

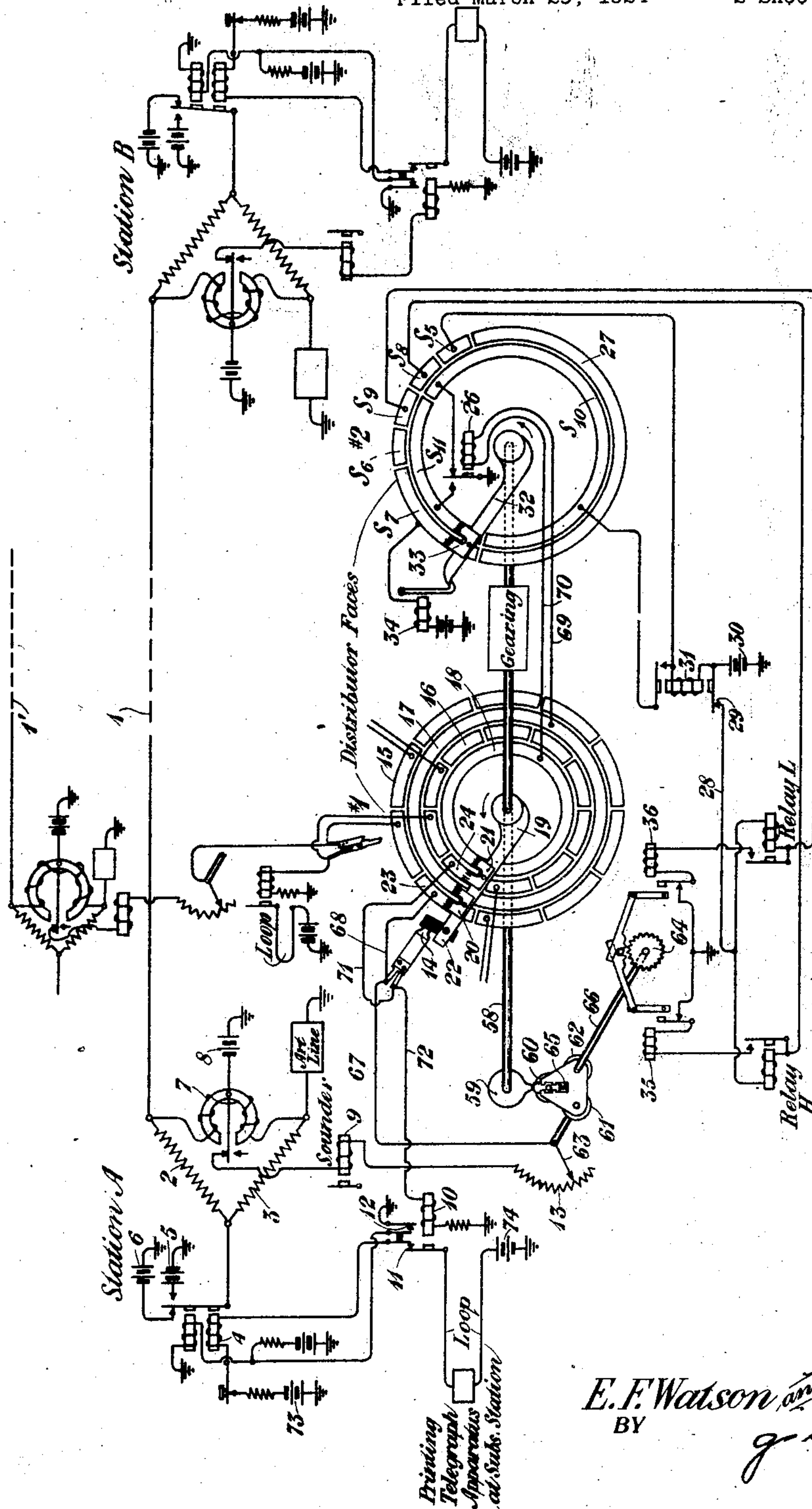
April 20, 1926.

