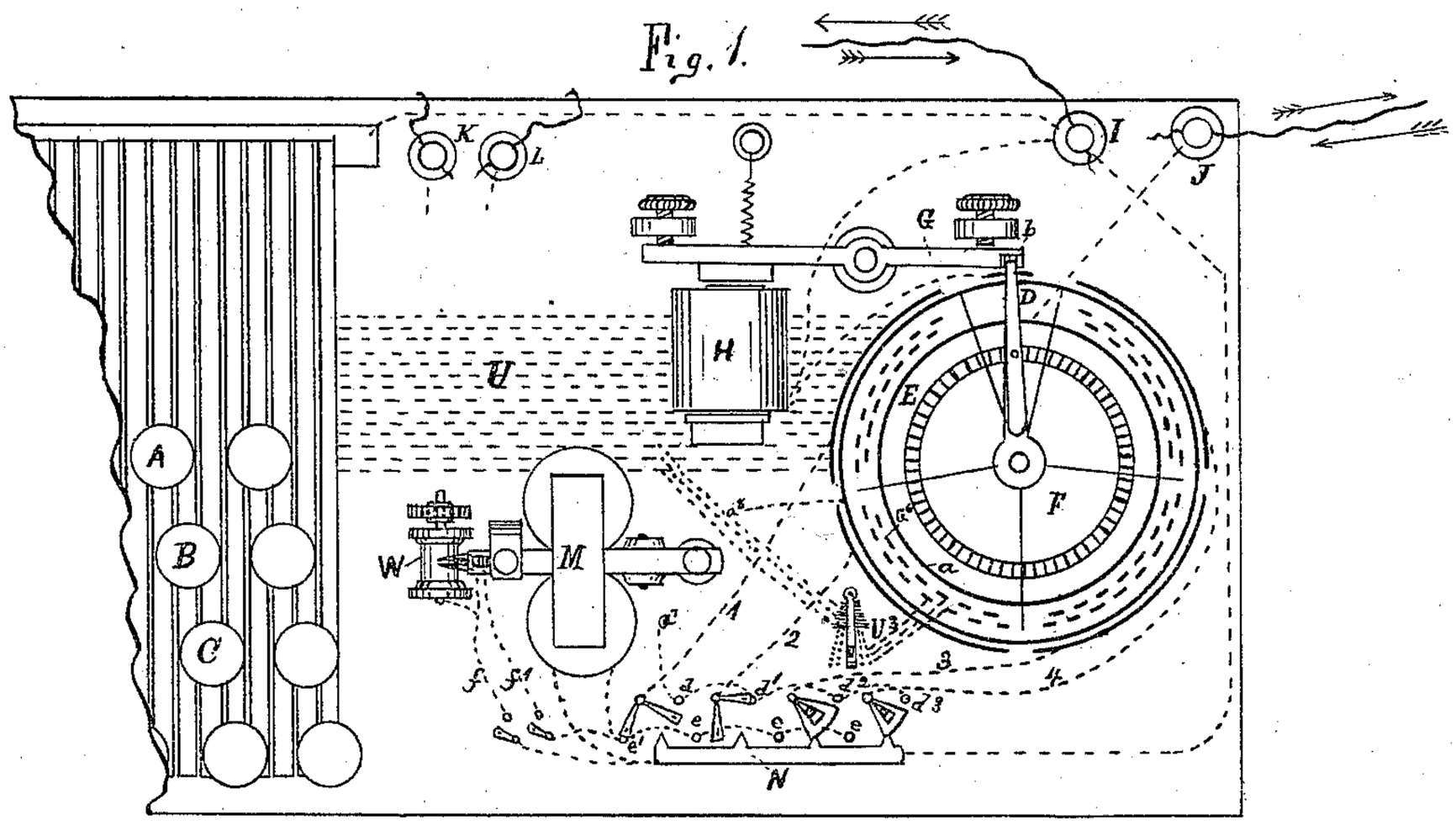
3 Sheets--Sheet 1.

M. GALLY.

Multiplex or Interval Telegraphs.

No. 143,341. Patented September 30, 1873.

Fig. 1.



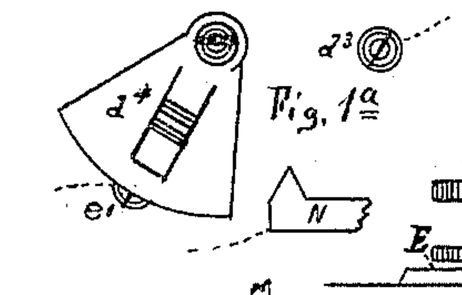
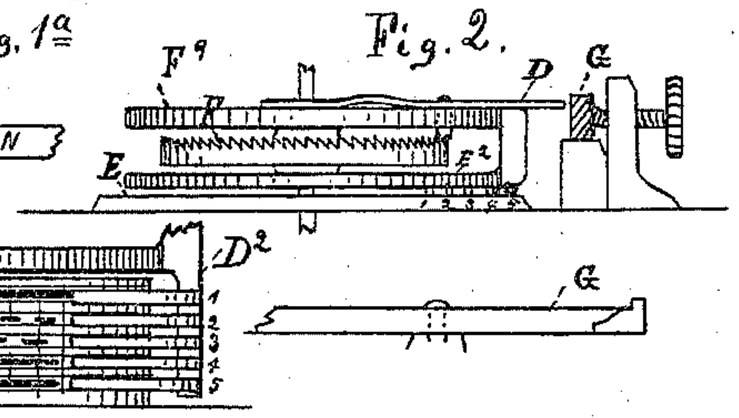


Fig. 1a.

