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AIRMEC LIMITED · HIGH WYCOMBE · BUCKS

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AIRMEC LIMITED

OPERATING INSTRUCTIONS

5 kV IONISATION TESTER TYPE 732

AIRMEC LIMITED,
HIGH WYCOMBE,
BUCKS.

Issue 7

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1. USES OF THE INSTRUMENT

The instrument introduces a new, non-destructive method of test whereby the voltage at which capacitive components commence to ionise may be readily ascertained, and, in addition, provides a means of measuring approximately, leakage resistances of less than 5000 megohms. The components may take the form of capacitors, cables, transformers, inductors, windings of electrical machines, etc.

It is obvious that an insulant subjected to a voltage stress equal to or greater than that at which an electrical discharge occurs can be expected to have a much shorter life than if the voltage were restricted to a value below this 'ionisation' value. In short, in terms of this particular test, a noisy insulation at the operating voltage is not as reliable as a quiet one. The instrument therefore enables components likely to give trouble whilst in service to be rejected and is also useful during the development of new components. It is common practice to subject electrical components, for example electrical machines, to tests which are destructive if the component fails to pass them. This instrument enables those components likely to fail on test to be determined so that remedial measures may be taken-measures which usually result in the components passing the test.

2. SPECIFICATION

Test Voltage

Continuously variable from less than 250 to 5,000 volts D.C.

Methods of Indication

Loud Speaker
Voltmeter
Microammeter
Telephone Jack which enables either earphones or a rectifier meter to be used.

Power Supply

The instrument will operate from 100-130, and 200-250 volt 50 c/s mains, the total power consumption being approximately 50 watts.

Dimensions

The instrument, which is suitable for both bench and rack mounting, is 19" wide, 7" high and $8\frac{1}{2}$" deep.

