No. 797,570. PATENTED AUG. 22, 1905.

T. GIARA.

MULTIPLEX TELEGRAPH SYSTEM.

APPLICATION FILED JULY 5, 1904.

4 SHEETS—SHEET 1.

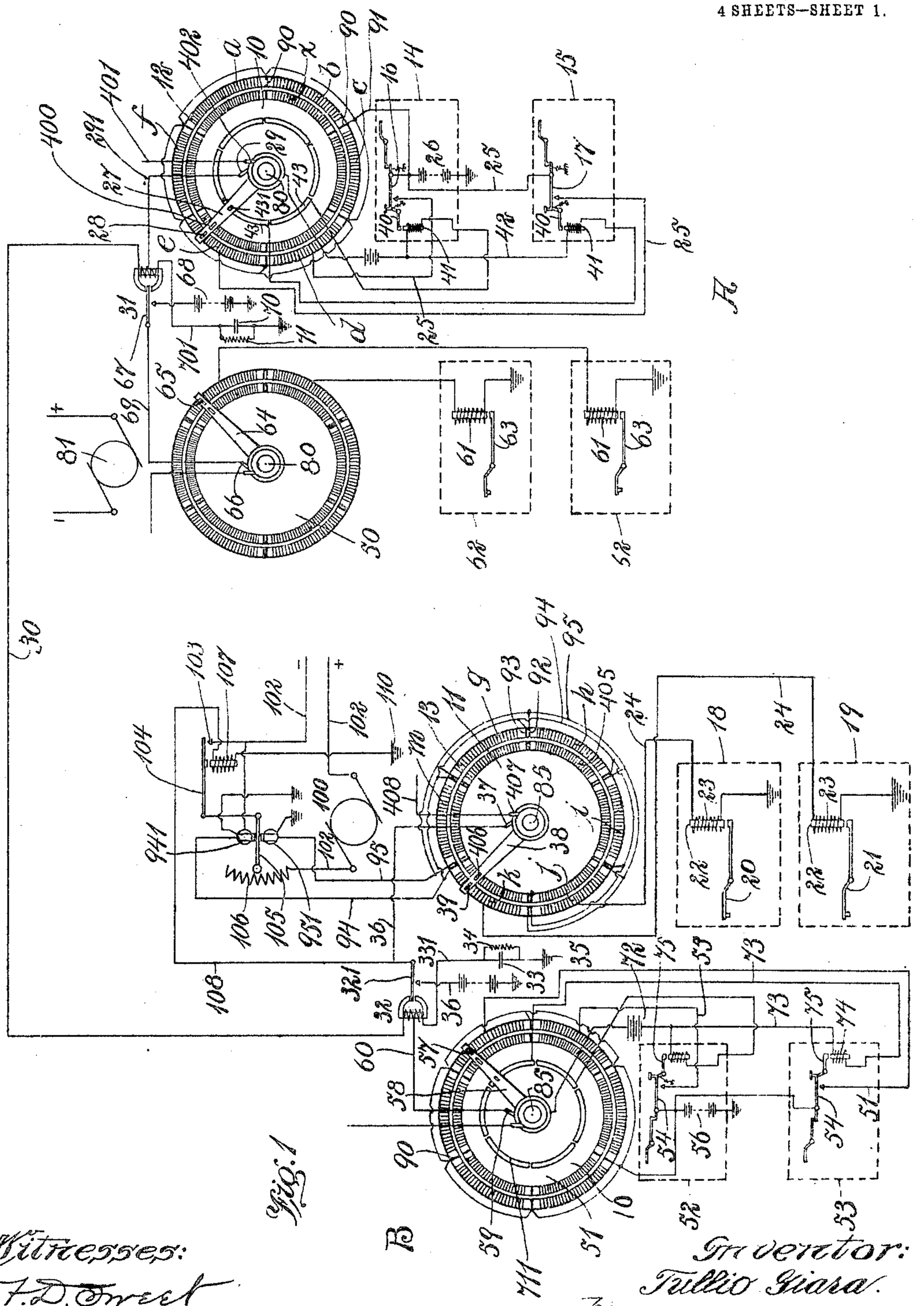

Fig. 1.

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4 SHEETS—SHEET 2.

