(No Model.) 3 Sheets—Sheet 1.

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TELEGRAPHY.

No. 562,004. Patented June 16, 1896.

Fig. 1

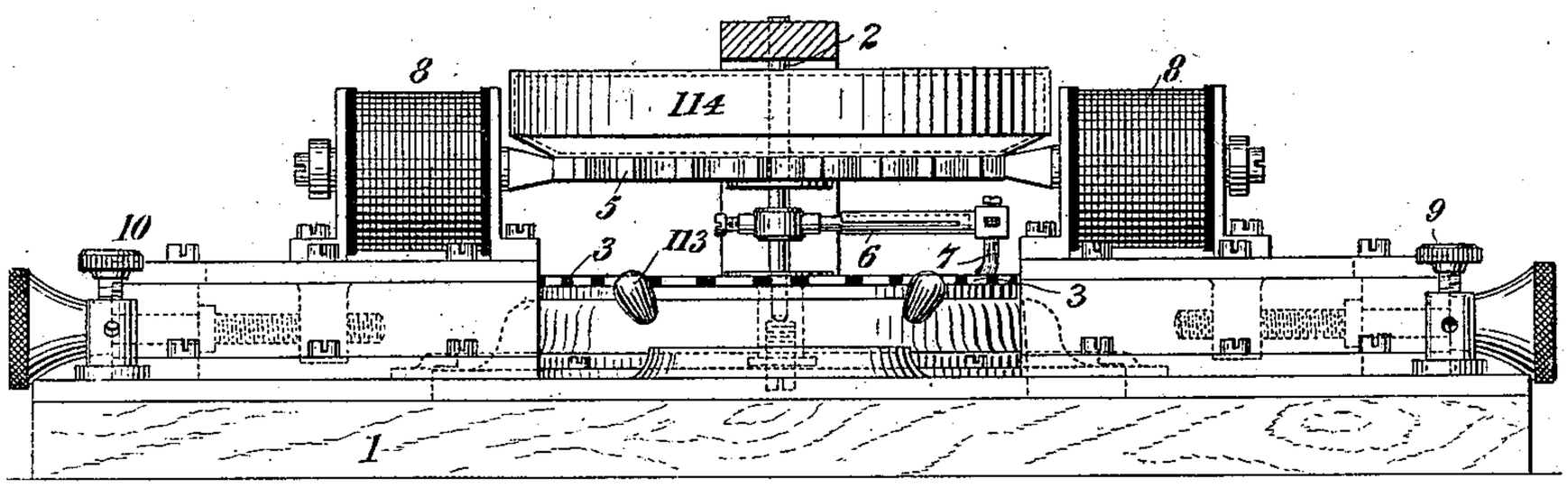
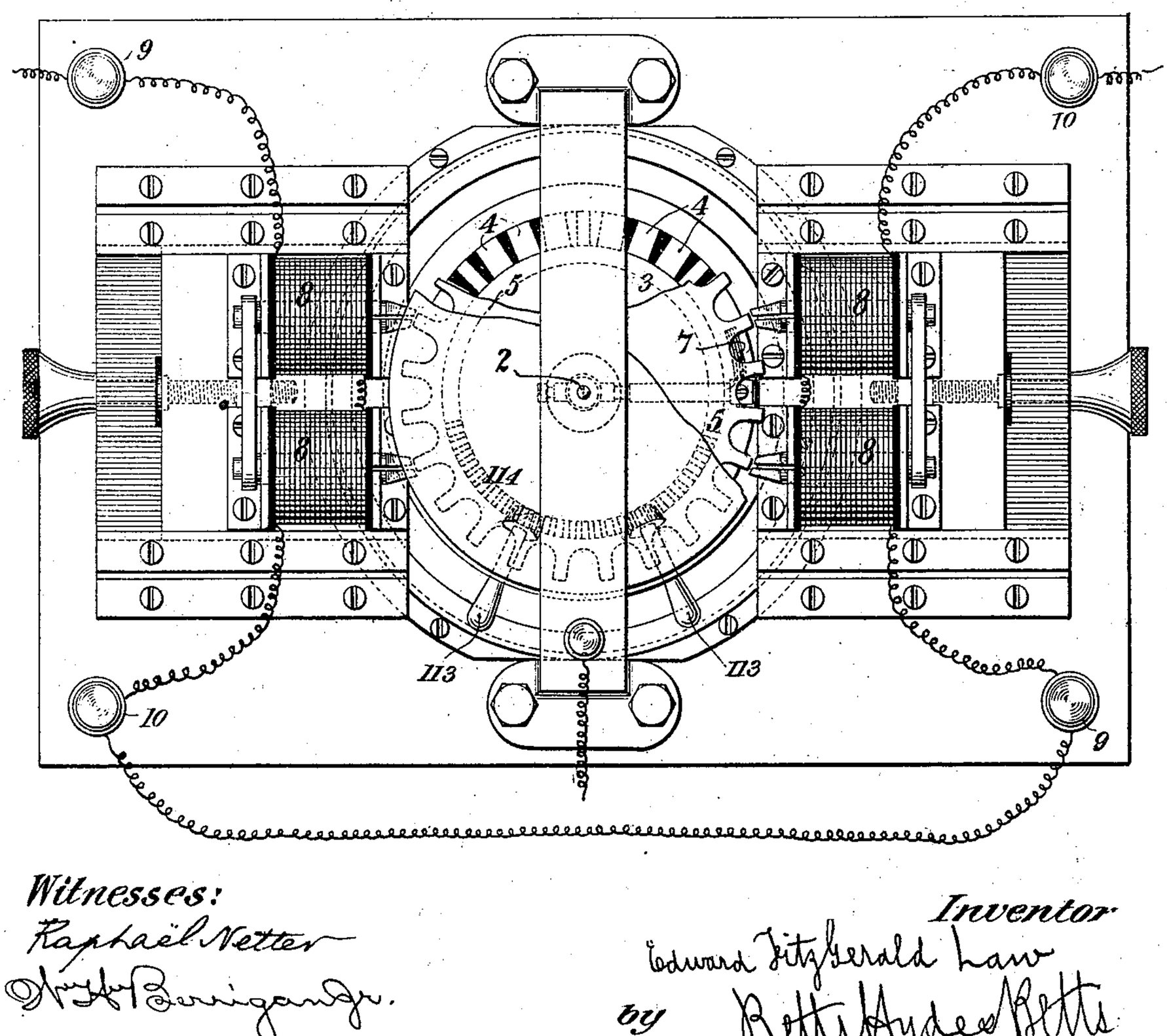


