A. N. CHENOWETH.

TELEPHONE LINE TESTING SYSTEM.

APPLICATION FILED AUG. 6, 1908.

938,974. Patented Nov. 2, 1909.

3 SHEETS—SHEET 1.

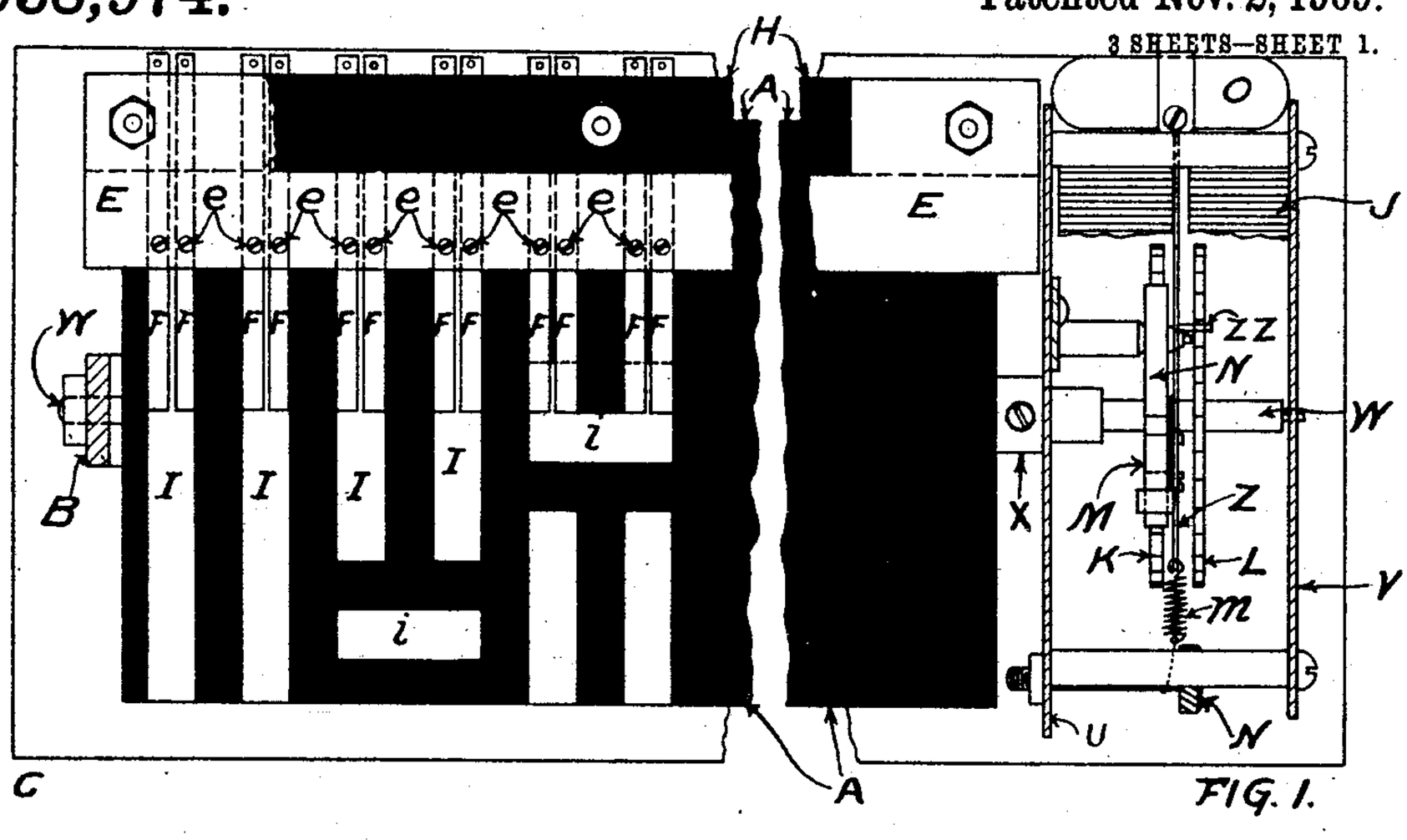

FIG. 1.