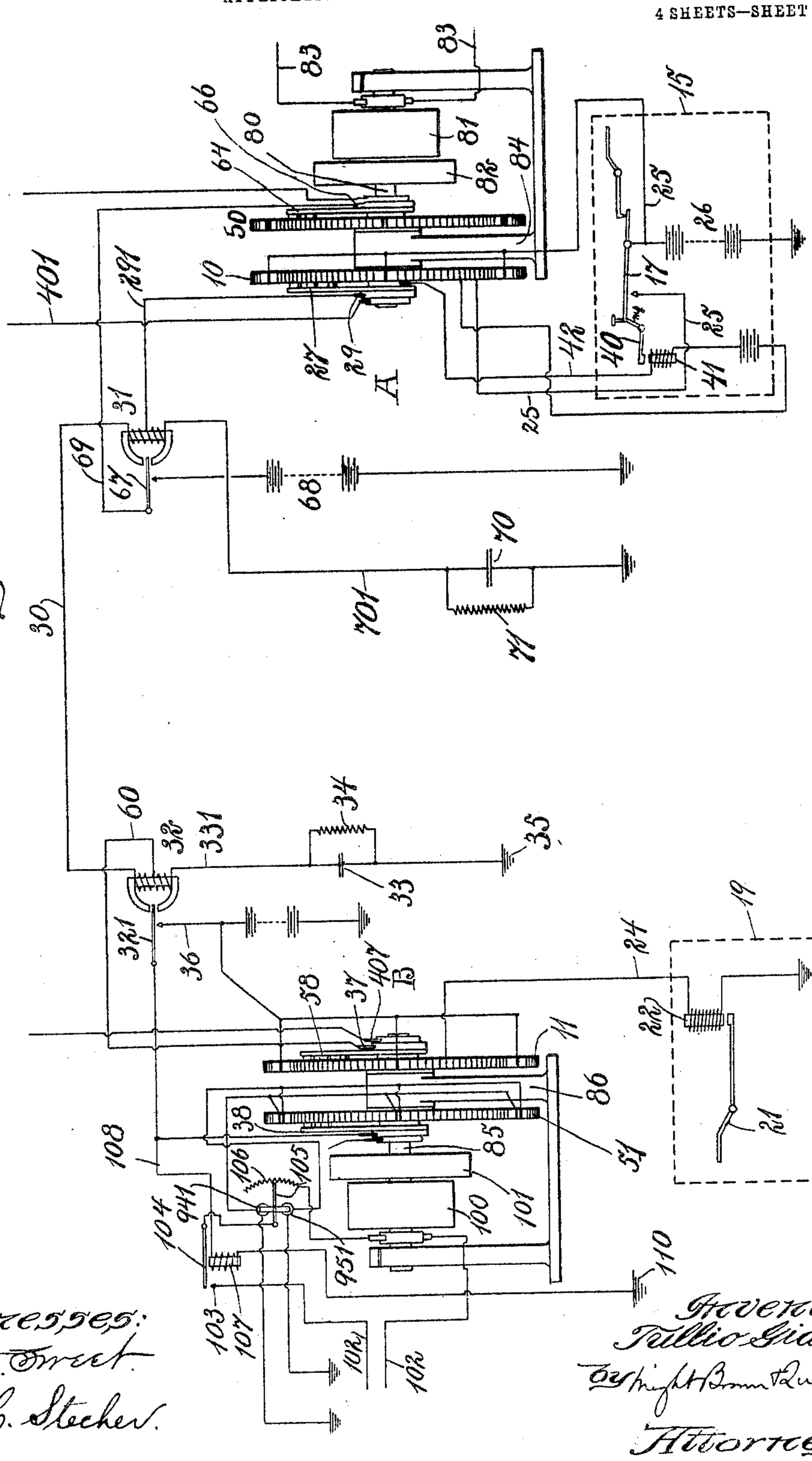

Fig. 2.