Fig. 2



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(No Model.) 3 Sheets—Sheet 2.

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TELEGRAPHY.

No. 562,004. Patented June 16, 1896.

Fig. 3

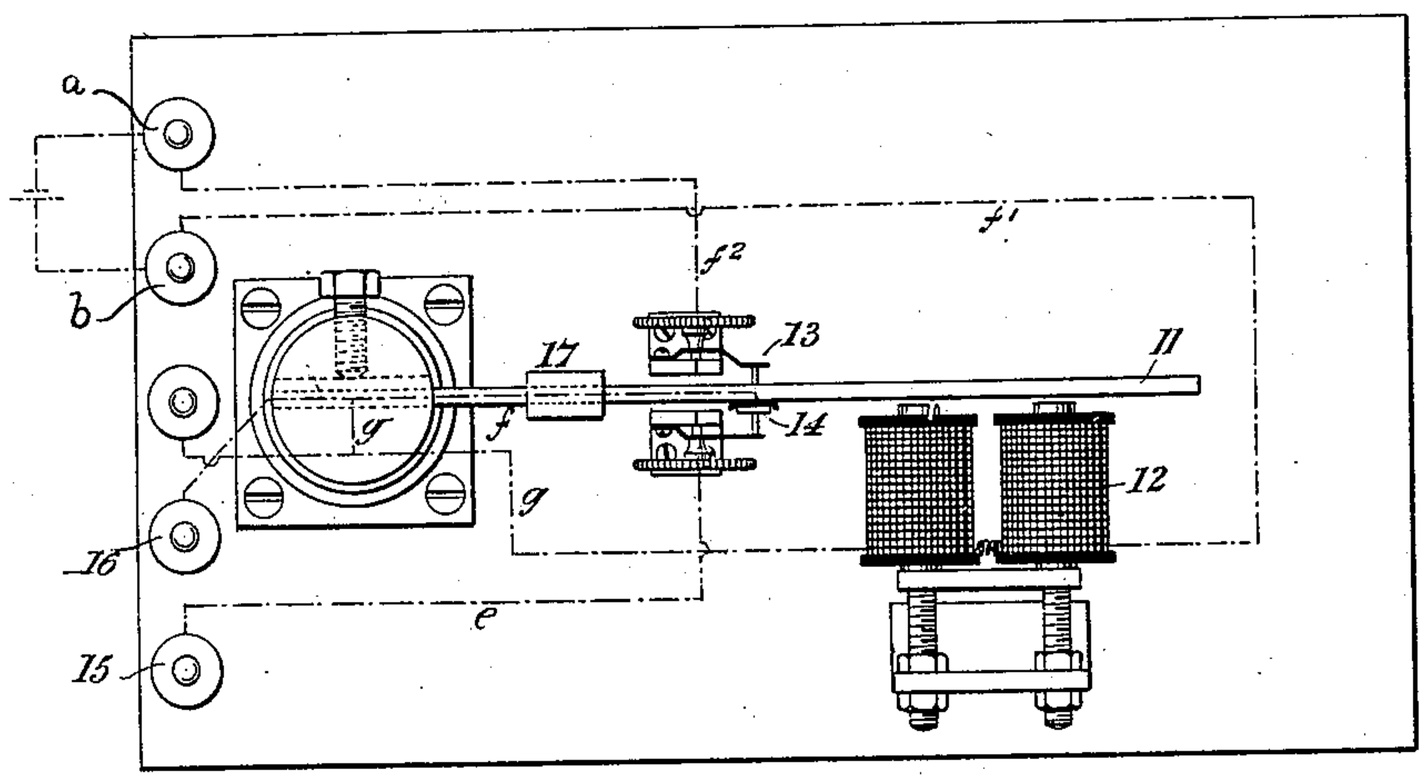
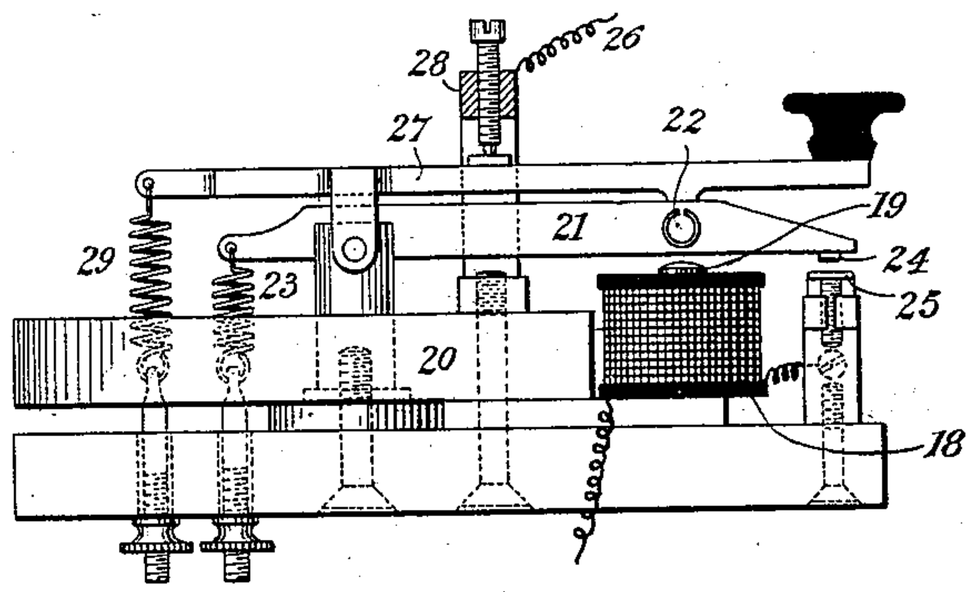