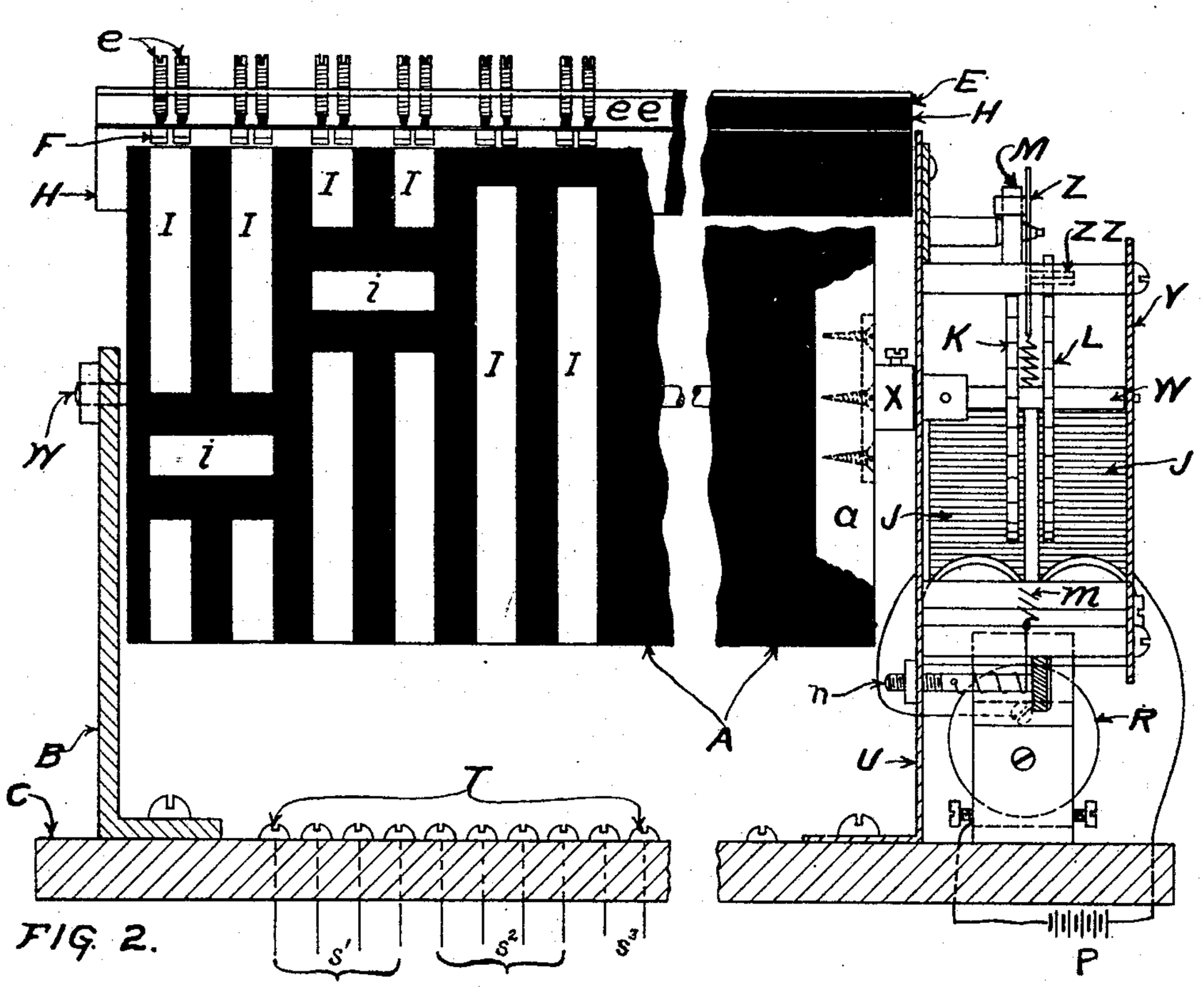

FIG. 2.

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FIG. 4.