1,581,305

E. F. WATSON ET AL
ELECTRICAL CONTROLLING SYSTEM

Filed March 29, 1924

2 Sheets-Sheet 1



INVENTORS
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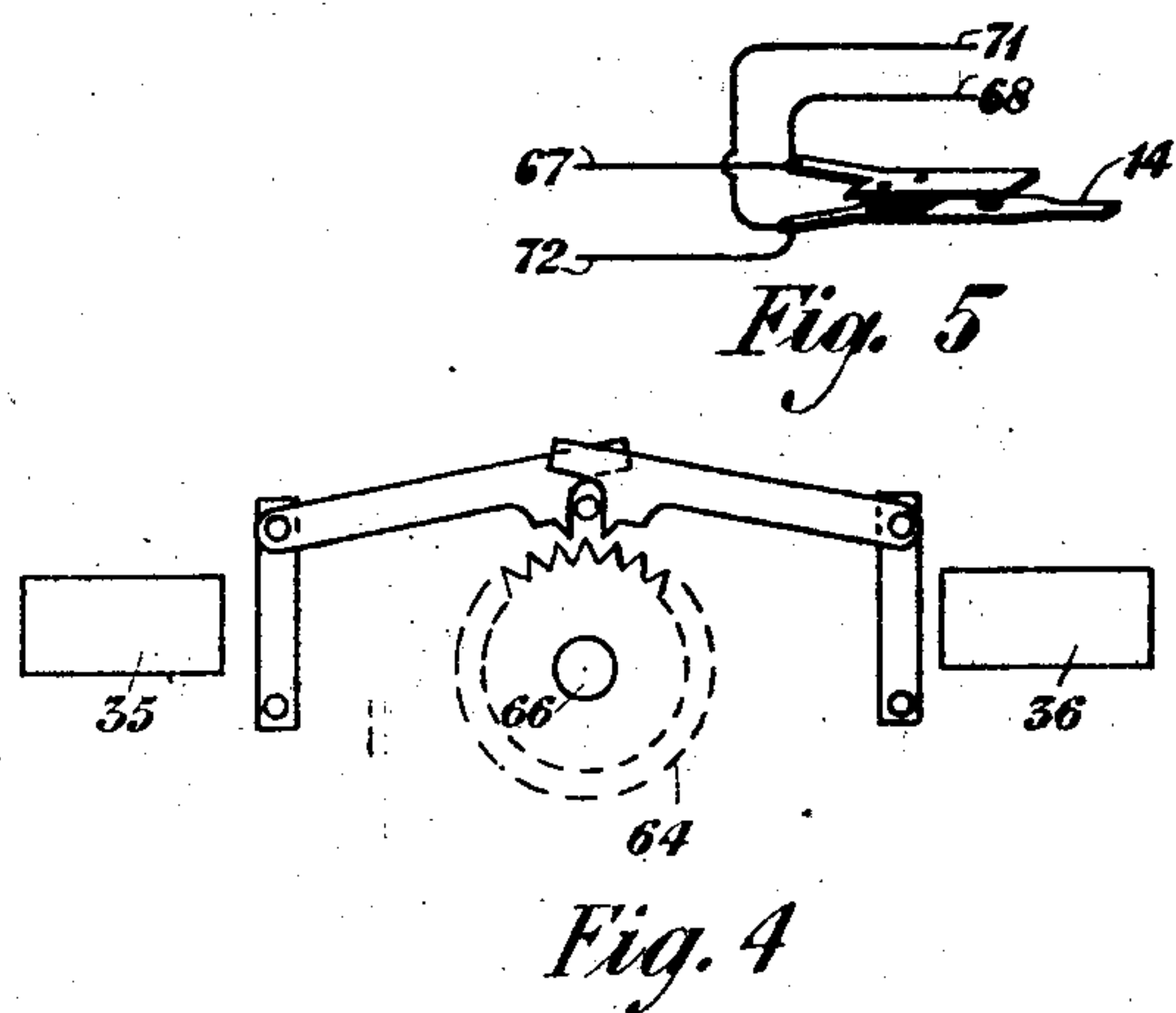
