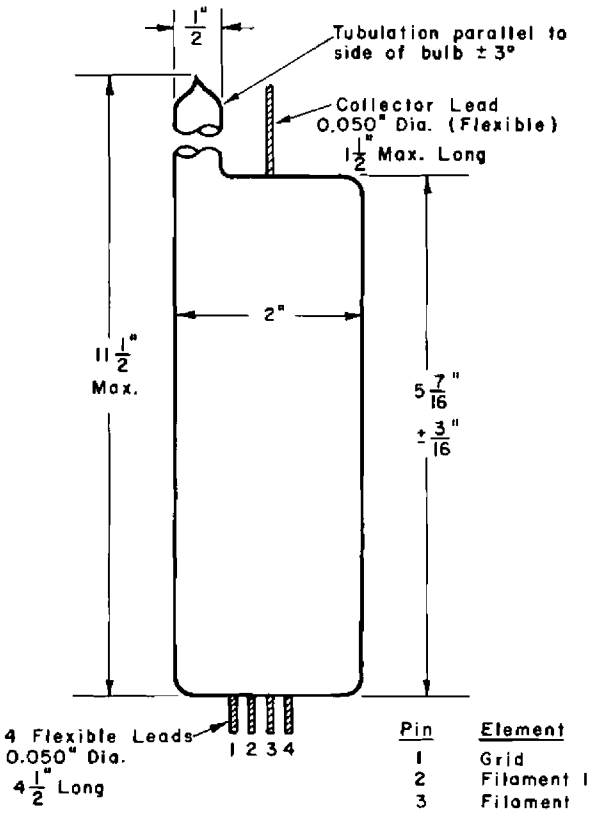
LOW PRESSURE ION GAUGE TUBE TYPE 7675

The 7675 is an ionization type of vacuum-gauge tube for measurement of gas pressures as low as 10^{-10} mm of mercury. The tube has a hard glass bulb with a one-half inch diameter tubulation. The 7675 employs an electrode structure having a minimum of metal surface with the result that the tube is easily out-gassed.

The 7675 is a triode of the Bayard-Alpert inverted geometry design having two tungsten filaments, one of which is a spare. The grid structure is operated at a positive potential with respect to the filament while the ion collector is at a negative potential. Electrons are accelerated from the filament to the grid; they bombard and ionize gas molecules, and the resultant positive ions are attracted to the collector. The ratio of the collector current (positive ion current) to the grid current is proportional to the gas pressure.



Pin	Element
1	Grid
2	Filament 1
3	Filament Common
4	Filament 2

ELECTRICAL:

Filament Type (Note 1)	Tungsten
Operating Filament Voltage (Approx.)	7 ac or dc Volts
Operating Filament Current	2.5 ± 8% Amperes

MECHANICAL:

Maximum Tube Length (including tubulation)	11-1/2"
Maximum Bulb Length	5-5/8"
Maximum Bulb Diameter	2-1/16"
Tubulation (Note 3)	1/2" (Approx.) Diameter Hard Glass Coming Code 7720
Mounting Position	Vertical

MAXIMUM RATINGS:

Absolute Maximum Values

Ion Collector Voltage	−100	max.	Volts
Grid Voltage	+500	max.	Volts
Ambient Temperature	100	max.	°C
Gas Pressure	0.001	max.	mm Hg
Filament Voltage (Note 2)	10	max.	Volts
Emission Current	200	max.	Ma.

TYPICAL OPERATION:

Ion Collector Voltage	−30	Volts
Grid Voltage	+150	Volts
Grid Current	10	Ma.
Sensitivity	1 μa./10^{-5}	mm Hg

CONDITIONS FOR OUTGASSING ELEMENTS:

Ion Collector	Connected to Grid		
Grid Voltage	+500	max.	Volts
Filament (Note 2), Series	20	max.	Volts
Parallel	10	max.	Volts
Grid & Collector Power	100	max.	Watts

NOTES

1. The 7675 has two filaments, both of which should be used during outgassing cycles. During pressure measuring operation only one filament need be used. The voltage and current values are for either filament operated alone.
2. If it is necessary to outgas the tube using one filament only, the voltage must not exceed 11V. Shorter life must be expected under these conditions.
3. Other ion gauges, similar to type 7675 but having different materials of tubulation, are available under different numbers.

