and the object of the prods is that they may be pushed into this depression, piercing the material, thus making contact without causing damage to the battery as a whole. A chuck is incorporated to facilitate easy replacement of damaged prod needles, two of which are included. Additional quantities are available, Part No. 15434–1. To avoid the possibility of corrosion the needles should be wiped after use.

Item h. **Extension Lead:** For use with shunts (see Items *a* and *b*).

Item k. **Hook-ended Leads:** These are the standard leads provided with the instrument, and are manufactured of high quailty oil-resistant rubber, one end of each providing termination to the meter terminals; the other, a socket, accepts all the various accessories referred to already, with the exception of Items *a*, *b* and *h*.

Item j. **Harness Connector:** An additional accessory adapted for use on various English and Continental cars to assist in Voltage Regulator measurements.
When checking a Voltage Regulator it is necessary to disconnect two connectors from the terminals of the control box and join them together temporarily. The purpose of this accessory is to ensure that these connectors are joined satisfactorily. The two larger contacts should be used for English cars, the other two contacts for Continental cars.
Care should be taken that the Harness Connector, when in use, is not inadvertently earthed.

NOTE: Although the instrument has been carefully designed for the automobile industry where a considerable amount of rough usage is anticipated, the instrument should be carefully handled and not be subjected to gross overloads.

WEIGHT AND DIMENSIONS

APPROX. WEIGHT:	8 lbs (3·60 kg)
APPROX. DIMENSIONS:	9¼" × 9¼" × 5¼" (245 X 235 X 125 mm)

APPENDIX 1

THE AVOMETER MODEL 12 TEST SET

SCHEDULE OF SPARE PARTS

PROCEDURE FOR ORDERING SPARES

During the past 35 years, AVO instruments have proved themselves to be unrivalled for versatility and reliability. It is, however, inevitable that instruments will fail from time to time. We are anxious that AVO instruments are repaired to the highest possible standard we have, therefore, produced this Schedule of Spare Parts, which will form a useful guide to the trained service engineer who has the task of maintaining this instrument.

By following the procedure set out below, delays will not occur due to unnecessary correspondence:

1. State the part number of the items required, also the quantity.
2. State the serial number of the instrument. This will be found on the scale plate.

Overseas users of our instruments should send their requirements to our representative on their territory.

If parts are required in Great Britain, application should be made direct to AVO Ltd.

FRONT PANEL ASSEMBLY 50127/A

Item	*Quantity*	*Part No.*	*Description*
1	1	40766/A	Front Panel Bare
2	1	40026/S	Movement Assembly (See page 14 for breakdown details)
3	1	16101/1	Window Glass
4	1	21321/A	Leaf Switch Assembly
5	1	21320/B	Bobbin Board Assembly (See page 14 for breakdown details)
6	1	15536/A	Red Terminal Complete
7	1	15536/B	Black Terminal Complete
8	1	14963/1	Black Terminal Cap
9	1	14963/2	Red Terminal Cap
10	1	11155/A	Ohms Zero Knob
11	1	10210/1	Ohms Zero Brush Arm
12	1	16113/A	Ohms Zero Resistance Strip (RV1)
13	1	16110/1	Shunt Strip (R1)
14	1	11577/13	Window Clip, left hand } Secures Window to Panels
15	1	11577/14	Window Clip, right hand } Secures Window to Panels
16	4	10064/1	Brass Spacer for Scale Plate
17	4	11585/1	Rubber Sleeve for Item 16
18	4	14941/34	Spacing Pillar for Items 17 and 18
19	1	12559/A	Contact (Located on Panel under Item 4)
20	1	11577/10	Spring Contact between Items 10 and 11
21	2	13793/14	Contact Pillar
22	1	11575/1	Movement Zero Screw
23	1	11571/2	Spiral Spring for Item 22
24	1	21128/3	Switch Knob
25	1	12422/3	Click Ball for Item 24
26	1	21129/2	Contact Spring for Switch Ring
27	1	21129/3	Contact Spring for Switch Ring
28	1	40584/A	Switch Ring
29	2	15314/2	Switch Contact
30	1	21134/4	Selector Switch Plate
31	1	21130/2	Selector Switch Contact Arm
32	1	15315/1	Selector Switch Cap
33	1	16114/1	Movement Mounting Plate
34	1	12360/3	Rev. Moving Coil Button
35	1	11604/27	Model Button

