Universal tube test equipment

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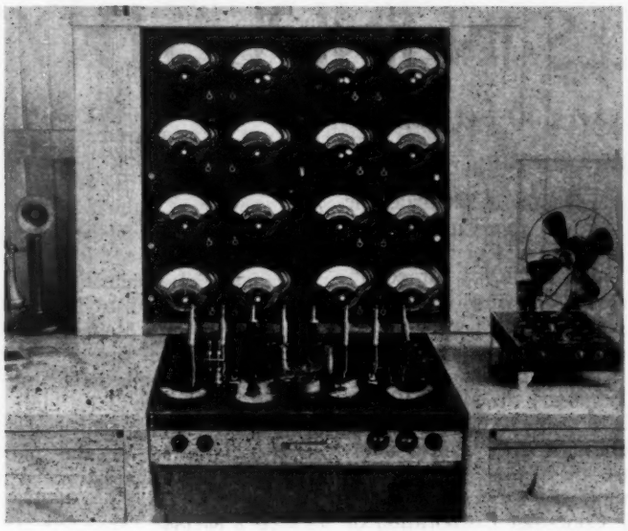


Entire tube test apparatus is installed in a standard office desk making an examination for defects a simple and time-saving procedure

DURING the past year, developments in radio tube design have been of such a nature as to necessitate complete revamping of all test equipment. For laboratory use, it is essential to have available test equipment which can be readily set up to accurately measure all standard types of tubes, and at the same time, the equipment must be so designed as to permit set-ups not ordinarily used in connection with routine characteristic checks. With the above in mind, the authors worked out an extremely flexible board which can be set up for any routine test by plugging in the proper meters and setting the selector switch for the type under test. Moreover, by the use of the unused sections of the selector switch, it will be possible at any future date to re-arrange test circuits to accommodate other conditions which may arise.

The testboard shown in the photograph, is made up of four distinct units, all of which may be easily removed from the main unit.

Power supply and battery charger

Three independent power supply systems are used to supply screen voltage, plate voltage, and grid voltage. The regulation of the plate and screen voltages is obtained by a carbon pile resistor which is a part of the voltage divider system. To obtain maximum voltage with minimum regulation, the new type 280 M mercury vapor rectifier tubes are used in the plate and screen units. Grid bias is supplied by a separate unit and regulation is obtained through a 2,500-ohm potentiometer connected across a section of the voltage divider. An additional resistor is used in series with the potentiometer to act as a vernier adjustment.

Power supply units are built up on one chassis with all leads brought out to a terminal strip. The chassis is mounted directly below the main control panel.

In the compartment on the left of the desk, a complete "A" battery supply is installed. Batteries are constantly being charged while the board is not in use, by means of an 866 mercury vapor rectifier tube which is connected in series with an incandescent lamp to regulate the charging rate. The entire unit is arranged on a steel angle-iron tray so that the complete battery unit may be easily removed for inspection.

On the upper right-hand side of the desk is a compact short-circuit checker and pre-heater. There are six sockets for 5-prong types, and two sockets for 4-prong types. A small single-pole double-throw switch changes the voltage from $2\frac{1}{2}$ to 7 to take care of the preheating of the new automotive series, types 236-7-8. Short circuits are indicated by a series of lights along the front of this unit.

Meter and control panel

All meters, with the exception of the gas meter, are brought out to single circuit jacks located at the side of each meter. The eight meters on the left are volt meters to cover every range from a fraction of one volt to 300 volts. Similarly, the meters on the right cover all current ranges.

The control panel acts simply as a switching unit to set-up various circuit connections. Switching is greatly simplified by the use of a Jewel gang switch which makes it possible to use only two sockets, a four and a five prong, and by means of the switch, set up any connection to the sockets which may be desired.

The anti-capacity switch to the left of the gas meter is used to change the grid polarity from negative to positive, and the anti-capacity switch at the right of the gas meter changes the circuit from emission to plate current and gas test. In order to protect all meters against overload and short-circuited tubes which might carelessly be placed in the socket, a double relay system has been used. The three-knobs on the right-hand side of the main panel regulate the sensitivity of the relays in series with the plate, screen, and emission current circuits.

Cathode to filament short test

For each set-up, the relay sensitivity is adjusted so that the meter will be shorted out the instant full scale deflection is reached.

In addition, series cut-out relays are used in the plate and screen voltage supply lines to disconnect the high

voltage supply when the load exceeds the safe carrying capacity of the power supply.

A rather unique method of detecting a short between the heater wire and the cathode, has been used in this board. The coil of a relay is connected in series with a single flashlight battery, and one side of this circuit is connected to the heater while the other side is connected to the cathode. If a tube is inserted in the socket which has a short from cathode to heater wire, the relay closes, ringing an alarm. This method of testing has been found far superior to visual methods, due to the fact that from the cathode to heater a short is extremely rare, and consequently test operators might carelessly overlook an occasional defect.