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4 SHEETS—SHEET 3

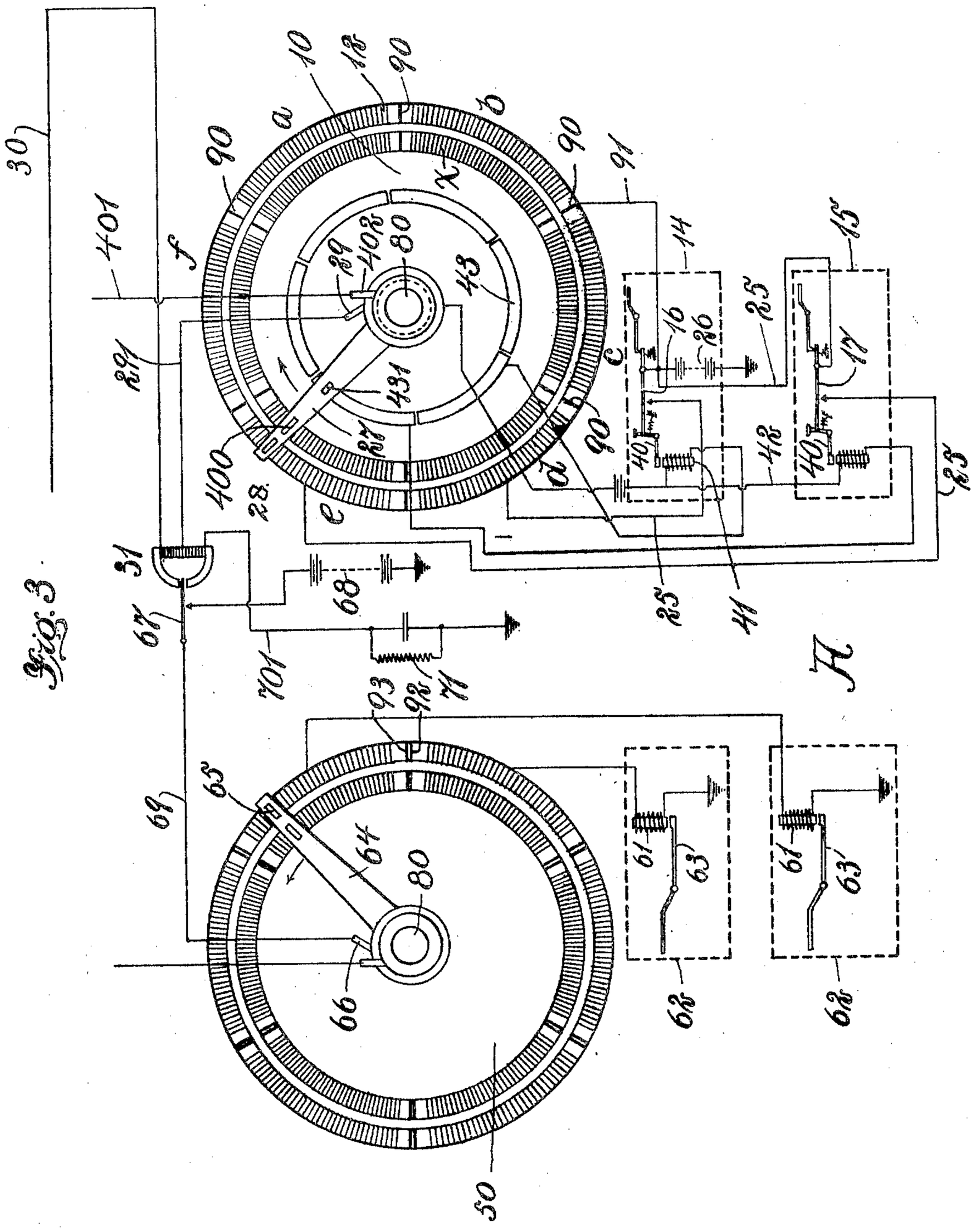

Fig. 3.

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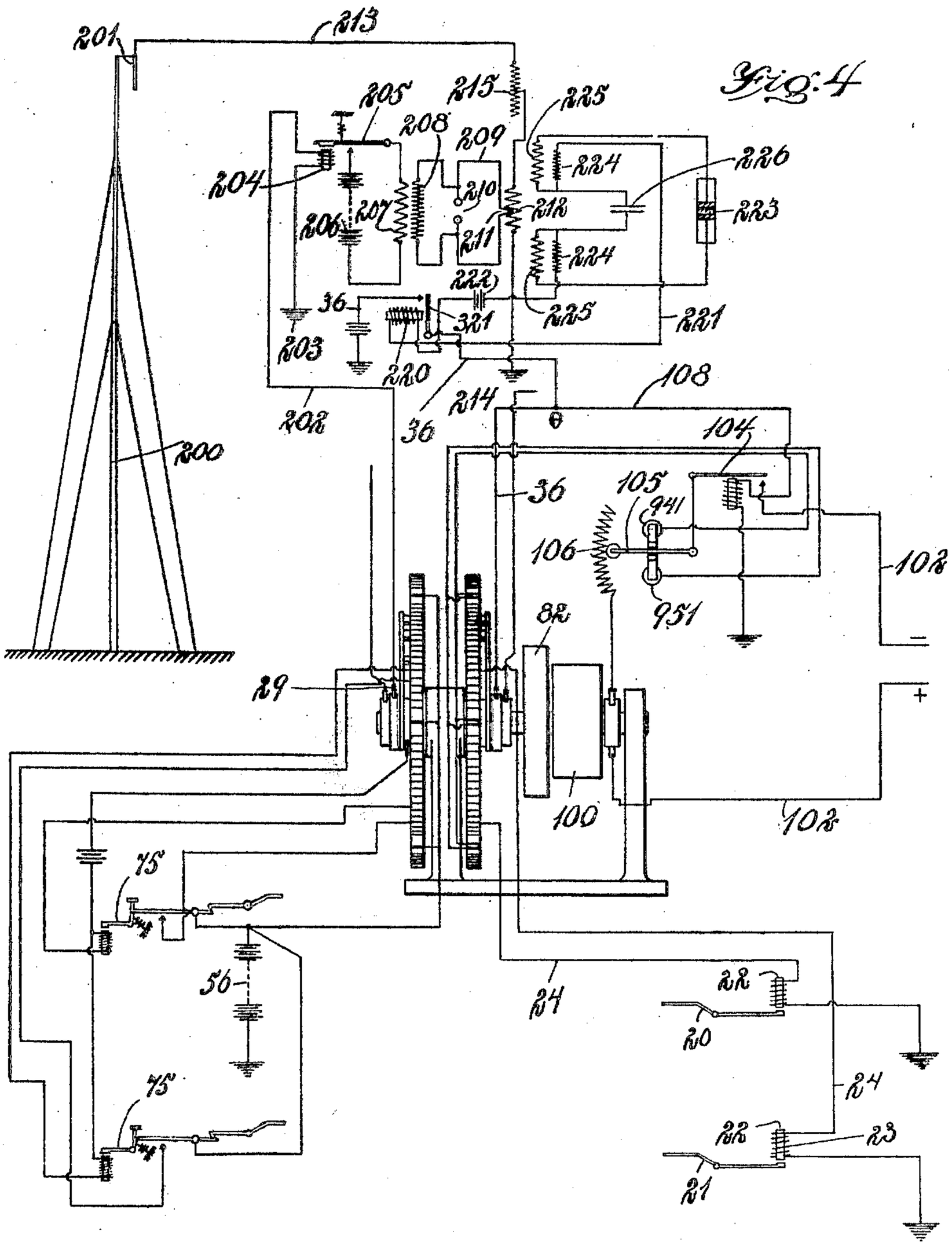
4 SHEETS—SHEET 4.

Fig. 4



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UNITED STATES PATENT OFFICE.