Fig. 2.



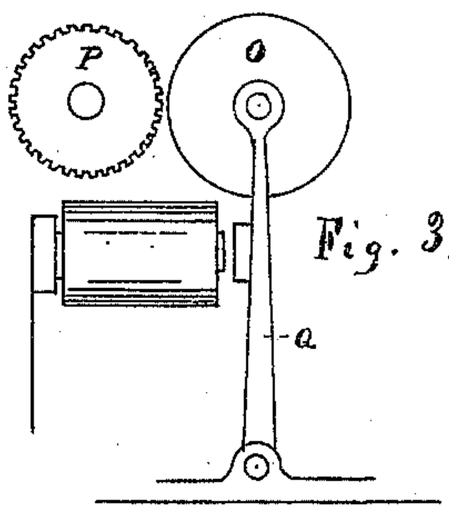


Fig. 3.

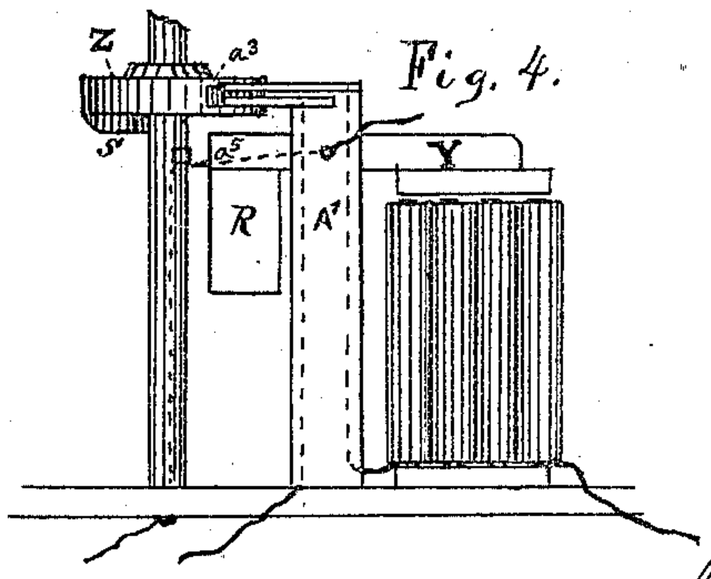


Fig. 4.

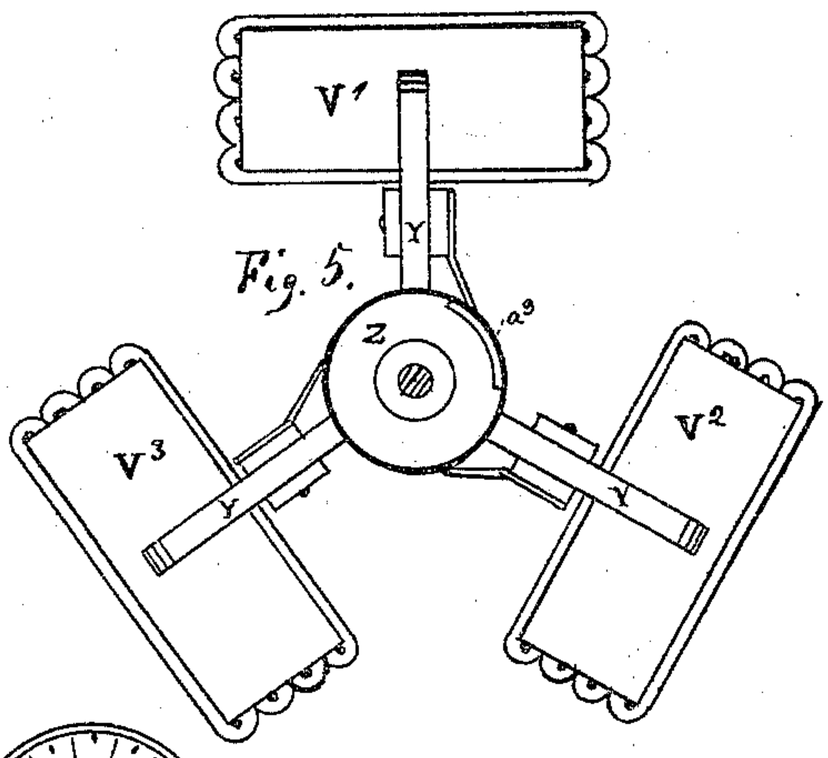


Fig. 5.

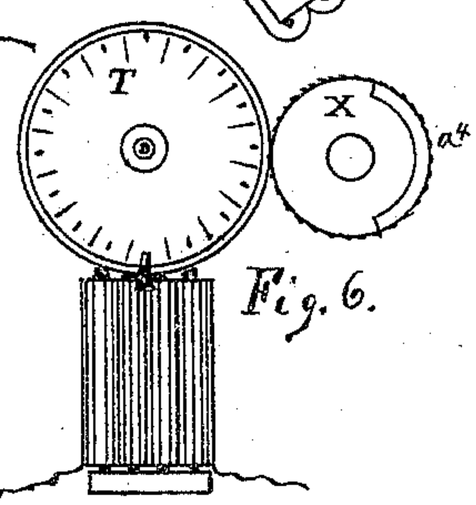


Fig. 6.

Witnesses.
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Melville Church

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Merritt Gally.

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Fig. 7.