Fig. 4



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(No Model.) 3 Sheets—Sheet 3.

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TELEGRAPHY.

No. 562,004. Patented June 16, 1896.

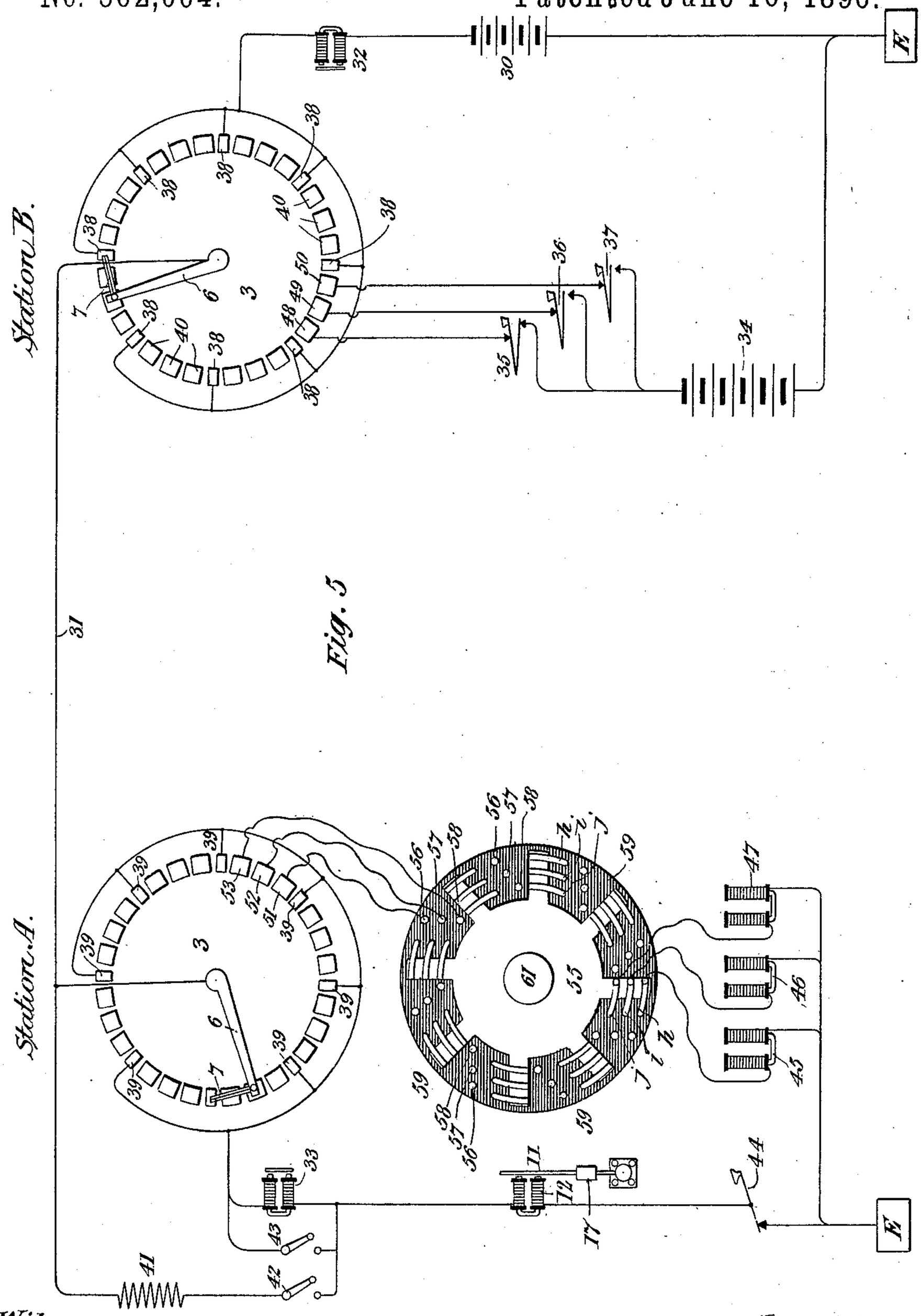

Fig. 5

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UNITED STATES PATENT OFFICE.

