

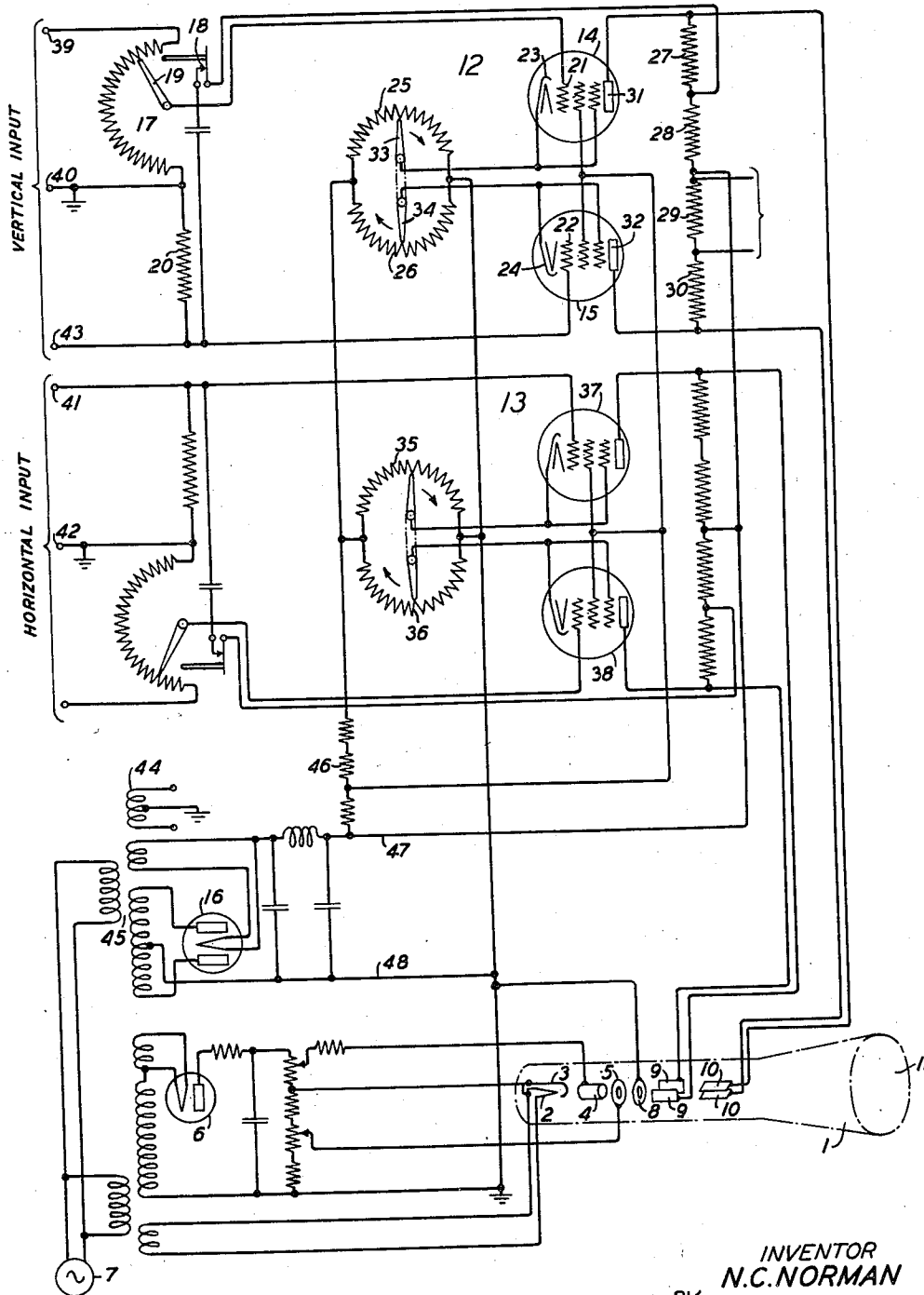
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AMPLIFIER

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AMPLIFIER

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This invention relates to amplifiers and particularly to amplifiers for use with cathode ray tube apparatus, such as oscilloscopes.

For some applications of such apparatus the signal currents to be amplified are derived from unsymmetrically grounded or unbalanced sources such as a simple microphone. In other cases they are derived from a symmetrically grounded or balanced source, such as a push-pull microphone and in still other cases the current to be amplified may be continuous.

The object of this invention is an improved amplifier which is particularly well adapted for use with cathode ray tube apparatus.

An amplifier according to this invention comprises two vacuum tubes with both their input and output circuits connected by resistor elements in push-pull relation. A feedback path is provided between the output circuit of one tube and the input circuit of the other whereby unbalanced signals impressed on the first tube are converted into balanced signals in the output circuit. When balanced signals are impressed across both input circuits the feedback path is opened and the amplifier then functions as a conventional push-pull amplifier. The input resistor element of the first tube is preferably a potentiometer associated with the switch in the feedback path in such a way as to open the path when the potentiometer is adjusted to the position of balanced input circuits.

When such an amplifier is used to apply potentials to the plates of a cathode ray tube, it is often necessary to vary the relative outputs of the two tubes to vary the position of the electron beam but as these tubes usually operate at high plate potentials, it is very desirable to avoid the use of the usual controls in the output circuit.

According to a further feature of this invention, the tubes are provided with individual grid biasing controls ganged in such a way that the bias on the two tubes may be varied simultaneously in opposite directions. With this circuit the beam of a cathode ray tube may be safely and quickly adjusted to any desired position on the screen of the tube.

These and other features of the invention will be more clearly understood from the following detailed description and the accompanying drawing illustrating one embodiment of the invention as applied to cathode ray oscilloscopes.