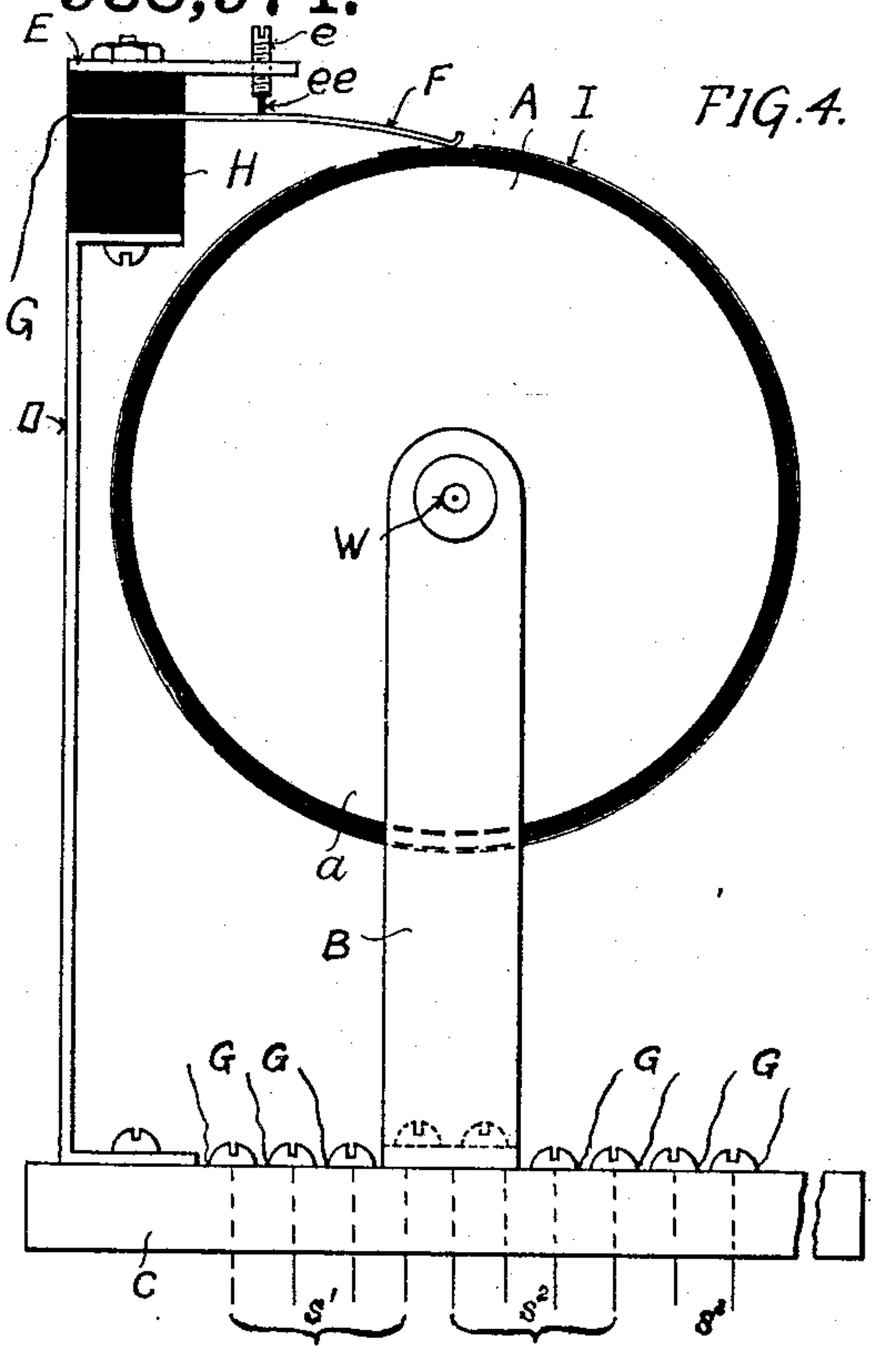


FIG. 3.