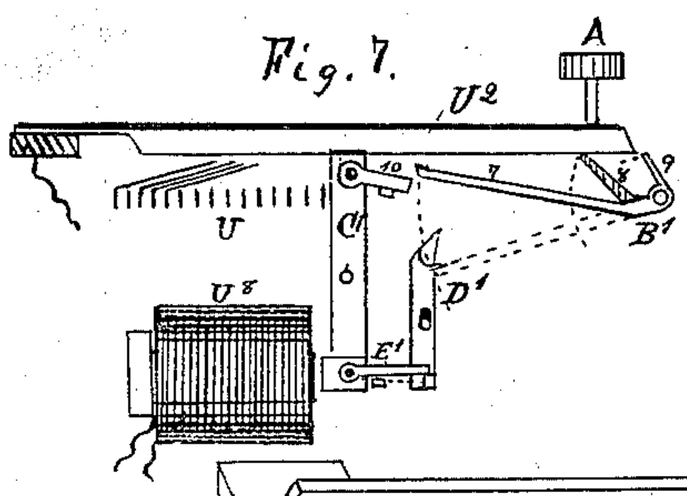
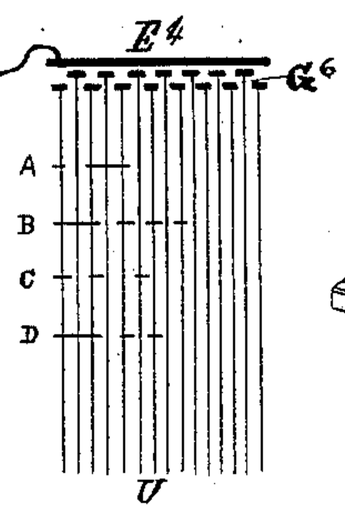


Fig. 8.



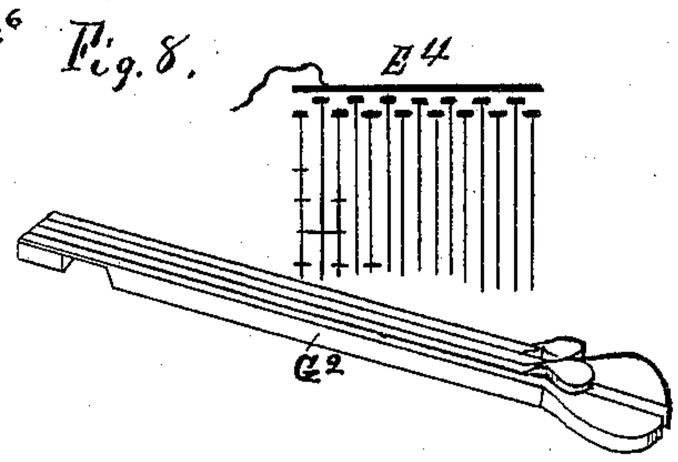
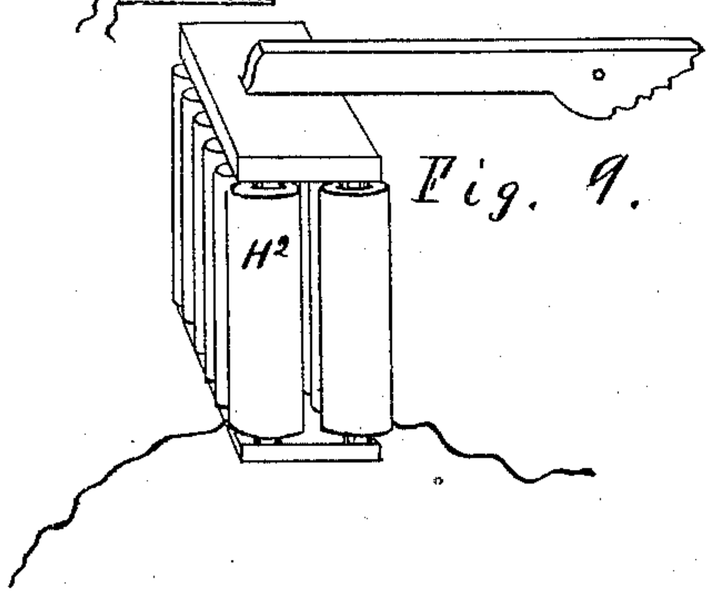
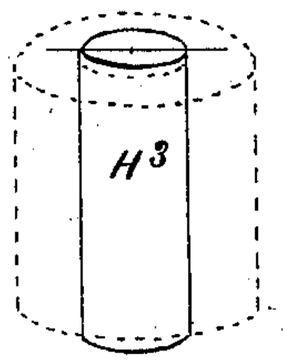


Fig. 9.





