Nov. 26, 1935. C. F. WATTS 2,022,330

SYNCHRONOUS TELEGRAVER SYSTEM

Filed April 19, 1932 2 Sheets-Sheet 1

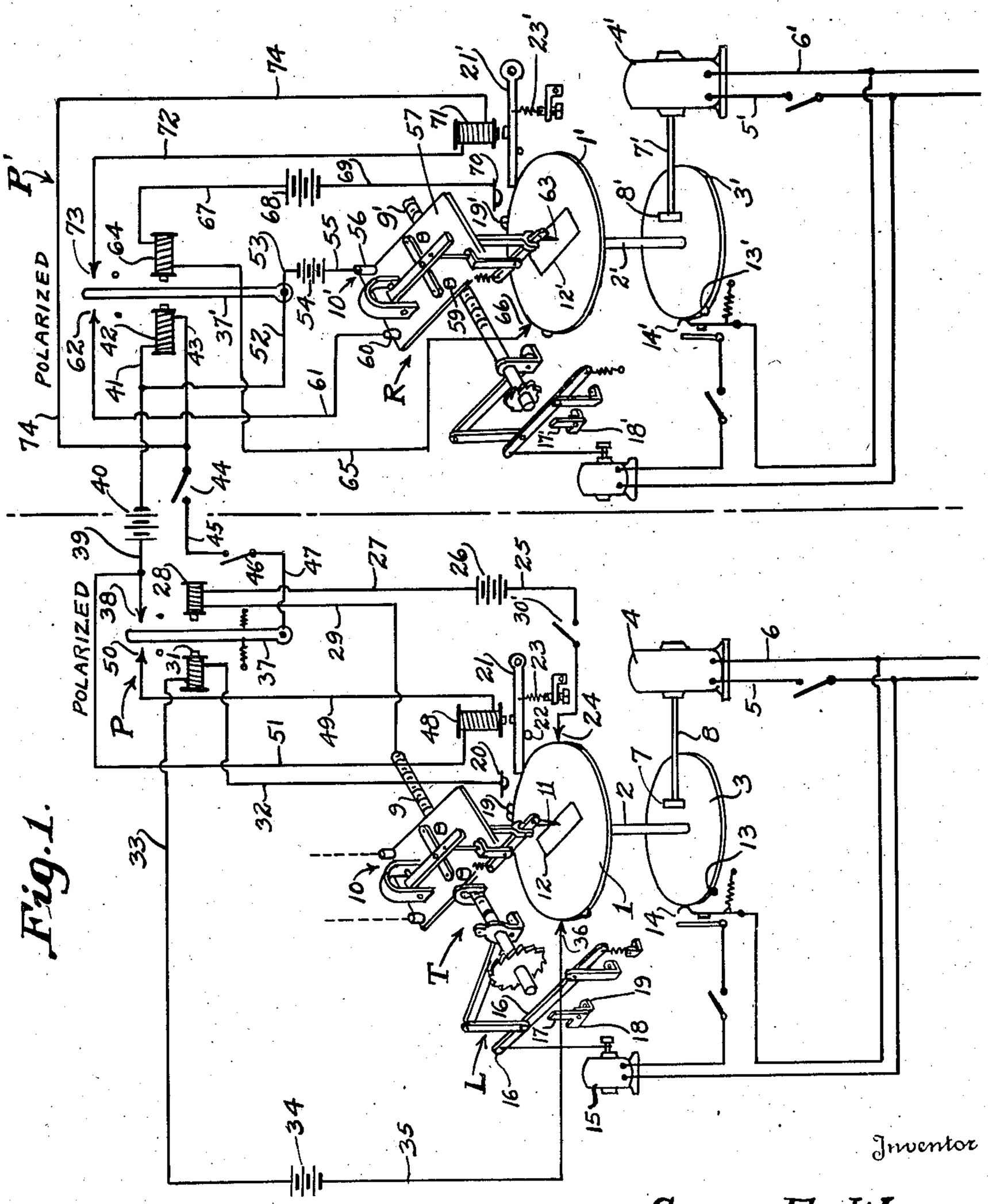

Fig. 1.

