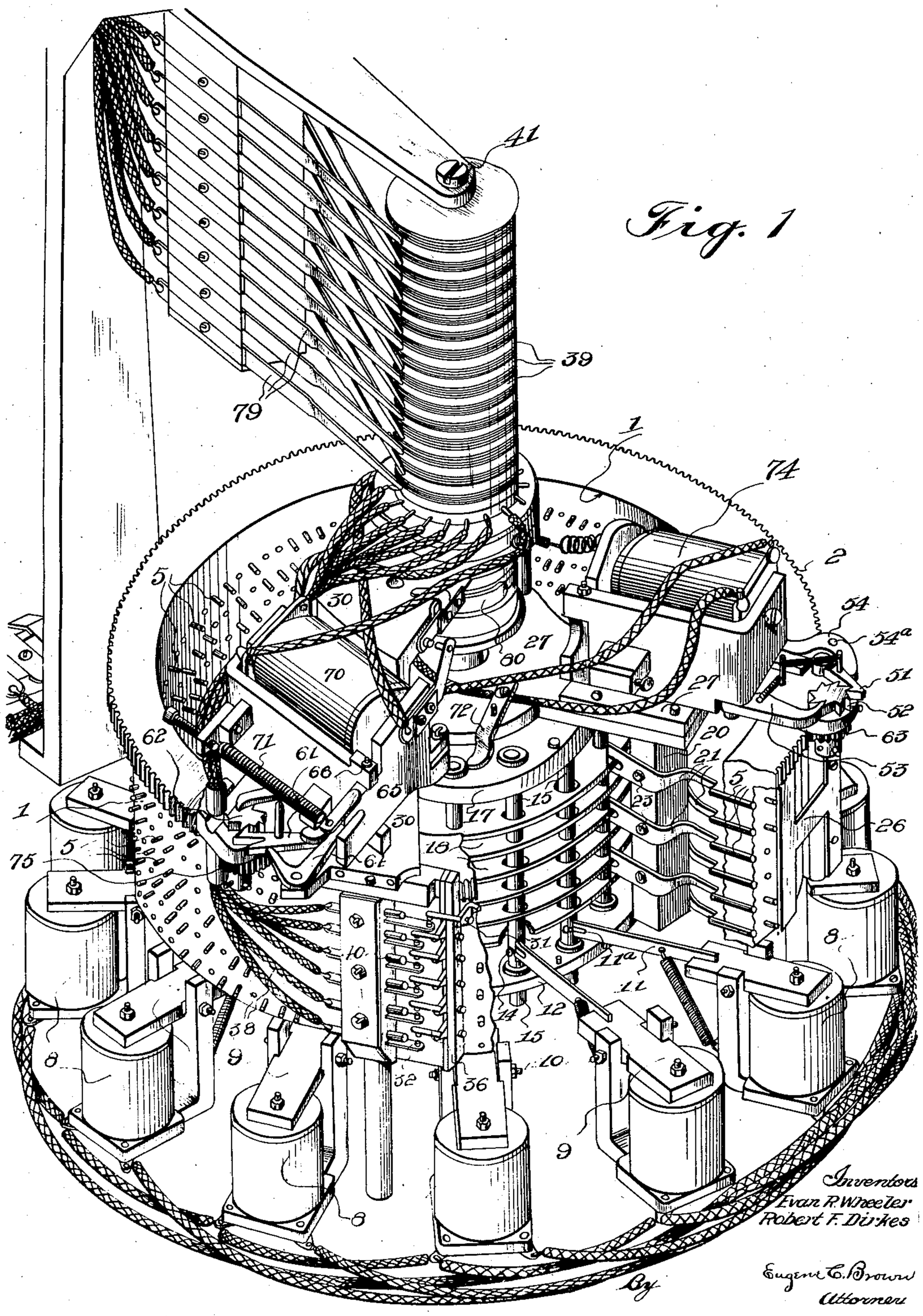
March 9, 1926. 1,576,167

E. R. WHEELER ET AL

STORING TRANSMITTER

Filed May 9, 1925 7 Sheets-Sheet 1

Fig. 1



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7 Sheets-Sheet 2

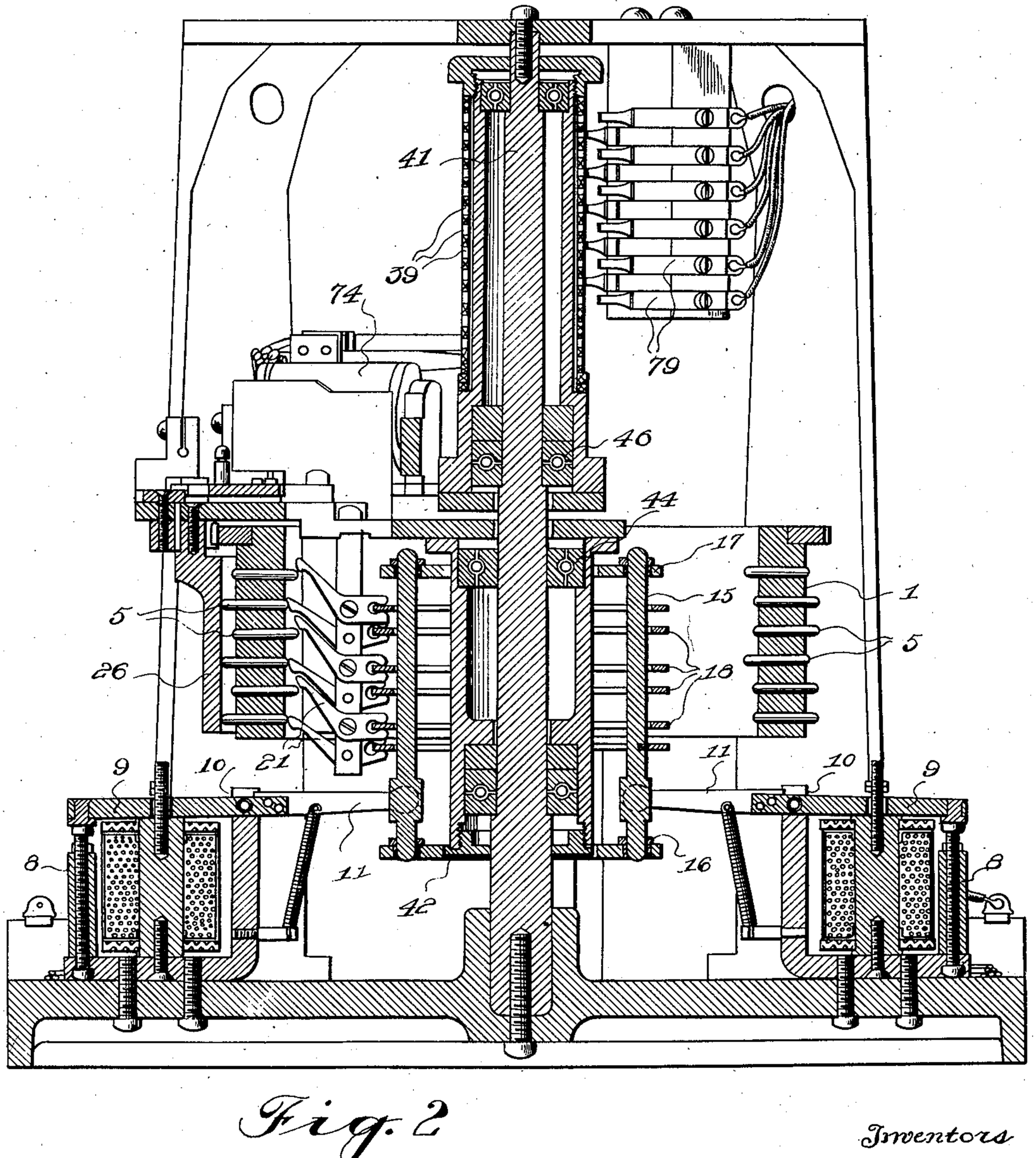

Fig. 2

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7 Sheets-Sheet 3

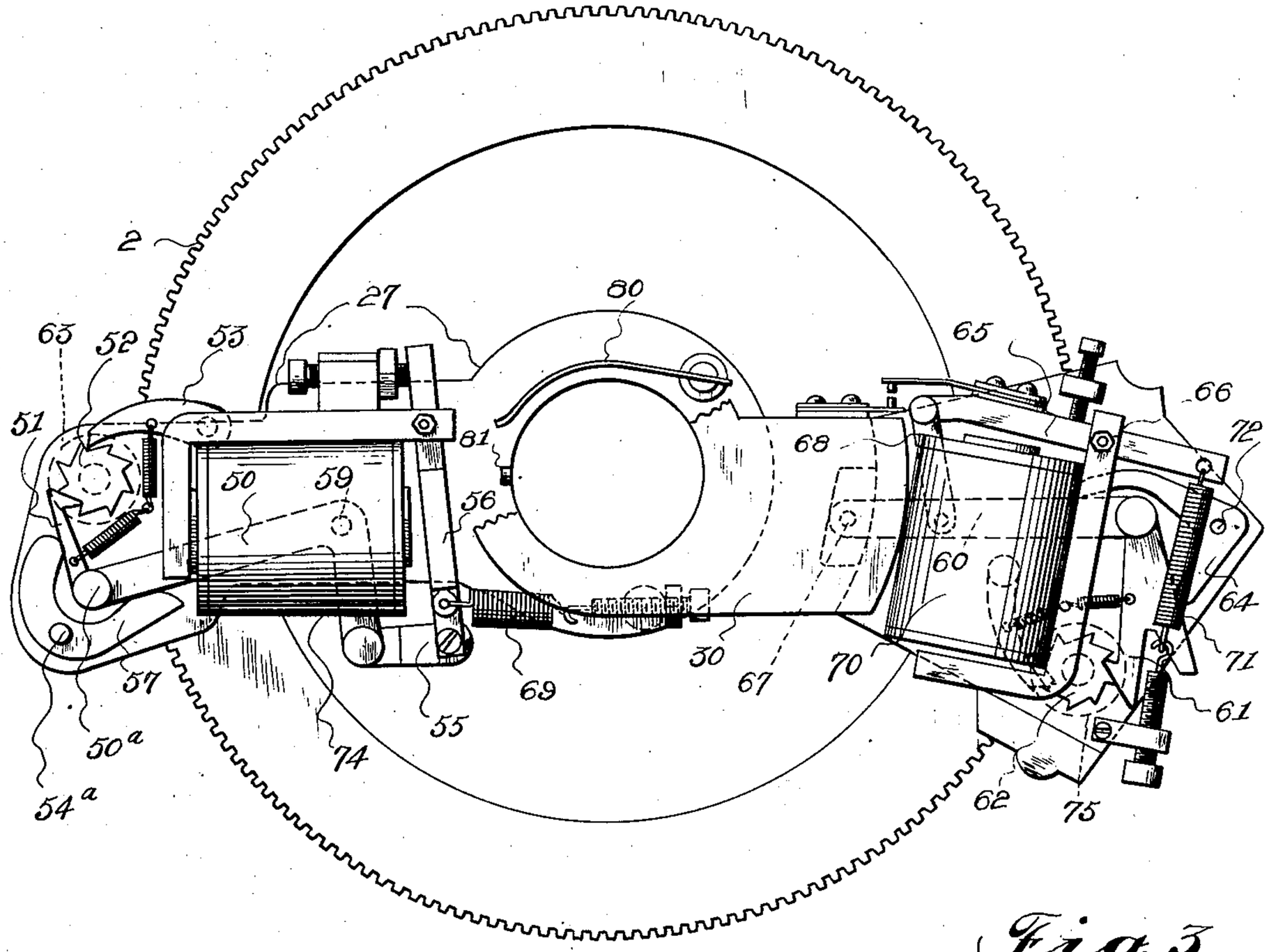

Fig. 5

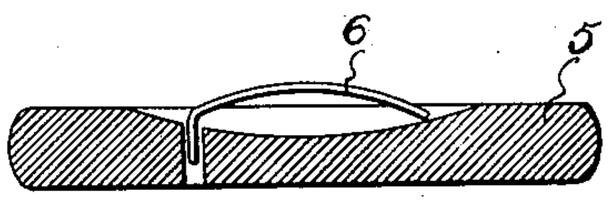

Fig. 7

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STORING TRANSMITTER

Filed May 9, 1925 7 Sheets-Sheet 4

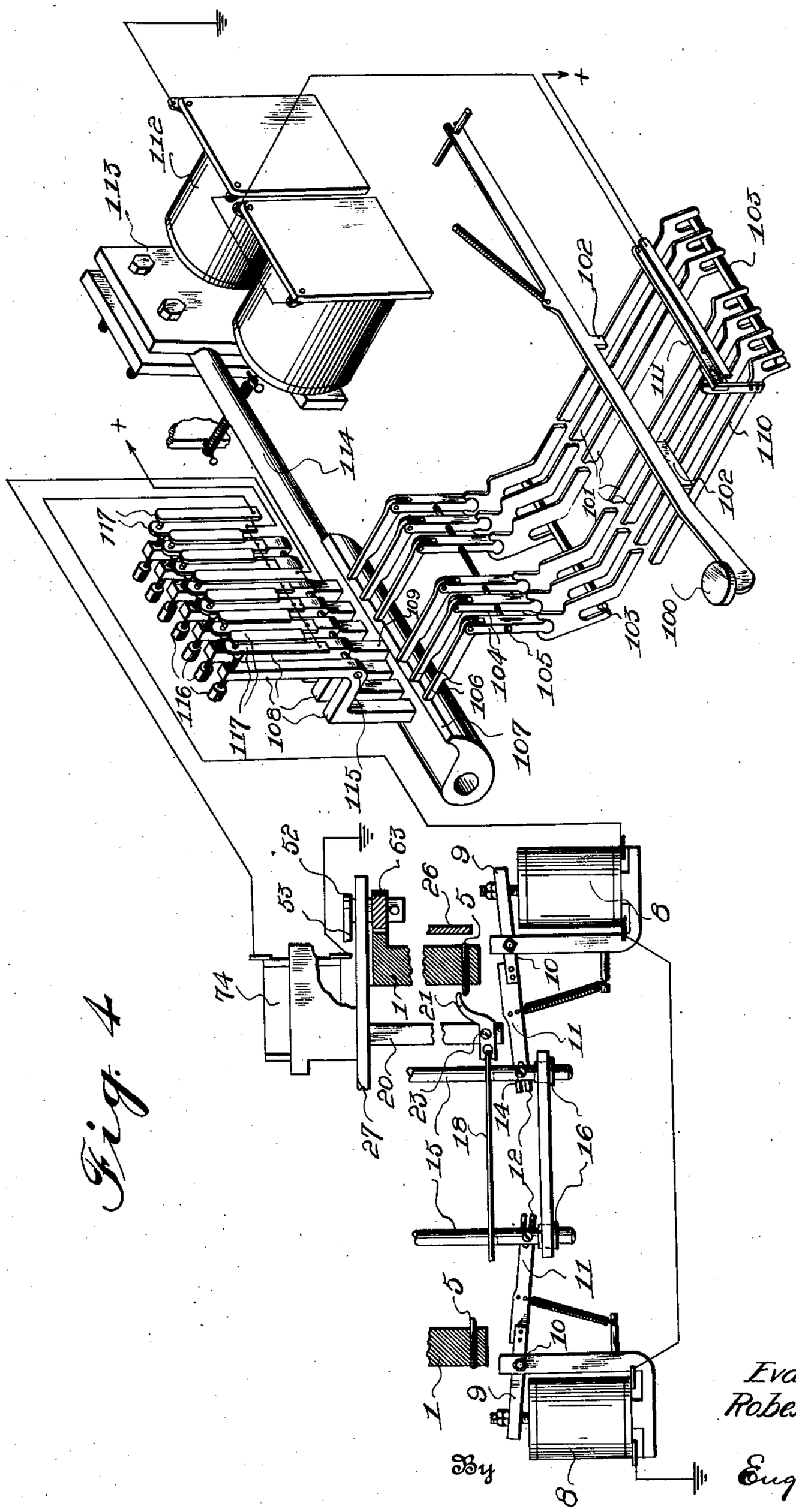

Fig. 4

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STORING TRANSMITTER

Filed May 9, 1925 7 Sheets-Sheet 5

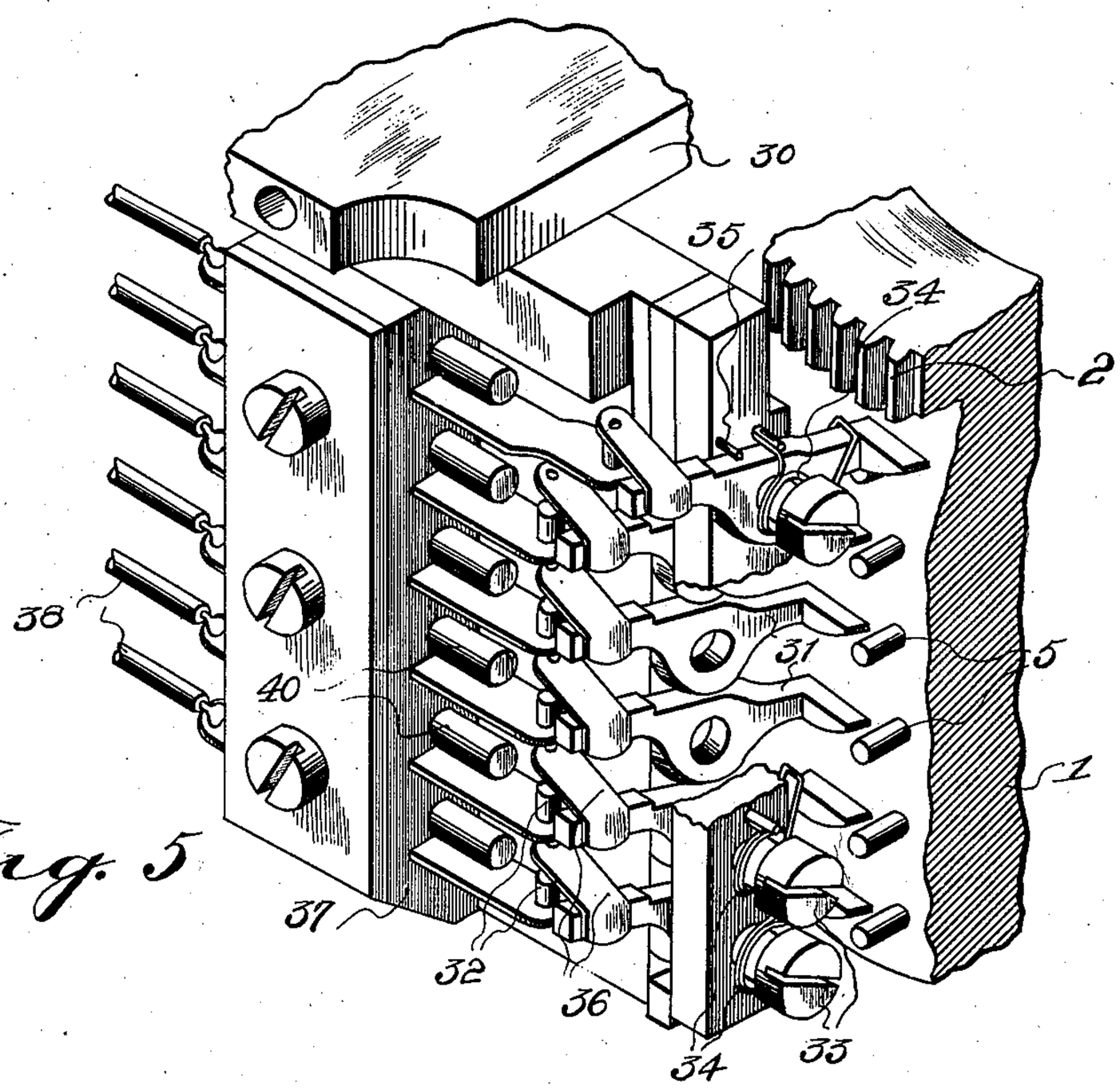

Fig. 5

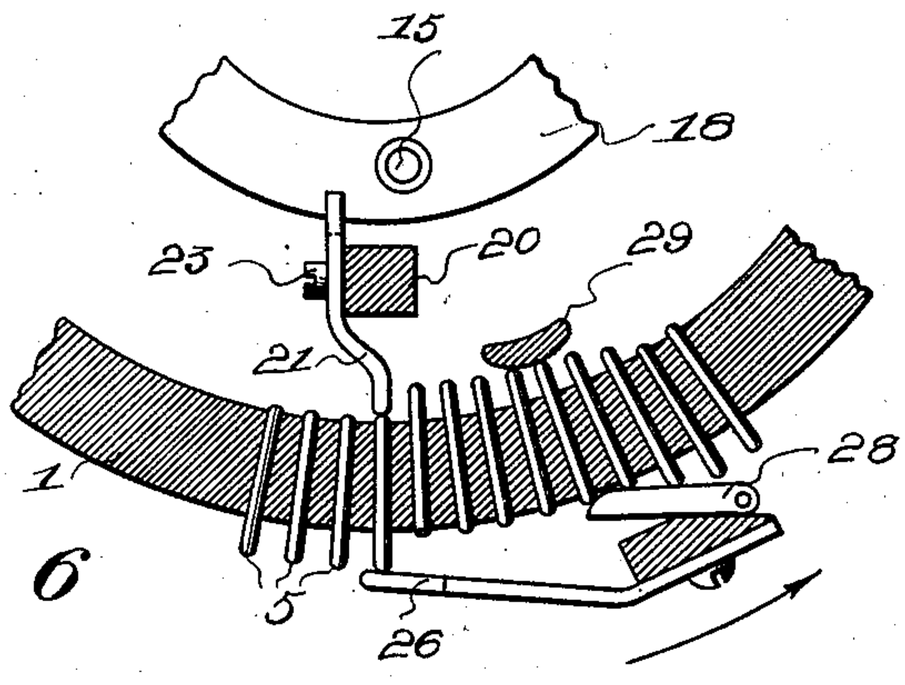

Fig. 6

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STORING TRANSMITTER

Filed May 9, 1925 7 Sheets-Sheet 6

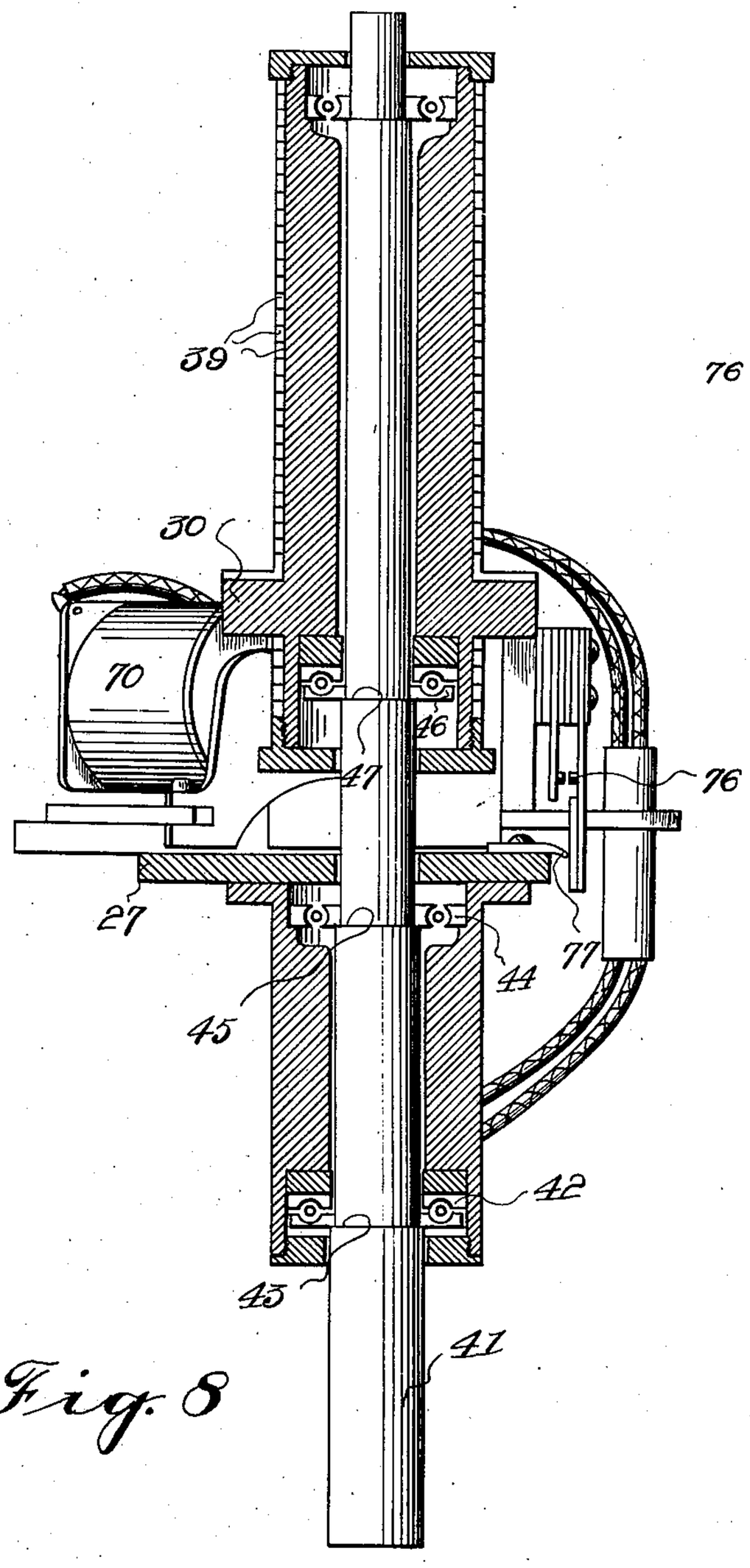

Fig. 8

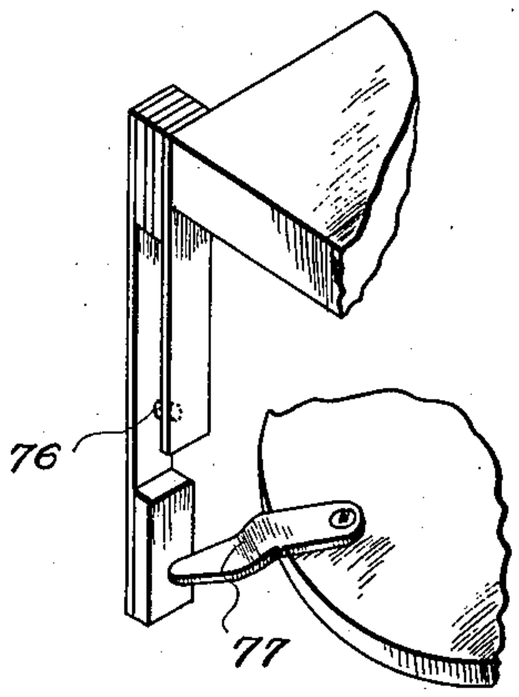

Fig. 9

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E. R. WHEELER ET AL

STORING TRANSMITTER

Filed May 9. 1925 7 Sheets-Sheet 7

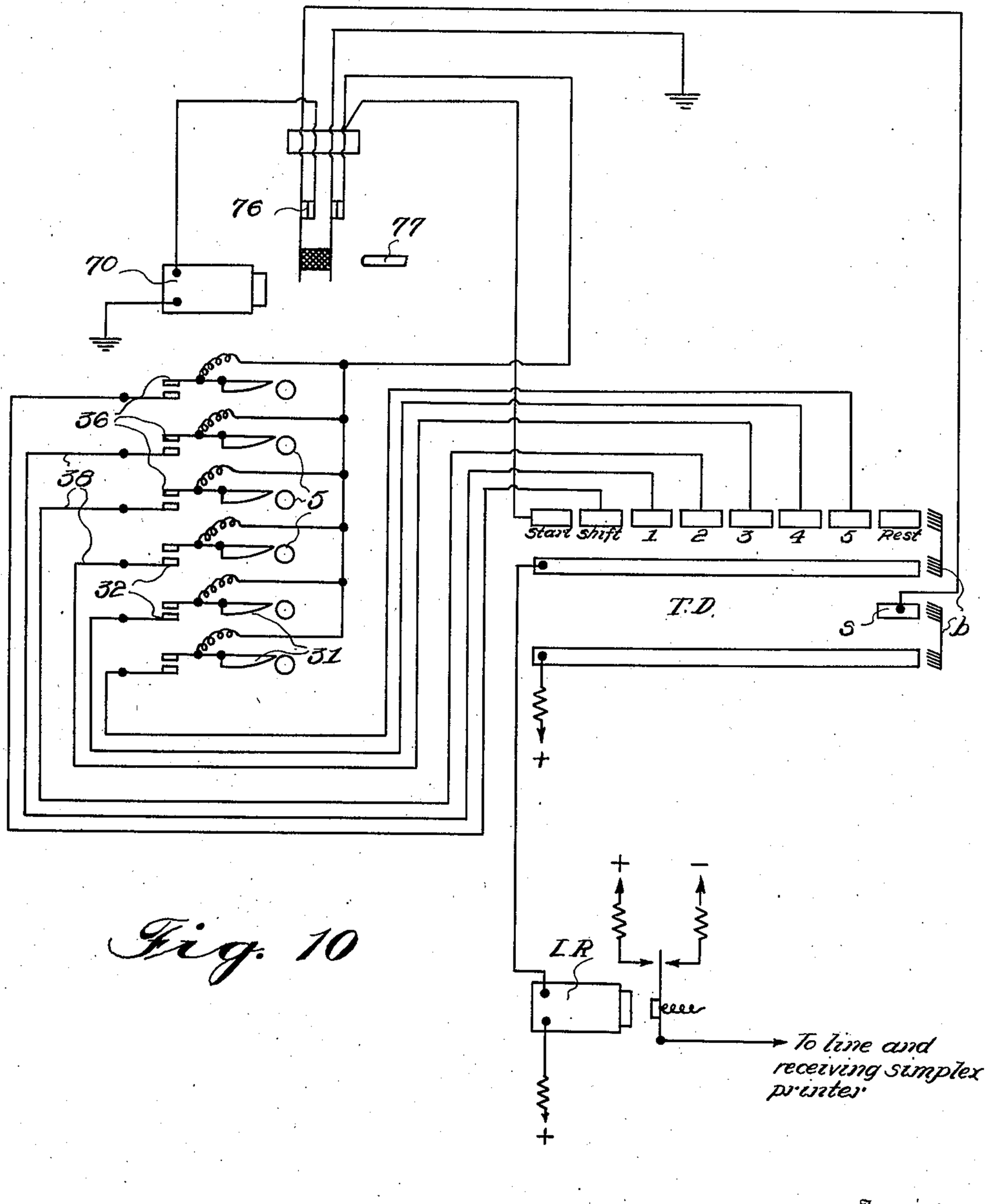