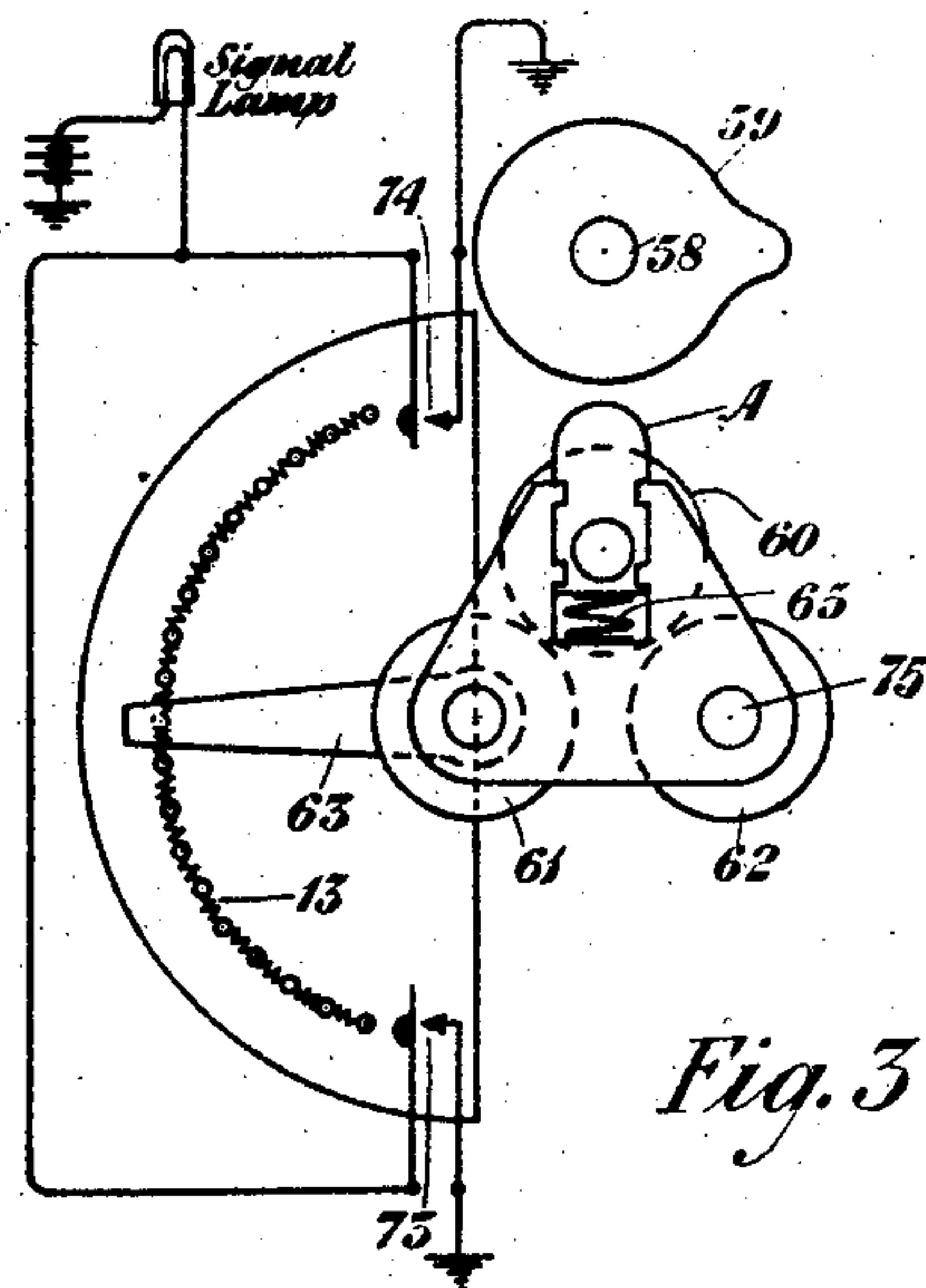
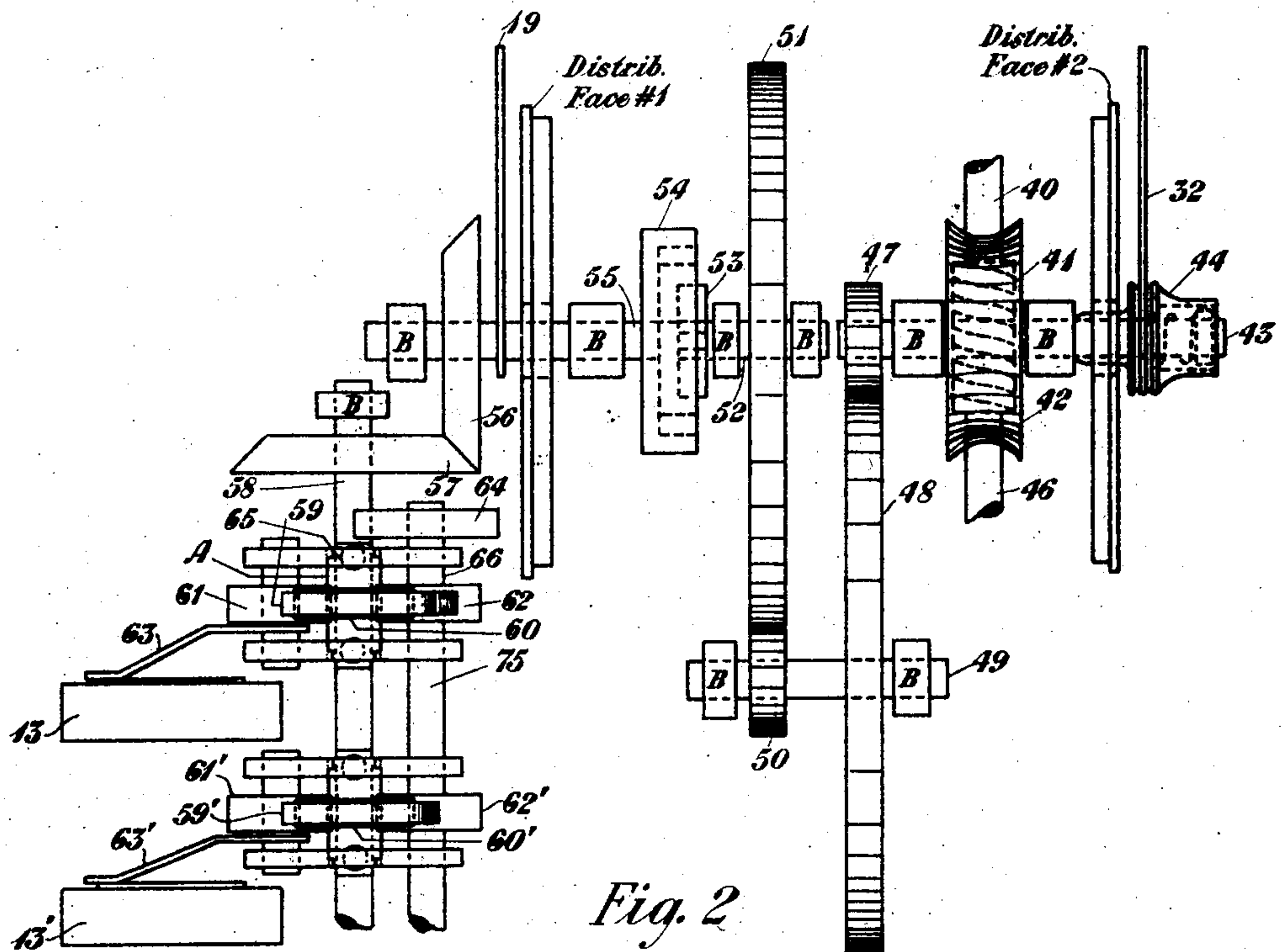
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UNITED STATES PATENT OFFICE.