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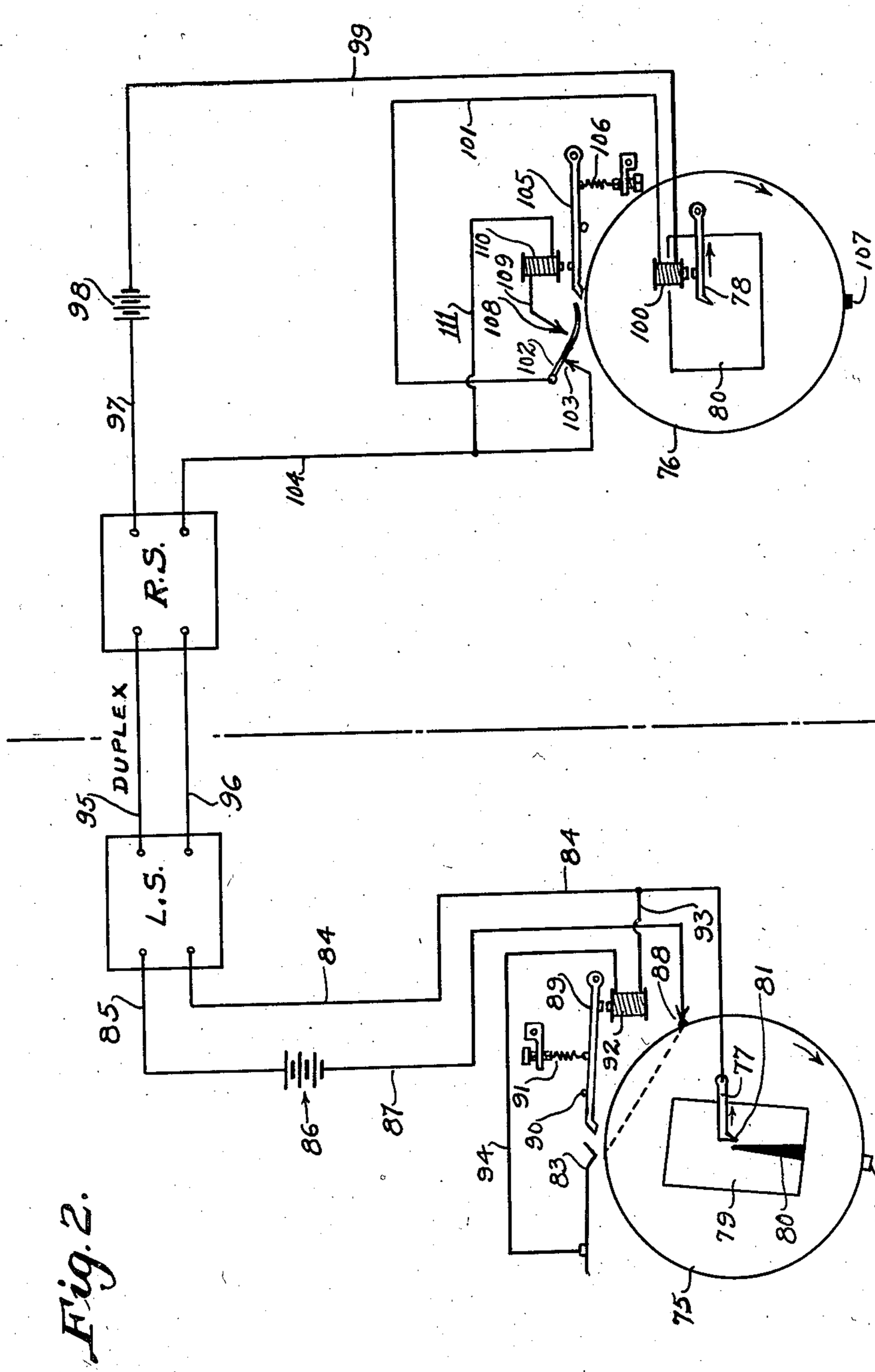

Fig. 2.