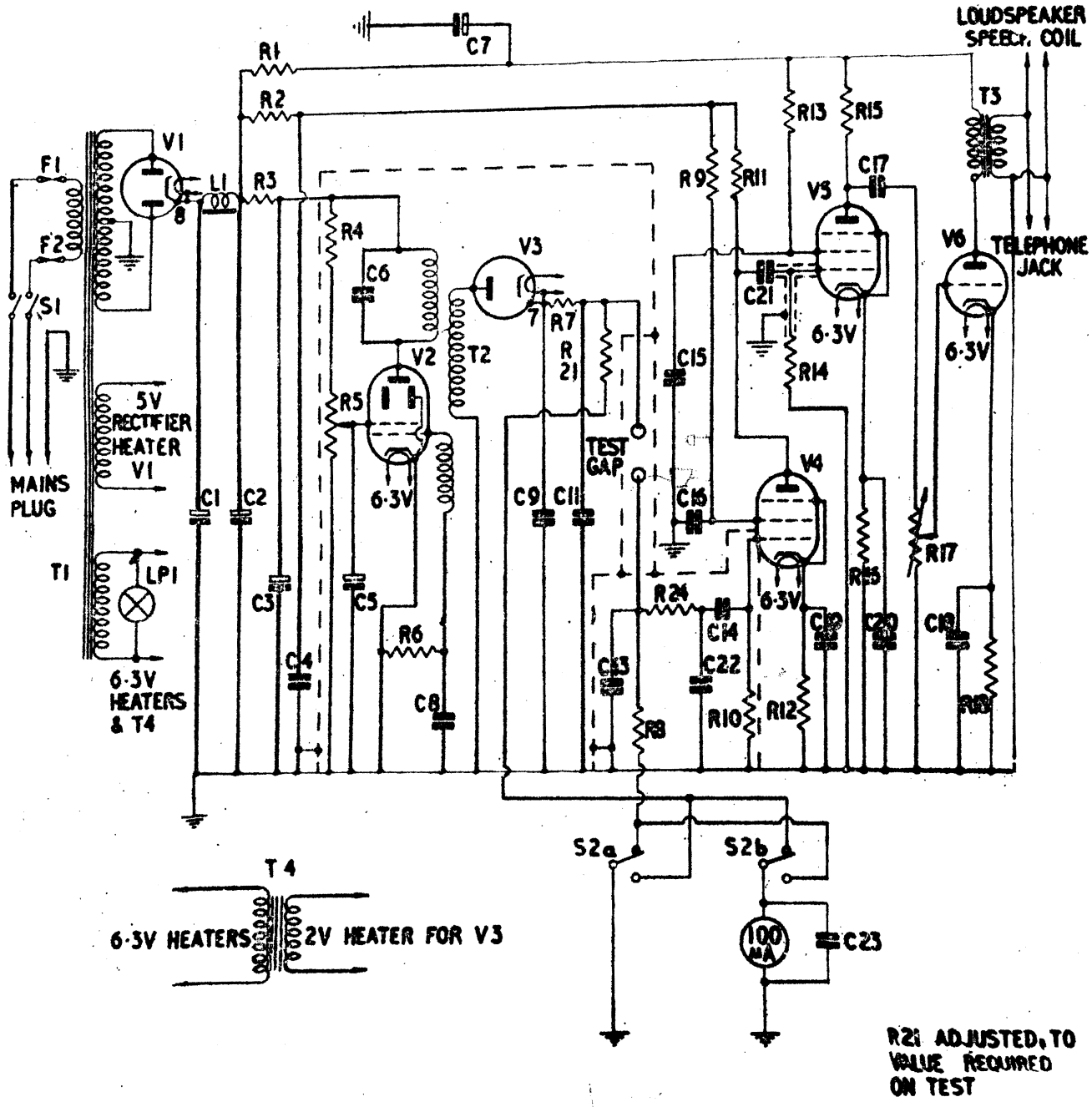

FIGURE 1. 5 kV IONISATION TESTER TYPE 732. CIRCUIT DIAGRAM.

Weight

The total weight of the instrument is approximately 26 lbs.

3. DESCRIPTION OF THE CIRCUIT

The instrument consists of three main units:-

(a) The H.T. Unit
(b) The Amplifying Unit
(c) The Power Unit

The circuit diagram is given in Figure 1 and the component values in Table 1.

A high direct voltage produced by the R.F. type power pack is impressed on the specimen in series with a resistor. When ionisation occurs the resulting erratic current causes a corresponding voltage drop across the resistor which, after amplification, gives rise to a distinctive noise in the loudspeaker. Thus the voltage at which ionisation occurs can be found by slowly increasing the voltage from zero until the noise is heard. As may be seen from the circuit diagram, should any continuous steady current flow through the resistor the value of this leakage current can be measured by switching S2 to Current. In the presence of a large leakage current the reading of the voltmeter will be greatly reduced since the impedance of the generator is high and the internal meter should not be used to measure the current flowing.

4. INITIAL ADJUSTMENT

The instrument is despatched from the Works with the voltage-tapping panel set for operation on 230-volt mains. If the instrument is to be used on mains of any other voltage it must be removed from its case and the terminal in the voltage-tapping panel, the position of which is indicated in Figure 2, moved to the correct position. Apart from this adjustment the instrument is ready for use when it leaves the Works and needs only to be connected to the mains by the 3-core mains lead supplied, in which red and black cores are lines and the third core is earth.

5. OPERATION

It is important that the instrument be properly grounded or excessive hum may be heard from the loudspeaker. With both controls turned fully anti-clockwise, switch on the instrument by means of the 'mains' switch on the front panel (illumination of the pilot light situated below the Meter Switch indicates that the instrument is energised) and allow two or three minutes for the valves to warm up.