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ELECTRICAL CONTROLLING SYSTEM.

Application filed March 29, 1924. Serial No. 702,902.

To all whom it may concern:

Be it known that we, EDWARD F. WATSON and ARTHUR E. HUNT, residing at Larchmont and New York, in the counties of Westchester and New York and State of New York and New York, respectively, have invented certain Improvements in Electrical Controlling Systems, of which the following is a specification.

This invention relates to electrical controlling systems, and particularly to means for correcting the distortion of signaling impulses such as are used in printing telegraph systems.

In order to obtain efficient operation of printing telegraph systems, it is necessary to eliminate the effect of distortion upon the receiving apparatus connected with the line circuit over which the signaling impulses are transmitted and which is the principal source of such distortion. If a signal is distorted in the course of transmission over a line, an impulse of wrong polarity may be applied to a segment of the receiving distributor of the printer, which in turn produces an incorrect signal character in the apparatus associated therewith. A device for determining the existence of distortion of telegraph signals without discontinuing the transmission of commercial service over the circuit is disclosed in the co-pending application of Watson, Serial No. 638,124, filed May 10, 1923. The invention therein disclosed simply indicates the presence of distortion and it is necessary to make a manual adjustment of the apparatus in order to correct for the said distortion.

It is the object of this invention to provide a method and means for automatically compensating for the distortion or bias in signals received by a telegraph repeater or terminal circuit connected with a line. A further object of the invention is to provide means whereby a plurality of such repeaters or terminal circuits may be successively tested for distortion and automatically adjusted to compensate for such distortion. A further object consists in the provision of means for signaling a repeater attendant in case the distortion becomes of such magnitude that the compensating apparatus cannot make sufficient adjustments to compensate for such distortion.

Other objects of this invention will be apparent from the following description, when read in connection with the attached drawing, of which Figure 1 shows, in general, the application of the invention to a plurality of duplex telegraph circuits; Fig. 2 shows in detail the driving mechanism for moving the rheostats which effect the adjustment of the circuit to compensate for the bias of the signals; Fig. 3 shows in detail the rheostat operating mechanism with the signal lamp for attracting the attention of the repeater attendant; Fig. 4 is a detail of the mechanism of Fig. 3; and Fig. 5 shows in detail a form of contact which may readily be opened by the arm of the distributor.

