SUBSCRIBER SETS
CONTAINING COLD CATHODE GAS-FILLED VACUUM TUBES

1. GENERAL

1.01 This section gives general information pertaining to the use of cold cathode gas-filled vacuum tubes in subscriber sets.

1.02 This section is reissued to convert it to letter size and to incorporate material from the addendum in its proper location. In the process of this conversion, marginal arrows have been omitted.

2. SUBSCRIBER SETS

2.01 Subscriber sets, with cold cathode gas-filled tubes, are intended for use principally on grounded ringing party lines where superimposed or pulsating ringing current is employed as on four-party selective and eight-party semiselective lines.

2.02 When the 313, 333, 372, 405 or 411-type vacuum tubes are to be replaced by a 425, or 426-type tube, the original mounting parts, vacuum tube socket, or bracket are no longer required, and should be removed, where practicable.

2.03 The 425 and 426-type vacuum tubes, permanently mounted on plastic angle brackets, require a screw for fastening in some sets, while in others special mounting brackets, screws, and lockwashers are required. (See Figs. 1, 2, and 3.)

2.04 The 426A vacuum tube will be furnished in new and converted tube-type sets. A limited supply of 313, 333, 372, 405, and 411 vacuum tubes will be available for replacement purposes, as long as the present supply permits.

2.05 The 425 and 426-type vacuum tubes and their associated mounting brackets may be added to metal or wooden sets having 1000, 1400, or 1500-ohm ringers. Sets with 1000-ohm ringers do not, however, provide as satisfactory a margin for operating the tripping relays in central offices as is provided by the 1400 or 1500-ohm ringers. The use of subscriber sets with vacuum tubes is subject to further limitations included in Section C63.252, Ringer Connection Limitations, Polarized Ringing Lines.

2.06 The following tables indicate the subscriber sets containing gas-filled cold cathode vacuum tubes.

Bell Boxes

434AT	634YT
495CT	686A
634AT	

Wall Sets

356C	653AT
433BT	653YT
633AT	

Extension Ringers

534DT	*531C
	*687B

Note *These sets are used in conjunction with auxiliary signals on four-party selective and eight-party semiselective service.

2.07 Where a loud ringing bell is required, use a 592C subscriber set containing a 359A tube.

3. VACUUM TUBES

3.01 The 426 type tube has three elements consisting of three electrodes; a cathode, a starter anode, and an operating anode. It contains a mixture of neon and other inert gases at low pressure. The cathode is coated with material that facilitates electron emission and, hence, ionization of the gas, which furnishes a path for current flow to the starter anode or operating anode.

3.02 In the following explanation of the cold cathode gas-filled vacuum tube, refer to Fig. 4 for reference.

3.03 The gaps between the electrodes are practically an open circuit, at voltages below a value called the breakdown point. Voltages above this value will cause ionization of the gases, permitting current flow through the tube. As used in the subscriber set, one of the control electrodes is always used as a cathode and the other is used as a starter anode to secure breakdown or ionization. This occurs in the control gap, (See Fig 4) of the tubes at potentials of 65 to 85 volts. A resistance of 120,000 ohms is connected in series with the starter anode to limit the current in the control gap to a value sufficient to ionize the gas. Ionization permits current to flow across the main gap through the ringer coils to ground, thus operating the ringer. If the tube were not first fired through the control gap, to the starter anode, a minimum instantaneous value of about 180 volts would be required to break down the main gap.

3.04 Once the gas becomes ionized and a current carrying path is established, there is a "sustaining voltage" of 58 to 72 volts maintained in the control gap. In the main gap, a "sustaining voltage" of 63 to 75 volts is also maintained

3.05 Both the starter anode and the operating anode are smaller and less emissive than the cathode so that both the control and main gap pass current more readily when the starter anode or operating anode are positive. In the usual operating range for this tube, it will pass only about 1/10 as much current when the anode is negative as it will when the anode is positive.

3.06 When the applied voltage in either gap is reduced below the sustaining voltage after a discharge has been started, the discharge stops abruptly and the gap restores to its original insulating condition.

3.07 The 425-type tube consists of four elements; two control electrodes, an anode, and a cathode, mounted in a glass envelope of the same size and containing a like mixture of inert gases at low pressure as the three element 426-type tube. It is to be used only for the purpose of reducing induction introduced into the talking circuit of the line by power line sources. The use of the 425-type tube is subject to limitations included in the section entitled, "Line and Ringer Connections, Use of Vacuum Tubes to Reduce Induction and to Provide Additional Ringing Bridges."

4. OPERATION

4.01 The connections for subscriber sets with tubes are shown schematically in Fig. 4. Refer to this figure for the circuit operation explanation which follows.

4.02 Considering first the —ring party, if negative superimposed ringing current is applied to the ring, the tip

being grounded, both tubes connected to the ring side of the line will break down and both will pass a very small current in their repective control gaps, this current being limited by the resistances. At the —ring station the ringer is poled to operate on negative current, and since the operating anode is connected to ground, which is positive, the main gap will pass current sufficient to operate the ringer. At the +ring station, however, the tube has its anode connected to the ring, which is negative, and it will not therefore allow any appreciable current to flow through the main gap of this tube and the ringer. Furthermore, the ringer is poled for positive current on the ring and will not operate on negative current.