EDWARD FITZ GERALD LAW, OF LONDON, ENGLAND.

TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 562,004, dated June 16, 1896.

Application filed January 8, 1895. Serial No. 534,171. (No model.) Patented in England December 15, 1886, No. 16,485, March 5, 1888, No. 3,359, and January 11, 1889, No. 506, and in France September 13, 1887, No. 185,824.

To all whom it may concern:

Be it known that I, EDWARD FITZ GERALD LAW, a subject of the Queen of Great Britain, residing at London, England, have invented a certain new and useful Means for Controlling Mechanisms, (patented in Great Britain in and by Letters Patent No. 16,485, dated December 15, 1886, No. 3,359, dated March 5, 1888, and No. 506, dated January 11, 1889, and in France in and by Letters Patent No. 185,824, dated September 13, 1887,) of which the following is a specification, reference being had to the accompanying drawings, wherein similar letters and figures denote corresponding parts.

My invention relates to that class of telegraph systems known as the "synchronous multiplex telegraph," wherein a single line or conductor is employed to connect a commutator at one station with a commutator at another station. There is a rotating trailing brush or equivalent device, to which is attached a toothed wheel influenced or controlled by a current from the main line. This operates to make contact successively with the insulated segments of the commutator. Each segment of the commutator is a part of a branch circuit in which is connected an electromagmetic or other communicating instrument.

The objects of my invention are:

First. To give to the rotating brushes at each station such a high speed as to render it impossible for an operator, in the ordinary course of signaling, to depress two keys in succession without an entire rotation of an arm occurring between the releasing of the first key and the depression of the second.

Second. In the method of securing synchronism between the rotating commutator of the several stations, which consists in increasing the speed of rotation and the weight of the rotating parts to a point where the momentum thereof overcomes interfering vibrations, and in making the mercury-box proportionately larger and heavier than heretofore, and in varying the quantity of mercury in the mercury-box, whereby the momentum of the rotating parts may be increased to any desired degree. In this way I am enabled to directly control the toothed wheel of one rotating apparatus by electrical impulses transmitted over the main line by the aid of the other rotating apparatus. In this way I compensate for alterations in speed due to variations of electrical impulses, and I overcome or obviate the effects of vibratory movements communicated to the revolving parts by the structures upon which they are mounted, as well as other causes.

Third. My object is also to provide, in a telegraph system of the character described, an improved transmitter or key, which upon being depressed will maintain contact until the rotating arm has completed the circuit of its particular branch. In this way it is impossible to give a double signal with one depression of the key, even with the increased high speed of revolution of the commutator apparatus forming a characteristic of my invention, without a complete revolution of the brush.

Fourth. My object is also to provide, in a telegraph system of the class described, a commutator-table which may be regulated or adjusted so as to have the trailing brushes at several stations bear simultaneously upon corresponding segments of the respective commutators.

Fifth. To provide a multiple-contact switch designed to transfer communicating instrument from one branch circuit to another at will.

Sixth. To provide, in a telegraph system of the class described, a commutator-table having comparatively few and broad contact-segments, so as to permit the effective working of the apparatus at an exceedingly high speed of revolution of the brushes.

My invention provides improved and simplified means whereby electricity may be usefully employed to effect the operation of a plurality of distant mechanisms, not only for signaling telegraphically, but for many purposes useful in the arts, including the operation of type-writing, type-composing, matrix-making, type-casting, or other news gathering and publishing apparatus, so that the more rapid and simultaneous receipt and printing of matters of interest may be effected at a greatly-reduced cost; and my invention consists in the new and improved methods

and devices and combinations of devices employed in effecting the results which I attain, and hereinafter set forth.

My invention comprises the employment, in combination with each of the type-setting, type impressing or printing, or other instruments, (or the controlling mechanism of such instruments,) of a suitable commutator, which is provided with contact pieces or strips insulated from each other and preferably having only some of the contact-strips upon these commutators to correspond with one or more of the keys or levers at the receiving instrument, while the remainder are advantageously used to synchronize the commutators at both the sending and receiving stations or to send Morse or other signals, so that the desired result will be obtained. The advantages of the use of such a commutator are that only a single wire between the sending and receiving stations need be used, while the sending and receiving may be accomplished at a very high speed and with a commutator having comparatively few contact-pieces, and I prefer to make the segments at one station a little wider than those at the other.

Referring to the accompanying drawings, showing a preferred embodiment of my invention, Figure 1 shows an improved commutator useful in effecting the synchronism at both stations. Fig. 2 is a plan view of such commutator. Fig. 3 is a plan view of my preferred form of reed apparatus for influencing the commutator-magnets. Fig. 4 shows the form of transmitting contact device which I prefer to employ. Fig. 5 shows the apparatus at two separated stations A and B.