Fig. 10

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Patented Mar. 9, 1926. 1,576,167

UNITED STATES PATENT OFFICE.

EVAN R. WHEELER, OF NORTH PLAINFIELD, NEW JERSEY, AND ROBERT F. DIRKES, OF JAMAICA, NEW YORK, ASSIGNORS TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

STORING TRANSMITTER.

Application filed May 9, 1925. Serial No. 29,158.

To all whom it may concern:

Be it known that we, EVAN R. WHEELER and ROBERT F. DIRKES, citizens of the United States, residing at North Plainfield, Somerset County, State of New Jersey, and Jamaica, in the county of Queens and State of New York, respectively, have invented certain new and useful Improvements in Storing Transmitters, of which the following is a specification.

This invention relates to transmitting apparatus for use in automatic telegraph signaling and is adapted for transmitting simplex, multiplex, Morse or automatic ticker signals.

The storing of the signals between the setting up by the typist on the keyboard and the automatic sending-on or transmission into the line or cable has heretofore been accomplished by a tape which was first punched by the keyboard mechanism and then passed through the tape-controlled transmitter. The use of a tape, however, introduced certain defects which are overcome by the storing transmitter disclosed herein, such as tape sticking, and dust from the tape. Moreover, the loss of time between the setting up of the characters and the printing of the same, due to tape lag, is practically eliminated. The operating cost is also greatly reduced since the perforated tape became a waste product as soon as it was used.

The storing transmitter allows the same flexibility of operation as tape transmission. The setting up and transmitting portions of the mechanism are independent both electrically and mechanically except as limited by the number of characters which can be stored up in the drum of the transmitter. The keyboard used for setting up the characters is what is termed as a free keyboard. that is, the operator is not required to keep in synchronism with any mechanism or device. The transmitting arm may be operated regularly or irregularly as determined by the requirements of the transmission system employed.