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MULTIPLEX-TELEGRAPH SYSTEM.

No. 797,570. Specification of Letters Patent. Patented Aug. 22, 1905.

Application filed July 5, 1904. Serial No. 215,222.

To all whom it may concern:

Be it known that I, TULLIO GIARA, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Multiplex-Telegraph Systems, of which the following is a specification.

This invention has relation to multiplex-telegraph systems, and has for its object to provide certain improvements therein by means of which a large number of messages may be sent over a single line in both directions at the same time.

The invention contemplates the employment with each line of sending apparatus and receiving apparatus at each end thereof, the sending apparatus consisting of a plurality of keyboards similar, for instance, to those of a typewriter, and the receiving apparatus consisting of a plurality of separate printing mechanisms, each printing mechanism being similar to that of a type-writer.

Considering the invention in its simplest form, it consists of a transmitter having a single set of keys, a receiver comprising a printing mechanism having a single set of type-bars, and a single conductor or line, each of the transmitter-keys being adapted to be electrically connected by a branch circuit with one of a series of contacts or sections at the sending-station, and each printing-key being similarly connected by a separate branch circuit with one of a series of contacts or sections at the receiving-station. In the sending apparatus and in the receiving apparatus there are movable brushes or contacts adapted to travel successively over the stationary sections or contacts with which the sending-keys or the printing-bars are severally connected. Any suitable motive power may be utilized for effecting the movement of the brushes or contacts, mechanism being employed for automatically synchronizing the movement of the said contacts or brushes.

In order that the apparatus may be utilized for sending messages in both directions over the same conductor, there is on each end of the conductor or line both a sending apparatus and a receiving apparatus, and in order that from each sending apparatus a number of messages may be sent said apparatus includes a plurality of keyboards and a plurality of sets of stationary contacts or sections, there being of course a similar number of sets of type-bars or printing mechanisms at the receiving end, with an equal number of sets of sections or contacts properly connected thereto. Preferably the stationary contacts or sections are arranged in series upon a flat disk, over which the movable contact travels in succession. In order that one operator may not interfere with another operator in sending a message, means are provided by which the keys of each keyboard are locked against actuation except when the movable contact enters that segment of the disk in which are located the contacts for that particular keyboard.

As an extension of this invention there may be located upon each sending-disk a plurality of sets of contacts or sections for use in connection with another line, there being corresponding sets of sections upon the receiving apparatus, with the proper number of keyboards and printing mechanism for use in connection therewith.

It will be understood that in the employment of the term "line" the invention is not limited thereby to a telegraphic system in which a metallic conductor is employed, for the invention may be embodied in the wireless system with equal facility, as will be subsequently explained in detail, and by said term I therefore include any means for effecting the transmission of an electrical impulse from the sending to the receiving apparatus.

Referring to the drawings, Figure 1 represents diagrammatically one form of telegraphic system embodying the invention. Fig. 2 represents the same, but shows the disks which carry the commutator sections or conduits in side elevation and illustrates how the movable contacts are mounted and actuated. Fig. 3 represents an enlarged diagrammatic view of the sending and receiving apparatus at one end of the line. Fig. 4 represents diagrammatically the invention as embodied in the wireless system.

It will be understood at the outset that I have not attempted to illustrate the apparatus in detail on account of the confusion that would result; but I have illustrated so much of the system as will enable one skilled in the art to embody the invention in practically working form.

Referring to the drawings, 10 11 indicate two disks, which for convenience I shall term, respectively, the "sending" and "receiving" disks and which are located at the stations A

and B, respectively. On the disk 10 are placed a plurality of sets of sections or stationary contacts, said sets being indicated at *a*, *b*, *c*, *d*, *e*, and *f*, the contacts in each set being insulated from each other and being indicated at 12. On the receiving-disk 11 are similar sets of contacts or sections, which are respectively indicated at *g*, *h*, *i*, *j*, *k*, and *m*, each insulated section or contact being indicated at 13. The contacts or sections of each set of the sending apparatus are adapted to be connected by branch circuits with the keys of the keyboard of a type-writing machine, so that there are as many keyboards as there are sets of contacts upon the disk. In Fig. 1 two keyboards are illustrated for two different sections, they being conventionally shown by dotted lines at 14 15. But one key is shown in each of the keyboards, as at 16 and 17, respectively; but as stated it will be understood that in each keyboard there is one key for each of the sections or contacts in the set reserved for it on the disk.

Referring now to the receiving-disk at the station B, it may be stated that there is a single complete printing mechanism for each set of stationary contacts *g h i*, &c., two printing mechanisms being conventionally illustrated by dotted lines, as at 18 and 19. These printing mechanisms have not been illustrated in detail, there being shown in each case a single type-bar 20 or 21. The sections or contacts 13 of one set thereof on the disk 11 are connected by branch circuits with the several devices which actuate the respective type-bars of the printing mechanisms. The type-bar-actuating mechanisms are illustrated conventionally as electromagnets 22, the coils 23 of which are in branch circuits 24, connected, respectively, to the contacts or sections 13. Referring once again to the sending-disk and its adjuncts, it will be observed that each key 16 or 17 of the keyboards is adapted to close a circuit 25 from the source 26 of electricity to one of the contacts or sections 12. All of the branch circuits 25 may be connected with the same source 26 of electricity.