The form of commutator which I prefer to employ is that of a circular table having segments upon its face, the said segments all being insulated from each other; but other forms may be employed. Referring generally to the form of commutator shown in Figs. 1 and 2, this is a modification of the well-known motor-magnet and transmission-wheel called "Le Cour's phonic wheel," and the principal parts of my commutator apparatus are the base-plate 1, provided with binding-posts 9 10, and a vertical rotary shaft 2. A circular table 3 has a series of insulated segments 4, arranged around the shaft 2. Upon the upper end of the shaft 2 is mounted a toothed wheel or disk of magnetic material 5 and a radial arm 6, fastened to shaft 2 and carrying a trailing brush 7 on its free end. The wheel 5 is arranged to be rotated by means of electro-magnets 8, the coils of which are connected to the insulated binding-posts 9 10. The said magnets 8 may be included in the main circuit or may be included in a local circuit.

The contact strips or segments are arranged upon the table 3, so as to be capable of rotary adjustment, by means of the handles 113 or by other means for effecting such adjustment, and this is to adjust the commutator at one station to coincide with the desired commutator-segment at the other station. In connection with this commutator I provide means whereby one line-wire is used to transmit electrical impulses from a controlling-reed at one station to control the motor-magnets at the several stations. Upon the same line I also transmit the electric impulses for operating the levers or keys of the receiving or type-setting or other machines at the other station or stations. I use some of the contact-segments of each of the commutators at the sending and receiving stations for the transmission of impulses from the sending-station to the electromagnets operating or controlling the motor-magnets at the several stations. For instance, I may reserve for this purpose, say, eight contact-segments of the commutator at the one station for transmitting impulses through the corresponding segments of the commutator at the several stations, the remaining segments being used for operating the levers or keys of the type-setting or other machines or for other purposes. I can, however, use any other desired number of contact-segments for operating or controlling the motor-magnets.

To maintain synchronism of the commutator-motors, I employ in combination with the rotary toothed wheel 5 of the several commutators a box or case 114, containing a large and variable quantity of mercury, but sufficient to insure and maintain by its momentum uniform rotation of the wheel between the reception of the impulses by the motor-magnet through the brush, inasmuch as the wheel would be liable to stoppage or alteration of speed on account of the temporary cessation or variation of the electrical impulses, and to overcome the tendency of vibration of the apparatus communicated to it by the structure upon which it is mounted or supported, or for other causes, heretofore necessitating complicated means for correction.

At one station I employ a battery 30, one pole of which is connected to earth and the other pole to each of the segments reserved for operating or controlling the motor-magnets at the several stations.

The reed apparatus or vibrator which I prefer to employ for making and breaking contact to energize the magnets 8 is shown in Fig. 3, wherein 11 is a bar or reed arranged to be vibrated by an electromagnet 12 to be included in a reed-circuit alternately opened and closed during the vibration of the reed by contact 13.

The local or reed circuit may be traced from screw-cup a by wire f^2, break-points 13, reed 11, wire g, magnet 12, wire f' to screw-cup b, and from thence to battery and screw-cup a. Reed 11 operates the make-and-break contact 14 in the controlling-circuit for the motor-magnets. The connections are from screw-cup 15, by wire e, to break-points 14, through reed 11, to screw-cup 16. These contacts 13 and 14 are included in the controlling-circuit, and this circuit will also be constantly opened and closed as the reed vibrates. To insure

regularity of vibration, the reed or vibrator may be freely or loosely held or suspended in any of the well-known ways.

I provide the reed with a sliding weight 17 or other suitable means to regulate its vibration.

The above-described reed-vibrator may be modified in many ways without departing from my invention.

By reason of the constant closing and opening of the motor-magnet circuit the magnets 8 are alternately magnetized and demagnetized, and thereby caused to keep the armature-wheel rotating, after it is once started, in the well-known way.

In carrying my invention into practice I find that it is desirable to employ a circuit-closing device such as shown in Fig. 4. The illustrated circuit-closer consists of magnet-coils 18, the cores 19 of which, when no current is passing through coils 18, are magnetized by a permanent magnet 20. The wire of the coils 18 is wound around the cores 19 in such a manner that when a current is passed through them it will weaken the induced or normal polarity of the said cores. A pivoted lever 21 carries a cross-bar 22, shown in the form of a longitudinally-split tube, which serves as an armature of the polarized cores 19. 23 is a spring at the rear of the lever, serving to normally hold the armature 22 out of contact with the cores 19. The lever 21 also carries a contact 24, which, when the armature 22 is in contact with the cores 19, bears upon an adjacent contact-spring 25 and partially completes the circuit through conductors 26. Another lever 27, pivoted upon the same fulcrum as lever 21, is used for the purpose of depressing the armature 22 into contact with the cores 19 and the point 24 in contact with the spring 25, the final connection with the strip of the commutator being completed through an insulated bridge 28 only when the lever 27 is released, and the lever 21 is free to rise when the attraction of the cores 19 is weakened or neutralized by the current passing through the coils 28. A spring 29, provided at the rear end of the lever 27, returns it to its normal position after it has been depressed. It will be noticed that there are three successive break-points in this branch circuit. After the contact 24 has been closed upon the contact 25 by depressing the lever 27 this contact is maintained until the brushes 7, Figs. 1, 2, 5, and 8, during their rotation bear upon the corresponding strips or teeth 40, and thus complete the line-circuit through the contacts. When this takes place, the cores 19, Fig. 4, are weakened or neutralized by the action of the current thereon, and the armature 22 is released, and the lever 21 is returned to its normal position by the spring 23, thereby breaking the circuit through this particular conductor.