APPLICATION

The basic principle of the ionization gauge is described briefly in the introduction, where mention was made of the ratio of collector current to grid current as a measure of gas pressure. In order to measure gas pressure with an ionization gauge tube, the current ratio or some proportional quantity must be observed. If the grid current is held constant, then gas pressure will be proportional to collector current. The accuracy of pressure values is, then, dependent on the stability of grid current. The grid current is reasonably independent of grid voltage for grid voltages above that corresponding to the maximum probability of ionization of any gas which may be present. A grid voltage of 150 volts is sufficient, and stability is increased by the use of a voltage regulator tube (0D3).

The collector voltage must be sufficiently negative to attract all positive ions. This value is not critical; in practice, a voltage of −22.5 or greater will be satisfactory.

Ionization gauge tubes are commonly operated temperature limited. Consequently, the grid current at a fixed grid voltage is a first order function of filament temperature. This effect provides a convenient means of controlling grid current, i.e., by control of filament voltage.

Outgassing of metal and glass parts can be accomplished conveniently by connecting grid and collector together and passing a high current through the tube. The voltage applied to the grid and collector should not exceed +500 volts and maximum outgas power is 100 watts. DC supply is recommended for outgassing, although line-frequency supply has been used successfully. The two units of the filament may be operated either in series or parallel. Emission current is adjusted by increasing the filament voltage until the desired outgassing condition is reached. Although the elements may be outgassed using only one filament, due to the higher operating temperature required to produce the necessary outgassing current, tungsten evaporation is rapid and seriously impairs the life of the tube. Consequently outgassing using both filaments is strongly recommended.

To facilitate outgassing, the following schedule should be followed, especially during the first outgassing of a new tube or after a tube has been exposed to air.

Starting at 25 mA raise the bombarding current in 25 mA steps to maximum desired current. Each step should be 5 minutes minimum and the tube should be switched off for 1 minute between steps. At no time should the filament voltage exceed the maximum allowed.

The filament should never be heated in air; therefore, it is desirable to employ a thermo-couple or Pirani gauge coupled to a relay system to prevent excitation of the tube until the gas pressure has been reduced to 0.001 mm of mercury. The power-supply control circuit shown in Figure 1 incorporates such protection. The thermocouple tube closes the sensitive relay when the gas pressure has been reduced to the operating range of the 7675. Next, an auxiliary relay closes the power contactor. In the event a leak develops, the circuit removes power from the 7675.

Two power supply circuit diagrams are given: Figure 2 is relatively simple. It does not provide automatic regulation of filament temperature. The operator is required to set a reference level of grid (electron) current each time a reading is taken. The reference is set by the variable transformer in the primary of the filament transformer. The accuracy is dependent upon steadiness of electron current in the time interval between setting the electron current and reading the ion current.

The second supply circuit, Figure 3 provides continuous regulation of electron current; therefore, the gas pressure can be continuously read without resetting the reference grid current. The filament temperature is regulated by a varying impedance in series with the primary of the filament transformer. This series impedance is the plate resistance of the 6AS7-G tube. The impedance is determined by the 6AS7-G grid potential which, in turn, is provided by the voltage potential drop across the plate load resistance of the 6AU6. The grid bias of the 6AU6 is derived from the electron (grid) current of the 7675 flowing through resistor R1. Thus, if the grid current of the 7675 tends to rise, the temperature of the 7675 filament is reduced and the electron current is maintained substantially constant.

The gas (ion) current can be measured by any commercial microammeter having a range of 0.01 microampere to 1.0 milliampere. The Beta Electronics microammeter is an example of a suitable meter. Precision meters of the D'Arsonval type may be used to measure gas currents in the higher pressure ranges.