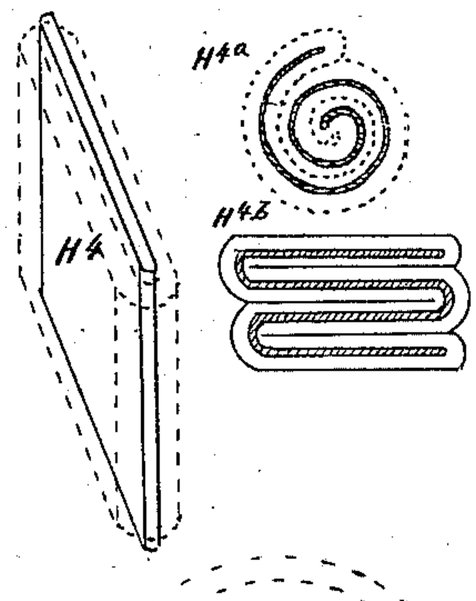
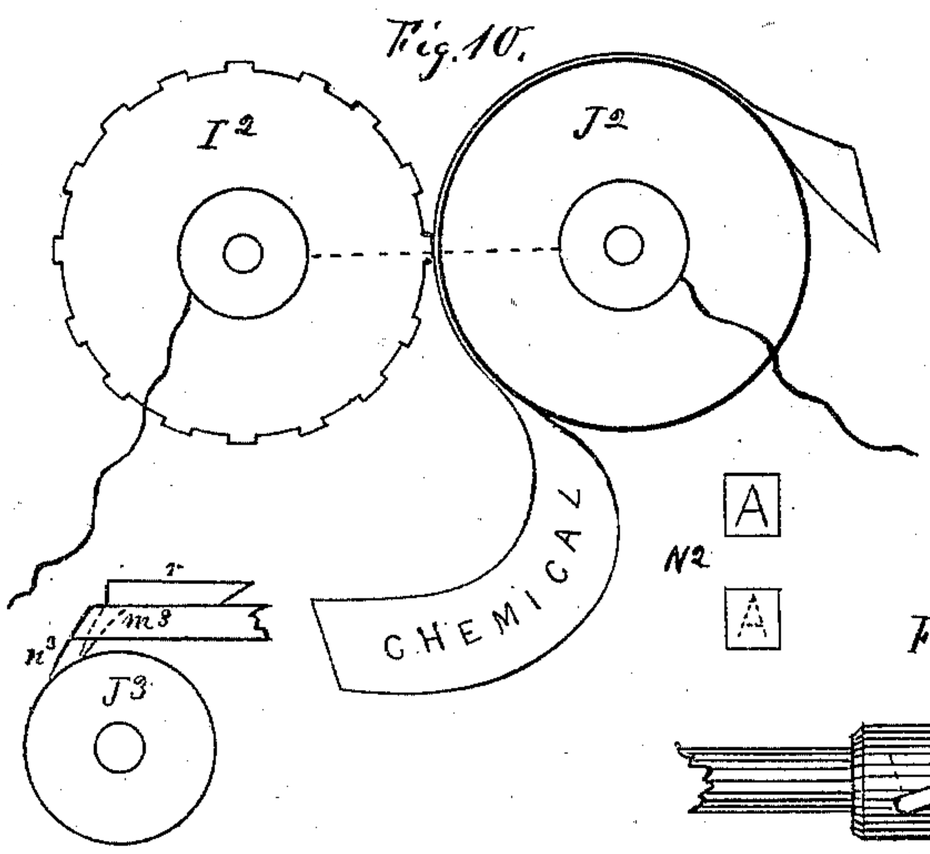


Fig. 10.



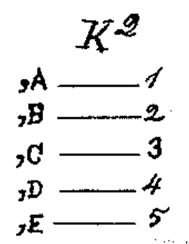


Fig. 11.

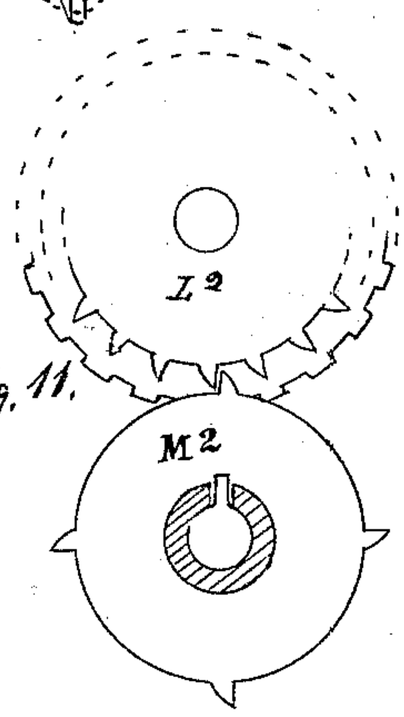
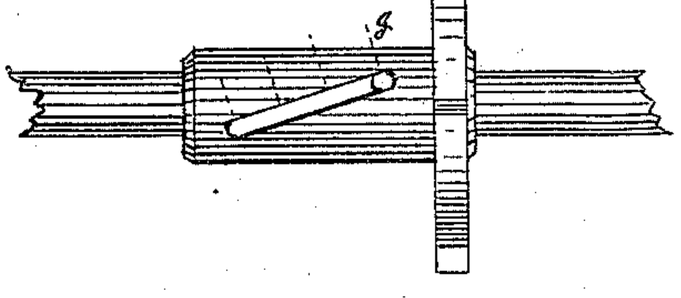


Fig. 12.



Witnesses.

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Inventor:

Merritt Gally.