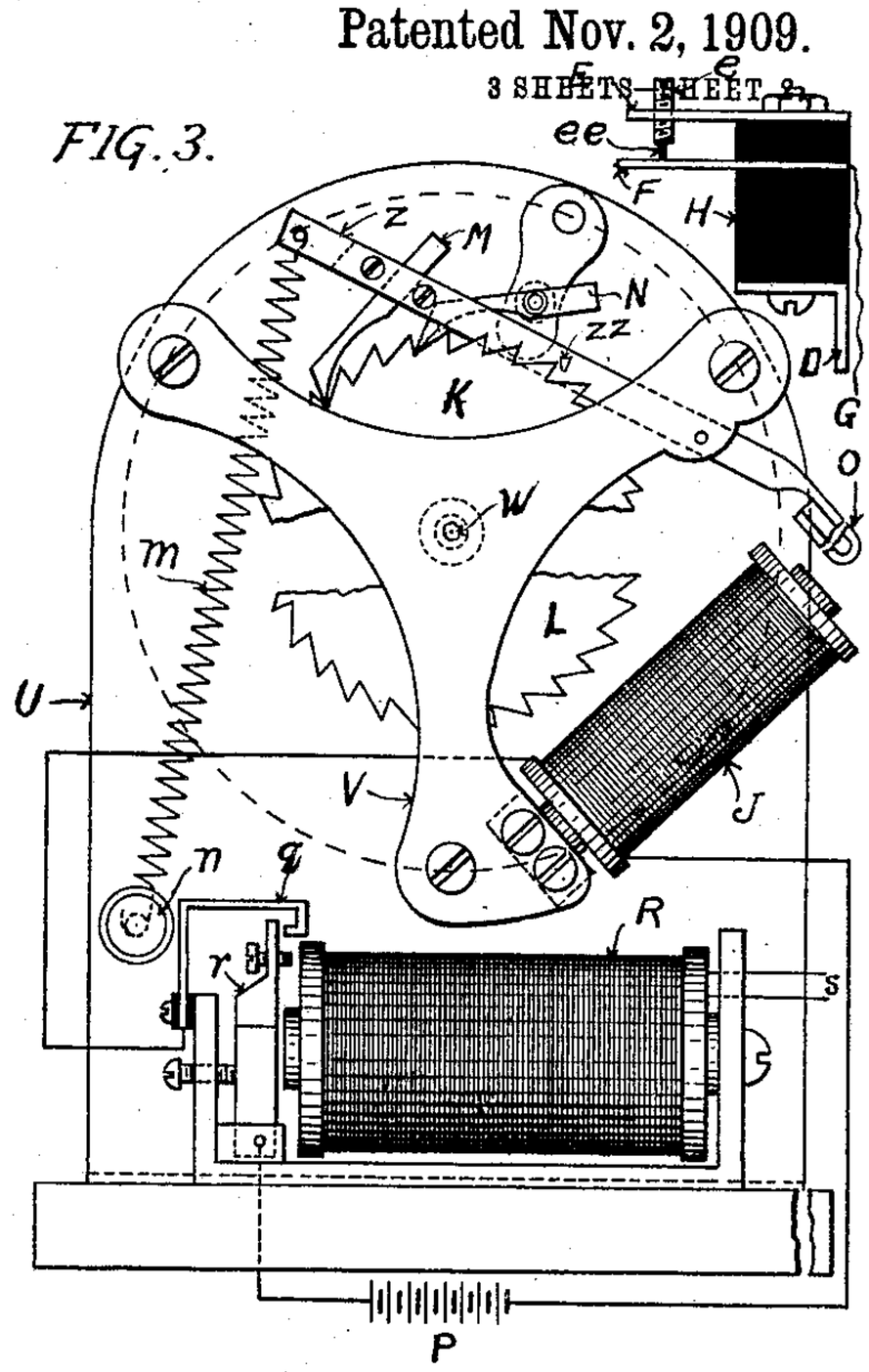


FIG. 6.

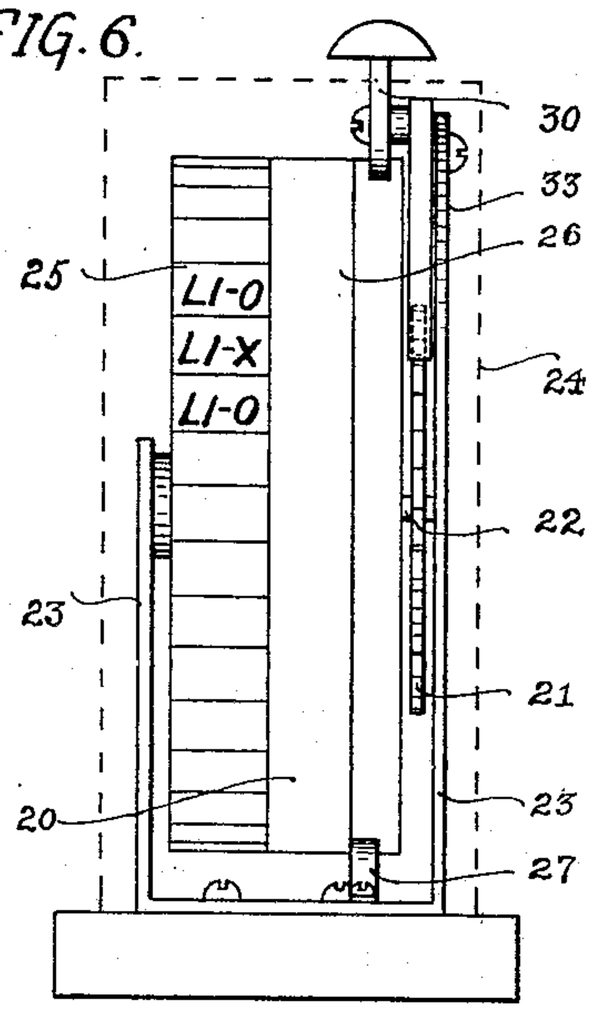
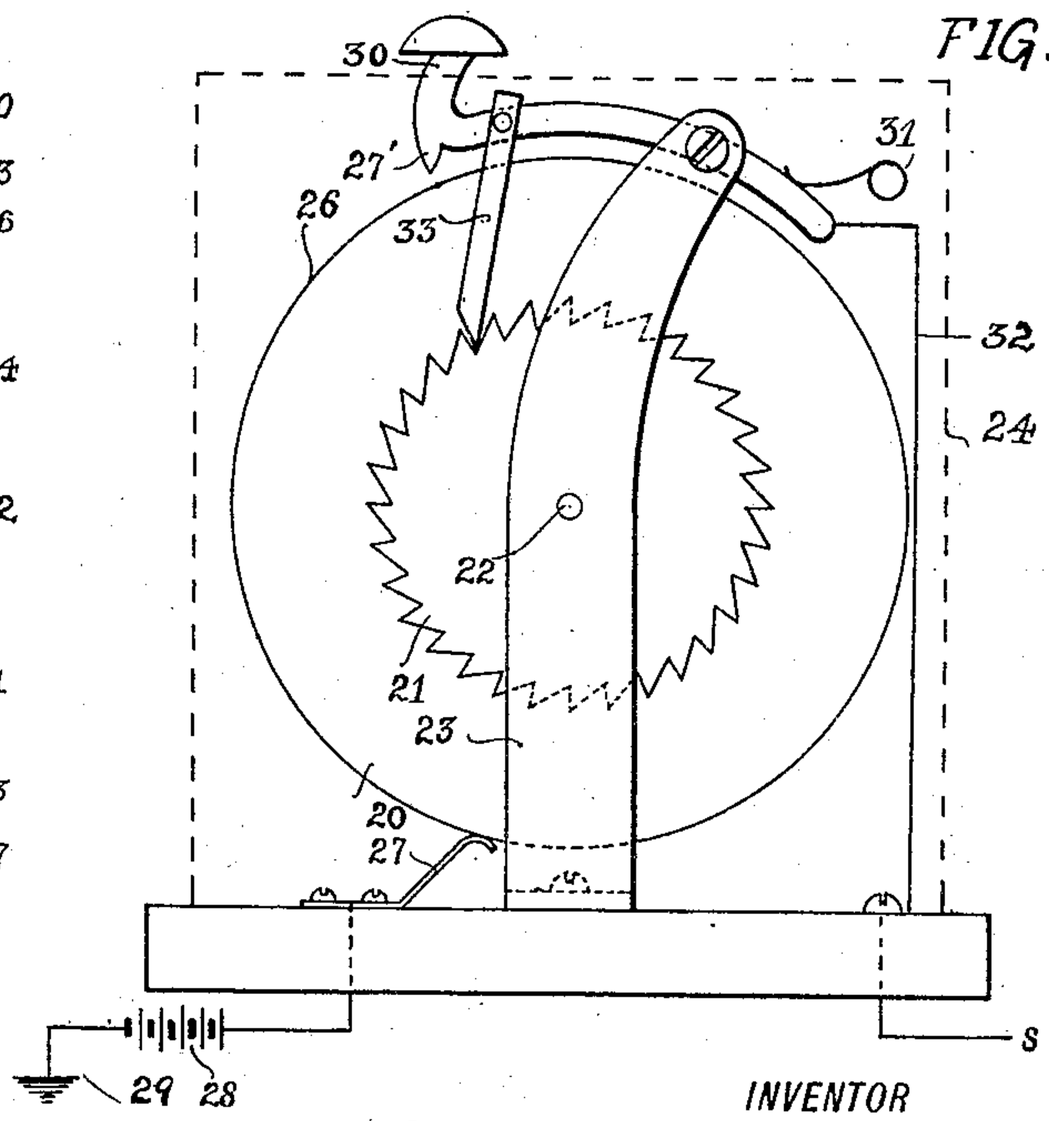