The advantages of the circuit-closing device hereinafter described are that the contacts 24 and 25 separate immediately after the circuit is completed, and the circuit cannot be maintained to allow of two successive impulses being sent therethrough. Moreover, should the lever 27 be depressed and released very quickly the circuit will nevertheless be maintained closed at points 24 25 until the current passes through the magnetic coils 18, influencing the cores 19, which hold down the lever 21.

The above-described circuit-closing device may be modified in many ways and advantageously used without departing from my invention.

To avoid complication, in Fig. 5 the motor-circuits at each station are omitted.

Referring now to Figs. 1, 2, and 5, the commutators are 3 3, and 30 is a battery for furnishing electric current through the line-wire 31 to drive a reed 11 at the distant station.

32 33 are electromagnetic devices of suitable construction for indicating the passage of an electric current from the battery 30 through the lines.

34 is a battery for furnishing electric current to transmit electric impulses over the line for effecting the operation of the levers or keys of the type-setting or other machine.

35 36 37 are circuit-closing devices, preferably of the construction shown in Fig. 4 and heretofore described.

38 are the driving contact-segments of the commutator at station A. When the brush 7 makes contact with either of the said segments, the battery 30 will be connected with the line, and, at station B, when the brush 7 makes contact with either of the segments 39 the reed-circuit will be connected with the line, so that when the brushes 7 at stations A and B are simultaneously in contact with driving-segments 38 and 39 an impulse from the battery 30 will be transmitted through the line and through the reed-circuit to earth. Between the said driving-segments there are other segments 40 for the transmission of electric impulses from the battery 34 for effecting the operation of the levers or keys of the type-setting machine.

A resistance 41 is interposed in a shunt between the line and the reed-circuit, a switch 42 being provided in the said shunt. Another switch 43 is provided in a shunt around the electromagnet 33. 44 is a circuit making and breaking key of any of the well-known forms, and operating for interrupting the reed-circuit.

45 46 47 are three of the relays for operating the local circuits at station B, in which are included the electromagnets for working the type-setting or other machine.

Connections are shown in Fig. 5 between a set or series of three segments 48 49 50 of the commutator at station A and keys 35 36 37 and between a similar set of segments 51 52 53 of the commutator at station B and corresponding relays 45 46 47. The remaining contact-sections are connected with receiving or transmitting apparatus to provide for the

interchange of communications between the two stations, substantially as shown and described with respect to the three contact-segments 48 49 50 and 51 52 53.

Referring to Fig. 5, the operation of the apparatus is as follows: The operator at station A first starts the apparatus at said station. The switch 42 at station B being closed, impulses are transmitted from the battery 30 through the electromagnetic device 32, the segments 38, and the rotating brush 7 at station A and through the line 31, the resistance 41, the switch 42, the controlling-magnet 12 of the reed 11, and the key 44 to earth, returning to the battery 30. If necessary, the operator at station B adjusts the said reed by shifting the sliding weight 17 or in any other convenient manner until he obtains the greatest regular amplitude of vibration thereof. He then starts the motor whereby the brush 7 is rotated. This brush will rotate in perfect synchronism with the brush at station A. It is probable, however, that it will on starting the apparatus be in a wrong position relatively to that at station A. The ring of segments must in this case be adjusted until the shunted impulses from the battery 30 are received through the brush 7 and the driving-segments 39 and through the electromagnetic device 33. The switch 42 is then opened, so that the reed 11 will receive its impulses only through the brush 7 and the driving-segments 39. When the device 33 is not required to act, it may be short-circuited by closing the switch 43.

The operator at station B by the key 44 signals to the operator at station A that he desires him to send a prearranged signal, upon receipt of which the operator at station B closes the switch 42 and turns or adjusts the ring 3, Figs. 1 and 2, until the impulses are transmitted to the proper relays. Then by further operation of the key 44 (indicated at station A by the device 32) the operator at station B informs the other operator that his adjustments are complete. The transmission of impulses for working the type-composing or other machine may then proceed by means of the segments 48 49 50, transmitters 35, 36, and 37, and at the station B by operation of the magnets 45 46 47 and their connected segments 51 52 53.

In Fig. 5 the ring of segments at station B is shown in the correct position for transmitting impulses for driving the reeds 11—that is, in such position that the brush 7 at station B will make contact with one of the segments 39 of the commutator at the same time that the brush 7 of the commutator at station A makes contact with one of the teeth 38 thereof. The parts, however, may not be in proper position for transmitting impulses for working the type-composing or other machine. It is, therefore, necessary in starting the apparatus at station B to close the switch 42 and thus put the line into direct connection with the reed-circuit and to adjust the ring of contact-segments until a shunted current is again received through segments 39. The direct-line switch 42 is then opened and the driving impulses received only through the said segments 39. Taking the case where there are eight segments 39, as in Fig. 5, interposed at equal distances, should the segments still not be in proper position relatively to the ring or table 3 at station A the direct-line switch 42 may be again closed until the adjustable ring has been rotated the eighth part of a revolution, and so on until the correct one of the eight positions is arrived at, when the direct-line switch 42 is permanently opened and the contact-segments 48 49 50 and 51 52 53 are made use of for the purpose of transmitting impulses to the type-composing or printing machine.