The storing transmitter consists essentially of a hollow cylinder or tube placed vertically on a base, around which by means of a circular rack and pinion drive, two arms rotate, one carrying a mechanism for setting up or preparing a character selection, and the other carrying a mechanism for converting into electrical selections the mechanical selections which have been previously prepared and stored. The elements used for mechanically storing the selections are small metal pins set into holes in the hollow cylinder or drum. The number and arrangement of holes and pins may be as required for the particular telegraph code and transmission system used. In the transmitter illustrated, a code of six impulses per character is chosen and there are accordingly six pins in each vertical row in the drum. The number of vertical rows of pins fix the number of characters which may be stored up at any one time.

The setting up mechanism is arranged inside of the pin-drum and acts to push the pins outward so that they extend from the outer surface of the drum. This is accomplished from the keyboard through the energizing of certain magnets of which there are twelve placed in pairs diametrically opposite each other. The operation of these magnets is transmitted mechanically through elevating rods and universal rings to levers on the setting up arm which in turn push out such pins as are required for each character selection. The operation of the keyboard also causes the setting up arm to advance to the next vertical row of pins following the preparation of any selection.

After the setting up of a character, the transmitting arm, which extends down over the outer surface of the pin-drum, causes collector shoes to ride up over the top of the pins which have been selected or pushed outward from the drum. The collector shoes in turn close contacts which are also carried on the transmitting arm. For completing the circuits from the contacts on the transmitting arm to outside apparatus, a commutator having a number of rings insulated from each other is mounted solidly on the transmitting arm. Stationary brushes with wires leading to outside circuits rub on the commutator rings as the arm revolves. Following the transmission of any one character the transmitting arm is advanced so that its collector shoes move onto the next row of pins. This is done by a magnet mounted on the transmitting arm acting

through links and a pawl on a ratchet and pinion. The stepping magnet is energized from certain of the transmission control circuits.