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SYNCHRONOUS TELEGRAVER SYSTEM

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Application April 19, 1932, Serial No. 606,190

4 Claims. (Cl. 178—69.5)

This application is a continuation-in-part of my application for Telegravure apparatus, Serial No. 505,855, filed December 31, 1930.

In said application, pictures are transmitted electrically from an image placed on a rotating disk to a plate arranged on a similar disk at a distance from the first named disk. In this picture transmitting system the tracer on the sending mechanism is moved step by step radially and intermittently over the disk to describe a series of concentric contacting circles over conducting and non-conducting spots formed by the lines of the image on the transmitter disk, or by halftone screening where the picture to be transmitted is shaded.

In the receiving apparatus, the receiver disk is intended to be rotated in exact synchronism with the disk of the sending apparatus. In actual practice, however, it has been found that one disk will lag or lead in its rate of rotation relative to the other, and thereby cause distortion in the picture transmitted. Attempts have been made to correct this distortion by rotating the receiving disk at a slightly greater speed than the sending disk and to stop the receiving disk at each complete rotation thereof; and to connect the two electrically so that release of the receiving disk is effected only when transmitting disk passes through a position corresponding to the stop position of the receiving disk. This means that the two disks start rotation simultaneously at the completion of each revolution of the transmitting disk.

The objection to this method is that it produces a distortion in the transmitted image. The deliberate speeding up of rotation of the receiving disk ensures a positive out of step partial rotation of the receiving disk at each complete rotation of the transmitting disk, and repetition of this lead in the receiving disk produces a cumulative lead in the received picture and causes distortion. If the disks of the two machines were set to rotate as nearly as possible in exact synchronism, it is quite likely that there would be less relative lag or lead between the two disks in a hundred revolutions than that deliberately set up to ensure a positive lead in the receiving disk alone.

It is the main object of the present invention to eliminate this distortion whether deliberate or accidental; and, to ensure co-operating control between the sending and receiving disks so that either may correct the out of step rotation of the other whenever the lag or lead of either requires it.

While the invention is particularly described herein in connection with a rotating disk system, such as described in my said application, it is to be understood that it is not to be considered as limited to the particular mechanism illustrated herein. The invention is designed to synchronize the movements of any two rotatable bodies regardless of whether they be in the form of rotating disks or rotating drums on which the transmission and reception is effected.

In the present application, the invention is shown as embodying an apparatus in which a tracing tool in the sender controls a graving tool in the receiver. It is contemplated, however, that this invention shall also be used in connection with any optical picture transmitting system, since it involves substantially the same mode of operation insofar as synchronization of the rotation of the transmitting and receiving members are concerned. The description and drawings herein are merely intended to illustrate the broad inventive idea and are not intended to be in any way limited to the particular form of apparatus shown.

This invention also has for its object the addition to the apparatus shown in said application of mechanism whereby the image transmitted may be reproduced either enlarged or reduced on the receiver.

Other objects of the invention will become apparent as the detailed description thereof proceeds.

In the drawings:

Figure 1 is a diagrammatic layout of parts of the apparatus disclosed in my said co-pending application with the synchronizing apparatus forming the present invention added thereto; and

Figure 2 is a diagrammatic layout of the synchronizing mechanism adapted for use with similar telegravure apparatus over a duplex system of transmission.

As shown in Figure 1, the invention is illustrated as applied to picture transmitting apparatus designated generally by the reference character T, and receiving apparatus designated generally by the reference character R. The mechanism for operating the transmitter is exactly the same as that for operating the receiver. In the transmitting mechanism, a disk 1 is suitably supported for rotation about a vertical shaft 2 having a friction disk 3 connected thereto. A motor 4 supplied from the mains 5 and 6 has a friction pinion 7 secured to its rotor shaft 8. The pinion 7 is in driving contact with the friction disk 3 and serves to rotate the disk 1 at constant speed. In the re-

ceiver apparatus, a disk 1' is supported for rotation about a vertical shaft 2' having a friction disk 3' secured thereto, a motor 4', supplied through the mains 5' and 6', has a rotor shaft 7' provided at its end with a friction pinion 8' which rotates in contact with the friction disk 3 to impart rotation to the disk 1'. The driving mechanism in both sender and receiver is intended to rotate the disks 1 and 1' at exactly the same speed.