In Fig. 1, the line 1 connects the terminal circuits at station A and station B, the terminal circuit at B being substantially identical to that at A with the exception that the compensating apparatus shown at A is omitted at B for simplicity. The terminal circuit at A comprises the bridge coils 2 and 3, the junction point of which is connected with the armature of the pole changer 4. This armature, which is controlled by the operation of the transmitting apparatus connected with the loop circuit, applies impulses of opposite polarity from the batteries 5 and 6 to the line. The armature of the receiving relay 7 is adapted to apply impulses of current from the battery 8 to that branch of the receiving circuit including the sounder 9 and the control relay 10. By the operation of the control relay, the loop circuit is opened and closed at the contact 11, thereby transmitting open and closed impulses to the subscriber's station, herein represented as comprising printing telegraph apparatus. The contact 12 of the control relay 10, which opens whenever contact 11 opens and, vice versa, closes whenever contact 11 closes, controls the action of the holding winding, that is, the upper winding, as shown in the figure, of the pole changer 4. The branch of the receiving circuit which includes the sounder 9 and the control relay 10 will hereinafter be referred to as the control relay circuit. This circuit includes the rheostat 13 and the circuit is normally closed through the contact 14 which is closely located to the distributor face No. 1. This contact is so arranged that it will be opened

by the rotating arm of distributor face No. 1 during the interval in which the line 1 is being tested for distortion. The distributor face No. 1 comprises four rings, two of which, designated 15 and 16, are segmental, and 17 and 18 are continuous. The rotating arm 19 of this distributor carries two brushes 20 and 21, both of which are insulated from the arm. Brush 20 is adapted to connect the segments of ring 15 with the adjacent ring 17, and in like manner, brush 21 makes a connection between the segments of ring 16 and ring 18. The extension of arm 19, which is designated 22, is adapted to open the normally closed contact 14 of the control relay circuit during the interval in which the brushes 20 and 21 are upon the segments 23 and 24 connected with the line circuit 1 to be tested. The distributor face No. 1 is intended to successively connect with the compensating control circuit ten lines such as 1, each having its own terminal circuits connected therewith. For the sake of simplicity, only one complete circuit, viz, line 1 and the terminal circuit at station A will be shown connected with this distributor but it is to be understood that the leads taken out from the other segments of rings 15 and 16 are to be connected with control relay circuits of the terminal circuits of other lines. The continuous rings 17 and 18 are connected by conductors 69 and 70 with the line relay 26 associated with the distributor face No. 2. This distributor face is, in general, similar to that used in the start-stop type of printers comprising two segmental rings, the outer ring having a plurality of segments of equal size and equally spaced. Segment S_6 is normally connected with the printing apparatus and segment S_7 controls the starting of the distributor. Interposed between segments S_7 and S_6 are segments S_8 and S_9 , segment S_8 being connected with relay H, which in turn is connected over conductor 28 and through contact 29 with the battery 30. Segment S_9 is similarly connected with relay L, which in turn is connected by conductor 28 through contact 29 with the battery 30. Relays H and L control the magnets 35 and 36 respectively. The fifth segment S_5 is connected with the winding of relay 31, the function of which is to open the circuit of relays H and L in the event that the fifth impulse received by the apparatus over the line 1 is a closed impulse. The reason for doing so will be made clear later.

The inner ring comprises two segments, designated S_{10} and S_{11} . One of the divisions between these segments coincides in radial position with the division between segments S_8 and S_9 . One of the contacts of relay 26 is connected with segment S_{10} and the other with S_{11} . The arm 32 of this distributor carries the brush 33 insulated therefrom, which

is adapted to connect the segments of the inner and outer rings of this distributor. This arm is controlled in its operation by the starting magnet 34.

The mechanism for effecting the rotation of the arms of distributor faces No. 1 and No. 2 and also for controlling the rheostat 13 is shown clearly in Fig. 2. In this figure, 32 is the revolving brush arm of distributor face No. 2, which is driven by a motor through the shaft 40, worm 41, worm gear 42, shaft 43 and friction clutch 44. Attached to arm 32 is the brush 33 as shown in connection with the distributor face No. 2 in Fig. 1. This brush makes contact with the segments of the distributor face No. 2. On the shaft 46 connected with the worm 41 is a governor to control the speed of rotation of the brush arm 32 and to keep it uniform. This arrangement is similar to that in use in connection with the well-known start-stop type of distributors, with the exception of the size of the segments of the distributor face No. 2. Connected with the shaft 43 is a spur gear 47 which meshes with the gear 48 connected with the shaft 49. This shaft also carries the spur gear 50 which meshes with the gear 51 connected with the shaft 52. The shaft 52 also carries a one-tooth gear 53 which coacts with the internal gear 54 connected with the shaft 55, to which is attached the brush arm 19 of the distributor face No. 1. The gears 47, 48, 50 and 51 give a speed reduction of 25 to 1, so that the single tooth gear 53 makes one revolution for 25 revolutions of shaft 43. The internal gear 54 has ten teeth, so that each revolution of gear 53 advances gear 54 the distance of one tooth or one-tenth of a revolution. This means that shaft 55 and brush arm 19 rotate one-tenth of a revolution for every 25 revolutions of shaft 53. Attached to the brush arm 19, as mentioned heretofore, are the brushes 20 and 21 which make contact with the segments of the distributor face No. 1. At the end of the shaft 55 are two bevel gears 56 and 57, the latter of which is connected with the shaft 58 which serves to operate the rheostat controlling mechanism.

