

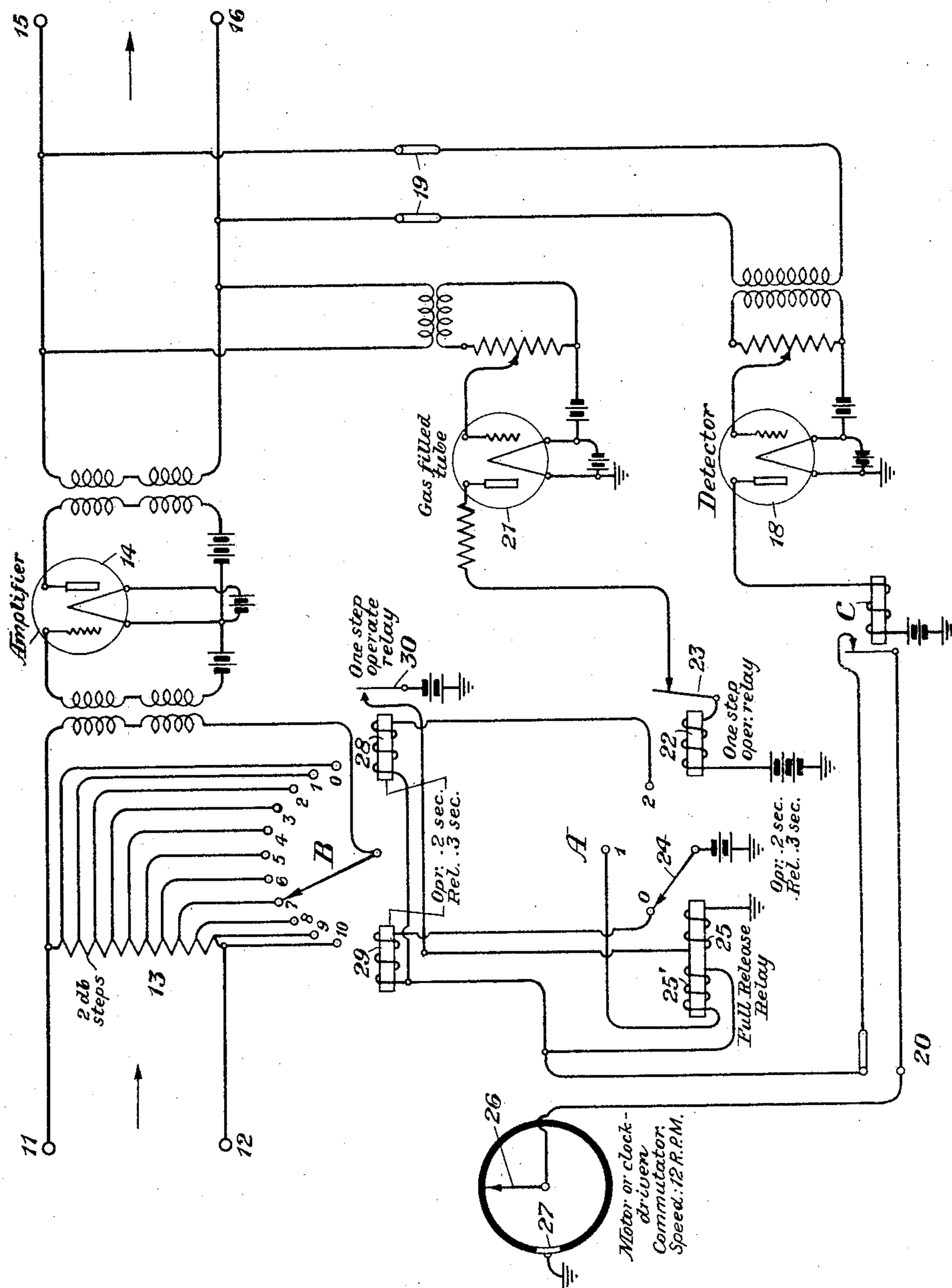
May 2, 1933.

E. M. STAPLES

1,906,775

VOICE OPERATED GAIN ADJUSTER

Filed Dec. 23, 1931



INVENTOR
E. M. Staples
BY *g r 40*
ATTORNEY

UNITED STATES PATENT OFFICE

ELLIOT M. STAPLES, OF HOHOKUS, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

VOICE OPERATED GAIN ADJUSTER

Application filed December 23, 1931. Serial No. 582,896.