Hereinabove I have described and shown a preferred form of commutator, Figs. 1 and 2, and manner of adjusting the said commutator at the stations; but I may, if I desire, be greatly assisted in the starting or adjusting of apparatus such as hereinbefore described and shown when I employ a switch, as 55, (shown in Fig. 5,) immediately below the commutator, as at station B.

The preferred switch has two series of contacts, in each of which series there are as many contacts as there are contact-segments at station B for conducting the electrical impulses from station A to the keys, levers, or the like. One of the said series of contacts is made adjustable relatively to the other series thereof, or, if desired, most of the said series are made adjustable relatively to each other. The contacts of one of the said series are connected with the said segments of the ring at the receiving-station, and the contacts of the other series are connected with relays for closing and interrupting local circuits for operating the keys, levers, or the like. In using this switch, should the rotating brushes at the stations A and B, when started, not bear upon corresponding contact-segments the ring of segments at station B is first adjusted until the brush at this station bears upon either of the segments employed for the transmission of impulses for operating the keys or levers or for driving the reed or vibrator at the same time that the brush at the sending-station bears upon either of the segments employed at this station for the same purpose. Then if the position of the brush relatively to the segments at station B does not correspond with that of the brush at station A in respect of the transmission of the impulses to the proper relays the connections are altered by adjusting one series of contacts of the switch relatively to the other until the correct connections are obtained.

The switch comprises a number of contact-studs 56 57 58, fixed to a plate 59 of insulating material. The number of said contact-studs corresponds to the number of contacts or segments 51 52 53, Fig. 5, for operating the le-

vers or keys, and the said studs are arranged in sets and correspond in number of sets to the number of driving-segments 39, which are arranged on the commutators for driving the reed at station B. Each of the said studs is connected to one of the segments for operating the levers, the stud 56 being connected with the segment 51, the stud 57 being connected with the segment 52, and the stud 58 being connected with the segment 53. Contact-springs H I J, Fig. 5, are attached to the arms 59, (also of insulating material,) forming the upper rotating portion of the switch, and may be provided with a handle attached to the shaft 61, whereby it may be adjusted for the purpose hereinafter specified. Each of the contact-springs H I J is connected with one of the relays 45 46 47 for closing and interrupting local circuits for operating keys or levers of the type-composing or other machine. Means may be provided to limit the movement of the upper portion 59 of the switch and prevent the undue twisting of and injury to the wires which connect the springs H I J and the relays. For instance, a spring may be fixed beneath the plate 59, and be provided with a stud adapted to enter one or the other of a series of notches or depressions in the under side of the disk 59, and thus retain it in operative position, and a stop-pin may be fixed to the under side of the disk 59 to come in contact with one or the other side of the aforesaid spring, and thus limit the movement of the said disk.

In the diagram, Fig. 5, the segments at station B are shown in correct position for transmitting impulses for driving the reed—that is to say, in such position that the brush of the commutator at station B will make contact with one of the segments 39 of said commutator at the same time that the brush of the commutator at station A makes contact with one of the strips 38 thereof. The parts are not, however, in the proper position for the transmission of the impulses for working the type-composing or other machine. The required adjustment can be very readily made, by means of the intermediate switch, by simply turning the upper portion 59 of the switch until the contact-springs H I J, which are permanently connected to the relays 45 46 47, are in contact with the studs 56 57 58 for receiving the corresponding impulses from the commutator-segments, and the impulses are by this means transmitted to the proper relays.

It is evident that my improved switch is also applicable for many telegraphic and other purposes where apparatus for obtaining synchronous movements is required to be rapidly adjusted.

The construction of my switch may be modified without departing from my said invention. For instance, the contact-studs may be arranged in a single circle instead of sets, as above described, the studs may be rotated and the springs remain stationary, or the studs and springs may be arranged on concentric cylinders or otherwise.

What I claim, and desire to secure by Letters Patent, is—

1. The combination in a telegraph system of the character described, of two separate stations united by a single line or conductor, a rotating arm, a series of insulated electrical contacts, a branch wire connecting each contact with a communicating instrument and a circuit-closer consisting of a manually-operated movable contact, a retractor therefor, a complementary contact, a polarized electromagnet having its armature fixed to said movable contact in position to retain it in a closed condition, a circuit including said magnet, and a normally-opened circuit-closer operating to release the first-named circuit-closer when both are closed, substantially as described.

2. The combination, in a telegraph system substantially as hereinbefore described, of two separate stations united by a single line or conductor, a rotating arm, a series of insulated electrical contacts, a branch wire connecting each contact with a communicating instrument, and a multiple-contact switch, including one pair of contacts in each of the last-named circuits or branches, so arranged that the movement of said switch the space of one step or interval transfers the receiving instrument of one line or branch to the next adjacent line or branch, substantially as described.

3. The combination, in a telegraph system of the character hereinbefore described, of two separate stations united by a single line or conductor, a rotating arm, a series of insulated contacts, branch wires connecting some of the contacts with communicating instruments, and branch wires connecting others of the contacts with the means for driving the rotating arm, a branch circuit from the main line to the said means for driving the arm, and containing means to close said circuit at will, and a branch circuit from the main line to an indicating device, and containing means to include or withdraw said indicating device with respect to said circuit at will, substantially as described.