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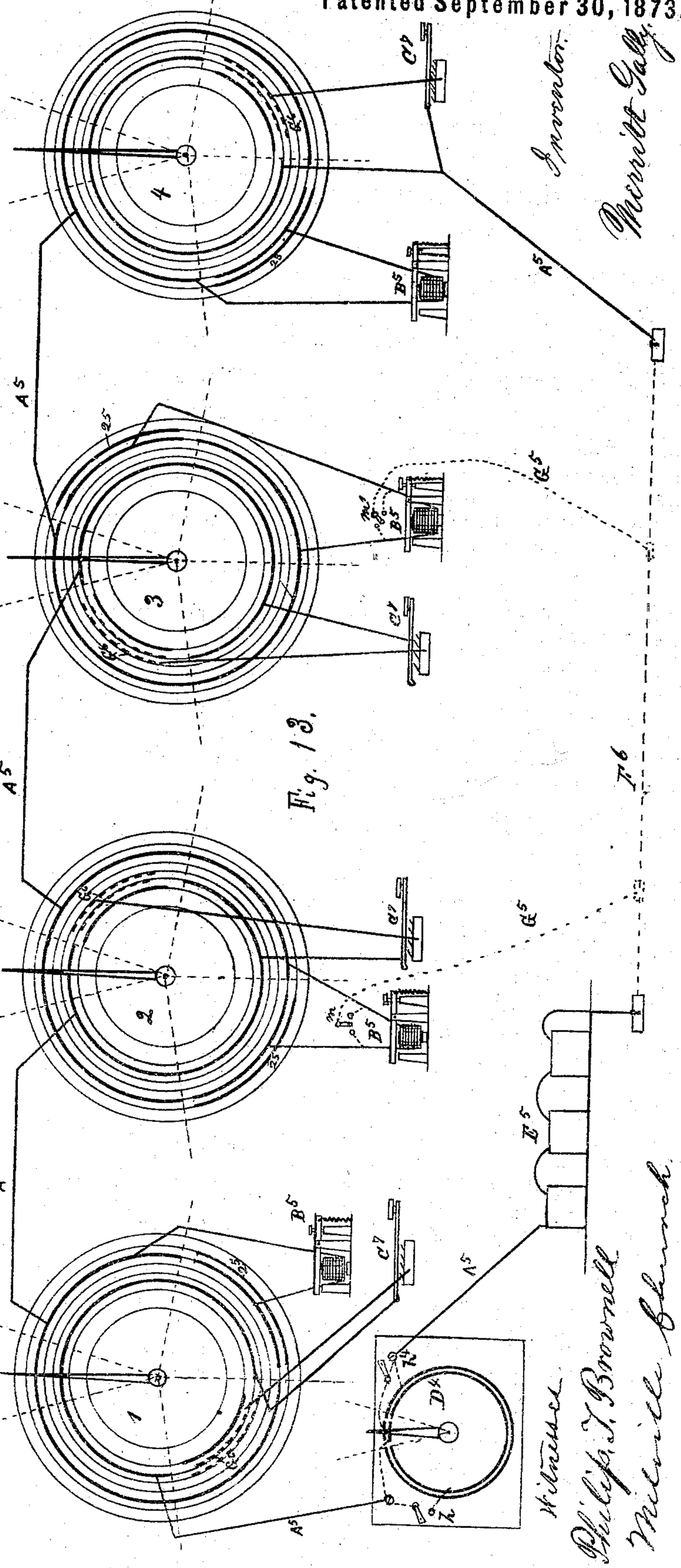

Fig. 13.

UNITED STATES PATENT OFFICE.

MERRITT GALLY, OF ROCHESTER, NEW YORK.

IMPROVEMENT IN MULTIPLEX OR INTERVAL TELEGRAPHS.

Specification forming part of Letters Patent No. **143,341**, dated September 30, 1873; application filed September 11, 1873.

To all whom it may concern:

Be it known that I, MERRITT GALLY, of Rochester, in Monroe county and State of New York, have invented certain new and useful Improvements in Telegraphic Apparatus; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings and to the letters of reference marked thereon.

In the drawings, Figure 1 is a plan of a number of the devices with circuits arranged for a "multiplex" instrument. Fig. 2 is a front view of the tripping-escapement; also, the revolving circuit-closer. Fig. 3 is an end view of vibrating paper-cylinder with type-wheel and magnet. Fig. 4 is an elevation, showing magnet with automatic returner for armature; and Fig. 5 is a plan of same. Fig. 6 is magnet with rotary indicator. Fig. 7 represents the mechanism for controlling the key-movements. Fig. 8 is a plan, showing the arrangement of conductors for forming a telegraphic alphabet by a series of combinations; Fig. 9, different methods of constructing magnets; also, a group of magnets operating in connection with a single armature. Fig. 10 represents devices for an electro-chemical register. Fig. 11 represents a partial gear for securing "interval" movements to type-wheel or paper-motor. Fig. 12 is a front view of partial gear, showing a means of adjustment; and Fig. 13 is a plan, representing a line of instruments arranged according to my multiplex system, the circuit-closers being each shown with one group of transmitting-conductors, corresponding to the plan of Fig. 8, and also showing the relative positions of the receiving-conductors, the instrument-circuits, the main line, and line-pulsator.

I. By examining the telegraphic alphabet in common use, which is made up of dots and dashes, either recorded by a register or read by sound, it will be found that the entire length of the longest character (the period, for example) occupies the length of fifteen dots, and that, by omitting some of these dots and joining others in combination, any of the letters, numerals, or punctuations may be formed. In order, therefore, to produce the letters of the alphabet for telegraphic transmission by a set of keys, each key representing an entire letter, I use fifteen short conductors, G^6, for instrument circuit-closer, as shown in group E, Fig. 1, and, by means of the operating-keys A, B, C, &c., make connection of the circuit only through such combinations of the conductors of the circuit-closer as shall produce the letters represented by such keys as the connector of the circuit-closer is passing in contact over its conductors. In order to secure the proper connections of the circuit only through the proper conductors for each letter, I project from the fifteen conductors, group E, Fig. 1, fifteen metallic lines, U, passing them under the key-bars, as more clearly shown in Fig. 7, in which the key representing the letter A is shown. As the key-bar is depressed by forcing down the key, such key-bar will come in contact with the four small spring-wires which project from four of the metallic lines U. The office of these spring-wires is simply to insure contact of the bar with the proper number of metallic lines, the four representing the letter A, as will be seen by referring to the diagram E^4, Fig. 8. Different numbers of such spring-wires lie under the different key-bars, each key connecting with such a number, and projecting from such of the metallic lines as shall produce its particular letter as the circuit-closer is making a movement over the group of conductors E of Fig. 1.