Among the objects of my invention is to provide a new and improved method and corresponding apparatus for adjusting the gain of an amplifier in a signal transmitting system. Another object of my invention is to provide for adjusting the gain in accordance with the frequency of occurrence of voltage peaks. Still another object is to count voltage peaks on the output side of an amplifier and adjust the input thereto so as to keep the number of such peaks as nearly as practicable in constant ratio to elapsed time. All these objects and various other objects and advantages of my invention will become apparent on consideration of the following disclosure of a specific example of practice in accordance with the invention. It will be understood that the following disclosure relates principally to this particular example of my invention and that its scope will be indicated in the appended claims.

Referring to the drawing, this is a diagram of an amplifier and associated apparatus with which my invention may be practiced.

The amplifier 14 lies between the pair of input terminals 11, 12 and the pair of output terminals 15, 16. A potentiometer 13 is introduced on the input side and it will readily be seen that by adjustment of the arm of the switch B, steps of resistance are transferred from series to shunt and vice versa.

The detector 18 is connected across the line through the switches 19 on the output side of the amplifier 14. This detector 18 is adjusted so that any currents on the line above a certain low level will cause enough current to flow through the relay C to close its contacts and hold them closed. Thus, when the line is not in service or the currents on the line are not above a certain level, the relay C will permit its contacts to open, but when it is in service for voice or signal transmission these contacts will be closed.

Also connected across the output terminals of the amplifier 14 is the three-electrode gas-filled tube 21. The potentiometer on its input side, that is in its grid circuit, is adjusted so that at a certain desired voltage

the tube will "flash over", that is give a sudden current rush in the plate circuit containing the relay 22. This relay is slow acting. It and likewise the other relays presently to be mentioned, namely, 25—25', 28 and 29, require 0.2 second to operate and 0.3 second to release. When the flash-over current in the output circuit of the gas tube 21 operates the relay 22, it opens its own circuit at 23 for at least 0.3 second. When the relay 22 operates, it steps the switch arm 24 of the switch A one step to the right, that is from the 0 point to point 1, or from point 1 to point 2. Likewise for the operating relay 28, it steps the arm of switch B one step to the right. The release relay 29 steps this arm one step to the left, but release relay 25—25' returns the arm 24 all the way to the left even if relay 22 is operated. The switch arm 26 is driven by a motor or clock so as to make one revolution in 5 seconds. At one point in each revolution it makes contact with the grounded metallic segment 27 for a period long enough to operate relays 28 or 29.

Further details of structure will become apparent in connection with the following description of the operation of the system.

Case I.—As will be seen when all cases have been considered, arm 24 will be left on the 0 point immediately after arm 26 engages segment 27. Suppose that during a single rotation of the arm 26 from 27 around again to 27 there is one and only one voltage peak in the plate circuit of the gas tube 21 of sufficient intensity to operate relay 22. This single operation of the relay 22 will step the arm 24 of switch A from its 0 point to point 1, where it will remain until the arm 26 again reaches the segment 27. Thereupon a circuit will be closed from ground through segment 27, arm 26, front contact of relay C, winding 25' of relay 25—25', point 1 of switch A, arm 24 and battery to ground. The corresponding impulse of current in the circuit just traced, energizing the relay 25—25', will return the switch arm 24 to its 0 point. In this case no adjustment of the potentiometer switch B will be made, and as long as there

is a recurrence of one and only one effective voltage peak per 5 second interval, no adjustment will be made at B. Each time the switch arm 24 will step from its 0 point to point 1 and then at the end of the 5 second interval drop back to its 0 point. One such voltage peak per 5 second interval is considered to indicate a proper gain adjustment of the amplifier 14.

10 *Case II.*—Suppose that during such a 5 second period of rotation of the switch arm 26 from the segment 27 around and back to the segment 27 there is no voltage peak sufficient to operate the relay 22 in the output circuit of the gas tube 21. Then the arm 24 will remain on the 0 point of the switch A, and when the arm 26 arrives at the segment 27 at the end of the 5 second period a circuit will be closed as follows:
20 From ground through segment 27, arm 26, front contact of relay C, release relay 29, 0 point of switch A, its arm 24, and through battery to ground. The corresponding current impulse in the relay 29 will step the arm of switch B one step to the left, thus transferring a step of resistance 13 from series to shunt and increasing the intensity of the amplifier input, that is increasing the over-all gain. Each time that a 5 second
25 interval passes without an effective voltage peak, the arm of the switch B will be stepped one point to the left until it reaches the end of its possible travel in that direction, putting all the resistance in shunt and none in series. The absence of a voltage peak in a 5 second interval is deemed to indicate that the amplifier 14 is not giving enough gain and the adjustment is made accordingly.