27 represents an arm which rotates with a shaft about an axis concentric with the disk 10. The said arm carries a movable contact 28, which is electrically connected by a conductor with a brush 29. From the brush 29 a conductor 291 is connected to the coils of a duplex relay 31. One of the coils of said relay is connected electrically to the conductor, which in this case constitutes the main line 30, the other coil being connected with the artificial line 701, which consists of the resistance 71 and the condenser 70. At the other end of the line 30 it is connected to the coils of a duplex relay 32, there being another artificial line 331, comprising a condenser 33, and a resistance 34, and grounded at 35. Each artificial line is equal in resistance and capacity to the main line. The relay 32 is adapted to close a local circuit 36 at the station B through a brush 37 on an arm 38, journaled on an axis concentric to the disk 11. The said arm 38 rotates in synchronism with that at 27, and it carries a brush or movable contact 39, electrically connected with the brush 37. As soon as this circuit is closed to the contact 39 the current passes therefrom to a stationary contact or section 13, and thence through the conductor 24, effecting the energization of the coil 23 therein and the actuation of the printing-bar 20. Consequently it will be apparent that upon a depression at the sending-station of a key 17 and the registering of the brush or contact 28 with the section or contact 12, with which said key is connected, a current will pass out over the line 30 and close the local circuit 36 through the brush or movable contact 39 to effect the actuation of a printing-bar corresponding to the key which was depressed. Assuming that the two arms 27 and 38 are rotating in exact synchronism and at a rate of speed of, say, one hundred and fifty revolutions, more or less, per minute, it will be seen that operators may work at all of the keyboards connected with the disk 10 and the signals will be successively transmitted over the line 30 to effect the actuation of the type-bars in the several printing mechanisms connected with the contacts or sections 13 on the disk 11.

For the purpose of preventing the actuation of the keys of the keyboards other than that in which the keys are connected with the set of contacts over which the movable contact 28 is passing locking mechanisms are provided. Each mechanism consists of a pivoted lock 40, which normally rests under the keys of the keyboard to prevent the actuation of the keys. There is one lock for each keyboard and for each lock there is an electromagnet 41, the coils of which are connected by a branch circuit 42 with a segment 43 on the disk 10. There are as many of these segments as there are sets of stationary contacts or as there are keyboards, and the segments are so located that when a movable contact 431 engages with one of the segments it closes the branch circuit through the corresponding electromagnet 41, which thereupon withdraws the lock from under the keys of the keyboard and permits the operator to depress the one upon which he has his finger, the keys of all the other keyboards being locked at this time.

In order that messages may be sent in both directions, there is at each station a sending apparatus and a receiving apparatus. At the station A there is a receiving-disk 50, and at the station B there is a sending-disk 51. The said sending-disk 51 is similar to that at 10, and it has a plurality of sets of stationary contacts, each set of contacts being connected with the keys of a separate keyboard. Two separate keyboards are indicated conventionally at 52 53, and in each keyboard there is illustrated

a key 54. Each key is adapted to close a branch circuit 55 to one of the contacts, the keys all being connected in series with a source of electricity 56. On an arm 58, similar to that at 27, is a contact 57, in constant electrical connection with a brush 59. Said brush is connected by a conductor 60 with a portion of the coils in the duplex relay 32 in the same manner that the brush 29 is connected with the duplex relay 31. The receiving-disk 50 has a plurality of sets of stationary contacts, each set of contacts being connected with the various actuating-magnets 61 of the printing mechanism. The two printing mechanisms are conventionally indicated at 62 62, and in each there is represented a printing-bar 63. Movable relatively to the disk is an arm 64, similar to that at 38, and carrying a contact 65 in constant electrical connection with a brush 66. The said brush is connected to the switch 67 of the duplex relay 31, which closes the local circuit through said contacts 65, brush 67, and source of electrical energy 68. The local circuit is indicated at 69. When a signal is sent from the disk 51 over the line 30, it divides and passes through all of the coils of the duplex relay 31 and into a condenser 70 and through resistance 71 to ground and also to the main line 30. From this explanation it will be apparent that when a signal is sent from the disk 10 the current traverses the coils of the relay 31 and divides into two equal parts, one of them going to the ground through the resistance and the capacity and the other going over the line to the duplex relay 32. The switch 321 of the relay 32 closes the local circuit 36 through the proper contact of the receiving-disk 11. As the current passes over a line it has no effect upon the switch 67 at the station A. In the same manner when a signal is sent from the sending-disk 51 of the station B it produces no effect on the duplex relay 32, but causes the closing of the local circuit 69 at the station A. At the station B it will be understood that the disk 51 has segments 711 corresponding to those at 43 on the disk 10, the said segments being arranged in multiple with relation to each other, but connected in series with a source of electricity 72. Each segment is in a branch circuit 73, in which there is placed an actuating-magnet 74 for the key-lock 75, which key-lock corresponds to that at 40, which was hereinbefore described. Assuming now that all of the arms 27, 38, 58, and 64 are rotating in synchronism and that the sending and receiving disks are properly related, it will be apparent that at each of the stations there may be as many operators sending as there are keyboards. The speed at which each operator may send his messages is limited by the number of rotations per minute of the traveling contacts, since an operator may send an impulse representing one character over the line only when the arm of the sending-disk is on the segment 43 corresponding to the keyboard upon which he is operating; or, in other words, he can send one impulse for each revolution of the arm.