II. In Fig. 1 the circuit-closer is represented as having four segments, each segment containing a group of transmitting-conductors. These segments are reached at different times by the revolving connector D; and it will be seen that, if four manipulators were connected each with a particular group or segment of conductors, all could transmit through a single main-line wire without conflict, one part of such main line connecting with the key-bars of the several manipulators, and the other part of the line connecting with the revolving connector D. For convenience, and to accommodate other points of construction, to be hereafter explained, I make the connection of the main line from the binding-post J to the revolving connector D through the entire ring-conductor of the circuit-closer, within the circle of the groups of transmitting-conductors. This ring corresponds to the conducting-bar of diagram E^4, Fig. 8.

I have arranged the circuit-conductors in Fig. 1 in plan view for better illustration, although they may occupy the periphery of a drum, as shown by E^2, Fig. 2, spring-connectors being shown at D^2.

Although different instruments may be made to transmit messages upon a single wire without conflict by being connected with different segments of an automatic circuit-closer, or even different instruments at different stations may accomplish the same by using different circuit-closers running synchronously, each instrument having its particular segment, nevertheless it will be clearly seen that such a system of "multiplex telegraphy" would be impracticable. The number of instruments on the line would necessarily be limited to the number of segments employed, or different stations would be obliged to give up intervals to other stations, when required, leaving many instruments unemployed, as in the common system.

The part of my invention which I am now to describe does not consist in giving to an instrument, by any construction of devices, a particular interval of time on which it may operate, and confining it to such interval; but it consists in such a construction of instruments as shall enable the operator to set his instrument to any unemployed interval, either for transmitting or receiving; also, to be able to ascertain what intervals are and what are not being employed by other instruments; also, to set his instrument to transmit on one interval and receive on another, or a number of others, as he may desire. This enables any station having but one instrument to communicate with any operator of a station having fifty instruments, and allows him to know at once without call whether he may use one of the intervals for his communication. It also enables any one of the operators at the large office to know immediately whether all the intervals of the line are occupied, and, by means of a particular interval left open for calls, to be always in communication with every office on the line, and to secure the attention of any operator on the line when it is important so to do.

I will particularly describe the devices shown in the drawings for accomplishing these results as follows, although they may be greatly modified, and I do not intend to be limited as to the particular means I shall employ. In Fig. 1 an interval-switch is shown at U^3. The lines lying underneath the part of the switch nearest its pivot represent conductors, with which the switch, by a set of spring-connectors, remains in contact. The conductors with which these springs connect should equal in number the fifteen metallic lines U, and connect therewith, as partially shown. The two radial lines of dots on each side of the switch U^3 represent conductors, each line corresponding in number to one of the groups of transmitting-conductors of the circuit-closer, and connecting therewith, as partially shown. The switch is provided with fifteen more spring-connectors upon its under face, each one of which has connection with one of the fifteen first mentioned, all the pairs being insulated from each other. It will be seen that, if the switch U^3 be turned onto any one of the radial lines of conductors, it will connect the key mechanism, through the metallic lines U, with one of the transmitting-segments of the circuit-closer; also, that the key mechanism may be connected with any one of the segments at will by changing the switch from one radial line to another, and thus be set to the different intervals of transmission.

The instrument having thus been set to transmit on any desired interval, the remaining intervals, one or all, may be set for receiving messages from other stations, or may be given to any other instrument on the line for transmitting or receiving, as the case may be; and I will now describe the method and means for ascertaining whether the other intervals not being used by the transmitter are employed or unemployed, and, if unemployed, how to set any one or all of them to receive the particular message or messages intended for such station. The external ring of the circuit-closer, Fig. 1, is divided into five sectors, four of which correspond with the transmitting-segments, and represent the receiving-conductors. The small segment at D is given to the line-pulsator for tripping the circuit-closer and connecting its time. The dotted line from each of the four receiving-sectors of the circuit-closer leads to one of the four switches of the group shown at N, and represents metallic connection between the switches and the sectors. These switches set the circuit-closer to the interval or intervals upon which the instrument is receiving. Four conductors, *e*, corresponding with the four switches, connect with a line leading to the receiver M, as shown; or each of these conductors may connect with a separate receiver, if desired. The four conducting-points of the bar N are connected with the main line coming in at the binding-post I. This part of the main line also connects with the receiver M, as shown. If any one of the switches of the group is turned onto its conductor *e*, it will connect its receiving-sector of the circuit-closer with the register, and any message passing on the main line during its interval will pass from the binding-post I through the receiver M; thence to the receiving-switch, which is set to such receiver; thence to the receiving-sector for that interval; thence to the interval metallic ring; and thence to the binding-post J, onto the main line. If the message is coming from the opposite direction, it takes the same path from J to I. All the instruments on the line or branch lines set upon this interval will receive the same message. Any operator may let it pass by, however, by turning the receiving-switch for that interval onto its conductor of the group N, connecting directly with the main line, without allowing the message to pass through the receiver; or the operator may stop the message for that interval by connecting

his receiving-line for that interval with the ground. This will not interfere with messages passing on other intervals, as the sector for this interval is cut out, while the circuit-closing connector is passing other segments. The receiving-switches are made double, as represented by the two at the right hand of the group. The other two are shown in pairs, to clearly represent that the switches are to come in contact with one conductor before leaving another. When any interval is to be used for transmission, its receiving-switch is turned both from the line and receiving-circuit. This breaks the line at this instrument for that interval; and after setting the transmitting-switch U^3 to the interval, the path of the circuit can only be through the operating-keys to the key-bars from I, and, if any of the key-bars are depressed, giving its proper pulsations through its segment of the circuit-closer; and thence to J. When any interval is not being used by the instrument for transmitting or receiving, the transmitting-switch U^3 should not connect the manipulator for that interval, and the receiving-switch for the same interval should be turned onto its conductor N of the main line. All the switches may be set thus, and the entire number of intervals be given to other instruments on the line.