Suitably supported above the disk 1 is a feed screw 9 which intermittently moves a sending device 10 lengthwise thereof. The sending device 10 includes a tracer 11 designed to move in a direction over disk 1, and in contact therewith, parallel to the axis of the screw 9 during the rotation of the disk 1; thereby tracing a series of concentric circles on the disk 1 or on any picture 12 suitably secured to said disk 1. To effect this intermittent movement, the friction disk 3 is provided on its periphery with a projecting lug 13 which, at each complete revolution of the shaft 2 and the disk 1 carried thereby, wipes against a spring contact 14 to close a circuit to the motor 15 deriving its energy also from the mains 5 and 6.

In each closing of the switch 14 the motor operates a ratchet linkage designated generally by the reference character L, and pulls down the rod 16 of said linkage into contact with one or the other of the arms 17 or 18 of a stop member rotatably mounted on a suitably supported bracket 19. The angle of rotation of the screw 9 at the end of each revolution of disk 1, is therefore controlled as to magnitude in accordance with the stop positions of the arms 17 or 18. Variation in this angular movement necessarily causes corresponding variations in the movements of the tracer and receiving mechanism lengthwise of the screws 9 and 9'.

As fully described in my said application, this movement, step by step, is designed to move the tracer 11 so as to trace out a series of contacting concentric circles on the sending disk 1. This arrangement therefore, insures a positive contact with each conducting or non-conducting spot on the picture 12 to be transmitted.

The receiver mechanism supporting the graving tool is operated in exactly the same manner as the corresponding mechanism of the transmitter and the several parts thereof are designated by the same numerals primed. Of course, when it is desired to receive pictures on the same scale as the picture on the transmitting disk, it is necessary to arrange the appropriate stop arm 17' or 18' in the receiver to effect this result. Where the image is reproduced on an enlarged scale, the contact of the concentric circles on the reproducing plate may be secured by making the graving tool of sufficient width. For example, if the reproducing tool be moved three times as far as the tracer at each revolution of the disk the contacting effect would be secured by making the end of the tool three times as wide as the end of the tracer.

Referring now to the transmitter disk 1, there is shown on the edge of said disk a conducting lug 19 adapted to wipe against an electrical contact 20 at the same instant as the lug 13 closes the switch 14. An armature 21 is pivoted to the supporting mechanism of the transmitter and is held normally against a stop 22 by means of an adjustable spring 23, so that its end lies in the path of the said conducting lug 19. The end of this armature clears the periphery of the disk 1 and merely lies in the path of movement of the conducting lug 19.

The disk, as usual in devices of this character, is of conducting material. The picture sending circuit starts with a contact 24 on the end of switch controlled line 25 connected to battery 26 which is connected by a wire 27 to terminal of a magnet 28. The other terminal of magnet 28 is connected by a wire 29 to the feed screw 9 which is electrically connected to the tracer 11. The picture circuit completed or interrupted when the switch 30 is closed in accordance with whether or not the point of the tracer 11 is on a conducting or non-conducting spot of the image plate 12. The magnet 28 forms part of a polarized relay designated generally by the reference character P. The other magnet 31 of the relay P is connected by a wire 32 to the brush contact 20 and by a wire 33 to a battery 34 and wire 35 to a contact 36 wiping against the edge of the conducting disk 1.

The armature 37 of the polarized relay P is normally in neutral position between the electro-magnets 28 and 31 and therefore, normally out of contact with the terminal 38 of the picture transmission wire 39. The wire 39 is connected through a battery 40 to a wire 41 connected to one terminal of an electro-magnet 42 having its other terminal connected by wire 43 through switch 44 wire 45 switch 46 and wire 47 to the armature 37.

An electro-magnet 48 is arranged adjacent the stop armature 21 to raise the latter when it becomes necessary to move said armature out of the stop position relative to the stop lug 19. One terminal of the magnet 48 is connected by a wire 49 to the other contact 50 of the polarized relay P; and the other terminal of the magnet 48 is connected by a wire 51 to the line 39. This completes the synchronizing wiring of the transmission apparatus.