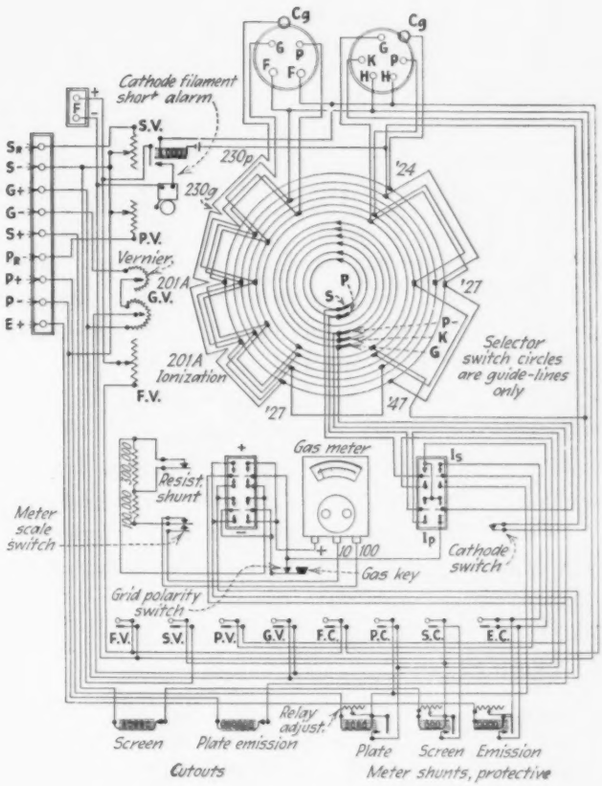
Grid emission and ionization test

To test for grid emission in cathode type tubes, a single-pole snap switch is located alongside the plate current emission switch. When this switch is open, the gas meter will read any current which flows directly from the grid to the plate.

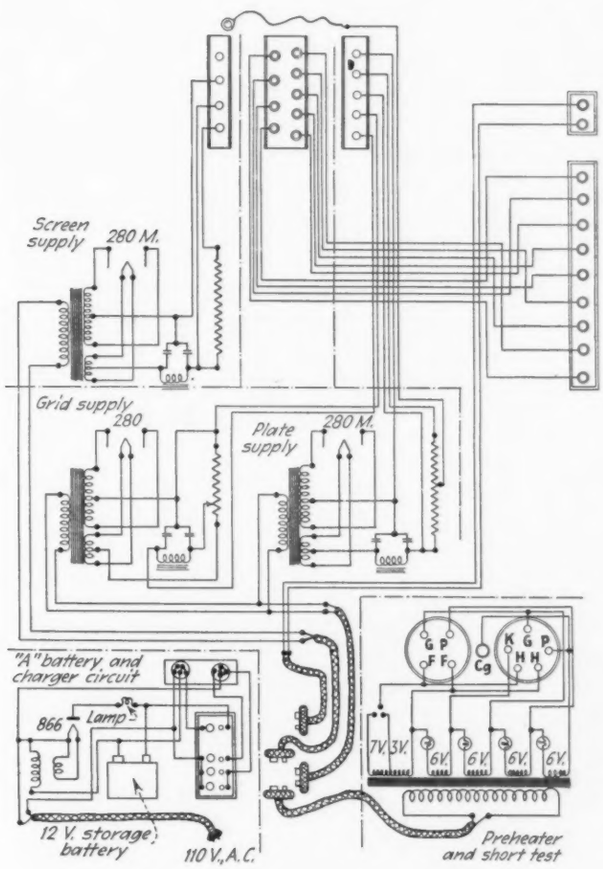
In testing low filament current tubes for emission and gas, the so-called ionization method is superior to the regular emission method. In this test the grid is maintained at a positive potential, and the plate is made negative. A milliammeter in series with the grid measures the emission current, and a micro-ammeter in series with the plate, measure the gas current. All that is necessary to make the ionization test with this equipment is to turn the selector switch to the position marked 201A ionization and apply the desired voltages to the plate and grid of the tube.

Dynamic characteristics

Although this test equipment is designed primarily for static tests, dynamic characteristics may be obtained by plotting a family of curves, and computing from the data so obtained, plate resistance, mutual conductance, amplification factor, undistorted power output, etc.



Sixteen meters protected by relays, on the upright panel and a gas current meter in the desk top are controlled by jacks and switches to test all modern tubes



Power supply equipment for the tube testing board. Leads are brought out to a terminal strip connecting with similar terminals on the testing panel proper

For precision laboratory measurements of all characteristics, the test equipment described in this article used in conjunction with an accurately calibrated dynamic bridge, offers a rapid and efficient method of testing all types of tubes.

The arrangement of the apparatus in an office desk puts all the meters within easy view of the operator; the control jacks and switches can be easily reached. The entire equipment is designed to speed the testing of tubes.

The circuit diagrams shown above give the essential connections of the various pieces of apparatus including power supply system, protective relays for the meters, etc.

Although the ideas set forth in this article are basically fundamental, it is the belief of the authors that the equipment is unique in that it incorporates many ideas heretofore never assembled in a single piece of test equipment.