40 *Case III.*—Suppose that during a 5 second interval, as determined by the rotation of the switch arm 26 from segment 27 around again to segment 27, there are two or more effective voltage peaks; thus, the arm 24 of switch A will be stepped twice to the right and will rest on point 2 when the arm 26 arrives at the segment 27. Thereupon a circuit will be closed from ground through segment 27, arm 26, front contact of relay
50 C, relay 28, point 2 of switch A, its arm 24, and through battery to ground. The corresponding current impulse in the relay 28 will step the arm of switch B one step to the right, thus transferring a step of resistance from shunt to series and thereby decreasing the over-all gain of the amplifier 14. It is considered that if effective voltage peaks occur as often as twice in a 5 second interval, this means that the amplifier gain
60 is too high and requires an adjustment downward. The energization of the relay 28 also closes a contact at 30, thus putting battery to a circuit through the winding 25 of relay 25—25' which restores the arm 24 of switch
65 A to its 0 point.

Briefly summarized, the operation involves increasing the gain, or leaving it unchanged, or decreasing it according as the number of effective voltage peaks is none per 5 second period, or one, or more than one. If there is over-adjustment one way due to fortuitous scarcity or frequency of voltage peaks in a 5 second period, it will be quickly corrected the other way in ensuing 5 second intervals. On an average, that is in the long run, the potentiometer 13 will be held at such adjustment that voltage peaks will occur at the rate of once per 5 second interval.

The detector 18 as connected in the system prevents adjustment when there are no voice currents on the line. It can be omitted by opening the switches 19 and shifting the switch 20. When it is omitted in this way and there is no speech on the line, then there will be an absence of voltage peaks and in each 5 second period there will be an adjustment as described above for Case II, so that eventually the amplifier 14 will be adjusted for the utmost gain. Then when speech starts, the necessary steps of adjustment down will quickly be made to bring the amplifier output to the proper level.

What is claimed is:

1. The method of adjusting for gain which consists in counting voltage peaks above a certain degree of intensity, holding the gain unchanged when these peaks occur at a certain time rate, increasing the gain when they occur less frequently, and decreasing the gain when they occur more frequently.

2. The method of adjusting for gain which consists in holding the gain unchanged when a voltage peak of as much as a certain degree of intensity occurs once in each of certain successive equal intervals of time, increasing the gain a step when no such peak occurs in such a period, and decreasing the gain a step when more than one such peak occurs in such a period.

3. The method of holding a certain desired power level at a certain point of a transmission line which consists in making gain adjustments in steps, with an added step when no voltage peak above a certain intensity occurs at that point within a certain period of time, with no step either way when there is one such voltage peak in said period, and with a subtracted step when there are more than one such peak in said period.

4. The method of adjusting for gain which consists in keeping the adjustment unchanged when voltage peaks above a certain degree of intensity occur at a certain rate and adjusting to increase or decrease the gain when these peaks are respectively less frequent or more frequent.

5. An amplifier adjustable for gain, a device responsive to voltage peaks above a

5 certain degree of intensity in the amplifier output, and a connection therefrom to adjust the amplifier, said connection comprising time lapse means to make adjustment dependent on frequency of response of the said device.

10 6. An amplifier, means to adjust its gain in steps, a device responsive to voltage peaks above a certain degree of intensity on its output side, a relay controlled accordingly by said device, a motor driven commutator, and means controlled jointly by said relay and commutator to adjust said first mentioned means for gain according to the relative frequency of occurrence of the voltage peaks.

15 7. An amplifier, means to adjust it for gain, a device connected on its output side and responsive to voltage peaks above a certain intensity, a counting mechanism to count such voltage peaks to 0, 1 or 2, a motor driven commutator, and circuit connections to actuate said means for adjusting the amplifier according to the count in the counting mechanism and the completion of a time cycle in the commutator.

20 In testimony whereof, I have signed my name to this specification this 22nd day of December 1931.

25 ELLIOT M. STAPLES.