March 4, 1930. H. H. HAGLUND 1,749,735

MULTIPLEX TELEGRAPH SYSTEM

Filed June 22, 1927 4 Sheets-Sheet 1

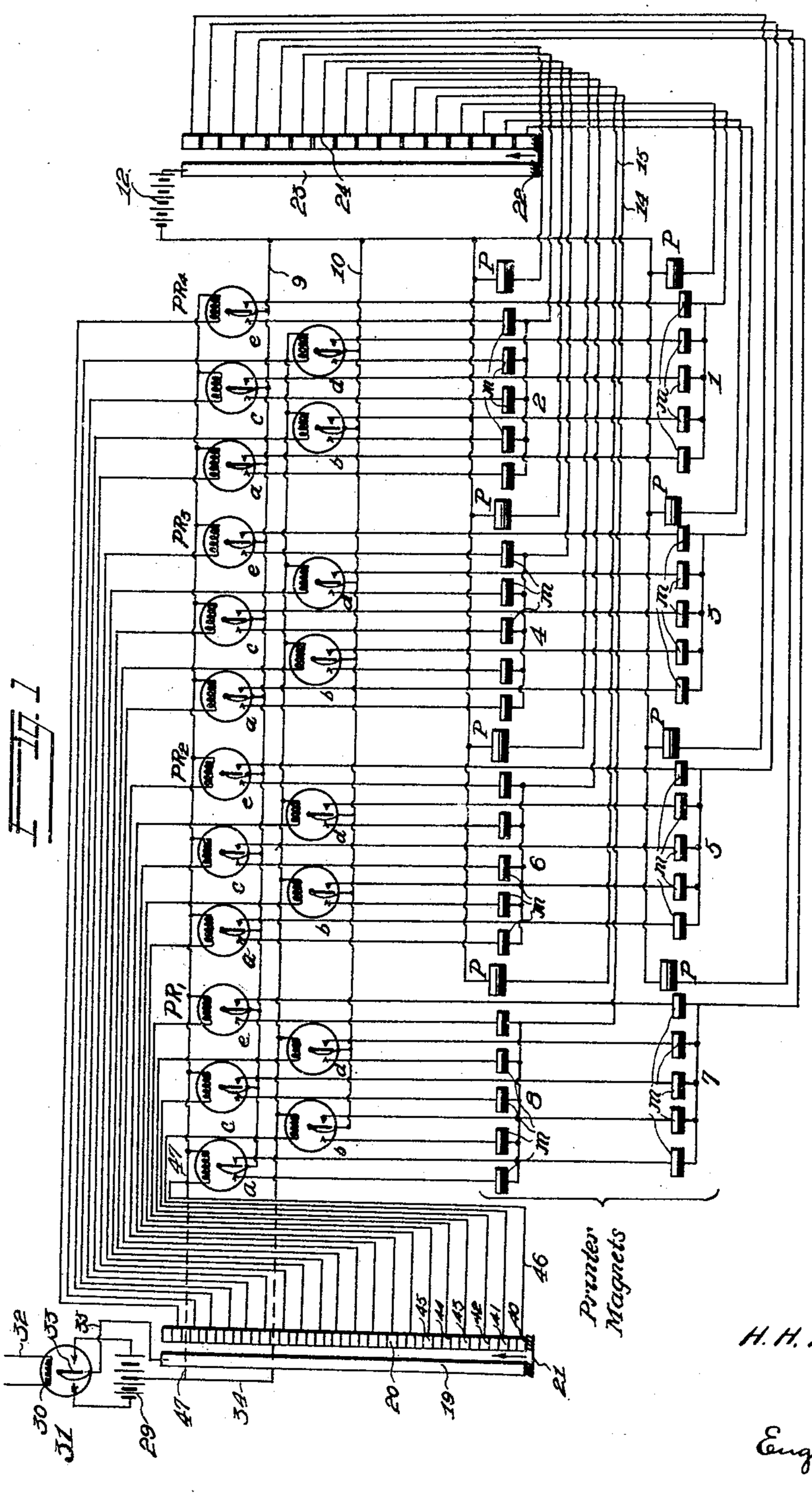

Fig. 1

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MULTIPLEX TELEGRAPH SYSTEM

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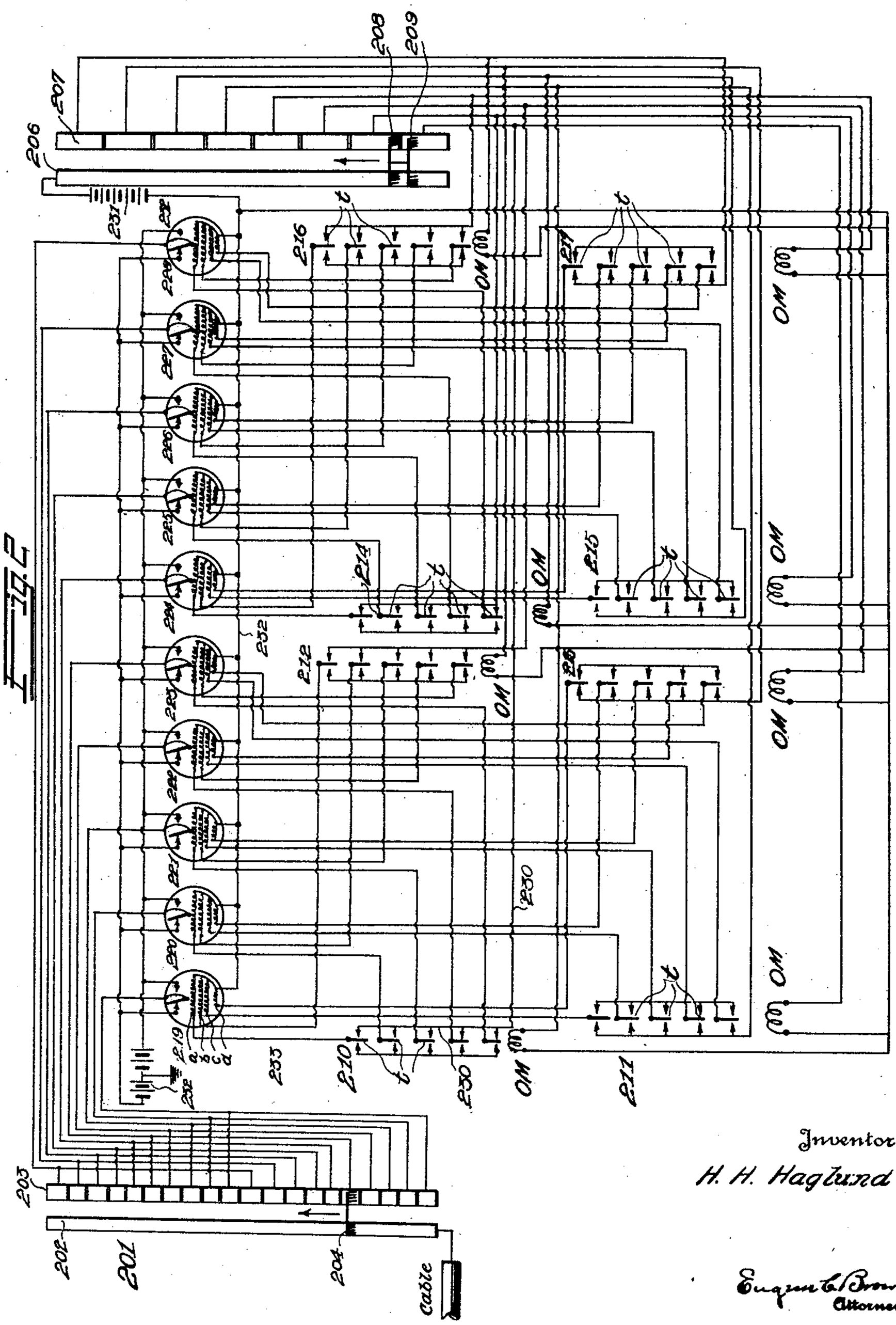