The shaft 58 carries a plurality of cams, one for each rheostat. Such a cam is shown clearly by 59 of Fig. 3. This cam causes the idler gear 60 to engage the gears 61 and 62, so that gear 61, to which is attached the arm 63 of the rheostat, will be operated by gear 62 whenever the ratchet wheel 64 is operated by the magnets 35 and 36 as shown in Fig. 1 and in greater detail in Fig. 4. The idler gear 60 is normally held out of engagement with gears 61 and 62 by means of the spring 65 or equivalent means associated with the journal of the said gear. The ratchet wheel 64 (shown in detail in Fig. 4) will be moved whenever one of the magnets

35 or 36 is energized, and the direction of rotation depends, of course, upon which magnet is energized. As will be seen in Fig. 2, this ratchet wheel is connected with the shaft 66 to which is also attached the gear 62. It will accordingly be seen that whenever the projection of the cam 59 depresses the gear 60 into engagement with the gears 61 and 62, the arm 63 of the rheostat will be moved in one direction or the other whenever the magnets 35 and 36 are energized. As will later be seen, this movement of the arm of the rheostat varies the resistance 13 in the control relay circuit and effects such adjustment that the bias of the signals is compensated for. The arrangement in Fig. 2 shows a plurality of rheostats connected with the shafts 58 and 63 by means of which the bias in a plurality of terminal circuits may be compensated for.

Having in mind the foregoing description of the apparatus and of the circuit in which this invention is embodied, the invention itself will be made clear by the following description of the mode of operating the circuit.

In the well-known start-stop printing telegraph system, for each character there will be transmitted an open or start impulse followed by five selecting impulses, each of which may be either open or closed, and then a closed or stop impulse. By the term "open impulse" is meant an impulse of such character as to deenergize the line relay 26 and the control relay 10 and to allow their armatures to drop back, and similarly, the term "closed impulse" means one that will energize these relays so that their armatures will be attracted. The existence and magnitude of distortion is determined by investigating the condition of the sixth impulse, which, if understood, is applied to the line relay 26 while the brush 33 is moving from segment S_8 to S_9 . Any distortion of this impulse, namely any lengthening or shortening thereof, will cause the operation of either relay H or L and will, in turn, effect the operation of the compensating rheostat. In the start-stop printing telegraph system, the sixth impulse is always a closed impulse for each signal character transmitted. The biased condition of this sixth impulse controls the operation of the compensating device for each character except those in which the fifth impulse is closed. Where this condition prevails, the bias compensating device is rendered inoperative in order to prevent improper operation due to the fifth impulse overlapping on to segment S_8 . Since the fifth impulse is a closed one in only a few signal characters, it will be apparent from subsequent description of the operation of this device that this does not affect to any important degree the usefulness of this device. As mentioned before,

segments S_8 and S_9 are of equal size and are located between segment S_5 , designed to receive the fifth signal impulse, and segment S_6 designed to receive the sixth or printing impulse. When the signals are undistorted, the line relay 26 would be operated at the instant the brush 33 is passing over the division between segments S_8 and S_9 . Since this impulse is a closed impulse, relay 26 will be energized and the left-hand contact, namely that which is connected with the segment S_{11} , will be disconnected from the grounded armature. Accordingly, when the brush 33 moves on to segment S_9 , the circuit extending from battery 30 and including contact 29, conductor 28, winding of relay L and segment S_9 will be opened at the left-hand contact of relay 26. If there is distortion of the signaling impulses, the sixth impulse will start to be received when the brush 33 is upon either segment S_8 or S_9 .

Let us assume that the sixth impulse has been transmitted over line 1 and that the receiving relay 7 has been energized, so that its armature will move to the position shown in Fig. 1. Current will then flow from battery 8 through the upper contact of relay 7, thence over a circuit including the sounder 9, resistance 13, conductors 67 and 68, segment 23, ring 17, conductor 69, line relay 26, conductor 70, ring 18, segment 24, conductors 71 and 72, and control relay 10. Since this circuit is closed, relays 26 and 10 will be energized. By the energization of relay 26, its armature is attracted to its right-hand contact, and by the energization of relay 10, contacts 11 and 12 are closed. The closing of contact 11 establishes a circuit from the grounded battery 73 to the grounded battery 74, thereby transmitting a closed impulse to the printing telegraph apparatus connected with the loop circuit. The control relay circuit is closed through the line relay 26 for the reason mentioned heretofore, namely that the contact 14 is opened after the brushes of arm 19 move on to the segments 23 and 24, which are assigned to the particular circuit shown in Fig. 1. Furthermore, since the arm 19 is connected with the shaft 55, which is rotated by the single tooth gear 53 one-tenth of a revolution for each 25 revolutions of the shaft 43, to which the brush arm 32 of the distributor face No. 2 is connected, it will be seen that the control relay circuit of the terminal circuit at station A connected with line 1 will remain connected with the line relay 26 of the distributor face 2 during the time in which the arm of distributor face No. 2 is making 25 revolutions. This interval of time represents the receipt of approximately twenty-two signal characters, each made up of five signal impulses and a sixth or printing impulse. This duration of time is sufficient to determine the condition of twenty-two sixth impulses