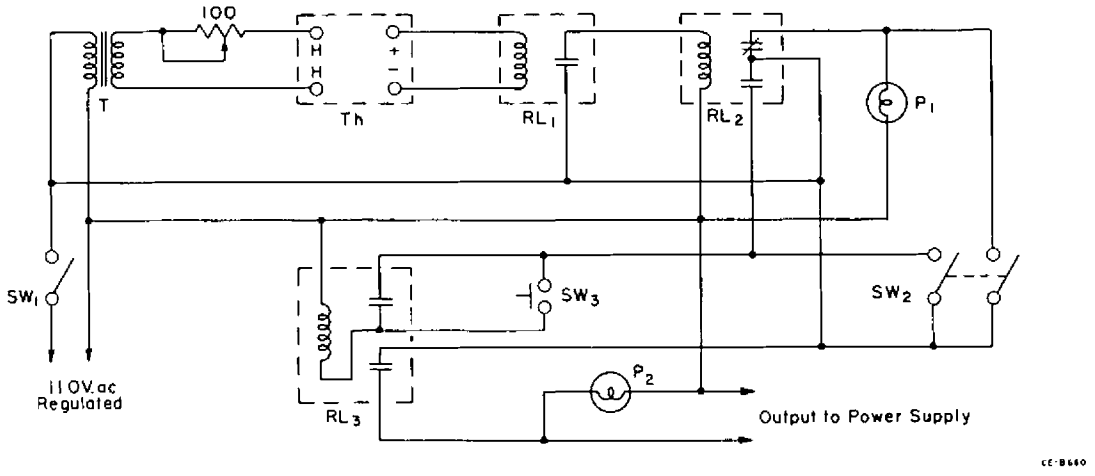


FIGURE 1

Resistor value in ohms

Th – Thermocouple: Type 7677 or equivalent
RL_1 – Sensitrol or equivalent
RL_2 – Weston 712 relay or equivalent
RL_3 – 115-volt relay
P_1 – 115-volt pilot lamp, red
P_2 – 115-volt pilot lamp, green
SW_1 – Switch
SW_2 – DPST switch
SW_3 – Manual start-reset (normally open push button)
T – Transformer: 110v primary; 6.3v, 1a. secondary