Fig. 2.

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MULTIPLEX TELEGRAPH SYSTEM

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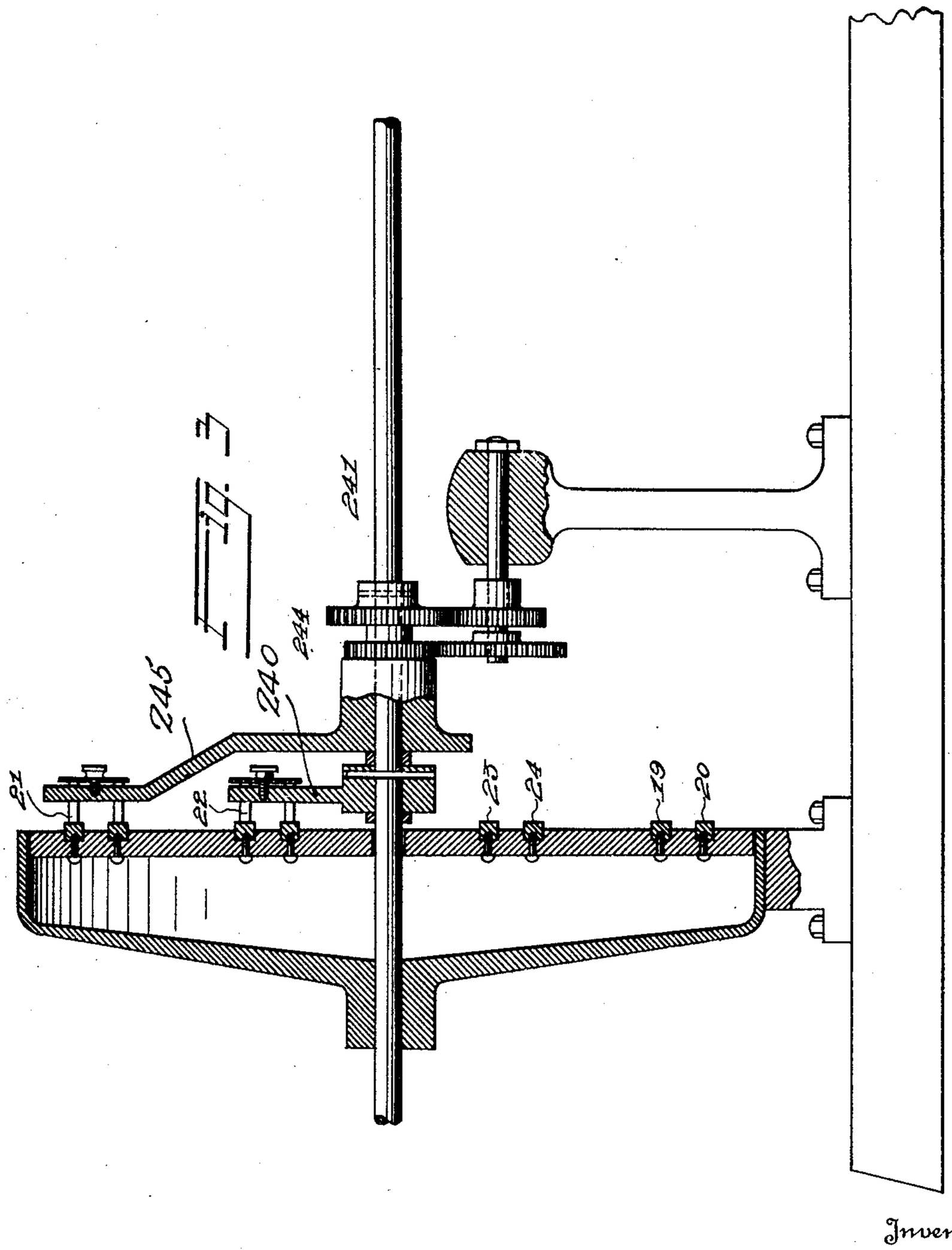