FIG. 5.



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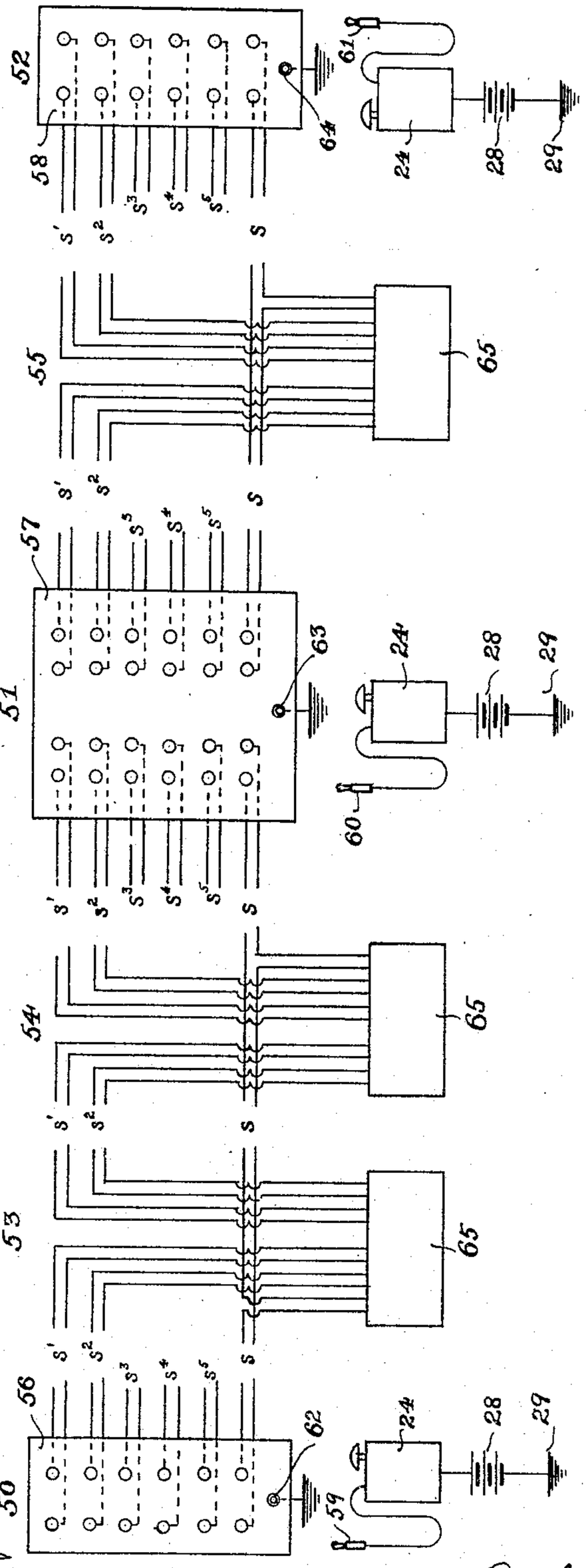
3 SHEETS—SHEET 3.