transmitted over the line 1 and to effect compensation for any bias or distortion of these impulses produced by line or repeater apparatus conditions. The distributor arm 32 is
 5 synchronized with the transmitting device at station B and the distributor face No. 2 is initially adjusted to put the apparatus in such condition that with undistorted signals the brush 33 of arm 32 should be passing
 10 across the division between segments S_8 and S_9 when the relay 26 is energized by the sixth or closed impulse.

Let it be assumed that the tongue of relay 7 touches its upper contact and thereby
 15 transmits a closed impulse over the control relay circuit during the time in which the brush 33 is passing over the segment S_8 , that is to say, just before it reaches the division between S_8 and S_9 . Relay 26 will accordingly be energized, so that the segment S_{10}
 20 will be grounded through the right-hand contact of this relay. Since at this instant the brush 33 connects segments S_8 and S_{10} , a circuit will be established from battery 30, over contact 29, conductor 28, winding of
 25 relay H and through segments S_8 and S_{10} to ground. Relay H will be energized and, in consequence thereof, the magnet 35 associated therewith will also be energized by
 30 current from the battery 30. The attraction of its armature will cause the rotation of the wheel 64, shown in detail in Fig. 4, which, by virtue of its being connected with the shaft 66, will effect the rotation of the
 35 gear 62. When the arm 21 of the distributor face No. 1 is in the position shown, the shaft 58 has been rotated to such position that the cam 59 has depressed the gear 60 into position where it meshes with gears 61
 40 and 62, so that when the toothed wheel 64 is rotated by the action of the magnet 35, gear 61 will also be rotated and the arm 63 will be moved in such direction as to increase the resistance in the control relay
 45 circuit, that is to say, the resistance 13.

If the signals are biased light, the sixth impulse will not be received until after the brush 33 has passed on to segment S_9 , that is to say, the line relay 26 and the control
 50 relay 10, which serves to control the impulse applied to the loop circuit, will not be energized until this instant of time. Consequently, when the brush 33 passes on to segment S_9 , the relay 26 is not operated and
 55 the grounded armature is against its left-hand contact. There will be established a circuit from battery 30, through contact 29 and conductor 28, winding of relay L and segments S_9 and S_{11} to ground. This will
 60 cause the operation of relay L, which in turn will cause the operation of the magnet 36 by current from the same source 30. The operation of magnet 36 will cause a movement of the toothed wheel 64 in opposite di-
 65 rection to that in the case mentioned above.

Accordingly, the gear 62 will be moved in opposite direction, and since the gear 60 is meshed with gears 61 and 62, the arm 63 of the rheostat will be moved in opposite
 70 direction to that previously mentioned so as to decrease the resistance in the control relay circuit and thereby to increase the current. This increase of current will tend to overcome the lightness of the signal and to com-
 75 pensate for the bias.

If the fifth impulse is a closed impulse, the compensating apparatus will not effect the desired result. In order to prevent false compensation, means have been pro-
 80 vided for effectively disconnecting the compensating apparatus in the event that the fifth impulse is closed. This disconnecting apparatus consists in the relay connected with the segment S_5 . If the fifth impulse
 85 is closed when the brush 33 moves over the segment S_5 , the relay 26 will be energized and a circuit will be established from battery 30, through winding of relay 31, segments S_5 and S_{10} and right-hand contact of
 90 relay 26 to ground. This opens the upper contact 29 of this relay and disconnects the battery 30 from relays H and L and their associated magnets. Relay 31 is locked up
 95 and remains so until the start impulse for the next signal character is received. This avoids a false adjustment of the relays controlling the compensating rheostat.

As will be seen in Fig. 3, if the arm 63 is moved sufficiently far in either direction, it
 100 will close the contacts 73 or 74 and will cause the operation of a signal lamp or other device for attracting the attention of the repeater attendant. This indicates that the bias is so great that the automatic compen-
 105 sating apparatus will not sufficiently correct the difficulty and it requires the manual adjustment by the repeater attendant.