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MULTIPLEX TELEGRAPH SYSTEM

Filed June 22, 1927 4 Sheets-Sheet 4

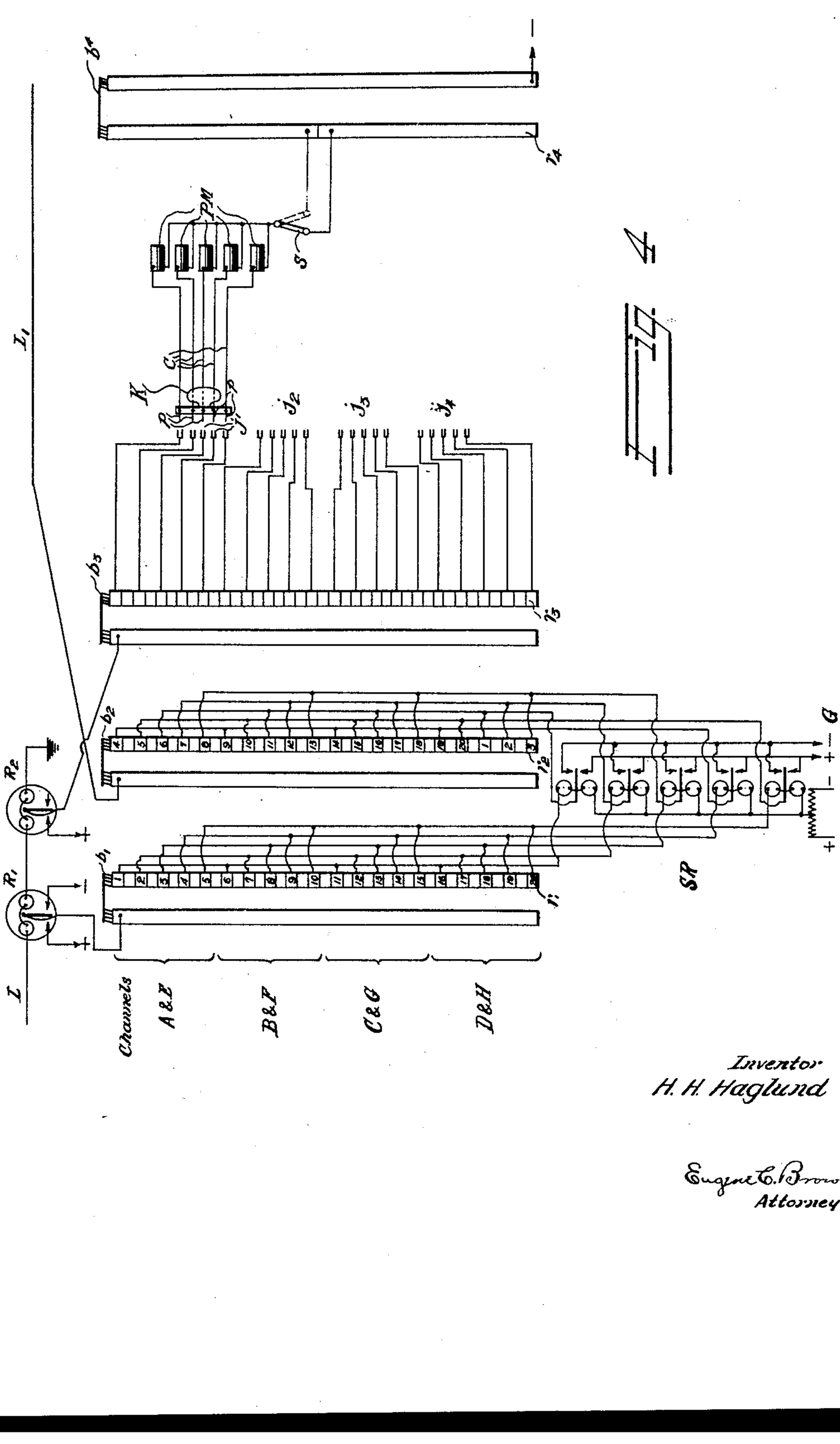

Fig. 4

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UNITED STATES PATENT OFFICE

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MULTIPLEX TELEGRAPH SYSTEM

Application filed June 22, 1927. Serial No. 200,686.

My invention relates to signalling systems, and more particularly to multiplex telegraph systems.

The distributors employed in multiplex telegraph systems usually comprise a pair of receiving rings, a pair of correcting rings, a pair of sending rings and a pair of local rings, a pair of vibrating rings and a pair of direction control switch rings, making a total of six pairs of rings.

The receiving rings include one solid ring and one ring divided into a number of segments insulated from each other, usually ten segments for each channel, five alternate segments being connected to the receiving magnets of the printer and the other five alternate segments being idle and arranged to be wiped by the brushes during the period at the beginning and at the end of each impulse, so that the printer magnets are operated in response to the middle portion of each impulse.

Similarly the correcting rings comprise one solid ring, and one ring with ten segments for each channel, the segments being multipled together and connected to the correcting mechanism.

The transmitting rings comprise one solid ring and one ring with five segments for each channel, each segment being connected to a transmitting relay armature.

The local rings comprise one solid ring and one ring with two segments for each channel as will be described more in detail hereinafter.

The vibrating rings comprise one ring with five segments for each channel and the other with ten segments for each channel.

The direction control rings comprise one solid ring and one ring with only two segments regardless of the number of channels.

In order to increase the number of channels in a system, two methods have heretofore been available. In one method the size of each segment is reduced as much as possible so as to increase the number of segments on the distributor. In the other method the circumference of the distributor is increased. Both of these varying quantities, however, have their limits, beyond which it is not practical to go. Thus, for example, the standard distributor face plate employs segments which are nine degrees in length, although it has been found that the selecting magnets can be made so sensitive that they would operate properly at maximum distributor speed with segments six or seven degrees in length. It is impractical, however, to make segments smaller than this. On the other hand, it is obvious that after the distributor has reached a predetermined circumference, it becomes unwieldy and therefore impractical. For this reason, the number of channels in a system have usually been limited to four or five channels.

From this brief description of the arrangement of the distributors, it is noted that the segments of the corrector ring for instance are connected together electrically. When the brushes pass over the correcting rings therefore, the alternate segments are connected through the brushes to the solid ring in such a manner that the continuous circuit through these alternate segments is simply made and broken at a certain rate. This rate remains the same whether the brushes pass over the eighty correcting segments of an ordinary eight channel distributor at a speed of three hundred revolutions per minute or if they pass over 40 segments of twice the length in degrees at a rate of six hundred revolutions per minute. Therefore, by merely doubling the speed of rotation of the distributor brushes, the effect would be the same as if an eight channel distributor were employed.