The cathode ray tube 1 is of a well-known type having a filament 2 for heating the cathode 3, a control grid 4 and accelerator anodes 5 and 8, all of which are energized by a rectifier 6 oper-

ated from the alternating current supply 7 in the usual way. Some of the electrons emitted by the cathode 3 are drawn through anodes 5 and 8 and pass between the two sets of deflecting plates 9, 9 and 10, 10 to the screen 11 at the end of the tube. In accordance with the usual procedure the voltages representing the phenomena to be observed are impressed on the plates 10, 10 and a sweep voltage synchronized with the phenomena is impressed on the plates 9, 9, to provide the time axis. Since the amplifiers 12 and 13 associated with the two sets of plates are identical only one of them will be described in detail.

The amplifier 12 comprises two vacuum tubes 14 and 15 which are energized by a conventional rectifier 16. In order to avoid unnecessary complication of the drawing the filament circuits have not been shown but it will be understood that they may be energized from the winding 44 on the transformer 45 supplying the rectifier 16. With the potentiometer 17 in its extreme clockwise position contact 18 is held open by the arm 19 and the input circuits of the tubes comprising the coupling potentiometer 17 and resistor 20, the control grids 21, 22, cathodes 23, 24 and the potentiometers 25, 26 are connected in balanced push-pull relation as shown. The output circuits comprising the tube cathodes 23, 24, the potentiometers 25, 26, the resistors 27, 28, 29 and 30 and the tube plates 31, 32, which are directly connected to the deflecting plates 10, 10 of the cathode ray tube, are also connected in push-pull relation and are supplied with plate potential over the conductor 47 by the rectifier 16.

The arms 33, 34 of the potentiometers 25, 26 are shown for convenience as mounted on separate pivots but in practice they are preferably mounted on a single shaft. The potentiometers are a part of the voltage dividing network 46 extending between the output conductors 47 and 48 of the rectifier 16 and the positive potentials of the arms 33, 34 are impressed on the cathodes 23, 24 so that the grids 21, 22 are effectively biased negatively with respect to the cathodes. As the potentiometers are rotated clockwise the bias on grid 21 is decreased and the bias on grid 22 is correspondingly increased thereby increasing and decreasing the plate currents of the tubes 14 and 15, respectively. Similarly a contra-clockwise adjustment will increase the plate current of the tube 15. These variations in the plate currents flowing through the resistors 27, 28 and 29, 30, respectively will produce corresponding variations in the relative potentials of the plates 10, 10

and the position of the beam between the plates will vary in the same manner as if the potential differences were produced in the usual manner by controls in the high potential side of plate circuits.

The potentiometers 35 and 36 may be used in a similar manner to vary the plate currents of the tubes 37 and 38 and thereby control the lateral position of the electron beam between the plates 9, 9. These two potentiometer units therefore provide a safe and convenient means of centering the beam or of moving it to any desired position on the screen 11.

With the novel input circuit shown these oscilloscope amplifiers may be used in a number of ways. When observing recurrent phenomena from an unbalanced source, terminals 39 and 40 of the vertical amplifier 12 (or terminals 41 and 42 of the horizontal amplifier 13) may be used. When amplifier 12 is so used potentiometer 17 is turned to some intermediate position according to the amplification required and since contact 18 is closed, the potential variations across the resistor 28 in the output of the tube 14 are impressed on the grid 22 of the tube 15. By a proper choice of the value of the resistor 28 the tubes 14 and 15 will therefore function as a balanced push-pull amplifier in the output circuit. When it is desired to observe the wave shape of the recurrent potential, the horizontal amplifier 13 may be driven by a relaxation oscillator or multi-vibrator to provide the necessary sweep circuit potential and this potential may be synchronized with the potential under observation by controlling the sweep circuit in the usual manner by a potential derived from the signal circuit such as that existing across the resistor 29.

When the phenomena are derived from a balanced source the potentiometer 17 is moved to its extreme clockwise position to open the contact 18, input terminals 39 and 43 are used, and the amplifier functions as a conventional push-pull circuit which may be used with or without a sweep circuit voltage as desired.

Since both the input and output circuits are resistance coupled, the amplifier will have a flat characteristic over a wide frequency band and even direct current (zero frequency) measure-

ments may be made by using the terminals 39 and 43. A direct current potential applied to these terminals will change the relative potentials of the grids 21 and 22 and thereby deflect the electron beam in the vertical plane in a manner similar to that already explained in connection with the use of the ganged potentiometers 25 and 26.

While the invention has been described with reference to a particular application, it will be understood that it is capable of a variety of uses and that it may be modified in various ways within the scope of the following claims.

What is claimed is:

1. An amplifier comprising two vacuum tubes 15 having input and output circuits connected in push-pull relation, a terminal connected to the input circuit of one of the tubes for unbalanced signal sources, a second terminal connected to the input circuit of the other tube for balanced signal sources only, means for deriving from the output of the one tube when operating from an unbalanced source a potential equal to the control potential at the input of said one tube, a feedback path for impressing the derived potential on the input of the other tube in opposed relation to the control potential in the input of said one tube, and means for opening the feedback path to condition the circuits for amplifying signals from a balanced source.

2. The combination with a push-pull amplifier comprising two vacuum tubes having input and output circuits each including portions individual to the tubes and a grounded portion common to the tubes, of a feedback path from the output of one of the tubes to the input of the other tube, a switch in said path, and means for varying the impedance of the portion of the input circuit individual to said one tube and for operating the switch.

3. A push-pull amplifier comprising two vacuum tubes having input and output circuits, an impedance across the input of each of the tubes, a feedback path from the output of one tube to the input of the other, and means for varying one of the impedances and for opening and closing the feedback path.

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