The picture receiving circuit in the receiving apparatus includes the conducting armature 37' which is connected at its pivoted end by a wire 52 to the line wire 41 in advance of the magnet 42 of the polarized relay P'. This picture reproducing circuit is completed by wire 53, battery 54, wire 55, terminal 56, plate 57, electro-magnets 58 and 59, plate 57, terminal 60, wire 61, and contact 62. It will be obvious from inspection of the drawings that every time electro-magnet 28 of the relay P in the transmitter is energized the electro-magnet 42 of the receiver relay P' will also be energized and will pull the armature 37 into contact with the contact 62 and close the circuit through the magnets 58 and 59 operating the graving tool 63.

The relay P' also includes an electro-magnet 64 connected by a wire 65 to the conducting disk 1' by a wiping contact 66. The other terminal of the magnet 64 is connected by a wire 67 through a battery 68 and wire 69 to a wiping spring contact 70 arranged in the path of movement of the conducting stop 19'. The stop armature 21' is adapted to be raised against the tension of the spring 23' by energization of the electro-magnet 71. The magnet 71 is connected by a wire 72 to the relay contact 73 and by a wire 74 to the return line 44 of the transmission line. This completes the wiring of the synchronizing system in the receiving apparatus.

In operation: with the various switches closed the passage of the tracer 11 over the conducting and non-conducting spots of the image 12 causes the electro-magnet 28 to move the armature 37 of the relay P into intermittent contact with the contact 38 of the transmission line. Every time the armature 37 makes contact with contact 38

the electro-magnet 42 is energized and draws the armature 37' of the receiving relay against the contact 62. The reproducing circuit completed through the armature 37' and magnets 58, 59 of the receiver and wiring included in the circuit causes the graving tool to reproduce the image of transmission plate 12 on the receiving plate 12'.

It is necessary in this system that in both the transmission and receiving circuits the current for the magnets 31 and 64 shall be strong enough to pull the armatures 37 and 37' away from the contacts 38 and 62, respectively, even when current is circulating in the main transmission line. With this understanding, then, it becomes evident that when the stop contact 19' is against the end of the armature 21', the disk 1' is prevented from rotation and the armature 37' has been pulled over into contact with the contact 73 even when current is circulating through magnet 42. Since the circuit including the armature 37' and contact 62 is now broken the spring mechanism of the receiving tool holds the tool 63 up from the receiving plate 12'.

While the armature 37' is being held against the contact 73 and the disk 1' is stopped, the transmitting disk is still in rotation clockwise toward the end of the armature 21, and the magnet 28 is being intermittently energized by the movement of the tracer 11 over the conducting and non-conducting spots. This intermittent energization of the magnet 28 causes intermittent closing of the circuit through the transmission line and magnet 42 and also causes the intermittent flow of current, by means of the by-pass wire 52, armature 37', contact 73 and wire 72 through magnet 71 and wires 74 and 44 to the armature 37'. However, the tension of the spring 23 is adjusted so as to prevent raising of the stop armature 21' by these intermittent impulses. It is only when the conducting stop 19 on the transmitting disk 1 contacts with the end of the armature 21 and with the wiping contact 20 that current of sufficient strength flows through both magnets 48 and 71 for simultaneously raising the armatures 21 and 21', thereby permitting both disks to resume simultaneously their synchronous rotation.

As previously stated, the intermittent current due to the intermittent swings of the armature 37, while the disk 1 was rotating in stop 19 toward contact with the wiping contact 20, is insufficient to energize the magnet 71 for the purpose of freeing the receiving disk. However, just as soon as contact is made between the contacts 19 and 20 the circuit energizing the electro-magnet 31 is completed through the wires 32, 33, battery 34, wire 35 and contact 36 to the edge of the disk 1. Immediately upon completion of this circuit the armature 37 is pulled over and held in contact against the contact 50 thereby effecting a continuous closed circuit through the main transmission line and magnets 38 and 41 sufficient to raise the armatures 21 and 21' simultaneously to release the disks 1 and 1'.