The segments of both rings in the vibrating ring set are also connected in a similar manner, that is, alternate segments are strapped together. If the brushes on these rings are therefore rotated at twice the original speed, the same rate of opening and closing the vibrating circuit is effected when using rings having only half as many segments as would ordinarily be required and this may be done without any modification of the circuit.

The segmented ring of the direction-control local rings contains only two segments and the brushes on this ring can readily be rotated at twice its normal speed and the direction-control operating circuit will therefore be operating in the usual manner with-

out altering the circuit. Similarly, the remaining sets of rings can be modified to fit into the new scheme of operation.

An object of my invention is to provide means for increasing the number of channels in a telegraph system without increasing the number of segments on the distributor or increasing the diameter of the distributor.

A further object of my invention is to provide means for employing the same segments of a distributor to operate a plurality of channels in a telegraph system.

Another object of my invention is to provide means for successively employing the same group of segments of a distributor to control different printers.

A further object of my invention is to provide means for transmitting or repeating stored received impulses selectively to different printing magnets.

Another object of my invention is to provide storing devices common to a plurality of printers.

Another object of my invention is to provide a method of telegraph signalling in which received impulses are first stored and then transmitted selectively to different printers under local control.

Still another object of my invention is to provide means for increasing the number of channels of a telegraph system without increasing the apparatus necessary at the transmitting or receiving end.

Another object of my invention is to provide repeating relays common to a plurality of printers and arranged to repeat the impulses to the printer selectively under local control.

Other objects of my invention, together with the foregoing, will appear in the following description, wherein:—

Figure 1 discloses the circuit diagrams and apparatus employed at the receiving stations in the preferred embodiment of my invention.

Figure 2 discloses the circuit diagrams and apparatus employed at the transmitting stations in carrying out my invention.

Figure 3 discloses one arrangement for rotating the brushes of the distributor at different speeds.

Figure 4 is a diagrammatic illustration of circuits for carrying out my invention at a repeater station with means for recording the signals of any channel.

Referring to Fig. 1, the winding 30 of the line relay 31 is connected across the transmission line 32 and operates an armature 33 in accordance with the received impulses to engage its right or left hand contact. Eight printer channels, 1 to 8 are shown, comprising printing magnets m, and sixth impulse printer-operating magnets P, individual to each group of printing magnets for performing the printing operation after the selection has been set up in the well known manner. A receiving distributor comprising a solid ring 19 and segmented ring 20 comprises 20 live segments for the eight channel system as distinguished from the 40 live segments which would be necessary in the systems heretofore employed. A brush 21 wipes over these segments at twice the speed at which the brush 22 moves over the solid ring 23 and segmented ring 24 of the local receiving distributor in a manner to be described in more detail hereinafter.

Each alternate segment of the ring 20 is connected to an individual winding of a relay in one of the four groups of storing polar relays PR_1, PR_2, PR_3 and PR_4, the other side of each winding being multipled together and connected to the midpoint of the battery 29. The opposite poles of the battery 29 are connected to the armature contacts of the main receiving relay 31. The relay armature is connected to the solid ring 19 by conductor 35.

The polar relays, when operated, move their armatures to engage either their right or left hand contacts and remain in engagement therewith until the relays are operated by an impulse of the reverse polarity. The armatures of the polar relays PR_1, PR_2 etc., are multipled together and connected over the conductors 9 and 10 to the battery 12 and then through the brush 22 to the segmented ring 24. Each of the armature contacts of each polar relay is associated with an individual selector magnet m of a printer in one of the channels. It should be noted at this point, however, that each contact of any one polar relay armature is connected to a printer selector magnet in a different channel, from the other. Thus the left hand armature contact of the polar relay a, in group PR_1 is connected to a printer magnet of the channel 8 and the right hand contact is connected to a printer magnet of the channel 7. Each of the other armature contacts of the other polar relays are similarly connected to magnets of different channel printers. The opposite sides of the printer magnets in each channel are multipled together and connected to alternate segments of the segmented distributor ring 24, the remaining segments of ring 24 being connected to the printer operating magnets P of the several channels. It will be noted that there are sixteen segments on the ring 24, there being one individual to each channel or group of printer magnets and one for each of the operating magnets P in each channel, that is, two segments for each channel.

Heretofore, in order to operate an eight channel system, it has been necessary to employ at least five segments on the receiving distributor for each of the channels, a total of forty segments. It has also been necessary to employ a repeating relay for each of the

printer magnets or a total of forty repeating relays. Although the apparatus disclosed in Fig. 1 is sufficient to operate an eight channel telegraph system, the receiving distributor comprises exactly half as many segments as were heretofore necessary, and employs only twenty repeating relays. The operation of the apparatus thus far described is as follows:—

It will be assumed for illustration, that the brush 21 is passing upwardly from bottom to top and over the first group of segments 40 to 44 on the segmented ring 20 and simultaneously impulses are being received over the signalling line 32 to energize the winding of the receiving magnet 31. As the distributor brush moves into engagement with the segment 40, let it be assumed that relay 31, is energized in response to a received impulse in such a manner as to move its armature 33 into engagement with its left hand contact. A circuit is thereupon completed for the winding of relay *a* in group PR_1 from the battery 29, left hand contact and armature 33 over the wiper brush 21, the segment 40, conductor 46, through the winding of said polar relay *a* and thence back over conductor 47 to the mid-point of the battery.

It will be assumed for the present that this is a marking impulse and that the armature of said relay *a* of group PR_1 thereupon engages its left hand contact. A circuit is thus prepared or conditioned for the first printing magnet *m* of the channel 8, but this circuit will not be completed at this time by reason of the fact that the circuit must be completed over a certain segment of the ring 24 when the brush 22 reaches that segment.

In a similar manner, as the brush 21 wipes over the succeeding segments 41 and 44 and the armature 33 is operated in response to incoming impulses received by the energizing winding 30 of the main relay, the remaining armatures of the polar relays in the first group, PR_1 will be actuated in accordance with the received impulses to engage either their left or right hand contacts, and thereafter remain in that position until another impulse is received as will be described in more detail hereinafter.