*MOVEMENT ASSEMBLY 40026/S (CALIBRATED)

Item	*Quantity*	*Part No.*	*Description*
1	1	21323/3	Scale Plate
2	1	30006/AC	Movement Bobbin (R16) (adjust to suit movement)
3	1	40289/B	Movement Frame
4	1	20673/F	Jewel Screw Top
5	1	20673/G	Jewel Screw Bottom
6	1	20672/G	Moving Coil Assembly
7	2	15581/18	Rectifier, type 10B1 (REC2, REC3)

***Important Note:**

Unless facilities are available for *expert* repair it is considered advisable to return this complete assembly to our works for servicing

BOBBIN BOARD ASSEMBLY 21320/B

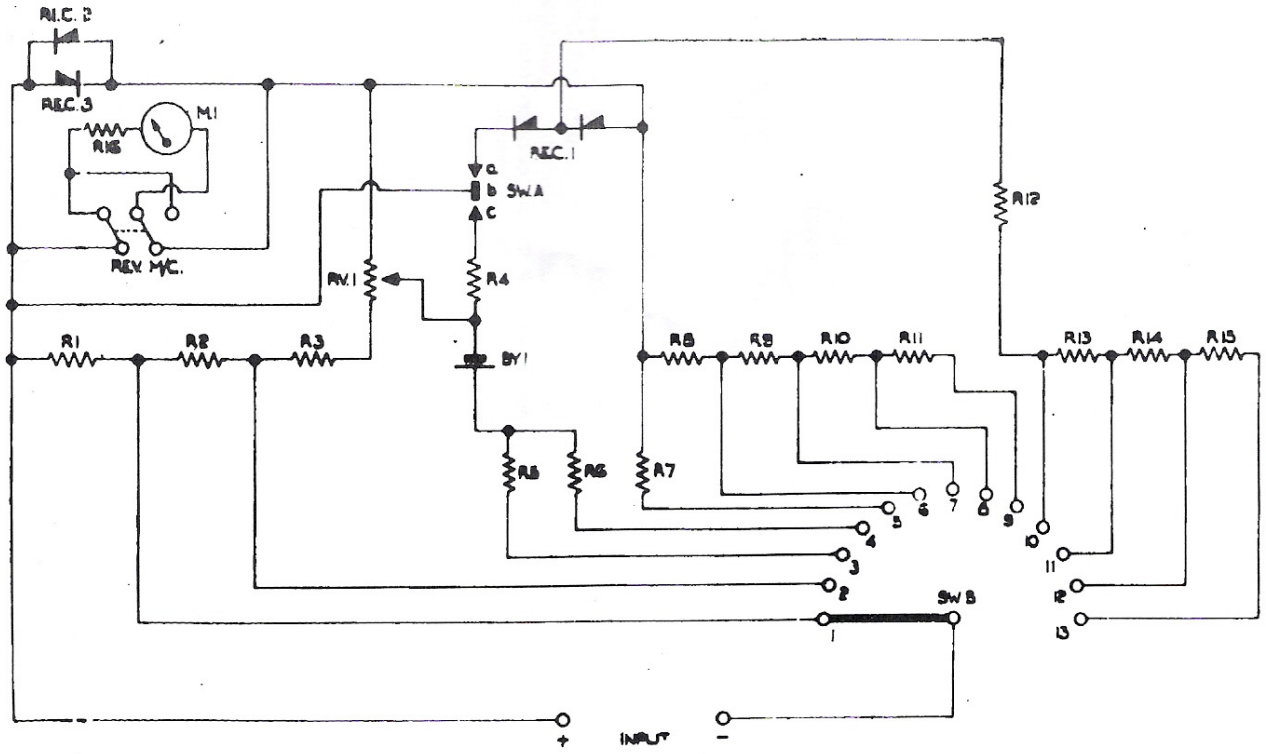
Item	*Quantity*	*Part No.*	*Description*	*Circuit Reference*
1	1	21320/A	Board with Tag	
2	1	16137/2	Support Bracket, left hand	
3	1	16138/2	Support Bracket, right hand	
4	1	30006/SH	740 Ω Bobbin	R12
5	1	30006/TH	810 Ω Bobbin	R13
6	1	30006/UH	710 Ω Bobbin	R8
7	1	30006/VH	1080 Ω Bobbin	R9
8	1	30006/WH	3600 Ω Bobbin	R11
9	1	30006/XH	1800 Ω Bobbin	R10
10	1	30006/YH	1·11 Ω Bobbin	R4
11	1	30006/ZH	6500 Ω Bobbin	R14
12	2	30006/AJ	12150 Ω Bobbin	R15
13	1	30006/BJ	13·97 Ω Bobbin	R3
14	1	30006/CJ	8 Ω Bobbin	R7
15	1	30006/DJ	240 Ω Bobbin	R6
16	1	30006/EJ	23·5 Ω Bobbin	R5
17	1	12049/756	Rectifier, type CIGP.302	REC1