FIG. 7.



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UNITED STATES PATENT OFFICE.

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TELEPHONE-LINE-TESTING SYSTEM.

938,974. Specification of Letters Patent. Patented Nov. 2, 1909.

Application filed August 6, 1908. Serial No. 447,191.

To all whom it may concern:

Be it known that I, ARTHUR N. CHENOWETH, a citizen of the United States, residing at Waterbury, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Telephone-Line-Testing Systems, of which the following is a specification.

My invention relates to telephone lines, and particularly to a method of and an apparatus for testing the same.

It has for its object the determination of the location of trouble peculiar to long distance telephone lines such as opens, crosses and grounds between terminal stations; and to avoid the necessity of conducting the tests at an intermediate point or points, allowing the same to be made from either or both of said terminal stations. I attain these objects by the mechanism and arrangement illustrated in the accompanying drawings in which—

Figure 1 is a plan view of the line controlling apparatus. Fig. 2 is a side elevation of same. Figs. 3 and 4 are end views of said line controlling apparatus. Fig. 5 is a front elevation, and Fig. 6 a side elevation of the operating key. Fig. 7 is a diagrammatic view of the various stations and connections.

Similar characters of reference designate corresponding parts throughout the several views.

In Figs. 1 to 4 I have illustrated the line controlling or selecting apparatus which is located at a testing station, or at a number of testing stations if desired, intermediate of the two terminal stations of a plurality of telephone lines connecting the same. At one, or at both of the terminal stations if desired, is located the operating key, Figs. 5 and 6, for the said line controlling apparatus.

The line controlling apparatus, located at the intermediate station and shown in Figs. 1 to 4, comprises a suitable base C upon which a cylinder A, preferably hollow and closed at both ends *a*, is supported on a rotatable shaft W carried by standard B and frame plate U. This cylinder is of a suitable electrically non-conductive material, as fiber or hard rubber, and is made as thin as permissible to retain a perfect cylindrical surface. The shaft W passes through the said cylinder A and is held to the true center of same by means of a collar X secured to the end *a* and through which it passes.

The shaft W carries at one end, and between frame plates U and V, advancing mechanism for the cylinder A. This mechanism comprises two ratchet wheels K and L, the teeth of one being oppositely disposed to those of the other. An advancing pawl M and a locking pawl N are arranged to engage the teeth of ratchet K, the former being carried by the arm Z, and the latter pivoted to a support carried by frame plate U. The arm Z is pivotally connected to frame plate V and carries at its outer end the armature O of electro-magnet J. At the inner end of arm Z is attached a spring *m*, adjustable by means of thumb screw *n*. The said arm Z carries also a pin Z Z, adapted to engage the teeth of ratchet wheel L to prevent the said wheel K from advancing more than one tooth at a time during the forward movement of same caused by spring *m* upon release of armature by electro-magnet J. This electro-magnet J is in a local circuit including local battery P to operate the said electro-magnet and contacts *q* and *r* of a relay R, operated from one of the plurality of telephone lines as hereinafter set forth. Contacts *q* and *r* are adapted to close this local circuit when the relay R is energized, and thereby operate electro-magnet J and upon release of armature O advance the wheel K and its cylinder A.

As the armature O is drawn down by electro-magnet J, arm Z is raised causing thereby the pawl M to drop into the succeeding tooth of wheel K, the pawl N engaging wheel K to check return movement of shaft. When the local circuit is again opened through action of relay R, armature O is released, allowing thereby spring *m* to draw arm Z down to normal position causing pawl M to advance wheel K one tooth and with it the cylinder A. Completely circumscribing the said cylinder A, with the exception of a distance corresponding to a definite number of movements of the same, and in this case three movements, are a number of adjacent thin narrow strips of copper I, arranged in pairs and connected to the various telephone lines as hereinafter set forth. One pair is required for each line, and the break is progressively arranged, the

dimension of the cylinder A and number of teeth of the advancing wheels K and L being proportioned to the number of lines controlled. In the break of copper strips I, and at the position corresponding to the second of the said three movements, are second, transverse copper strips *i*, and equal to the space of the surface of the cylinder included by two of said strips I.

Directly above each copper strip I (and strips *i*) and adapted to wipe same, is a pair of contact brushes F, held in position by a hard rubber block H and adjusted by means of set screws *e*. The block H is supported by a standard D, and carries at its top a brass plate E tapped to accommodate the set screws which are insulated from the contact brushes F by means of hard rubber tips *e e*. Each brush F is connected by means of wires G to connections T at the base C, and to which in turn are connected the line wires S^1, S^2 etc.