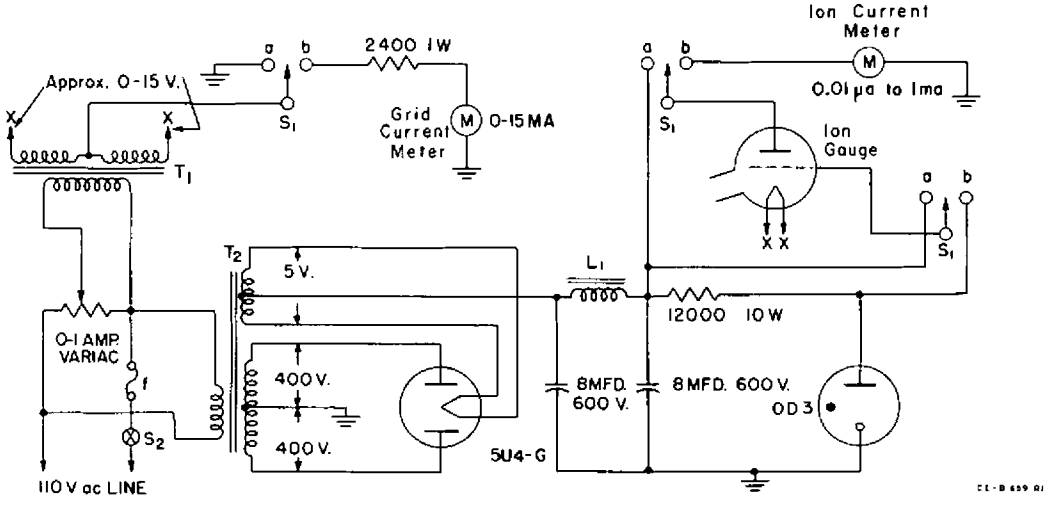
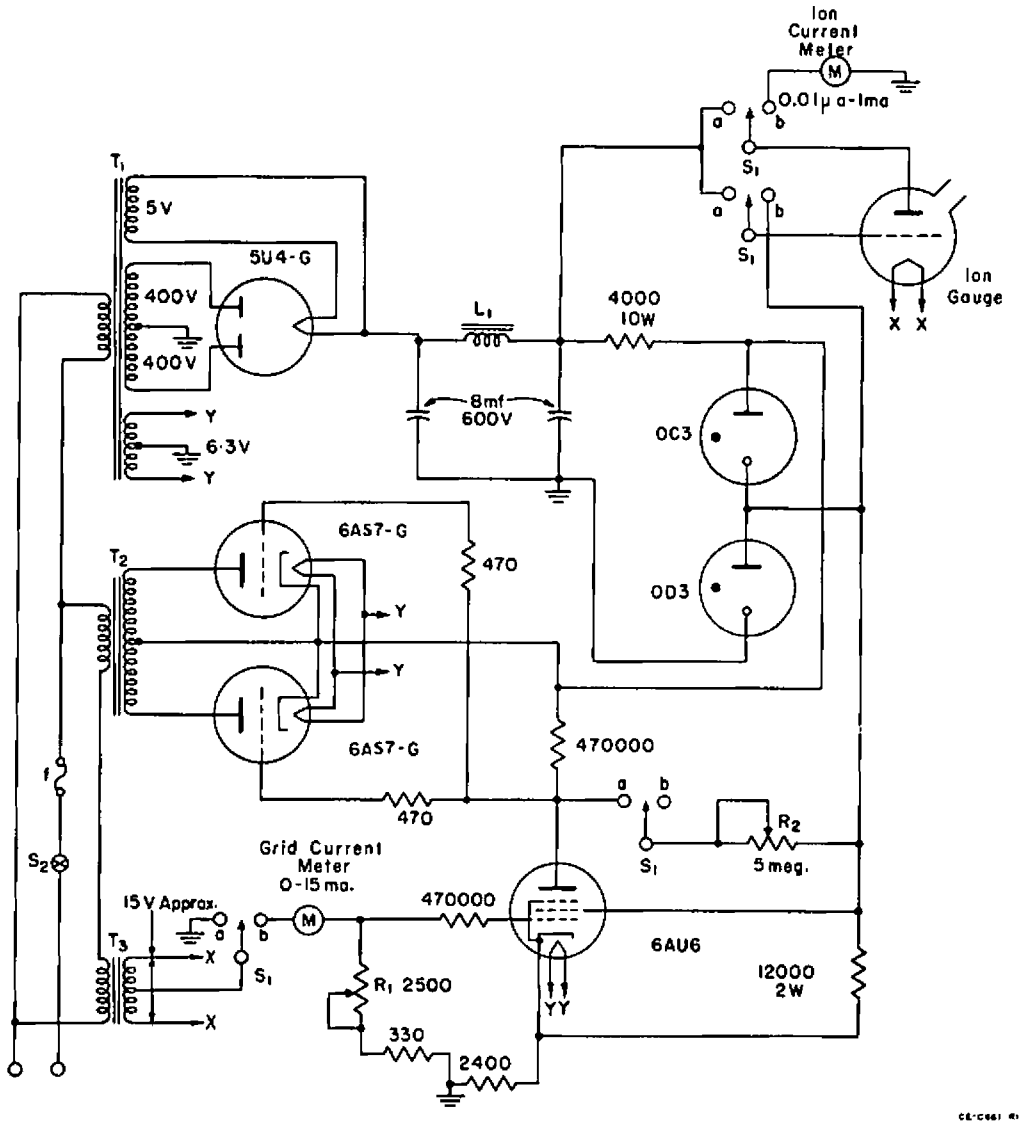


FIGURE 2

Resistor value in ohms

L_1 – Stancor C-1721 or equivalent
T_1 – UTC S70 or equivalent
T_2 – Stancor PM8412 or equivalent
S_1 – 3PDT switch (position a to outgas, position b to operate)



Resistor value in ohms
Resistors are 1/2 watt except as specified.

S_1 – 4PDT switch (position a to outgas, position b to operate)

R_1 – Grid current adjustment

R_2 – Outgas adjustment

T_1 – Stancor PM-8412 or equivalent

T_2 – Stancor PM-8410 or equivalent

T_3 – UTC S70 or equivalent

L_3 – Stancor C-1721 or equivalent