CASE ASSEMBLY 40599/D

Item	*Quantity*	*Part No.*	*Description*
1	1	40597/D	Case, Bare
2	1	21095/1	Battery Cover
3	4	11596/4	Rubber Foot
4	2	30008/81	Washer for Item 3
5	2	R.134	Rivet (Secures Items 3, 4 and 8 to Case)
6	2	14415/3	Shaped Battery Contact
7	2	15193/2	Flat Contact (Fixed to Battery Box)
8	1	21348/2	Instruction Plate
9	1	12379–9	Battery, type U2 1·5V (BY1)
10	2	R135	Rivet (Secures Items 1 and 8)

ACCESSORIES

Item	*Quantity*	*Part No.*	*Description*
1	1	20913/J	Meter Lead Black (oil resistant)
2	1	20913/K	Meter Lead Red (oil resistant)
3	2	12381/B	Holdtite Clip
4	1	11588/A	Red Prod
5	1	11588/B	Black Prod
6	2	16192/A	Battery Piercing Prod Assembly (complete)
7	2	15434/1	Prod Needles for Item 6
8	1	21443A	Long reach safety Clip Mk 2 (Black)
9	1	21443B	Long reach safety Clip Mk 2 (Red)
10	1	21340–5	Voltage Reg. Clip Red
11	1	21340–4	Voltage Reg. Clip Black
12	1	21341–2	Shunt Ext. Lead
13	2	14774–2	Bolts (Ext. Shunt) $\frac{1}{4}$" × $\frac{1}{8}$" B.S.F.
14	2	W.74	Washers (Ext. Shunt) $\frac{1}{4}$"
15	1	40777/D	Instrument Case, Leather
16	1	10072–378	Instruction Book
17	1	10072–317	Instruction Card
18	1	16489/B	Harness Connector.
19	1	20214–J	90A Shunt
20	1	20211–D	900A Shunt
21	1	10072–377	Applications Manual



CCT Ref.	Description	Remarks
R1	2·78 milli-ohms	
R2	25 milli-ohms	
R3	13·97Ω	±0·25%
R4	1·11Ω	
R5	23·5Ω	±0·5%
R6	240Ω	±0·5%
R7	8Ω	±0·25%
R8	710Ω	±0·25%
R9	1080Ω	±0·25%
R10	1800Ω	±0·25%
R11	3600Ω	±0·25%
R12	740Ω	±0·5%
R13	810Ω	±0·5%

CCT Ref.	Description	Remarks
R14	6500Ω	±0·5%
R15	24300Ω	±0·5%
R16	Swamp Bobbin	Adjust to suit Mvt.
RV1	6Ω	
REC1	CIGP 302	Westinghouse
REC2	10 B1	Internl. Rectifier
REC3	10 B1	Internl. Rectifier
M1	Meter Movement	2·5mA f.s.d.
BY1	Battery 1·5V	Ever-Ready U2
SWA	Leaf Switch	Open on d.c. and ΩX10 a and b closed on d.c. b and c closed on ΩX1
SWB	Range Switch	

SWITCH POSITION	RANGE
1	36A. d.c.
2	3·6A. d.c.
3	Ω × 1
4	Ω × 10
5	EXT. SHUNT (90 mV)
6	3·6V. d.c.
7	9V. d.c.
8	18V. d.c.
9	36V. d.c.
10	9V. a.c.
11	18V. a.c.
12	90V. a.c.
13	360V. a.c.

Fig. 2—Circuit Diagram of the AVOMETER MODEL 12