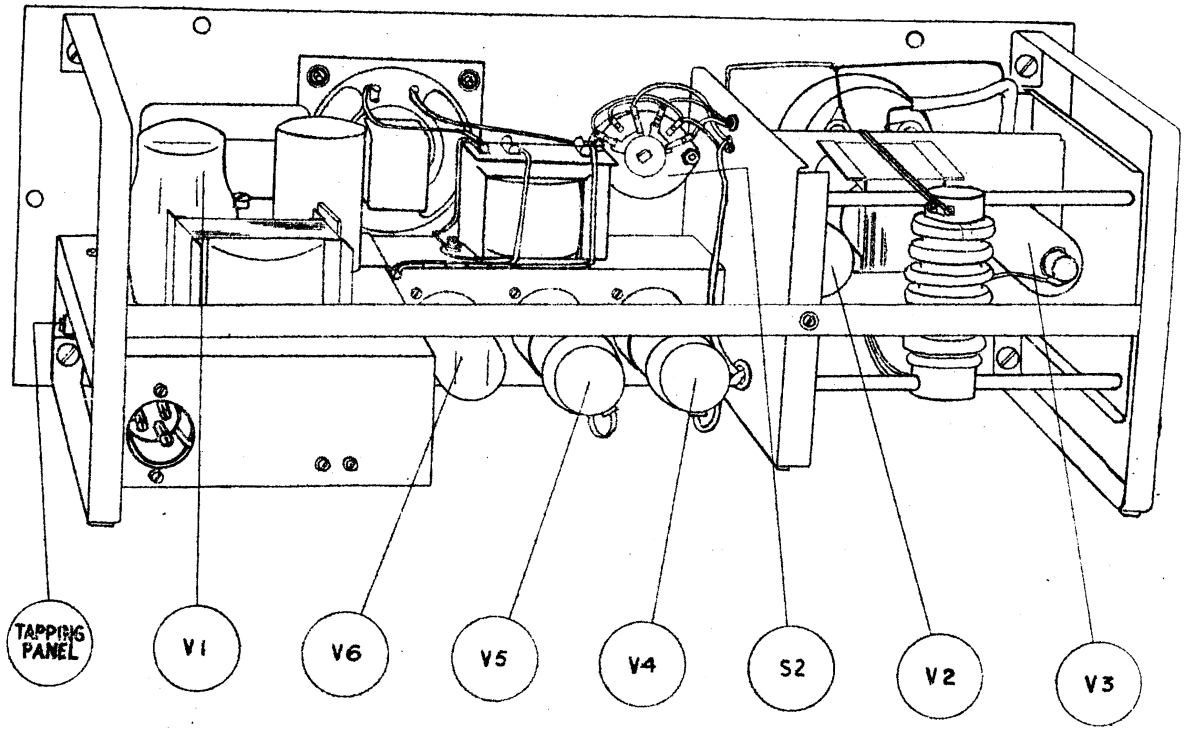

FIGURE 2. 5kV IONISATION TESTER TYPE 732. REAR VIEW.

The voltmeter will then register about 200 volts and if the voltage control is turned fully clockwise a full-scale reading should be obtained with no noise from the loudspeaker other than the normal background noise obtained at zero volts, even with the volume control turned to maximum.

With both the voltage and volume controls turned fully anti-clockwise to their minimum positions, connect the component to be tested across the red and black 'Test' terminals. The red test terminal is at high potential whilst the black test terminal is at low potential but of necessity cannot be earthed. Neither side of the test gap should be earthed and if this is unavoidable a different technique, described later, must be adopted. The earth terminal is brought out for convenience and may be used for earthing screened leads.

When using the instrument to measure leakage currents it should be noted that the meter has full scale deflection for a current of 100 microamps. It is desirable that measurements be made at a low voltage initially to ensure that the component being tested is not of low resistance, readings being taken at progressively increasing voltages up to that at which a figure is required. It has been assumed that this final value will rarely be in excess of 100 microamps and that in such a case the use of an external meter will be permissible.

The H.T. Test Leads should be kept as short as possible to avoid hum pick-up. The noise associated with ionisation can usually be distinguished, however, through quite loud hum. A good contact between the H.T. leads and the component to be tested, which should be supported on good insulation, is essential. The hum level may be lower if the connections are reversed and if excessive hum is present this should be tried.

Turn the volume control about half up, so that the background noise can be heard, then slowly raise the H.T. Voltage. Frequently discrete noises are heard whilst the voltage is actually rising but a slight pause will show whether the noise is persistent or only occurs during the rise.

The commencement of ionisation is indicated by a persistent noise of a hissing nature, often accompanied by a sharp clicking noise at irregular intervals. Further advancement of voltage results in a sharp increase of noise and if the voltage is increased still further breakdown will eventually occur, provided that the breakdown voltage lies within the range of the instrument.