At this instant the brush 22 is in engagement with the lowermost segment of the ring 24 and completes a circuit for a printing magnet in channel 3, operating these magnets in accordance with the setting of the group of polar relays PR_3 in a manner as will be described in connection with the printer magnets of channel 8.

The distributor brush 21 will now pass over the next five segments of the ring 20 to energize the polar storing relays connected to these segments and set up a condition on the armatures in accordance with the received impulses over the second channel and in like manner each group of polar relays are operated according to received code combinations of impulses.

When the brush 22 engages the fifth segment of the ring 24, the circuit for the printer magnets of channel 8 are completed and these printer magnets will be energized in accordance with the setting of the armatures of the polar relays of group PR_1. Thus for example, the first printer magnet of channel 8, by reason of the fact that the armature *a* in group PR_1 is in engagement with its left hand contact, will be energized over a circuit from the negative side of the local battery 12, through conductor 9, the armature of relay *a* and its left hand contact, winding of the first printer magnet of the channel 8, over the conductor 14, the fifth segment from the bottom of the ring 24 through the brush 22 and ring 23 to the positive side of battery 12. In a similar manner, all of the remaining printer magnets are energized, or not, in accordance with the positions of the armatures of their associated polar relays which have been set in accordance with the impulses received over the line 32.

Following the setting of the printer magnets *m* of channel 8, brush 22 moves into engagement with its sixth segment and the printer operating magnet P of channel 8 is energized over a circuit from the negative side of the battery 12, to the winding of the printer operating magnet P, thence over the conductor 15, and through the sixth segment of the ring 24, the brush 22, ring 23 and to the positive side of battery 12. The energization of the operating relay P performs the necessary printing operation in the well known manner.

As was pointed out above, however, the brush 21 is arranged to rotate at twice the speed of the distributor brush 22. When therefore the brush 21 has passed over all of its segments, and operated the four groups of polar relays shown in accordance with the received impulses, the brush 22 will have passed over only one-half of the distributor segments on the ring 24.

The brush 21 now again passes over the segments 40 to 45 to operate the polar relays PR_1 again in the manner described above to set up a new combination on their armatures in accordance with the impulses received over the line 32. The setting of the armatures however, will not at this time prepare circuits for the printer magnets of the channel 8, as was described above but instead will prepare circuits for the printer magnets of the channel 7. The common return circuit for the printer magnets of channel 7, it will be noted, is completed over the fourth segment from the top of the segmented ring 24, whereas the circuits for printer magnets of channel 8 is completed over the circuit including the fifth segment from the bottom.

As was pointed out above, the brush 21 ro-

tates at twice the speed of brush 22. The brush 22, at this time will therefore have passed over only half of the segments of ring 24 while the brush 21 completed an entire revolution. The brush 22 will therefore be on the eighth segment and just approaching the ninth segment from the bottom when the brush 21 starts its second cycle of operations and will at this time, be controlling the printer of channel 6. When now the brush 22 reaches the fourth segment from the top, the common return circuit for the printing magnets of the channel 7, is completed and these magnets will be energized in accordance with the positioning of the armature of the polar relays of group PR_1, the armatures of which were previously positioned in the manner described above.

It will be obvious of course, that with the circuits shown, the second operation of the polar relays PR_1 to control the channel 7, should be operated in the opposite direction for marking impulses from that to which marking impulses operate them when the armatures control the printer magnet of channel 8. Thus, if a received impulse of one polarity represents a marking impulse in controlling the printer magnets of channel 8, an impulse of the opposite polarity will represent a marking impulse when the polar relays control the printing magnets of channel 7. It is obvious however, that this particular arrangement is not necessary and that the printer magnets of the channels 7 and 8 could be connected in multiple to the same contact of the polar relay armatures, since it is only essential that these circuits for the two channels shall be sequentially completed over the segmented ring 24 of the distributor.

In this manner, the same group of polar relays are operated, first to repeat the impulses to the printer magnets of one channel and then upon the next operation to repeat the impulses to the printer magnets of a second channel, this sequence of operation being under the control of the local distributor ring 24. The same segment on each distributor ring and the same polar relay is here disclosed as operating two different channels. It is obvious, however, that the same segment and the same polar relay could be employed to operate any number of desired printer channels by properly arranging the circuits and operation of the local distributor. Thus, by operating the brush 22 at one quarter the speed of the brush 21, the brush 21 would move over its segments four times while the brush 22 passes over its segments but once and would therefore operate four channels for each segment.

Referring now to Fig. 2, the transmitting apparatus and circuit arrangements for reducing the number of segments necessary for an eight channel system are disclosed.

The distributor 201 comprises a solid ring 202 and the segmented ring 203 over which a brush 204 is rotated to successively connect each of the segments on the segmented ring 203 to the solid ring 201. The distributor also includes a solid ring 206 and a segmented ring 207 over which the double brushes 208 and 209 are rotated to successively connect the segments of the ring 207 to the solid ring 206. Eight tape-controlled transmitters 210 to 217 are arranged to operate in response to perforated tapes individual thereto in the well-known manner.

Normally in order to transmit impulses for eight channels it would have been necessary to employ five segments per channel or 40 segments on the segmented ring 203, a number which is unwieldy for practical purposes and would therefore have made it difficult to operate an eight channel system. By the modification of the circuit arrangement herein described, the twenty segments of the distributor 203 are sufficient to transmit impulses for an eight channel system.

The first and the eleventh segments of the distributor ring 203 are multipled together and connected to the armature of the polar relay 219. Similarly, the second and the twelfth contacts of the segmented distributor ring 203 are multipled and connected to the armature of the transmitter relay 221. In the preferred embodiment of my invention, I employ ten such transmitting relays 219, 220, et cetera, for the eight channel system. Each of the polar relays comprises in addition to its armature, four windings connected to tape-controlled contacts in a different transmitting channel and a biasing winding, not shown. Thus the winding *a* of the relay 219 is connected to the uppermost tongue *t* of the tape-controlled transmitter 210, the winding *b* is connected to the uppermost tongue of tape-controlled transmitter 212, the winding *c* is connected to the uppermost tongue of transmitter 211, and the winding *d* is connected to the uppermost tongue of transmitter 213. The armatures of these relays are normally returned to their spacing contacts when not energized from the transmitters, as by means of biasing windings, not shown.

