AMPLIFIER
No. 81A

Instructions for Use

The Western Electric No. 81A Amplifier is a two-stage, adjustable gain, resistance coupled amplifier, intended for use as a low-level line amplifier in alternating current operated speech input equipments for radio broadcasting.

The No. 81A Amplifier is designed to operate between impedances of 200 ohms and 500 ohms with a gain of 30 db, 40 db, or 50 db, as determined by the position of the flexible connector which is soldered to one of three taps on the resistance in the grid circuit of the second vacuum tube. The frequency response characteristic is uniform within approximately 1 db from 30 cycles to 10,000 cycles per second. This amplifier will deliver a zero energy level (0.006 watt) with less than 1 percent total harmonics introduced by the amplifier. Two Western Electric No. 262A Vacuum Tubes are used; these tubes have a low noise level when the filaments are operated from alternating current. The vacuum tubes are not supplied with the No. 81A Amplifier and must be ordered separately.

The schematic circuit diagram is shown on Figure 1 and the wiring diagram on Figure 2.

DESCRIPTION

The component parts of the No. 81A Amplifier are assembled on a depressed metal panel 19 inches wide and 5¼ inches high designed for mounting in a standard relay rack or equipment cabinet. The panel is equipped with a dark gray mat on the front. The mat is removable to allow access to the panel wiring and the terminal blocks which, with the smaller pieces of apparatus, are located in the depressed section of the panel behind the mat. The larger pieces of apparatus such as the vacuum tubes, coils, and condensers, are mounted on the back of the panel and are protected from dust and mechanical injury by an aluminum finished back cover. The mat and the back cover may be obtained with a black finish if this is specified in the order.

An alternating current supply of approximately 0.64 ampere at 10 ± 0.3 volts is required for the filaments of the No. 262A Vacuum Tubes which are

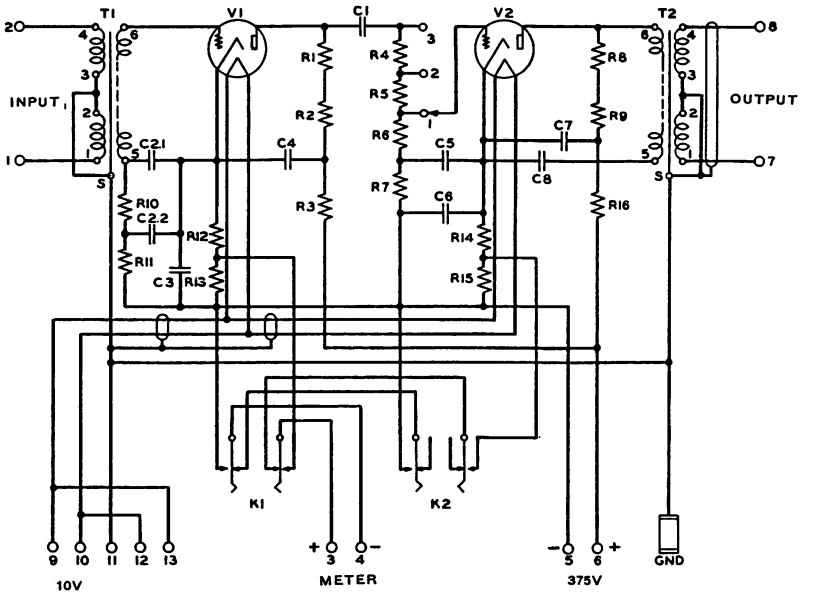

Fig. 1—Schematic Circuit

connected in parallel. The Western Electric No. 263A Voltage Regulator Panel, which supplies a constant 10-volt potential from 100-125-volt, 60-cycle power mains, is recommended for this purpose. (If the frequency of the power supply is 50 cycles, Western Electric No. 263B Voltage Regulator Panel should be used).

A plate power supply of approximately 0.005 ampere (5 milliamperes) at 375 ± 25 volts DC is required for the plate circuits of the vacuum tubes. The Western Electric No. 8A Rectifier and No. 716A Filter are recommended for this purpose.

The grid bias potentials for the vacuum tubes are obtained from voltage drops across resistances R12 and R13, and R14 and R15, located in the cathode circuits of the first and second tubes, respectively.