Means is provided on the setting up arm for restoring the selected pins to their normal unoperated position consisting of a sloping plate which pushes the pins back to the surface of the drum just as the setting up arm passes over them. The pins are restored just prior to the setting up of a new selection.

To prevent the transmitting arm from working too closely to the setting up arm and colliding with it, a contact is attached to the transmitting arm which is opened by a projection on the setting-up arm when the transmitting arm comes sufficiently close, the opening of the contact preventing further advancement of the transmitting arm.

A warning light or bell is provided which operates when the drum has been filled to its full storage capacity and the setting up arm has approached sufficiently close to the transmitting arm.

In the following detailed description we shall refer to the accompanying drawings, in which:—

Figure 1 is a perspective view of an apparatus embodying our invention, a portion being broken away to show the details of the setting-up magnets and the associated parts for selecting the pins in the drum;

Figure 2 is a central vertical sectional view of the same;

Figure 3 is a top plan view of the mechanism for rotating the setting-up arm and the transmitting arm step by step around the pin drum;

Figure 4 is a schematic view showing one unit of the setting-up mechanism of the storing transmitter and our arrangement of apparatus for actuating the same;

Figure 5 is an enlarged fragmentary detail perspective view showing the transmitting shoes and contacts for transforming the character selections mechanically stored in the pin drum into electrical selections.

Figure 6 is a fragmentary horizontal sectional view through a portion of the drum showing the method of resetting the pins;

Figure 7 is an enlarged longitudinal sectional view of one of the pins;

Figure 8 is a fragmentary vertical sectional view showing a preferred method of mounting the setting-up and transmitting arms.

Figure 9 is a detail view showing the automatic stop contacts; and

Figure 10 illustrates diagrammatically the application of the storing transmitter to simplex printer operation.

Drum and selector pins.

The pin-drum consists of a metal tube 1, which is usually about three inches long, six inches in diameter and three-eighths of an inch thick. The drum is drilled with vertical rows of six radially extending holes in which are inserted pins 5. Each pin is about one-quarter of an inch longer than the thickness of the drum and is slotted and perforated as shown in Figure 7 to receive a small spring 6 made of fine piano wire. When the pin is inserted in a hole in the drum, the spring exerts a pressure against the side of the hole which creates sufficient friction to maintain the pin in any set position unaffected by mechanical jars and vibrations. Each vertical row or set of pins represents one telegraph character, six pins being used for the six impulses of each character selection. The number of vertical rows or sets of holes may be varied according to the type of service for which the transmitter is intended, and the storage capacity desired. The apparatus has heretofore been constructed with 96 vertical rows.

Preparing selections in the pins.

Figure 4 shows one of the pins and its associated selecting mechanism. This mechanism is duplicated for each of the other five selection impulses of a character. The pin 5 is shown in its non-selected position with its outer end nearly flush with the outer surface of the drum. When a pin is selected it is pushed outward so that it protrudes on the outside of the drum and is nearly flush with the inner surface.

A pair of setting-up magnets 8 are provided for each impulse selection, arranged diametrically opposite each other just outside and below the pin drum. The armatures 9 are pivoted at 10 and carry arms 11 which are forked at their outer ends 12 to fit over shoulder pins 14 on the elevating rods 15, the latter sliding in lower bearing plate 16. The arms may be connected to the rods 15 by a ball and socket joint as shown in Figure 2. Rigidly mounted on each pair of elevating rods is a universal ring 18 which must be parallel with the pins.

When the magnets 8 are energized, the arms 11, carried by the armatures 9 raise the elevating rods 15 and universal rings 18. By using two magnets to lift each ring from opposite sides, the moving parts move freely without any tendency to bind and the rings are maintained in true horizontal position. Placed between the universal rings and the inside of the drum is a supporting column 20, depending from the setting-up arm 27, on which are mounted six selecting hammers 21, pivoted at 23 so that they may be rocked upwardly or downwardly. The inner ends of the selecting hammers are forked and fit closely over the outer edge of the corresponding universal rings 18.

When a universal ring is raised, the cor-

responding selecting hammer 21 is rocked about its pivot 23 and its outer sloped end strikes downwardly and outwardly upon the inner end of the corresponding pin 5, forcing it through the drum into selected position. To prevent overthrow of the pins when selected and to cause them to protrude a uniform distance from the surface of the drum, a limit plate 26 is positioned opposite the row of pins being selected and at a sufficient distance from the drum to allow a slight movement of the pins between the limit plate and the end of the selecting hammer. Following each character selection, the arm 27 with its attached mechanism is advanced one step in a manner to be described, so that the ends of the selecting hammers 21 come opposite the next following row of pins.

Restoring pins to inoperative position.

Just forward of the selecting hammers 21 and also hung from the setting-up arm 27 is a sloping steel plate 28 of sufficient height to extend over the rows of six pins. As will be seen from Figure 6, when the setting-up arm 27 is moved in the direction indicated by the arrow, the inclined plate 28 wipes the pins 5 back into their non-operated position. An inner limit plate 29, depending from the setting-up arm, prevents the pins from moving inwardly too far. The position of the pins on resetting is thus determined by the reset plate 28 and the inside limit plate 29 and on setting-up by the selecting hammers 21 and the outer limit plate 26.

Mechanism for collecting and electrically transmitting the stored-up character impulses.

After the preparation of the character selections in the manner above described, the pins 5, which have been selected and protrude from the outer surface of the drum are caused to actuate circuit closers or transmitting contacts for the purpose of sending electrical impulses to the line or of controlling other auxiliary sending apparatus by mechanism illustrated in Figure 5.

In this figure a row or set of pins 5 is shown in selected position. A transmitting arm 30 rotatable about the same central shaft as is the setting-up arm 27, extends down over the outer surface of the drum and carries six collector shoes 31 and six transmitting contacts 32. Each collector shoe is separately pivoted on a shoulder screw 33 which carries a coiled spring 34 acting to depress the end of the shoe nearest the pin drum and to correspondingly raise the outer end which is nearest the transmitting contact 32. Pins 35 stop or limit the upward motion of the shoes and determine their normal inoperated position. The upper collector shoe 31 in Figure 5 is shown one row of pins to the right of the five lower collector shoes and rests on a pin of the next following character. This is for the purpose of transmitting this impulse in advance of the others when the storing transmitter is used for automatic ticker transmission. If used for simplex printer operation or on other systems than tickers, the upper transmitting contact and shoe would not be advanced with respect to the others. It is evident that the transmitting shoes and contacts may be arranged in any desired relation to each other, as determined by the transmission requirement or the constructional requirements of the storing transmitter itself. Likewise the selecting hammers 21 previously described, may be arranged in staggered relation instead of the same vertical line, if desired.

The inner ends of the collector shoes 31 are beveled as shown, and as the transmitting arm 30 is stepped forward from left to right, these beveled surfaces strike the protruding pins 5 which have been selected and slide up thereon, thus causing a rocking of the collector shoes about the pivot screws. The outer ends of the collector shoes 31 carry contact springs 36 which are in a position to make contact with transmitting contacts 32 when the contact shoes are actuated by sliding up on a selected pin. Thus each pin 5 which is selected causes its corresponding shoe to rock and close its contact 36 against a transmitting contact 32. The impulse which was mechanically selected and stored by the pin in the drum is thus transformed into an electrical impulse.