The windings of the other transmitter relays are connected in a similar manner to tape-controlled contacts in different channels. One side of the contacts in each channel are multipled together as for example, at conductor 230, and then connected to a segment of the distributor ring 207. Each segment of the distributor ring 207, it will be noted, is connected to the common conductor of a transmitter and is also connected to the operating magnet OM of a transmitter. As is well known in the art, when these operating magnets are energized, the tape which is perforated with code combinations is moved

to bring the next set of perforations in alinement with the transmitter tongues. The brush 204 is arranged to be rotated at twice the speed of the brushes 209 and 208, so that for each revolution of the brushes 208 and 209, the brush 204 makes two complete revolutions.

The operation of the transmitting apparatus will now be described. It will be assumed that the brush 204 is in engagement with the lowermost segment. Just preceding this, the brush 208 has engaged the lowermost segment of ring 207 and thus completed energizing circuits for the windings *a* of relay 219 and the corresponding windings of each of the first five relays in accordance with the setting of the tape-controlled contacts of the transmitter 210, over a circuit from the negative side of battery 231, conductor 232, winding *a* of relay 219, conductor 233, tongue of distributor 210, and its right hand contact, the conductor 230 over the first segment of the distributor 207, the brush 208, the solid ring 206 to the other side of the battery 231. Similarly, the corresponding winding *a* on each of the other of the first five transmitting relays 219 to 223 will be energized or not according to the positions of the tape-controlled contacts in the transmitter 210. When now, the brush 204 passes over the first five distributor segments, impulses will be impressed upon the cable over a circuit from battery 232 to the armature and a contact of relay 219, over a segment of the ring 203, through brush 204 to the cable.

As is obvious from the disclosure, the polarity impressed upon the cable will depend upon the engagement of the relay armature either with its right or left hand contact. The brush 204, rotating at twice the speed of the connected brushes 208 and 209, will have passed over the first five segments before the brush 208 passes entirely over the first segment. However, by employing the connected double brush 209 and 208, the second segment of ring 207 is connected to the solid ring 206, a short interval of time preceding the completion of the preceding code character, and a circuit is thereupon completed for energizing the second set of five transmitting relays in accordance with the engagement of the tongues *t* with the contacts of the transmitter 214.

Simultaneously, a multiple circuit is completed for the operating magnet OM which controls the stepping of the tape in the tape transmitter 215, and thereby causing the tongues *t* to engage the contacts in accordance with a new combination of tape perforations. As the brush 204 now passes over the segments 6 to 10 of the segmented ring 203, the second group of polar relays will control the code to be impressed upon the cable, in accordance with the setting of the tape-controlled contacts of the transmitter 214.

By reason of the fact that the brush 204 is rotating at twice the speed of the brushes 209 and 208, the brush 204 will pass over the five segments while the brushes 208 and 209 pass over the second segment. However, as pointed out before, the brush 209 will engage the third segment a short interval of time before the complete transmission of the second code character. Upon engagement with the third segment, a circuit similar to that previously traced for the first transmitting channel is prepared for the transmitter 212, to control the setting of the armatures of the first five transmitting relays in accordance with the position assumed by the tape operated contacts of the transmitter 212. While the brush 204 passes over the segment 11 to 15, the code impressed upon the cable will be according to the setting of the tape transmitter 212, although the same group of transmitting relays 219 to 223 have here been employed.

In this manner, although segments sufficient ordinarily for the transmitters of only four channels have been employed, the eight channels are operated and although the transmitter relays, sufficient ordinarily for only two channels have been disclosed, the arrangement is sufficient for operating an eight channel transmitting system. It is obvious, however, that if it be desired, transmitter relays of the usual type can be employed instead of the relays here disclosed. When the distributor has completed one revolution and brush 204 is again in engagement with the first segment of the ring 203, the connected double brushes 208 and 209 will be in engagement with the fifth segment and will therefore prepare circuits for the transmitting channel 211. The first five transmitting relays will therefore be energized in accordance with the position of the five transmitting contacts of the transmitter 211.

It will be noted from the above description of the transmitting and receiving circuits, that the circuits have been so modified by multiple connections that the same apparatus may be employed for a plurality of channels, the connections being made successively under local control of a distributor having brushes arranged to operate at different speeds. By this arrangement, not only has a considerable saving in the apparatus been obtained but this adjustment has further resulted in increased simplicity and therefore more accurate operation.

The arrangement for rotating one distributor brush at twice the speed of the other may be performed in any well known manner. For purposes of illustration I have indicated one arrangement conventionally in Figure 3. The rotating arm 240 carrying the brush 22 of the distributor is pinned to the

shaft 241, which is driven by a suitable motor. The outer or faster moving brush arm 245 carrying the brush 21 is free to rotate on the distributor shaft and is driven from the shaft through the train of gears 244. A one to two ratio is employed between the gears so that for every rotation of the shaft 241 the brush 21 makes two revolutions.

In Fig. 4 I have shown an arrangement of circuits embodying my invention which may be used at a repeater station when it is desired to record the signals in any channel upon a monitor printer. The incoming signals over the line L actuate the repeating relay R_1, and the monitor relay R_2. I have shown these relays connected directly in the line L, but it is evident that they may be included in a local circuit controlled by the armature of a main line relay or cable relay of any suitable type, such as the well-known "drum" relay. The armature or tongue of relay R_1 transmits corresponding plus or minus impulses to the distributor ring r_1 as the brush b_1 is rotated thereover and thereby energize the polar storing relays SR. The twenty live segments of the ring r_1 constitute four groups of five each, corresponding to the five units of the code letters transmitted over each channel, the groups being connected in multiple to the five storing relays. Hence each time the brush b_1 moves over a group of five segments, a code character is stored in the relays SR. As the distributor brush b_2 moves over the segments of the ring r_2 corresponding plus and minus impulses from the battery or generator G are repeated through the tongues of the storing relays and transmitted into the next line section L_1.