The operating key, shown in Figs. 5 and 6, for operating the line controlling apparatus already described, is located at the various terminal stations, or when there are but two terminal stations it is sufficient to have an operating key at only one of the stations if desired. This key comprises a contact cylinder 20 supported with advancing ratchet wheel 21 upon axle 22 which is carried by standard 23 secured to the base of a surrounding casing 24. Upon a portion of the surface of cylinder 20 is marked an indicating scale 25, or the like, visible through a suitable opening in the casing (not shown) to indicate the position of the cylinder A of the line controlling apparatus as hereinafter set forth.

A copper strip 26 extends about the entire circumference of a portion of wheel 20, and electrical contact is permanently made with same at the bottom through brush 27 which wipes said strip and which connects with a suitable source of electrical power 28 grounded at 29. At the top, contact may be made through the contact points 27′ of key 30, which is pivoted to standard 23 and normally held out of contact with the cylinder 20 through spring 31, connection being made by wire 32 to base of the casing 24, and from which connection may be made to the line S of the plurality of telephone lines.

The cylinder 20 is advanced by means of an advancing pawl 33 pivoted to the key 30 and engaging the teeth of the wheel 21. As the key is depressed, contact is made through contact point 27′ with the strip 26, and the wheel 21 caused to move forward a distance of one tooth due to the action of pawl 33. Upon releasing the key, contact is broken with the strip 26 and the pawl also drops into the succeeding tooth.

The number of teeth of the ratchet wheel 21 is proportioned to the number of lines to be controlled, and corresponds to the number of teeth of wheels K and L, the cylinder A of the line controlling apparatus being designed accordingly.

Referring to Fig. 7, 50, 51 and 52 represent three terminal stations located at various parts of the country and connected by a plurality of lines S, S^1 and S^2 etc. Between the stations 50 and 51, are two intermediate testing stations 53 and 54; and between the stations 51 and 52, is a single intermediate station 55. These testing stations are located, as in the present practice, at points such as to suitably divide the distance between the terminal stations. At each of the terminal stations is the usual jackboard 56, 57 and 58 for the lines, S, S^1, etc. which lines terminate in suitable jacks of said boards. Testing plugs 59, 60, and 61 are provided at the respective terminal stations and are connected to the operating keys contained in the casings 24. Grounding jacks 62, 63 and 64 are provided at each board for the purpose of grounding one side of any desired line.

At each of the testing stations the lines S^1, S^2 etc. are opened by means of any of the well known devices for this purpose (not shown) each line (consisting of 2 wires), with the exception of the line S, having therefore four dead ends. Only one side of the line S is broken, and the two ends thereof are connected to the relay R thus placing the same in series in said line S. The four dead ends of each of the lines S^1, S^2, etc. are connected at each of the testing stations to the line controlling apparatus already described and installed at each of these intermediate stations. From the connections T of each of these controlling apparatus, connection is made through wire G to the corresponding brushes F in such a manner that each pair of said brushes is connected to the dead ends of one side of the line and the next pair to the other side. The relay R, as explained, is included in series with one side of the line S where there is but one intermediate station, and where there are several intermediate stations, as between the stations 50 and 51, the respective relays are included in different sides of the line S. Should there be more than two intermediate stations, additional lines may be opened for this purpose to include the relay R in series. At the terminal stations the operating key already described is arranged, when testing, to be included in series with the said side of the line by inserting the proper testing plug 59, 60 and 61 into the proper jack.

In its normal position the cylinder A is so designed that each pair of the brushes F bears upon the corresponding strips I, thus closing both sides of the corresponding

lines and the connections between the terminal stations are normal and as in the ordinary practice.

When, owing to a cross or a ground, it becomes necessary for testing to open a line at one of the intermediate stations, 53, 54 or 55, instead of making this opening by going to the intermediate station as is the present practice, such opening is automatically made from either of the terminal stations and the usual test applied. This is accomplished by depressing the operating key in casing 24 which has been thrown in one side of the line S by means of plugs 59, 60 or 61 at one of the terminal stations. The operator at the other end having been notified and the other of the said side of line S having been suitably grounded by said operator through grounding jacks 62, 63 or 64, a direct current of sufficient strength is sent through the said side of this line in a predetermined number of impulses to revolve cylinder A the required distance until the desired break in the strips I is reached, this being shown by the indication on wheel 11. The relay R is designed to be irresponsive to ringing and foreign currents of less voltage than that employed for the test. In this position the brushes F bear upon the surface of the cylinder A, and thus open the line. Should it be desired to cross or bridge a line at the intermediate station to determine the location of an open circuit, the cylinder is rotated until the transverse strip *i* is reached (in the case just described one impulse more) which bridges the two sides of the line. Another impulse opens the line, and another again restores it to its normal condition.

I claim:—

1. In an electrical system, comprising: terminal stations, and a plurality of connecting lines; an intermediate station or stations; means located at said intermediate station or stations, controlling the continuity of said plurality of connecting lines; and means, located at said terminal station or stations, operating said line controlling means to automatically open or bridge, at said intermediate station or stations, the desired lines.