Means are provided for effecting the synchronous movement of the arms 27, 38, 64, and 58, as will be explained. The two arms 64 and 27 at the station A are preferably mounted upon a shaft 80, which is driven by a motor 81 and which is equipped with a momentum-wheel 82 to cause it to rotate evenly. The motor 81 may receive its energy from a suitable source and may consist of an electrical motor to which current is supplied by a circuit 83. The two disks 10 and 50 are attached to an upright 84, in which the shaft 80 is journaled. The two arms 27 and 64 are secured to the shaft so as to rotate therewith, each of the arms having a hub against which the stationary brush 29 or 66 acts, as best shown in Fig. 2. At the station B the two arms 38 and 58 are secured to a shaft 85, being journaled in an upright 86, to which the disks 51 and 11 are attached.

It will be observed that on the sending-disk 10 there is, between each adjacent set of stationary contacts, an additional contact 90, which may be engaged by the brush 28 on the movable arm which sweeps around the disk. On the said disk 10 the contacts 90 are all connected in multiple with a circuit 91 in series with a battery or source of power 26, so that each time the brush 28 engages one of the contacts 90 an impulse is sent out over the line 30. At the receiving-disk 11 there are two insulated contacts 92 93, placed between each adjacent pair of the sets *g h*, &c., of stationary contacts 13. The contacts 92 are connected in multiple with a circuit 94, and the contacts 93 are connected in multiple with the circuits 95. The circuit 94 includes an electromagnet 941, and the circuit 95 includes an electromagnet 951, each of the circuits then grounding, as indicated. When an impulse comes over the line 30 to the brush 39, (it being assumed that the arm 38 is moving in synchronism with the arm 27,) the current will pass from the brush 39 and divide into the circuits 94 and 95; but if the arm 38 lags or is in advance of the arm 27 the current will flow into either one or the other of said circuits. This is for the purpose of accelerating or retarding the motor which drives the arm 38, as will be now explained.

The arbor 85 is driven by a motor 100, there being a momentum-wheel 101, as shown in Fig. 2. This motor is preferably electrical and receives its current from a circuit 102. The said circuit includes a stationary contact 103, a switch 104, a movable contact 105, and a rheostat or variable resistance 106, as shown in Figs. 1 and 2. The switch 104 is under the control of an electromagnet 107, placed in a branch circuit 108, connected in series with the duplex relay-switch 321 and grounded at 110. The movable contact 105,

which coacts with the resistance or rheostat 106, is under the control of the two electromagnets 941 951 and is adapted to be moved in one direction or the other, thereby to throw in or throw out more or less of the resistance-coils of the rheostat 106 to effect a variation in the speed of rotation of the armature of the motor 100. Each time that an impulse is transmitted over the line 30 to the station B the duplex relay 32 is energized to close the local circuit 36 through the brush 37, the contact 39, and one of the printing-bar-actuating magnets 23, and at the same time, however, a portion of the impulses passes through the branch circuit 108 and through the electromagnet 107 to close the motor-circuit 102. These impulses over the line 30 follow each other so rapidly that the residual magnetism in the magnet 107 serves to keep the switch 104 closed practically all the time, and therefore the arbor 85, which carries the arms 38 and 58, will be constantly rotated. When the arm 27 of the disk 10 at the station A and the arm 38 of the receiving-disk 11 of the station B are rotating in exact synchronism, the impulses sent over the line 30 by the engagement of the contact 28 with the stationary contacts 90 will have the effect of causing the impulse set up in the local circuit 36 to divide, a part of the current passing out from the contacts 93 over the circuit 95 to the electromagnet 951 and a part passing out through the contacts 92 through the circuit 94 to the electromagnet 941, in consequence of which the two electromagnets 951 and 941 will oppose each other and there will be no action of the movable contact 105; but should the arm 38 lag or should it slightly increase in speed relatively to the arm 27 all of the current would pass out through the stationary contacts 92 or 93, as the case may be, to cause the movement of the rheostat-lever 105 in one direction to reduce the resistance or else in the other direction to increase the resistance, and thereby accelerate or retard the speed of rotation of the armature of the motor 100 and of the arbor 85. From this description it will be apparent, therefore, that the speed of rotation of the arbor 85 will be automatically regulated and the contact-arm 38 thereon be caused to rotate in synchronism with the arm 27 on the sending-disk. The arm of the sending-disk 51 at the station B is on the arbor 85, and the arm 64 of the receiving-disk 50 at the station A is on the arbor 80, so that the said arms 58 and 64 will be caused to move in synchronism by the means just described. As it might happen that the two motors for rotating the arbors 80 and 85 might not stop at the same point when the apparatus is permitted to come to a state of rest, it is evident that provisions must be made for adjusting the receiving-disks about their arbors.

Some signal is selected for the purpose of testing the apparatus. For instance, the key representing the character "x" in the keyboard for the contacts *a* in the sending-disk 10 is depressed by the operator and a signal is sent over the line. This has the effect of starting the motor 100. Then the operator at the station B rotatively adjusts the disk 11 until the type-writing machine connected with the series *g* of contacts on the disk 11 (which corresponds to the series *a* of contacts on the sending-disk 10) prints the letter "x." The sending operator at B sends out a similar signal to the receiving operator at the station A, who adjusts the disk 50 until the signal "x" is transmitted to the proper printing mechanism and the proper type-bar is actuated. The apparatus is then ready for the transmission of messages.