4. In a synchronous telegraph system, the combination of a main line-wire, a rotating arm at each station, a series of insulated segmental contacts in the path of the rotating arm at each station, and at one station, say the first, a series of branch circuits, each extending from an insulated segment through a transmitting device, and to the main battery, and a series of contacts electrically united and a conductor extending from said last-named series to a special line-battery, and, at the second station, a series of conductors, each extending from an insulated segment, through a receiving instrument, to a return-conductor, or the earth, and a series of insulated segments electrically united, a conductor extending from said series of segments

to an electromagnet for receiving transmitted impulses, and to the operating-magnet for a vibratory reed, and to the earth, or the return-conductor, a branch or shunt conductor extending from a point between the rotating arm and the main line to a point in a branch conductor between the electrically-united series of contacts and the magnet of the reed, substantially as described.

5. In a synchronous telegraph system, the combination of a main line-wire, a rotating arm at each station, a series of insulated segmental contacts in the path of the rotating arm at each station, and at one station, say the first, a series of branch circuits, each extending from an insulated segment through a transmitting device, and to the main battery, and a series of contacts electrically united and a conductor extending from said last-named series to a special line-battery, and, at the second station, a series of conductors each extending from an insulated segment, through a receiving instrument, to a return-conductor, or the earth, and a series of insulated segments electrically united, a conductor extending from said series of segments through an electromagnet for receiving transmitted impulses, and through an electromagnet for controlling a vibrating reed, to a transmitting-key, or similar device, and to the earth or return-conductor, substantially as described.

6. In a synchronous telegraph system, the combination of a main line-wire, a rotating arm at each station, a series of insulated segmental contacts in the path of the rotating arm at each station, and at one station, say the first, a series of branch circuits, each extending from an insulated segment through a transmitting device, and to the main battery, and a series of contacts electrically united and a conductor extending from said last-named series to a special line-battery, and, at the second station, a series of conductors, each extending from an insulated segment through a receiving instrument, to a return-conductor, or the earth, and a series of insulated segments electrically united, a conductor extending from said series of segments to an electromagnet for receiving transmitted impulses, and to an operating-magnet of a vibratory reed, and to the earth, or the return-conductor, a branch or shunt extending from a point between the rotating arm and the main line to an artificial resistance, and from the artificial resistance to a point in the reed branch, substantially as described.

7. In a synchronous telegraph system, the combination of a main line-wire, a rotating arm at each station, a series of insulated segmental contacts in the path of the rotating arm at each station, and at one station, say the first, a series of branch circuits, each extending from an insulated segment through a transmitting device, and to the main battery, and a series of contacts electrically united and a conductor extending from said last-named series to a special line-battery, and, at the second station, a series of conductors, each extending from an insulated segment through a receiving instrument, to a return-conductor, or the earth, and a series of insulated segments electrically united, a conductor extending from said series of segments to an electromagnet for receiving transmitted impulses, and to the operating-magnet for a vibratory reed, and to the earth, or the return-conductor, a branch or shunt extending from a point between the rotating arm and the main line to a point in a branch conductor between the electrically-united series of contacts and the magnet of the reed, a branch or shunt extending from a point between the rotating arm and the main line to an artificial resistance and from the artificial resistance to a point in the reed branch, substantially as described.

8. In a synchronous telegraph system, the combination of a main line-wire, a rotating arm at each station, a series of insulated segmental contacts in the path of the rotating arm at each station, and at one station, say the first, a series of branch circuits, each extending from an insulated segment through a transmitting device, and to the main battery, and a series of contacts electrically united and a conductor extending from said last-named series to a special line-battery, and, at the second station, a series of conductors each extending from an insulated segment, through a receiving instrument to a return-conductor, or the earth, and a series of insulated segments electrically united, a conductor extending from said series of segments through an electromagnet for receiving transmitted impulses, and through an electromagnet for controlling a vibrating reed, to the earth, or the return-conductor, and a shunt-circuit, including a switch, extending from a point in the reed-circuit upon one side of the electromagnetic receiving instrument to a point upon the opposite side of the electromagnetic receiving instrument, substantially as described.

9. In a synchronous telegraph system, the combination of a main line connecting rotating arms at separated stations, a series of insulated segmental contacts in the path of rotation of each arm, and a device, at one station, for changing the circumferential position of the said insulated segments with respect to the position of the rotating arm, which consists of a rotatable table upon which said insulated segments are fixed and a device for moving said table, substantially as described.

10. In a synchronous telegraph system, the combination of a main line connecting rotating arms at separated stations, a series of insulated segmental contacts in the path of rotation of the arms, and, at one station, a rotating table upon which said segmental contacts are fixed and means for rotating the table to change the position of any segmental contact a space equal to the breadth of one contact,

a series of branch conductors each connecting an insulated segment with an electromagnetic receiving instrument, and a switch, or circuit-changer, located in said circuits between the segmental contacts and said electromagnetic receiving instruments, said switch consisting of a series of fixed contacts and a series of coöperating movable contacts, each series being equal in number to the branch conductors and receiving instruments, and means for changing the movable contacts whereby each receiving instrument may be changed from one branch circuit to another, substantially as described.

The above specification of my invention signed this 31st day of March, 1894.

EDWARD FITZ GERALD LAW.

In presence of—

M. DIXON,

J. M. CRAWFORD.