When a pin is not selected and hence does not protrude from the outer surface of the drum, the beveled end of the corresponding collector shoe 31 does not strike when passing the pin and consequently remains in inoperated position. When the transmitting arm 30 comes to rest after each advancement, the collector shoes 31 rest on top of the selected pins in that row and the contacts 36 and 32 are held closed until the arm 30 is again advanced. The length of the beveled end of collector shoes 31 is such that the contacts 26 do not break from contacts 32 when the shoes are advanced from one row of selected pins to corresponding pins in the next succeeding row which are also selected.

The contacts 36 are not insulated from the frame and the ground potential is applied directly to the frame. Contacts 32 are mounted in insulating material 37 and separate leading-out wires 38 extend from each contact 32 to the commutator rings 39 as shown in Figure 1. Each contact 32 is provided with a solid upper limit 40, set

into the insulating material 37 which acts as a positive stop for contact 32 when its contact 36 is leaving it.

Connections from the commutator rings 39 to the outside circuits and apparatus are made through brushes 79.

Mechanism for advancing the setting-up and transmitting arms.

The setting-up arm 27 and the transmitting arm 30 are separately rotatable about a central vertical shaft 41. Our preferred form of bearings is shown in Figure 8. Setting-up arm 27 has a thrust ball bearing 42 which rests upon a shoulder 43 on the shaft 41. This bearing supports the weight of the setting-up arm and its associated mechanism. Radial bearing 44 is placed in the upper part of the bearing housing of arm 27 and rests on shoulder 45 of shaft 41.

Similarly transmitting arm 40 has a thrust bearing 46 resting on shoulder 47 of shaft 41. Transmitting arm 30 carries the commutator 39 through which the electrical connections are made from the various contacts and magnets on the rotating arms to the outside associated apparatus.

As shown in Figure 1, setting-up arm 27 has secured to it the supporting column 20 which carries the selecting hammers 21 for setting the pins in the desired selections. This arm also carries the outer and inner limit plates 26 and 29 respectively and the reset plate 28. Figure 3 shows in top plan view the driving mechanism for actuating both arms. The setting-up arm 27 carries a bell-crank 50 which is pivoted at 59 and carries a pawl 51. Action of the armature 56 advances the pawl 51 one tooth on the ratchet wheel 52 and the armature 56, upon being restored under the influence of the spring 69, advances the ratchet wheel 52.

Mounted on the shaft of ratchet wheel 52 is a pinion 63 which meshes with gear 2 and steps the setting-up arm 27 one space. To prevent pawl 51 from throwing out on the return stroke and also to check the effect of the inertia of the arm tending to step two spaces instead of one, we have devised a novel locking device comprising a crank arm 57, pivoted at 54^a, and which is so shaped and located with respect to the arm 50 and pawl 51 as to prevent the latter from turning on its bearing 50^a and disengaging when the lever arm 50 is in the position shown. This locks the pawl 51 between the crank arm 57 and a tooth of the ratchet 52 and thereby prevents any further movement of the setting-up arm. Upon the operation of the magnet 74, the crank 57 releases, due to its shape and arrangement and offers no resistance to the advancement of the pawl 51 by turning on its pivot 54^a. Thus a positive step and lock is obtained with a ratchet combination. Backward movement of the ratchet 52 is prevented by the pawl 53.

The transmitting arm 30 is driven in a similar manner. Lever 60, pivoted at 67 is actuated by armature 65 pivoted at 66, through link 68. The lever carries pawl 61 which engages ratchet 62 and through the pinion 75 and circular rack 2 advances the arm 30 on the return stroke of the armature 65 under the tension of spring 71. Crank 64 pivoted at 72 prevents the overthrow of pawl 61 at the end of the return stroke in the same manner as previously explained with crank 57 acting to prevent overthrow of the setting-up arm 27.

Automatic stop for the transmitting arm.

The storing transmitter disclosed herein is capable of sending the character immediately following the one set-up, but for better mechanical working margin, it is usually better to transmit the second character following the one set-up. Thus the lag between the preparation of a character and the transmission of the same character is greatly reduced when compared with tape transmission. If the operator should stop sending or for some reason send slower than the speed of transmission, a device is provided for stopping the operation of the transmitter stepping magnet. A contact 76 in series with magnet 70 carried by the transmitting arm 30 is adapted to be engaged by a rod 77 carried by the setting-up arm 27 when the relative position of the arms is such that the transmitting arm is within two characters of the setting-up arm thereby opening the circuit of the transmitter actuating magnet 70.

Warning light for setting-up arm.

As the speed of the transmitting arm, due to its regulation from associated outside apparatus may be appreciably slower than the speed of character preparation, all of the sets of selecting pins in the drum can be filled and the setting-up arm 27 will then be liable to interfere with the transmitting arm 30. We therefore, provide a signal to warn the operator of the impending interference so that he can stop until the transmitting arm has regained its lead. We therefore, attach a leaf spring 80 to the setting-up arm 27 and a contact stud 81 to the transmitting arm 30 so that when the setting-up arm is within ten characters of the transmitting arm, the stud 81 engages the spring 80 and thereby completes a circuit through a red lamp. The operator thereupon completes the quotation or word being set up and then waits for the light to be extinguished. As soon as the transmit-

ting arm has regained its lead, the contact between the stud and the spring is broken and the operator then resumes work on the keyboard.

Operation of setting-up mechanism in storing transmitter from manually operated key-board.

One means for causing the setting-up mechanism in the storing transmitter to function from a key-board is illustrated in Figure 4. This form of key-board and the method of selecting is the same as used in the well-known Western Union key-board tape perforator.

Referring to Figure 4, when one of the keys of the key-board, represented by the key 100, is depressed, it engages certain of the selectable bars 101, determined by its comb 102. The selected bars slide downward and to the right upon fixed rods 103 and cause a rotation of the corresponding selecting fingers 104 about pivot rod 105. The outer ends 106 of the fingers which are thus operated, slide across the hammer 107, thereby interposing the ends 106 between the hammer and the lower ends of the corresponding bell-cranks 108. There are six cranks 108, one for each of the six selecting impulses of a character and a seventh, 109, which controls the energizing of the actuating magnet 74 which advances the setting-up arm 27. As the depressed key 100 approaches its lowest point, it strikes bar 110 and causes contact 111 to close and thereby complete a circuit through magnet 112. Armature 113 rotates shaft 114 anti-clockwise and causes the hammer 107 to carry the ends 106 of the selected fingers upwardly until they impinge upon the lower ends of the corresponding cranks 108, causing them to rotate about shaft rod 115. The insulated adjusting screws 116 carried by the cranks 108, strike against one leaf of their respective pairs of contacts 117 and this causes the selected contacts to close and complete circuits to the pairs of ring magnets 8 which are connected to the operated contacts. The operation of magnets 8 cause the selecting pins 5 to be pushed outwardly in the drum of the storing transmitter as previously explained.