It will be seen that the instrument may be constructed with any number of segments in the circuit-closer, and any number of switches to correspond, thus securing any number of intervals, and as many operators can be employed upon the line simultaneously as the capacity of recording-instruments will allow. With electro-chemical recorders the number may be very great.

III. I now pass to the third part of my invention, which has reference to the key mechanism.

It will be seen that, if the manipulator were not cut out from connection with the circuit-closer during all the intervals except the one to which it is set for transmission, the depression of a key during any of the intervals given to other instruments or to the receiver would conflict with other messages. This would be in all cases of attempted transmission unless the segments were separated from each other a sufficient distance to allow the operator to depress his key during the passage of the circuit-connector over the space just preceding the transmitting-segment to be used; and if the key were worked during its transmitting interval, it might not transmit the entire letter desired. Magnetic locks have been devised for holding operating-keys during their proper time for transmitting contact, and a signal click or bell to inform the operator when to depress a key and when he must not; but such devices must, of necessity, occasion very slow and deliberate manipulation, the constant watching of signals taking the mind of the operator from his message, and giving rise to many mistakes and misstrokes. The third part of my invention provides against all such defects, first, by allowing the operator to strike a key at any time, securing its effect only at the proper instant; and, secondly, in allowing the key to be depressed quickly or slowly, occupying any portion of the intervals given to other instruments for transmitting contact, or to the receivers of the line. If the key be struck at the time it should be in transmitting contact, it cannot be depressed, and will not yield until the interval is passed, when it will be ready for the interval when it next occurs.

I will particularly describe the devices for securing these results, as shown in the drawings; but, as they are subject to various modifications, I shall not limit myself to the peculiar construction shown.

The receiving-switches, with their lines connecting with their receiving-sectors of the circuit-closer, have another office besides that already described. I previously mentioned the fact that, when the instrument is set to transmit on any interval, the receiving-switch for that interval should be turned both off from the main-line connector and the receiver. It may now be set on one of the conductors *d*. The receiving-sector for the interval which is set for transmission now becomes a part of the transmitter, and is used in connection with the conducting-ring next within the circle to connect the circuit of a local battery to affect a magnet, U^8, situated under the key-bars, as shown in Fig. 7. In plan, Fig. 1, the circuit will be seen to lead from the switch and conductor *d*, entering the instrument at a^7. It then passes to the magnet under the key-bars; thence to the local battery provided for this circuit; thence back to the instrument through a^8, to its ring-conductor of the circuit-closer; and thence back through the sector to the switch, completing the circuit. While the circuit-connectors of the circuit-closer are passing the transmitting interval, the magnet U^8, Fig. 7, is charged by the local battery, and attracts its armature. The lever 7 is attached to the rocking bar 8, which lies under all the key-bars, and, while the magnet U^8 is charged, the stop 10, which is pivoted to the armature-lever, is thrust under the lever 7, and prevents the depression of any key while the armature is thus held by the magnet. There is no magnetic lock for holding a key down after being depressed, nor for preventing a second one being worked before another has accomplished its object, the devices for such purposes acting automatically. The rocking bar 8 rocks on its pivot at B′, and, when a key is depressed, the lip 9 of the bar turns to a position under all the remaining key-bars, preventing their being worked until the operated key returns again to its first position. As the circuit-closers of the manipulator are cut out from the circuit-lines of the revolving circuit-closer of the instrument on all intervals except the one set for transmission, it will be seen that the operating-keys may be safely struck during any of the intervals, and, if depressed before the time arrives for transmission, it will only be

necessary to furnish a device for holding them depressed until their interval arrives, and also through the time of their transmitting contact. For this purpose I use the lever 7 and catch D^1, Fig. 7. Whenever the key is depressed the catch D^1 connects automatically with the lever 7 and holds it fast, thus holding down the key-bar; and the lip 9 of the rocking bar 8 shuts over the depressed key-bar at the same time it passes under the remaining bars. The depressed key-bar remains in its position until it has accomplished its transmitting contact, when the recoil of the armature-spring of the armature-lever, which has been used to work the stop 10, trips the catch D^1 by means of a thruster, E^1, as shown.

It will be seen from the foregoing description, that if the instruments are constructed for four intervals, any four of the operators on the line may be simultaneously employed, and each will have three-fourths of his time for operating his keys, only one-fourth being used for their transmitting contact; or, if the instruments be arranged for fifty intervals, with electro-chemical recorders, fifty operators would be employed, and each would have forty-nine fiftieths of his time for his downward strokes. The instruments might be run as rapidly as the operators could possibly finger their keys, and still no mistake or collision as to time could occur.

IV. The fourth part of my invention has reference to an interval for calls, through which all the operators on the line can always be in communication with each other. To accomplish this object I select a particular switch of the group N of each instrument, and mark it "for calls," or have it understood as such by all the operators. I connect with this switch a separate receiver from the one or more used for messages; and if a sounder be used for this purpose, I give to it a peculiar quality of tone, differing so much from the sound of the other instruments as never to be confounded in its strokes with those of other sounders. I now keep all the instruments of the line turned for this interval onto the call-receiver, unless any particular operator wishes to send a call, when he, for the moment, turns on his manipulator, and all the offices on the line receive his call. Thus, all the offices are in constant means of communication, at least on one interval, and, in case of necessity, can call for any other interval to be given to any operator. In an unemployed instrument, all the switches are turned onto the line except for the call-interval, which is on its receiver. If, now, the operator wishes to know whether there is an unemployed interval which he can use for a communication, he turns the several switches, one after another, onto his receiver, until he finds one interval on which the receiver will not respond. He immediately turns such switch both off the line and receiver, and he has broken the line at his instrument for that interval, and it is secured to him for his message. He then signals the station with which he wishes to communicate through the call-interval, giving the number of the interval he has secured; and if such station has an unemployed instrument, it is set to receive his message; if not, he is informed through the call-interval how soon he may communicate.