In order that the tongues of the relays SR shall have time to rest firmly upon their contacts before the impulses are repeated, the ring r_4 is oriented or positioned so that segment 4 of ring r_2 is in alinement with segment 1, of ring r_1. It will be evident from this arrangement that when the brush b_1 is receiving the first impulse of any code character and storing it in the first of the storing relays SR, the brush b_2 will be transmitting the fourth impulse in the preceding code character which was stored in the fourth one of the relays SR. This arrangement for receiving, storing and repeating the code impulses is covered in U. S. patent to Houghtaling No. 1,551,500.

In accordance with my invention this repeater apparatus must receive, and store successively the code characters for eight channels coming in over the line L and retransmit them in succession into the line L_1. These signal impulses are being transmitted over the cable or line from the transmitting station shown in Fig. 2 at twice the usual four channel speed and are therefore being received by the relays R_1 and R_2 at the repeater station shown in Fig. 4, at double the usual speed. In order, therefore, to receive and store these code characters, each composed of five signal impulses, and retransmit them into the next line section L_1, I rotate the distributor brushes b_1 b_2 and b_3 at twice the normal four channel speed. Hence during alternate revolutions of the brushes the code signals coming in over the line or cable L for the channels A, B, C and D are regenerated by the relays SR and repeated into the next line or cable section L_1 and during the next revolution of the brushes the code signals received from the channels E, F, G and H are regenerated by the relays SR and repeated into line L_1.

In order to record the code signals from any desired channel upon a monitor printer, indicated by the five printer selecting magnets PM, I provide the auxiliary relay R_2 and the segmented distributor ring r_3 with its corresponding solid ring and the rotating brush b_3. The twenty active segments of the ring r_3 are divided into four groups of five segments each, and these groups are connected to sets of jacks j_1 j_2 j_3 and j_4. A switch member K is provided with five plugs p adapted to engage any one of the sets of jacks, the plugs being connected by a cable cord c with the selecting magnets PM of the monitor printer. The common return circuit from the selector magnets is connected to a switch arm s so that the printer magnets may be connected to either half of the divided ring r_4. The brush b_4 is rotated at one-half of the speed of the other brushes and hence while the brushes b_1 b_2 b_3 make one complete revolution, the brush b_4 only moves over the upper segment or half ring of the ring r_4 and while the brushes b_1 b_2 b_3 make the next complete revolution, the brush b_4 moves over the lower segment or half of the ring r_4.

It will be evident that if the switch member K is plugged into the group of jacks j_1 the selecting magnets PM of the monitor printer will receive the five signal impulses of the code character received over either the A channel or the E channel depending upon the position of the switch arm s. In like manner the code signals from any desired channel may be recorded on the monitor printer by shifting the switch member K to the corresponding set of jacks and moving the switch arm s to connect the return circuit of the selecting magnets PM to the proper segment of the ring r_4. The printer actuating magnet and the segment on the slow moving distributor for operating it are not shown as this is well known.

Although I have disclosed my invention as applied to a multiplex telegraph system, it is obvious that it has broader applications and I intend to limit myself only in so far as set forth in the appended claims.

I claim:

1. The method of operating a telegraph distributor which comprises associating the segments thereof with one set of printer magnets during a rotation thereof and with another set of magnets during the succeeding rotation thereof.

2. The method of operating a telegraph distributor which comprises associating the segments thereof with one set of printer magnets during a rotation thereof and with another set of magnets during another rotation thereof.

3. The method of operating a telegraph distributor which comprises associating each group of segments thereof successively with different printers, each segment serving to operate one selector magnet in each of a plurality of printers.

4. In a telegraph system, a plurality of printing magnets, a receiving distributor comprising a segmented ring, each of the segments of said ring being associated successively with a plurality of said printer magnets.

5. In a telegraph receiver, a segmented distributor ring comprising segments for a predetermined number of channels, a plurality of printers, greater in number than the number of said channels on said distributor, groups of relays connected to said distributor, each group being associated with a plurality of printers and switching mechanism for switching said groups of relays from one printer to another.

6. The method of operating a telegraph receiving apparatus embodying a rotary distributor which comprises distributing the received signal impulses to one group of printers during the first rotation of the distributor, and to another group of printers during the next rotation thereof.

7. The method of operating a printing telegraph receiver which comprises associating the same segments of the distributor successively with different printers.

8. The method of operating a telegraph receiver embodying a rotary distributor which comprises successively switching the distributor segments to operate different printers.

9. In a telegraph receiver, a rotary distributor having a segmented ring, a plurality of relays, each connected to an individual segment on said distributor ring, said relays being divided into groups, a plurality of printers greater in number than said groups of relays, each printer having a set of selecting magnets, and switching means for sequentially swtiching the relay armatures of said groups to different sets of said printer selecting magnets.

10. In a telegraph receiver, a rotatable distributor, electro-magnetic means individual to each segment of said distributor, said means being divided into groups, a plurality of sets of printer selecting magnets individual to each of said groups of electro-magnetic means and switching mechanism for switching said groups from one set to another set of said printer selecting magnets.

11. In a telegraph receiver, a rotatable distributor, a plurality of relays, each connected to an individual segment on said distributor, said relays being divided into groups, a plurality of sets of printer selecting magnets greater in number than said groups of relays, said rotary distributor having means for sequentially switching the relay armatures of said groups to different sets of said printer selecting magnets.

12. In a telegraph receiver, a rotatable distributor having a segmented ring, electro-magnetic means individual to each segment of said distributor, said means being divided into groups, a plurality of sets of printer selecting magnets individual to each group of said electro-magnetic means, said rotary distributor having means for switching said group of electro-magnetic means from one set to another set of said printer selecting magnets.

13. In a telegraph receiver, a rotary distributor having a segmented ring, electro-magnetic means divided into groups which are associated with alternate groups of segments of said distributor ring, a plurality of printer magnets, individual to each of said groups of electro-magnetic means, a second distributor, means including said first distributor for operating said electro-magnetic means in accordance with code combinations of impulses for operating all of said printers, and means including said second distributor for causing said printers to operate in accordance with the operation of said electro-magnetic means.