The mechanical details of construction of the apparatus have not been illustrated, since they may vary greatly and may be made to suit particular requirements. For instance, the keyboards which are utilized for sending the messages are preferably those of a type-writing machine, so that the sending operator not only sends the messages over the line, but prints them on the type-writing machine that he may preserve an accurate record of the message which he has sent. Similarly the printing mechanisms connected with the receiving-disks are all of suitable character, such as type-writing machines in which the carriage is automatically shifted and the platen automatically moved at the proper time.

As stated at the outset, the invention may be embodied in wireless-telegraph systems, as illustrated in Fig. 4. The apparatus at only one station is illustrated. The sending and receiving disks and their connecting electrical and mechanical mechanisms are similar to those previously described, the means for effecting the synchronous rotation of the contact-arms being no different from that hereinbefore explained. Instead of the continuous conductor 30 there is at the station a mast 200, having antenna 201, which may receive the impulses sent from a mast at the other station. I will first explain how the messages are sent out from the mast 200. The conductor 202, which corresponds to the conductor 291 from the brush 29 in the system shown in Fig. 1, is grounded at 203 and is connected with an electromagnet 204. This electromagnet controls a switch 205 for closing a circuit which includes the said switch, a source of electric energy 206, and the primary 207 of an induction-coil. The secondary 208 of the said coil is in a circuit 209, which includes the oscillator 210 and another primary 211. The last-mentioned primary 211 is placed in inductive relation to a secondary 212 in a circuit 213, one end of which is grounded at 214 and the other end of which is connected to the antenna 201. This is the usual arrangement of circuits in wireless telegraphy for

sending an impulse to the antenna to be discharged into the atmosphere. The circuit 213 includes the usual resistance 215. From this description it will be seen that each time a key in one of the keyboards of the sending apparatus is depressed a signal is discharged from the antenna. The receiving apparatus will now be explained. The switch 104 corresponds to that indicated by the same numeral in Fig. 1, and it controls the motor-circuit 102, as previously explained. The local circuit 36 108 is likewise the same as previously described; but the switch 321, corresponding to that indicated by the same numeral in Fig. 2, is under the control of an electromagnet 220 instead of the duplex relay. The said magnet is placed in a local circuit 221, including a battery or source of power 222. Said local circuit includes a coherer 223, two resistances 224, and the coils 225 of the jigger. The said coils 225 are arranged in inductive relation to a coil similar to that at 202 of the local circuit 213, previously described. The usual condenser 226 is located, as ordinarily, between coils 225 225, as shown. When an impulse is received at the antenna 201, it acts through the jigger 225 upon the coherer 223, whereupon the circuit 221 is momentarily closed and an impulse is received in the local circuits 36 and 108. The printing mechanism is properly actuated in the same manner as hereinbefore described in detail.

In order that a single sending apparatus may be employed for sending over more than one main line and be therefore utilized for transmitting messages to two or more relatively remote receiving-stations, each sending-disk may be equipped with more than one series of sets of stationary contacts, as illustrated in Fig. 1, where the disk 10 as a second series (indicated as a whole at *x*) is arranged concentrically within the series comprising the sets *a b c*, &c. The arm 27 has a second contact 400, which coacts with the contacts of the series *x*, and there is a second circuit 401, with which the contact 400 is connected by the brush 402 and which corresponds with that at 291 and forms a part of a second main line. (Not shown.) Each set of contacts of the series *x* has its separate keyboard or type-writing machine and also has the synchronizing contacts, as previously described, which coact with the other elements of the motor-controlling mechanism.

To permit one receiving apparatus to be employed in connection with the sending devices at relatively remote stations, the receiving-disk, as at 11, may have a plurality of series of sets of contacts, as at 405, with which a contact 406 on the arm 38 may coact. The contact is connected by a brush 407 with a local circuit 408 similar to that at 36 and controlled by signals on a main line like that at 30. The series of contacts 405 will of course be connected with the proper printing mechanisms, as previously described.

It will be understood that many and various changes may be made in the hereinbefore-described system without departing from the spirit and scope of the invention.

Having thus explained the nature of the invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. In a multiplex-telegraph system, a main line, a plurality of key-circuits each connected to a source of electrical energy and having a contact, a revolving contact for successively engaging said contacts respectively and connected to the line, so that when a key is moved to close its circuit, an electrical impulse is sent over the line upon the engagement of the movable contact with the stationary contact in said key-circuit, a plurality of printing-circuits, each having a printing device, and each having a contact, a second revolving contact connected with a source of electrical energy, and adapted to successively engage the last-mentioned contacts, a relay in the main line for closing the circuit through said last-mentioned revolving contact and thereby through one of the printing-circuits when a signal is sent over said main line by any one of the key-circuits, a motor for revolving the revolving contact at the sending-station, an electric motor for revolving the revolving contact at the receiving-station, and means for synchronizing the movement of said revolving contacts, by automatically varying the speed of said electric motor.