After the shaft 45 of the distributor face No. 2 has rotated 25 times, the single toothed gear engages with the internal gear 54 and
 110 moves the shaft 55 one-tenth of a revolution. This moves the arm 21 of distributor face No. 1 on to the succeeding segments which are connected with another terminal circuit or repeater, as shown in Fig. 1. The move-
 115 ment of shaft 55 also moves shaft 58 one-tenth of a revolution which operates a cam 59' and effectively connects the gears 61' and 62' for controlling the rheostat 13' of another terminal circuit or repeater similar to
 120 that shown completely in Fig. 1. The distributor face No. 1 is shown with ten sets of segments, rendering it possible to test ten terminal circuits or repeaters such as are
 125 shown connected with the lines 1 and 1'. It is, of course, to be understood that the number of circuits to be tested may be varied by increasing or decreasing the number of sets of segments upon the distributor face No. 1.
 130 As soon as the arm 21 has been rotated so

that the brushes 20 and 21 pass on to the next segments 23 and 24 connected with the circuit shown in Fig. 1, the control relay circuit of station A is closed through by the closing of contact 14. The contact is so positioned in regard to the cam that the brushes must be on the segments such as 23 and 24 before the contact 14 is opened, and also the contact must be closed before the brushes pass on to the next succeeding segments. This prevents the possibility of opening the control relay circuit and interrupting the receipt of signals from the sending station.

While this invention has been disclosed as embodied in a particular form, it is to be understood that it is capable of embodiment in other and different forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a system for compensating for bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a line of terminal circuits having printing telegraph apparatus connected therewith and means to automatically adjust the said terminal circuits to compensate for bias of the signals.

2. In a system for compensating for bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a line of terminal circuits having printing telegraph apparatus connected therewith, and means responsive to and controlled by the printing impulse transmitted with each signal character over the said line to automatically adjust a terminal circuit to compensate for bias of the said printing impulse.

3. In a system for compensating for bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a line of a terminal circuit having means responsive to signal impulses transmitted by the said line and applied to the said terminal circuit, and means connected with the terminal circuit and controlled by impulses received from the said line to compensate for bias of the signals.

4. In a system for compensating for bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a line having terminal circuits connected therewith adapted to apply signals consisting of impulses of opposite polarity to the said line, and means connected with one of the said terminal circuits responsive to the signaling impulses applied by the said line to the said terminal circuit and adapted to control compensating means to correct for the bias of an impulse.

5. In a system for compensating for the bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a duplex telegraph circuit

of terminal circuits having printing telegraph apparatus connected therewith adapted to transmit and receive signal characters each consisting of a group of impulses of which a predetermined one is closed in each character, and automatic compensating means connected with the said duplex telegraph circuit and controlled by the said predetermined closed impulse to adjust the said circuit for bias of the said closed impulse.

6. In a system for compensating for bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a plurality of lines each having a terminal circuit having apparatus responsive to signaling impulses sent over the line connected thereto, and means connected with each terminal circuit and common to all of said circuits to adjust automatically the respective terminal circuits to compensate for bias of received signals.

7. In a system for compensating for bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a line of a printing telegraph transmitter connected with one end of the said line to apply impulses thereto, a polar relay connected with the opposite end of the said line responsive to the said impulses, a receiving circuit, controlled by the said polar relay, having a current varying device connected therewith, and an impulse testing arrangement comprising means responsive to biased impulses, operatively connected with the said current varying device, to actuate the latter in accordance with the degree and the nature of the bias.

8. In a system for compensating for bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a line of a printing telegraph transmitter connected with one end of the said line to apply impulses thereto, a polar relay connected with the opposite end of the said line responsive to the said impulses, a receiving circuit, controlled by the said polar relay, having a current varying device connected therewith, a relay connected with the said receiving circuit, a plurality of electro-responsive devices connected with the said current varying device, and switching means to connect the said relay with the said electro-responsive device whereby the said device will be actuated and the said current varying device will be operated.

9. In a system for compensating for bias of telegraph signals consisting of a lengthening or shortening of an impulse, the combination with a plurality of lines, of printing telegraph transmitters individual to and connected with each of the said lines, polar relays individual to and connected with each of said lines, a receiving circuit for each

line controlled by its polar relay and having current varying means connected therewith, an impulse testing device common to all lines comprising compensating means responsive to biased impulses operatively connected with the current varying device, of each receiving circuit, and switching means to connect the said compensating

means with the receiving circuit of each line circuit for a limited period of time. 10

In testimony whereof, we have signed our names to this specification this 27th day of March, 1924.

EDWARD F. WATSON.
ARTHUR E. HUNT.