14. In a telegraph receiver, a first distributor having a segmented ring provided with segments for operating a predetermined number of printer channels, a plurality of printers greater in number than the channels of said first distributor, a second distributor rotatable with said first distributor, and means including said first distributor and said second distributor for operating the magnets of said printers in accordance with received code combinations of impulses.

15. In a printing telegraph receiver, a first distributor having a segmented ring provided with segments for a predetermined number of telegraph channels, electro-magnetic means associated with the segments of said distributor, means including said distributor for operating said electro-magnetic means in accordance with received code combinations of impulses, a plurality of sets of printer selecting magnets greater in number than the channels of said distributor, a second distributor, and means including said second distributor

for causing said sets of printer magnets to operate in accordance with the operation of said electro-magnetic means.

16. In a printing telegraph receiver, a storage device, a plurality of groups of electro-magnetic means cooperating separately with said storage device, means for operating said storage device in accordance with received code combinations of impulses, and switching means for successively operating said groups of electro-magnetic means in accordance with the operation of said storage device.

17. In a telegraph receiver, a storage device operated in accordance with received code combinations of impulses, a plurality of printers cooperating separately with said storage device and means whereby said storage device successively repeats said code combinations to one and then to another of said printers.

18. In a telegraph receiver, a storage device operated in accordance with received code combinations of impulses, a plurality of printers cooperating separately with said storage device and switching means whereby said storage device successively repeats said impulses to one and then to another of said printers.

19. In a telegraph receiver, a storage device operated in accordance with received code combinations of impulses, a plurality of printers cooperating separately with said storage device and distributor means whereby said storage device successively repeats said impulses to one and then to another of said printers.

20. In a telegraph receiver, a rotary distributor, comprising a segmented ring having a plurality of segments, a plurality of electro-magnetic means each having a pair of armature contacts, each of said electro-magnetic means being connected to a segment on said distributor, means including said distributor for operating said electro-magnetic means in accordance with received code combinations of impulses, a plurality of printers each comprising a set of printer selecting magnets, each of said printer magnets being associated with one of the contacts of one of said electro-magnetic means, the other contact of said electro-magnetic means being associated with the printer magnet of a different printer, a second rotary distributor comprising a segmented ring, each set of said printer selecting magnets being individual to one segment of said second distributor and means including said second distributor for operating one or another of said printers in accordance with the operating of said electro-magnetic means.

21. In a telegraph transmitting apparatus, a rotary distributor comprising a segmented ring having groups of segments for transmitting a code of impulses for a predetermined number of channels, a plurality of transmitters greater in number than the channels on said distributor, and means including said distributor for transmitting code combinations of impulses successively for each of said transmitters.

22. In a telegraph transmitting apparatus, a rotary distributor comprising a segmented ring having groups of segments for transmitting a code of impulses for a predetermined number of channels, a plurality of transmitters greater in number than the channels on said distributor, and means whereby code combinations of impulses are successively transmitted for each of said transmitters.

23. In a telegraph transmitting apparatus, a rotary distributor comprising a segmented ring having groups of segments for transmitting a predetermined number of channels, a plurality of transmitters greater in number than said channels on said distributor, and a second distributor cooperating with said first distributor, whereby the code combination of impulses set up on said transmitter are transmitted over said first distributor.

24. In a telegraph transmitting apparatus, a group of transmitting storing relays, a plurality of transmitters associated with said group of transmitting relays, and switching means for associating said group of relays successively with each of said transmitters.

25. In a telegraph transmitting apparatus, a rotary distributor comprising groups of segments for transmitting a predetermined number of channels, electro-magnetic means the armatures of which are each connected to segments on said distributor, a plurality of transmitters associated with each of said electro-magnetic means, means for operating said electro-magnetic means successively in accordance with the operation of each of said telegraph transmitters, and means responsive to the operation of said electro-magnetic means for transmitting code combinations of impulses over said line in accordance with the operation of said telegraph transmitters.

26. In a telegraph receiving apparatus, a rotary distributor, a second rotary distributor rotating at a speed which is a sub-multiple of the speed of said first distributor, a plurality of telegraph receivers, and means including said second distributor for associating said first distributor successively with different ones of said receivers.

27. In a telegraph transmitting apparatus, a rotary distributor, a second rotary distributor rotating at a speed which is a sub-multiple of the speed of said first distributor, a plurality of transmitters, means including said second distributor for successively associating said transmitters with said first distributor.

28. In a telegraph system, a telegraph line

or cable, a rotary brush distributor having a solid ring and a cooperating ring provided with groups of segments for a predetermined number of channels, a line relay connected to said line and transmitting the signal impulses received to said solid ring, said brush being rotated at a speed which is a multiple of the normal speed for said predetermined number of channels, and means connected to said segments adapted to respond successively to signal impulses transmitted over said line for a number of channels greater than said multiple of the normal speed of said brushes.

29. In a telegraph receiving apparatus, a rotary distributor, a second rotary distributor rotating half the speed of said first distributor, a plurality of telegraph receivers, and means including said second distributor for associating said first distributor successively with different ones of said receivers.

30. In a telegraph transmitting apparatus, a rotary distributor, a second rotary distributor rotating at half the speed of said first distributor, a plurality of transmitters, means including said second distributor for successively associating said transmitters with said first distributor.

31. In a telegraph system, a first station, a second station, a distributor at said first station for transmitting a predetermined number of channels, a plurality of transmitters greater in number than said channels on said distributor, a distributor at said second station arranged to receive a predetermined number of channels equal to said transmitter distributor, a plurality of receiving printers equal in number to said transmitters, said number being greater than the number of channels on said receiving distributor, and means including said first and second distributors for successively operating all of said printers.

32. In a telegraph system, a plurality of transmitters, a receiver individual to each of said transmitters, a rotary distributor at said first station for transmitting impulses for channels less in number than said number of telegraph transmitters, a distributor at said second station for receiving impulses for a number of channels less in number than said number of telegraph receivers, and means including said first and said second distributors for successively operating said telegraph receivers under control of said telegraph transmitters.

In testimony whereof I affix my signature.

HAKON H. HAGLUND.