Keys K1 and K2 are provided at the front of the panel for measuring indirectly the plate currents of the vacuum tubes through an external meter which should be connected to terminals 3(+) and 4(−) of the amplifier. For these measurements the voltage across a part of the bias resistances in each vacuum tube circuit is measured on the external meter by depressing the proper key. An interlock circuit is provided so that the space current in only one tube can be measured at any one time even though the keys may be operated

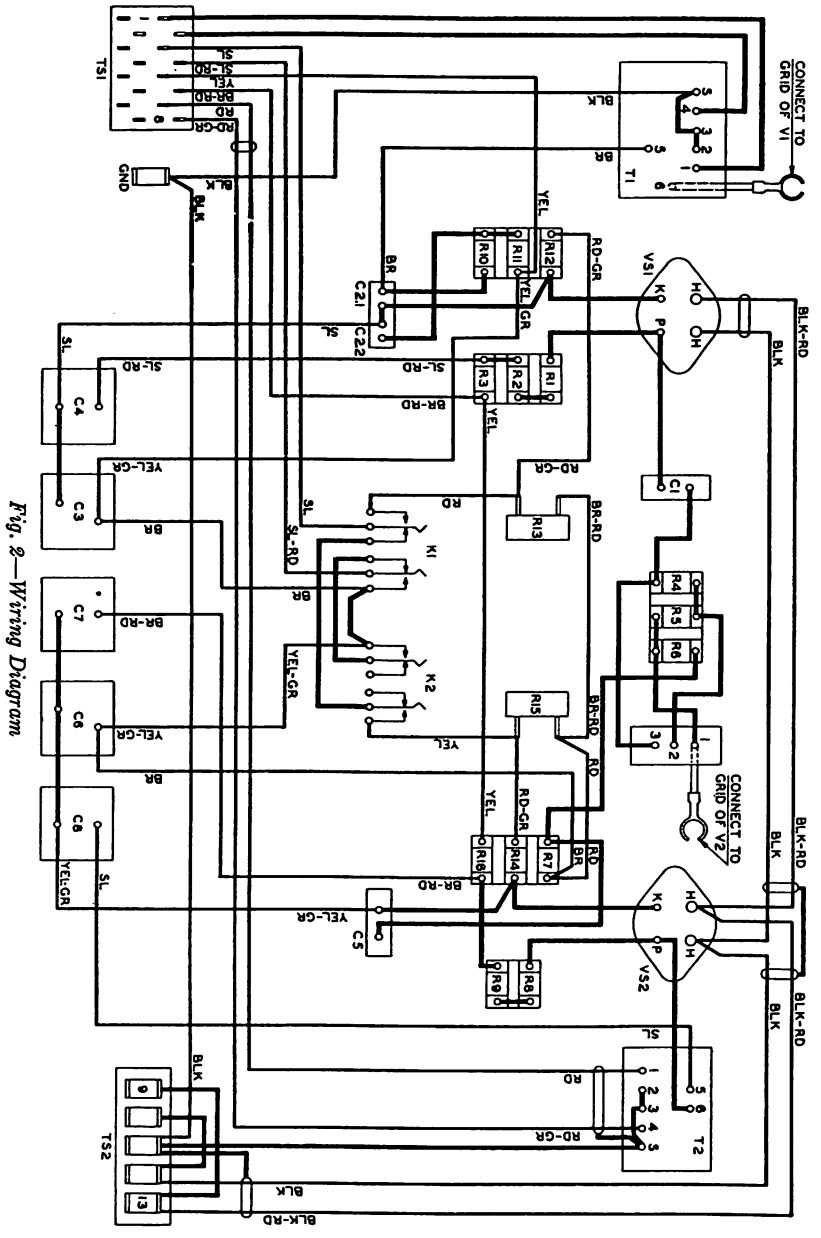

Fig. 2—Wiring Diagram

simultaneously. The circuit is designed for use with a Western Electric No. 262A Meter Panel, which is furnished as an integral part of the speech input equipments of which this amplifier forms a part. If the No. 81A Amplifier is used in assemblies other than those for which it is designed, it is recommended that a No. 262A Meter Panel be obtained for measuring the space currents. It will likewise be necessary to provide, externally, power control switches for the filament and the plate circuit power supply voltages since these controls are not included in the No. 81A Amplifier. The No. 8A Rectifier contains a power control switch with a time delay feature which permits the cathodes of the vacuum tubes in the amplifiers to reach their normal operating temperatures before the high voltage plate power is applied. This is a necessary precaution to insure long life for the vacuum tubes. The No. 8A Rectifier also contains terminals for connecting to a No. 716A Filter which is designed for the plate supply circuit of the No. 81A Amplifier.