4.03 From the foregoing, it is evident that only the ringer at —ring station will operate and that the +ring station draws very little current from the line. The tip stations are, of course, inoperative when current is applied to the ring side of the line as the tip side of the line is grounded.

4.04 When positive superimposed ringing current is applied to the ring of the line, ground being negative, the —ring station ringer will not operate since the main gap passes very little current and the ringer is poled against this current. Both tube and ringer at the +ring station are, however, poled correctly in this case and the +ring station ringer will operate.

4.05 The operation is similar for the tip parties when positive or negative superimposed ringing current is applied to the tip side of the line, the ring side being grounded.

4.06 It should be noted that with the tube system the operations of the ringers is substantially that which would be obtained on pulsating currents, as the reversals in polarity of the ac ringing voltage are at too low a potential to affect the ringers even though they may in some cases be sufficient to cause a momentary discharge in the tube. For example, at +ring party stations, when negative superimposed ringing current is on the ring side of the line, the anodes of tubes at these stations are at a negative potential equivalent to the effective voltage of the superimposed battery, and during the positive cycle of the ac ringing current the effective potential across the main gap of the tube is roughly equal to the ac ringing voltage minus the voltage of the superimposed battery which is ordinarily too low a voltage to cause a breakdown.

4.07 Since the tubes convert the ac component of superimposed ringing current into a pulsating current for operating the ringers, pulsating ringing current may also be used to operate stations connected as shown in Fig. 4, negative pulsating current, of course, being employed to ring the negative stations and positive current to ring the positive stations.

4.08 The winding of the ringer in series with the main gap must be properly poled to have the ringer operate on the unidirectional current from the tube. In the case of the C4A ringer, the associated winding must also be poled, so that the discharge current from the condenser is in a direction to move the armature from the operated to the nonoperated position.

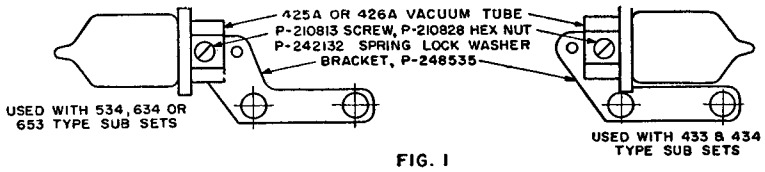

FIG. 1

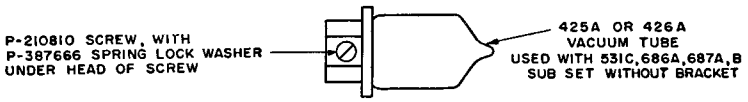

FIG. 2

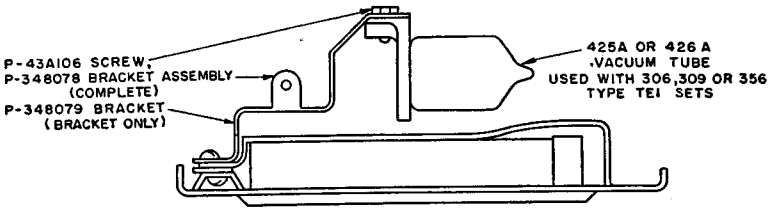

FIG. 3

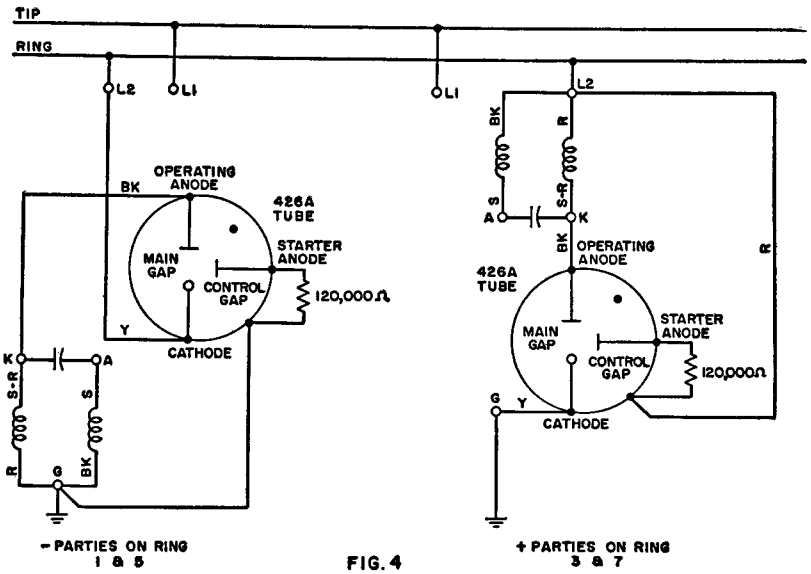

FIG. 4