The feed contact crank 109 being longer than cranks 108 is actuated with each movement of the hammer to close the circuit of the magnet 74. While the energizing of magnet 74 coincides with the energizing of the ring magnets 8, it will be remembered that the step forward of the setting-up arm 27 takes place upon the de-energizing magnet 74 and hence the hammers 21 return to their normal position just before the setting-up arm 27 is advanced to the next row of pins.

Use of storing transmitter for controlling transmission for simplex printer operation.

Figure 10 illustrates diagrammatically the application of the storing transmitter to simplex printer operation.

The transmitting contacts 32 on the storing transmitter are electrically connected as shown, to segments on one ring of the distributing transmitter TD, the brushes B of which rotate continuously at a constant speed as is well understood. These contacts in turn, through the distributor segments and brushes, act on the line transmitting relay LR which sends the marking or spacing signals to line.

As the last contact No. 5 on the segmented ring of the distributor has actuated the line relay LR, a segment S on the local distributor ring operates the magnet 70, which steps forward the transmitting arm 30 on the storing transmitter. This advances the transmitting shoes 31 to the next row of pins 5 and a new selection is thereby made ready when the distributor brushes reach the first or shift segment on the transmitting ring of the distributor.

When the transmitting arm 30 advances sufficiently close to the setting-up arm 27, the projection 77 acts to open contacts 76, as previously explained, thereby opening the circuit through the stepping magnet 70 on the transmitting arm and removing ground from the transmitting contacts. The arm cannot advance therefore, until more selections are set up and while contact 76 remains open, the line transmitting relay LR does not receive any impulses and sends only spacing current to the line.

Use of storing transmitter in other systems.

It will be evident to telegraph engineers that this storing transmitter may be used instead of the tape transmitter in multiplex, Morse and automatic stock ticker systems.

In using the storing transmitter for the control of automatic transmission for stock ticker systems such as disclosed in the application of Evan R. Wheeler, Serial No. 754,188, the ticker transmitter, selector heads and control relays are the same, but instead of having the tongues and contacts of a tape transmitter connected to the selector head segments, we connect the tongues and contacts of a group of selector relays to said selector head segments. These selector relays are in turn operated by the transmitting contacts on the transmitting arm 30 of the storing transmitter.

The operation of the storing transmitter when substituted for the tape transmitter in the ticker system described in said application will be evident. After the preparation of a selection in the form of pins 5 pushed outward from the drum 1 of the storing

transmitter, the transmitting arm 30 advances the transmitting shoes 31 to the pin selection and causes the closing of the transmitting contacts 32, 36 corresponding to the character selected. These contacts complete circuits to the coils of their respective relays, each contact operating two selector relays in series.

The front and back contacts of these selector relays are joined directly to the segments of the "A" and "B" selector heads on the ticker transmitter shown in said application. The brushes of the ticker transmitter wiping over the selector heads, complete a circuit to the stop magnet when they reach the line of segments corresponding to the character selected and, as described in said application, the energizing of the stop magnet stops the rotation of the ticker transmitter shaft and causes the ticker to print the desired character. The closing of the operating contact on the ticker transmitter starts the operation of the control relays and at the same time energizes the stepping magnet 70 on the transmitting arm 30 of the storing transmitter which on its return stroke advances the arm with the transmitter shoes to the next line of pins.

As previously noted, the top shoe 31 on the transmitting arm is shown in Figure 5 one row of pins in advance of the other five shoes. This controls the shift selection for each character which is necessary in automatic ticker transmission.

We claim:—

1. In a telegraph system, a signal storing transmitter, comprising a stationary drum or cylinder, a series of sets or groups of permutation elements positioned upon axial planes of the cylinder and slidably mounted in radial apertures therein, a setting-up or selecting carrier rotatable about the axis of said cylinder, selectable members mounted on said carrier for successive engagement with said sets of elements, a transmitting carrier rotatable axially of said cylinder, and circuit closers positioned on said transmitting carrier for engagement successively with the selected elements.

2. In a storing transmitter as set forth in claim 1, said permutation elements comprising pins provided with yieldable means frictionally engaging the walls of said apertures to hold the pins in any set position.

3. In a storing transmitter as set forth in claim 1, means for rotating said carriers independently of each other.

4. In a storing transmitter as set forth in claim 1, said cylinder having a peripheral rack, said carriers being each provided with a pinion and ratchet mechanism engaging said rack, and an actuating magnet to operate said mechanism to impart a step by step movement to the carriers.

5. A storing transmitter comprising a stationary drum or cylinder, a transmitting carrier axially rotatable about said cylinder, circuit controlling elements mounted on the carrier, permutation pins arranged in sets or groups, slidable in radial apertures in said cylinder and selectively movable into the paths of respective ones of said circuit controlling elements, a selecting carrier rotatable axially of said cylinder and having a set of permutation controlling elements located within the cylinder operating to shift the pins of a set selectively in various combinations depending upon the signal to be transmitted by that set, means to rotate said carriers independently, and mechanism to actuate said permutation elements as they are brought successively opposite each set of pins, said mechanism having a single reciprocable member for each permutation element operatively connected therewith to actuate the same in any position.

6. A storing transmitter of the type described, comprising a stationary drum or cylinder, a transmitting carrier axially rotatable about said cylinder, circuit controlling elements mounted on said carrier and movable exteriorly of said cylinder, permutation pins mounted in radial apertures in the cylinder and selectively movable into the path of respective ones of said circuit controlling elements, the latter being adapted to slide upon the sides of the selected pins and thus exert no force to change the position of the pins.

7. In a device of the type described, a cylinder or drum, a carrier arm axially rotatable about the cylinder, and means to actuate said carrier, comprising a pawl and ratchet driving mechanism and means restricting the movement of the pawl and permitting it to move over only one tooth of the ratchet at a time and preventing any overthrow of said pawl due to the inertia of the mass of the moving parts.

8. A storing transmitter, comprising a stationary drum or cylinder, permutation pins carried thereby and arranged in groups or sets, hammers mounted upon a carrier rotatable axially of said cylinder to position said hammers opposite said sets successively, a series of rings positioned in planes parallel to said pins and operatively connected respectively to said hammers to permit the latter to move circumferentially thereabout, stationary magnets having their armatures operatively connected to reciprocate said rings parallel with the axis of the cylinder, and a keyboard selecting mechanism to selectively energize said magnets in various combinations depending upon the signals to be transmitted.

9. A storing transmitter, comprising a stationary cylinder mounted upon a vertical axis, a plurality of sets of permutation pins arranged around the periphery of said cyl-

inder in vertical rows, a setting-up or selecting carrier rotatable within the cylinder and having actuating members arranged to move said sets of pins successively into selected combinations, a transmitting carrier rotatable exteriorly around said cylinder and having circuit closing members actuated successively by the selected pins in said sets, and means for rotating said carriers independently of each other.

In testimony whereof we affix our signatures.

EVAN R. WHEELER.
ROBERT F. DIRKES.