2. In an electrical system, comprising: terminal stations, and a plurality of connecting lines; an intermediate station or stations; means, located at said intermediate station or stations, responsive to electrical impulses and adapted to control the continuity of said plurality of connecting lines; and means, located at said terminal station or stations, to impress a predetermined number of electrical impulses upon any selected line to operate said means at the intermediate station or stations to automatically open or bridge, at said intermediate station or stations, the desired lines.

3. A telephone line testing system, comprising, terminal stations and a plurality of connecting telephone lines, an intermediate testing station or stations, means located at said testing station or stations controlling the continuity of said plurality of telephone lines, and means located at said terminal station or stations operating said line controlling means to automatically open or bridge, at the said testing station or stations, the desired telephone lines.

4. A telephone line testing system, comprising terminal stations and a plurality of connecting telephone lines, an intermediate testing station or stations, means located at said testing station or stations and in one of said plurality of telephone lines and controlling the continuity of said lines, and means located at said terminal station or stations and in series with said line controlling means and operating same to automatically open or bridge, at said testing station or stations, the desired telephone lines.

5. A telephone line testing system, comprising terminal stations and a plurality of telephone lines connecting the same, an intermediate testing station or stations, electric circuit opening and bridging mechanism at said testing station or stations controlling the continuity of said telephone lines, and means at said terminal station or stations adapted to operate said circuit opening and bridging mechanism to automatically open or bridge, at said testing station or stations the desired telephone lines.

6. A telephone line testing system, comprising terminal stations and a plurality of connecting telephone lines, an intermediate testing station or stations, electric circuit opening and bridging mechanism at said testing station or stations controlling the continuity of said telephone lines and included in series in one of said plurality of telephone lines, and means at one or more of said terminal stations adapted to be included in circuit with said line controlling mechanism to operate the same to automatically open and bridge the desired telephone lines.

7. In a telephone line testing system: terminal stations and a plurality of connecting telephone lines; an intermediate testing station or stations; a selecting or line controlling device located at said testing station or stations, and included in series in one of said plurality of telephone lines, and to which the remaining lines are connected in such a manner as to be normally closed; and an operating key or keys located at said terminal station or stations adapted to be included in circuit with said selecting device, and cause same to be operated to open or bridge the desired telephone line.

8. In a telephone line testing system: terminal stations and a plurality of connecting

telephone lines; an intermediate testing station or stations; a selecting or line controlling device located at said testing station or stations, and included in series in one of said plurality of telephone lines, and to which the remaining lines are connected in such a manner as to be normally closed; an operating key or keys located at said terminal station or stations adapted to be included in circuit with said selecting device and cause same to be operated to open or bridge the desired telephone; and means carried by said operating key or keys to indicate the condition of the plurality of telephone lines due to the operation of the selecting device.

9. In a telephone line testing system: terminal stations and a plurality of connecting telephone lines; an intermediate testing station or stations; selecting or line controlling mechanism located at said intermediate testing station or stations, included in series in one side of one of said plurality of telephone lines and to which the remaining lines are connected in such a manner as to be normally closed, said mechanism being adapted to control the continuity at said testing station or stations of the remainder of said plurality of telephone lines; an operating key or keys at said terminal station or stations adapted to be placed, at one end of the line, in series with said selecting device; and means at the other end of said line adapted to be connected to said line to ground the corresponding end of same.

10. In a telephone line testing system: terminal stations and a plurality of connecting telephone lines; an intermediate testing station or stations; a selecting or line controlling device located at said testing station or stations, included in series on one side of one of said plurality of telephone lines, and comprising: a rotatable cylinder, electromagnetic means to rotate same in a step by step movement; a number of pairs of circumferential contact strips upon the surface of said cylinder, progressively arranged and extending over a predetermined distance such that a break in same is left, said break corresponding to definite number of movements of the cylinder; a number of pairs of contact brushes, each pair being adapted to wipe one strip of said pairs of contact strips, and each connected to the ends of a corresponding side of said plurality of telephone lines; and second contact strips located transversely with respect to said pairs of contact strips upon the surface of the cylinder and in the break between the ends of a pair of contact strips, and leaving a break at each side corresponding to a definite step in the rotation of the cylinder, said transverse strip extending over the distance included by a said pair of contact strips, and corresponding to a definite step in the rotation of cylinder.

11. In a telephone line testing system: terminal stations and a plurality of connecting telephone lines; an intermediate testing station or stations; a selecting or line controlling device located at said testing station or stations adapted to control the continuity of said plurality of telephone lines; and an operating key or keys located at said terminal station or stations adapted to be included in circuit with said selecting device, and comprising: a rotatable cylinder; a circumferential contact strip upon the surface of same; a depressible contact key adapted to make contact with said contact strip and at the same time advance the cylinder a predetermined distance, and thereby through making contact and closing the circuit likewise advancing the said selecting device; and indicating means in connection with said cylinder adapted to indicate the corresponding position of said selecting device.

In testimony whereof I affix my signature in presence of two witnesses.

ARTHUR N. CHENOWETH.

Witnesses:
FRED'K. F. SCHUETZ,
A. FABER DU FAUN.