2. In a multiplex-telegraph system, a main line, a plurality of sets of key-circuits each connected to a source of electrical energy having a contact, the contacts of said sets being arranged serially in a circle, a revolving contact for successively engaging the said contacts and connected to said main line, a plurality of sets of printing-circuits each having a printing device and a contact, the last-mentioned contacts of said sets being arranged serially in a circle, a second revolving contact connected to a source of electrical energy and adapted to successively engage said last-mentioned stationary contacts, means controlled by the main line for closing the circuit through said second revolving contact, means for revolving said revolving contacts, and means for preventing the closing of the key-circuits of the other sets thereof when the first-mentioned revolving contact is in engagement with the contacts of the key-circuits of any one set.

3. In a system of the character referred to, the combination of two revolving contacts, means for revolving one of said contacts, an electric motor for revolving the other contact, an energy-varying device for the motor-circuit having movable contacts, electromagnets

for actuating the movable contacts of said device, separate circuits for said electromagnets, and means controlled by both of said revolving contacts for diverting current into said electromagnet-circuits.

4. In a multiplex-telegraph system, sending apparatus comprising a plurality of different series of sets of contacts, a key connected to each contact to close a circuit thereto, an independent line for each series of sets of contacts, and a movable element having insulated contacts electrically connected to said independent lines for engaging the contacts of said respective series of sets.

5. In a multiplex-telegraph system of the character described, a plurality of independent contacts symmetrically disposed in a circle at the sending-station; a source of electricity connected to said contacts; a multiple number of independent contacts symmetrically and identically disposed in groups in a circle at the receiving-station; a revolving contact at the sending-station; a motor for revolving said contact; a revolving contact at the receiving-station, an electric motor for revolving said last-mentioned contact; a motor-circuit; means for varying the energy of the current in said circuit; and electrical connections between said groups of contacts at the receiving-station and said energy-varying means, in consequence of which the speed of the electric motor is caused to vary to synchronize the revolution of said revolving contacts.

6. In a multiplex-telegraph system of the character referred to, a number of independent contacts symmetrically disposed in a circle at the sending-station, a source of electricity connected to said contacts; a main line; a revolving contact for engaging said independent contacts and connecting them to the main line in such manner that from them electric impulses go over the line to a receiving-station; means for moving the revolving contact; a revolving contact at the receiving-station connected to a source of electrical energy, an electric motor for revolving said revolving contact; a number of electrical resistances in series in the motor-circuit, a multiple number of independent contacts symmetrically disposed in groups in a circle at the receiving-station, each contact of the groups being connected to an electromagnet controlling one of the electrical resistances in the motor-circuit, in such manner that an impulse sent by an independent contact of the sending-station arrives at the receiving-station at one of the contacts of a group and energizes the corresponding electromagnet which inserts in or cuts out of the motor-circuit the corresponding resistance.

7. In a multiplex-telegraph system, a single main line, a plurality of sending devices at the sending-station, each including a keyboard with a plurality of keys, a plurality of printing mechanisms at the receiving-station, each printing mechanism having types corresponding to said keys, and electrical connections including said single main line between said devices and said stations in consequence of which upon the independent manipulation of the keys in the different keyboards electrical signals are successively transmitted from the sending devices to the said printing mechanisms over the same line, to cause the actuation of the corresponding types in the corresponding printing mechanisms, and the printing of different messages by said printing mechanisms.

8. In a multiplex-telegraph system, a single main line, a plurality of independent keyboards at the sending-station, each keyboard having a plurality of independent keys, a source of electricity for said keys, a plurality of printing mechanisms at the receiving-stations corresponding to said keyboards, each printing mechanism having a separate movable type-bar for each separate key of the corresponding keyboard, and means for connecting the keys of the keyboards and the corresponding type-bar of the corresponding printing mechanisms, successively, with said single main line, whereby different messages equal in number to the keyboards may all be sent over the single main line and printed at substantially the same time.

9. In a multiplex-telegraph system, a main line, a series of independent keyboards each having a set of keys, a plurality of sets of key-circuits each connected to a source of electrical energy having a contact, the contacts of said sets being independent of each other but arranged successively in a circle or arc thereof, a revolving contact for successively engaging the said contacts of the different sets and connected to said main line, a plurality of independent sets of printing-circuits each having an independent electromagnet actuating a type, and a contact, the last-mentioned contacts of said sets being arranged successively in a circle, or in an arc thereof, a second revolving contact connected to a source of electrical energy and adapted to successively engage said last-mentioned stationary contacts, means controlled by the main line for closing the circuit through said second revolving contact, and means for revolving said revolving contacts, said elements being arranged as described, whereby impulses for the different sets of keys are sent successively over the line.

10. In a multiplex-telegraph system, a plurality of independent sets of key-circuits at the sending-station each connected to a source of electrical energy having a contact, the contacts of said sets being arranged successively in a circle or the arc thereof, a main line, a revolving contact at the sending-station for successively engaging said independent sets of contacts, and connected to said main line; a plurality of independent printing mechanisms at the receiving-station each having an

independently-movable type-bar for each character, circuits equal in number to the type-bars, and each having an electromagnet for controlling a type-bar, and a contact, said contacts being arranged in sets successively in a circle; a revolving contact at the receiving-station connected to a source of electrical energy and adapted to successively engage the sets of contacts at the receiving-station, means controlled by the line for closing the circuit through said second revolving contact, and means for revolving said revolving contacts.

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

TULLIO GIARA.

Witnesses:

C. C. STECHER,

WALTER P. ABELL.