It will be obvious that the operation is precisely the same when the sending disk arrives at stop position ahead of the receiving disk. Therefore, there is an inter-control between the two systems which absolutely assures the control of each disk by the other. In the case of a break down in the line; or a break in the main circuit, it is also clear that both disks will continue their rotation to stop position and can only be started in operation again by repair of the break in the line.

The switches 44 and 46 are arranged in the transmission line to be controlled at the receiving and sending ends, respectively, so that the operators at either station can have independent control of the system.

The form of the invention shown in Figure 2 of the drawings is designed for use in duplex systems. In this form the sending and receiving disks 75 and 76 are designed to be rotated at the same speed by any suitable mechanism such as disclosed in Figure 1 of the drawings. The sending or transmitting device is provided with the usual tracer 77 which moves intermittently at each complete rotation of the disk to trace out the usual series of contacting concentric circles. The graver 78 in the receiving instrument is likewise moved radially and intermittently at each complete rotation of the receiving disk to describe a similar series of contacting concentric circles. On the transmitting disk 75, the image plate 79 is suitably fixed and is provided with an insulating radial control segment 80 adapted to contact with the point 81 of the tracer 77 at the same instant as a conducting stop 82 on the disk 75 makes wiping contact with a spring contact 83 adjacent the periphery of the disk 75 and spaced apart therefrom just enough to make good electrical contact with the stop contact 82 every time the disk 75 completes a rotation.

The sending circuit includes a wire 84 connected electrically at one end of the tracer 77 and at its other end to a local station LS where the circuit is completed suitably through the receiving station and receiver to wire 85, battery 86, and wire 87 and contact 88 of the periphery of the conducting disk 75.

At the transmitting station an armature 89 has one end pivotally supported, while the other end is held against a stop 90 by means of an adjustable spring 91. The free end of the armature 89 is bent so as to be drawn toward the periphery of the disk 75 by energization of the electro-magnet 92. Normally, the free end of the armature 89 is spaced from the periphery of the disk so as to clear the conducting stop 82 as it rotates past the end of said armature. The magnet 92 has one of its terminals connected by a wire 93 to the wire 84 and has its other terminal connected by a wire 94 to the spring contact 83.

The usual duplex wiring system 95—96 connects the local station to the receiving station RS. This station RS is connected by a wire 97, through battery 98 and wire 99, to the electro-magnet 100 which controls the movements of the graving armature 78 toward and from the receiving plate 80 which is adapted to receive the transmitted image on the receiving disk 76. The other terminal of the electro-magnet 100 is connected by a wire 101 to the pivot point of a double throw switch 102 normally contacting with a contact 103 at the end of a wire 104 also connected to the receiving station RS. It is understood, of course, that the circuit between the wires 97 and 104 will be completed through the apparatus of the receiving station.

At the receiving station, an armature 105 is pivotally supported and has its free end held by an adjustable spring 106 with its free end close to the periphery of the receiving disk 76. The disk 76 on its periphery has a non-conducting stop projection 107 adapted, as the disk 76 rotates, to move under the free end of the double throw

switch 102, and shift said switch from contact 103 against contact 108 at the end of a wire 109, which is connected to one terminal of the electro-magnet 110; the other end of said magnet being connected by a tap wire 111 to the wire 104. In the receiving apparatus the armature 105 is held normally in the path of rotation of the stop 107. Upon energization of the magnet 110, which can only happen when the double throw switch 102 is moved by contact 107 to energize the magnet 110, the armature 105 is raised from contact with the periphery of the disk 76 to permit rotation again of the said disk 76.

The insulating segment shown on the image transmission plate 79 is of sufficient width, even in its narrowest part, to insure the tracer point 81 making contact with that insulating segment at any instant that the non-conducting projection 107 on the receiving plate 76 shall have moved the double throw switch 102 from contact 103 to contact 109. In the normal operation of this form of the invention, the picture transmission is effected through the tracer 77, wire 84, local station LS, wire 96, receiver station RS, wire 104, contact 103, switch 102, wire 101, magnet 100, wire 99, battery 98, wire 97, receiving station RS, wire 95, local station LS, wire 85, battery 86, wire 87 and contact 88. It will be evident that every impulse transmitted from the transmitter will be repeated by the tool 88 in the receiving apparatus.