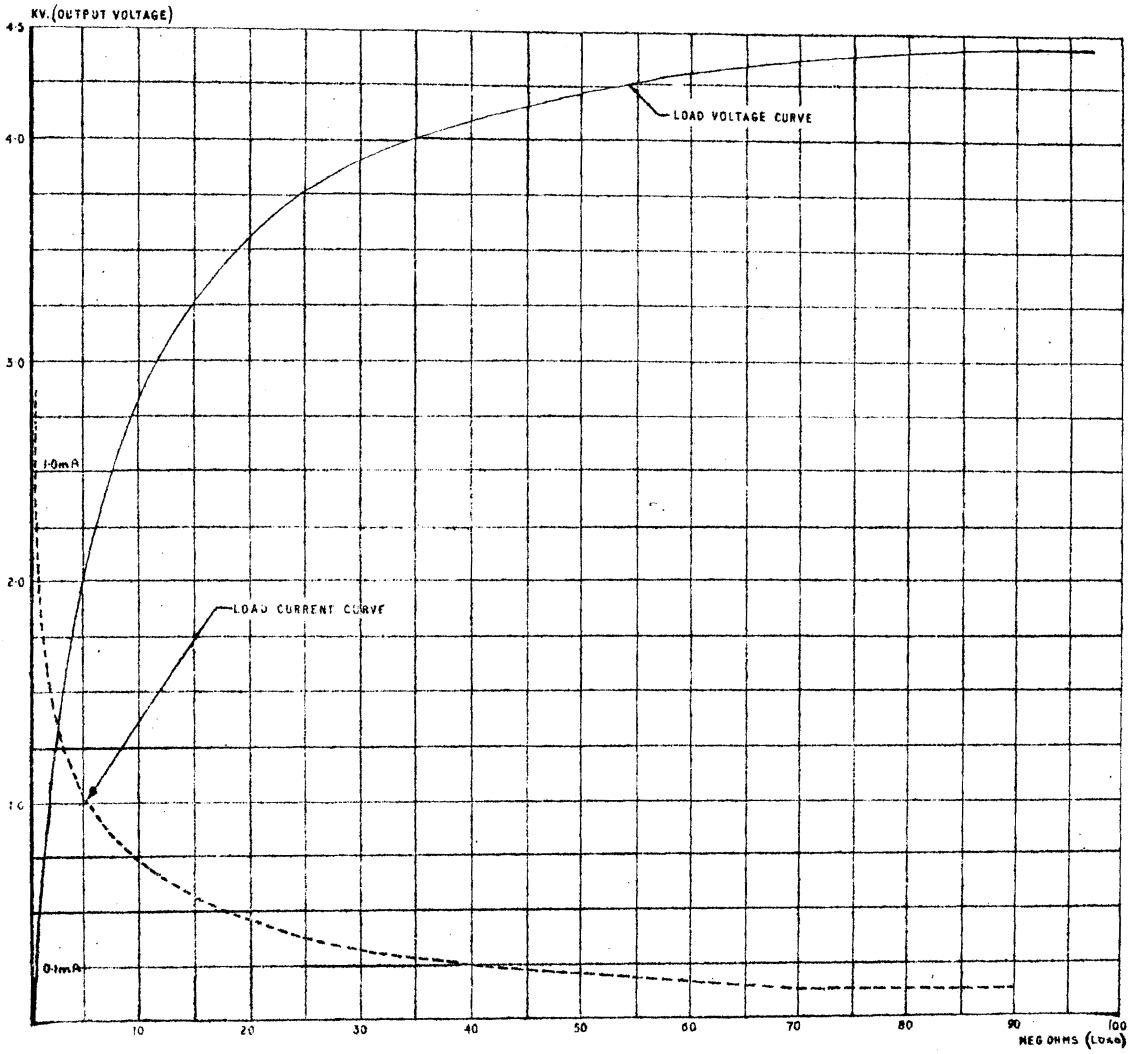

FIGURE 3. 5kV IONISATION TESTER TYPE 732.
LOAD VOLTAGE AND LOAD CURRENT CURVES.

Dielectrics other than air (or presumably other gases) almost always hiss before breakdown, usually at a much lower voltage, and when they break down the fact is accompanied by a thudding click which may be repeated if the insulation is self-healing. Air gaps, on the other hand, do not always give the hiss appreciably below breakdown voltage and the actual breakdown gives a very sharp click which is repeated until the voltage is raised sufficiently to cause a continuous discharge. Usually the click is accompanied by a background hiss.

It is to be noted that the voltmeter is connected directly across the gap and if fairly large capacitors are being tested the voltage must be raised very slowly as there will be a lag whilst the capacitor charges. Similarly there will be a lag during discharge but the meter reads the voltage on the tested item.

Care should be taken by the operator to avoid touching the H.T. Terminals after the voltage has been raised, as, although the shock received is not likely to be lethal when the instrument is not connected to a capacitance, it may be very unpleasant.