INSTALLATION

Care should be exercised in the installation of the No. 81A Amplifier to guard against unnecessary exposure to strong magnetic fields from rectifiers or other alternating current operated equipment. Since the amplifier as ordinarily employed forms a part of a larger system the gain of which may be as high as 110 db, it is obvious that any noise which is induced in the input circuit may become objectionable in the ultimate output of the system. Although special shielding precautions have been taken in the design of the amplifier, if this precaution is not observed an abnormal amount of hum due to magnetic coupling may be experienced. Two terminal strips are provided to isolate the alternating current filament leads from the input, output and plate supply wires. The terminal strip at the left side of the amplifier (viewed from the front) contains eight terminals, numbered from 1 to 8. The right side terminal strip contains five terminals, numbered from 9 to 13. The following table gives the terminal numbers and the connections to be made to each terminal.

TERMINAL NUMBERS AND CONNECTIONS FOR NO. 81A AMPLIFIER

Terminal Numbers	*External Connections*
1 and 2	Input
3 and 4	Meter Terminals; 3 is positive
5	−375 Volts DC
6	+375 Volts DC
7 and 8	Output
9 and 10	10 Volts AC
12 and 13	10 Volts AC (multiple)
11	Ground

All external connections to the amplifier should be made with shielded twisted pair copper wire and all joints should be securely soldered. The shields should be electrically continuous and grounded at the amplifier end by wrapping with several turns of No. 20 bare tinned copper wire, soldering, and connecting the free end to the ground lug of the amplifier.

The filament supply leads should be of such size that the voltage drop in the conductors, with the proper current flowing, does not reduce the terminal voltage at the amplifier below 10 volts.

After the connections have been made as outlined two Western Electric No. 262A Vacuum Tubes should be inserted in the tube sockets at the back of the panel, and the flexible grid leads extending from the top of the input transformer and from the coupling resistance should be attached to the metal caps at the tops of the vacuum tubes.

It is desirable to provide and install permanently a No. 262A Meter Panel for measuring the space currents. If this panel is not available a 200-scale microammeter with a 2000-ohm series resistance, or multiplier, may be used for this purpose. If this is done, the reading in milliamperes, obtained by depressing either one of the keys K1 or K2, should be multiplied by 20 to obtain the actual space current. The factor 20 is the ratio of the 2000-ohm multiplier, which is a part of the measuring circuit, to the value of resistance across which the measurement is made.

OPERATION

After the amplifier has been installed as described, it is ready for operation. The filament circuit should be closed and, after an interval of approximately 30 seconds (to allow the cathodes to reach normal operating temperatures) the 375-volt plate supply circuit should be closed. In the Western Electric Speech Input Equipments of which the No. 81A Amplifier is a part this complete operation is carried out automatically by means of the time delay circuit previously mentioned so that it is only necessary to operate a single power switch in starting.

The plate current of each vacuum tube should then be measured to determine if the tube is operating normally. With the No. 262A Meter Panel, or its equivalent, connected to the proper terminals on the amplifier the plate current measurements are made by depressing in turn each key on the front of the amplifier. The current in each tube should be 2.5 $\pm$0.5 milliamperes.

The gain of the amplifier should be set at the desired value by soldering the flexible connector to the proper resistance tap. The amplifier is supplied with the flexible connector soldered to tap 1 for 30 db gain. If a greater gain is required tap 2 (40 db gain) or tap 3 (50 db gain) should be used. The required gain will depend upon the use to which the amplifier is put, and upon the energy level desired at the output of the system. The input to the No. 81A Amplifier should be kept at such a level that its output does not exceed zero level as measured on a standard volume indicator.

In removing the amplifier from service the 375-volt plate supply circuit should not remain connected after the filament voltage is removed.

MAINTENANCE

The vacuum tubes used in the amplifier have a long but finite life and will require occasional replacement. The tubes should never be operated at higher filament or plate voltages than those recommended, as such operation shortens the useful life of the tubes and does not improve the operation of the amplifier.

Detailed instructions covering the maintenance of any of the apparatus incorporated in the amplifier will be found in Bulletin No. 517, "General Instructions for Maintenance of Speech Input Equipment".

When additional vacuum tubes are needed, they should be ordered as follows:

Name of Part	*How to Order*
Vacuum Tube	Western Electric No. 262A Vacuum Tube (for use in Western Electric No. 81A Amplifier)

Orders for other replacements should specify the apparatus designation (such as T1) shown on the schematic circuit and the wiring diagram as well as the code number which is marked on the apparatus. The order should state that the parts are intended for use in the Western Electric No. 81A Amplifier.

RECOMMENDED ACCESSORY EQUIPMENT

Apparatus	*Purpose*
Western Electric No. 262A Meter Panel	Amplifier Plate Current Measurement

The equipment described in this Bulletin
was designed and developed for the

Western Electric Company

by

BELL TELEPHONE LABORATORIES

2-D-36-2½C

Instruction Bulletin No. 695
WECO-T1170B