Assuming now that the receiving disk has moved slightly ahead of the transmitting disk 76 so that the insulating contact lug 107 shall have moved the double throw switch 102 from contact 103 against contact 109 it is evident under this condition that no current is being transmitted from the transmitter disk to the receiver and that the disk 76 is prevented from further rotation by contact of the end of the armature 105 with the stop 107. It will also be evident that under this condition of affairs the two magnets 100 and 110 are in series and derive their energization through the tap wire 111, instead of directly through the contact 103. During this slight period preceding the movement of the tracing point from the edge of the triangular segment 80 to the radial line bisecting the same, the conducting contact 82 will have moved directly under the spring contact 83. Just as soon as this contact is made the circuit through the magnet 92 is closed to pull the armature 89 into the path of movement of the stop 82 and thereby to stop the disk 75.

The circuit through this magnet 92 then includes the contact 83, wire 94, magnet 92, wire 93, wire 84, local station LS, wire 96, receiving station RS, wire 104, wire 111, magnet 110, wire 109, contact 108, switch 102, wire 101, magnet 100, wire 99, battery 98, wire 97, receiving station RS, wire 95, local station LS, wire 85, battery 86, wire 87, contact 88, through the conducting disk 75 and conducting stop 82 to contact 83. This impulse immediately energizes the magnet 110 and pulls the armature 105 out of the path of movement of the stop 107 to permit the disk 76 to start rotation again. Just as soon as the stop 107 moves from under the switch 102, the switch falls back from contact 108 to contact 103. During this momentary break or movement of the switch 102, the circuit through the magnet 92 in the transmitting station is broken, and the spring 91 immediately pulls the armature 89 out of the path of the conducting stop 82 so that the disk 75 follows instantaneously after the disk 76. The inter-control between the transmitting and receiving mechanisms of the system will be obvious to persons skilled in the art without further description.

While I have described my invention as embodied in concrete form and as operating in a specific manner in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

What I claim is:

1. In an electrical transmission system, a transmitting disk of conducting material rotatably mounted and having an insulating segment arranged in a predetermined position thereon, a conducting lug projecting from the periphery of said disk in predetermined relation to said segment, a receiving disk of conducting material rotatably mounted and having an insulating lug projecting from the periphery thereof and in fixed relation to the insulating segment of the transmitting disk, means for rotating said disks at substantially the same speed, and means operable by contact with said lugs to correct the lag of either disk relative to the other.

2. In an electrical transmission system, a transmitting disk of conducting material rotatably mounted and having an insulating segment arranged in a predetermined position thereon, a conducting lug projecting from the periphery of said disk in predetermined relation to said segment, a receiving disk of conducting material rotatably mounted and having an insulating lug projecting from the periphery thereof and in fixed relation to the insulating segment of the transmitting disk, stops mounted to move into the paths of movement of said lugs, and means controlled by simultaneous contact with said lugs to move said stops out of said paths.

3. In an electrical transmission system, a transmitting member of conducting material rotatably mounted and having an insulating section arranged in a predetermined position thereon, a conducting lug projecting from the periphery of said member in predetermined relation to said segment, a receiving member of conducting material rotatably mounted and having an insulating lug projecting from the periphery thereof and in fixed relation to the insulating section of the transmitting member, means for rotating said members at the same speed, and means operable by contact with said lugs to correct the lag of either member relative to the other.

4. In an electrical transmission system, a transmitting member of conducting material rotatably mounted and having an insulating section arranged in a predetermined position thereon, a conducting lug projecting from the periphery of said member in predetermined relation to said segment, a receiving member of conducting material rotatably mounted and having an insulating lug projecting from the periphery thereof and in fixed relation to the insulating section of the transmitting member, stops mounted to move into the paths of movement of said lugs, and means controlled by simultaneous contact with said lugs to move said stops out of said paths.

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