GREAT CARE MUST BE TAKEN TO ENSURE THAT CAPACITORS LARGER THAN ABOUT 0.001 uF ARE EFFECTIVELY DISCHARGED BEFORE HANDLING AFTER TEST, AS A DANGEROUS SHOCK MAY OTHERWISE BE RECEIVED.

As the generator resistance of the instrument is very high the voltage maximum is progressively lowered with lower load resistances (3.5 kV into 10 megohms and only about 200 volts into 0.1 megohm).

The instrument cannot be used for testing electrolytic capacitors owing to their high leakage current.

Leakage across the gap is accompanied by a reduction in output voltage obtained at a given control setting. Load-voltage and load-current curves are shown in Figure 3.

When one side of the component to be tested is earthed a high-quality capacitor of the order of 0.01 uF is connected across the test terminals and tested for noise as previously described. Having ensured that it is noiseless it is left in position and the H.T. lead connected to the unearthed side of the component. No connection must be made from the low-potential test terminal except to the above mentioned capacitor.

Any discharge occurring in the component will now be coupled into the test circuit and indicated by the usual speaker noises. The D.C. leakage current cannot be measured in this test as there can be no D.C. leakage across the test terminals through the specimen.

If desired low-impedance telephones or a rectifier pattern meter, having a full-scale deflection of between 100 and 200 mA and an impedance of approximately 2-10 ohms, may be used instead of, or in conjunction with, the speaker by using the telephone jack provided.

6. RACK MOUNTING

The instrument is designed so that it may be forward rack mounted on a standard 19" rack if required. The unit should be removed from the case and the case fixed to the rack by means of 0 or 1 B.A. screws through the slotted holes provided, after which the unit may be replaced. The instrument, including the feet, is intended to utilise the same rack space as is normally taken by a 7" panel.

7. SERVICING

Valve, pilot lamp, and fuse replacements are the only servicing changes normally required, and the respective positions of these are shown in Figure 2. Should any more serious fault develop the instrument should be returned to the Service Department for attention.

TABLE 1

SCHEDULE OF COMPONENTS

Reference	Description	Reference	Description
R1	10 kohms	R12	2.2 kohms
R2	100 "	R13	2.2 Mohms
R3	3.3 "	R14	1 "
R4	22 "	R15	470 kohms
R5	100 "	R16	2.2 "
R6	220 "	R17	1 Mohm
R7	2.2 Mohms	R18	1 kohm
R8	47 kohms	R21	Adjust on test
R9	2.2 Mohms		
R10	1 "		
R11	470 kohms		
C1	8 uF	C13	0.0001 uF
C2	16 "	C14	0.0001 "
C3	8 "	C15	0.1 "
C4	1 "	C16	0.1 "
C5	4 "	C17	0.0003 "
C6	0.0005 "	C18	0.5 "
C7	4 "	C19	0.1 "
C8	0.0005 pF	C20	0.1 "
C9	500 "	C21	0.0003 "
C11	500 "	C22	100 pF
		C23	2 uF
V1	5Z4G	V4	6J7GT
V2	6V6GT	V5	6J7GT
V3	U24	V6	6J5GT
F1	1 amp.	F2	1 amp.
LP1	6.5V, 0.3A		

GENERAL LIABILITY AND MAINTENANCE GUARANTEE

In lieu of any warranty, condition or liability implied by law, our liability in respect of any defect in or failure of the goods supplied, or for loss, injury, or damage attributable thereto, is limited to making good by replacement or repair defects which, under proper use by the original purchaser, appear therein and arise solely from faulty materials or workmanship within a period of twelve calendar months after the original goods shall have been first despatched, at the termination of which period all liability on our part ceases; provided always that such defective instruments are carefully packed and returned free to our Works unless otherwise arranged, and provided they have not been tampered with in any way. The repaired instrument will be delivered free to its destination in Great Britain or f.o.b. British Port, for overseas shipments. Reasonable charges will be made for attendance of Personnel at Customers' premises and for any dismantling should this be necessary in order to effect the required replacements.

For components not of our manufacture we extend only such benefits as we may receive under any guarantee given to us by the makers thereof. Electronic valves and cathode ray tubes manufactured by members of the British Radio Valves Manufacturers' Association are marked with the letters B.V.A. which is a guarantee of efficiency and quality. Our equipment has been designed and tested for use with the specific types of components supplied by us therein and no responsibility can be accepted for the performance of the equipment if other components are employed.

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