V. The fifth part of my invention has reference to a combination-key. This is shown in Fig. 8 at G^2. This key is a combination of four minor keys, as shown, which may be struck in different combinations, for producing the elements of the dot-and-dash alphabet. The four key-bars connect with four of the conductors of the group E^4. If the first one be struck, it will, therefore, produce a dot; if the first and third, they together produce two dots; if the first, second, and third, they will produce a dash; and if the first, third, and fourth be struck together, they will produce three dots. This key may be used for the manipulator, thus making the segments of the circuit-closer much smaller, only having four conductors to each; or it may be used to advantage as a call-key, thus making the call-interval much shorter. The third and fourth conductors of the small group should be separated by a space; or, for illustration, count on the diagram E^4, Fig. 8, the first, second, third, and fifth, and you have the group of four in proper position.

VI. The sixth part of my invention has reference to the correction at certain intervals of the circuit-closers of the line as to unison, without necessarily retarding, or stopping, or changing, in any way, the speed of the motors. Near the revolving circuit-closer is a magnet, H, which is affected by a "main-line pulsator," which passes a strong pulsation through the line while the circuit-connectors of the circuit-closer are occupying the short segment at D. The lever G of the armature of the magnet is provided with a lifting-cam; and as the circuit-connector D reaches this cam, a spring-latch upon the surface of the connector, provided with a tooth passing through the body of the connector, connecting with the toothed wheel F, as shown in Fig. 2, is lifted by its contact with cam of lever G, and, the tooth being freed from the toothed wheel, the circuit-connector is tripped at this point, having no driving power. The motor moves the wheel F, and is not affected by the tripping of the circuit-connector. When the line-pulsator charges the magnets H of the line, all the armature-cams are withdrawn, the circuit-closers are again connected with the motors, and make another revolution. The additional friction of the bearings of the wheel F, when the circuit-connector is tripped, is made to, as nearly as possible, balance the power required to drive the connector. The motor remains, therefore, unaffected by the corrections of the circuit-closer. The connections may be made less frequent by gearing backward from the shaft of the circuit-connector, and making the latch to connect with slower gear.

VII. In circuit-closers made of conductors with

intervening non-conducting material, if the connectors are allowed to have a bearing upon the non-conducting substance, a metallic dust soon collects, and the insulation of the conductors is soon imperfect. If the conductors are made to project from the surface, and the connectors are not allowed to have a non-conducting bearing, the friction of the circuit-closer is variable, and the connectors are liable to catch in their movement.

To avoid these difficulties I place the conductors in a trench. They are then surrounded entirely by an open space. I make the connectors wide enough to have a bearing at their edges upon the non-conducting material at the sides of the trench. Any amount of metallic dust may collect upon these bearings, and still not make any connection between the conductors. The circuit-closing drum E^2, Fig. 2, is shown as having such trenches for its conductors.

VIII. Sheet 3 of the drawings, designated as Fig. 13, shows the relative positions of the receiving and transmitting segments, which are set for illustration upon certain intervals, for transmission, or for receiving. The receiving-conductors correspond in position on the circle with the transmitter from which it is receiving. Each segment of each instrument has both transmitting and receiving conductors, differing, as will be seen from the foregoing description, as to number and form. The operating-conductors of the line, as adjusted, are shown in the plan, Fig. 13, all the others having been cut out by the adjustment. Remembering that all the circuit-connectors of the line are moving in unison, or are at least upon corresponding segments, the intervals of the line may be traced out, and it will be found that the message from station 1 is being received at stations 2 and 4; that from 4 received at 1, and that from 2 received at 3. A^5 represents the main line; F^6, the ground, and D^4 the line-pulsator. The switches of the line-pulsator are to turn the current of the line off or on. The short segment alone may connect with the line, and in this case the instruments may be kept regulated while the main battery is thrown off for all other intervals, which will allow business to be done between near stations of the line with local batteries without using the main battery. Any interval may thus be cut out from the main battery when desired, and thus consume less battery-power.

IX. The ninth part of my invention, on which I shall make claim, has been fully described in connection with the foregoing explanations.

X. It has been found difficult to secure strong pulsations to the armature of a magnet, and, at the same time, have such pulsations rapid. It requires time for the core of a magnet to become charged, and then it requires a certain amount of time for it to lose its magnetism. The time required to charge a magnet is in proportion to its size, the time differing in proportion to the squares of the diameters of the cores. A small magnet is therefore charged quickly; but it is proportionately weak. In order to affect the armature quickly, and still with great power, I use a group of small magnets, each acting upon the armature with quick effect, while all together give the power required. The circuit-wire may connect with each magnet separately, or pass from one to another, as shown in Fig. 9, H^2. In any broad sense this is not a combination-magnet, as each small magnet exerts its own independent power upon the armature. There is, however, another advantage in grouping them together, if not too far separated. It is the mutual induction caused by such position.

XI. To produce still more rapid magnetic pulsations I use a number of electro-magnets, such as previously described, shown at V^1 V^2 V^3, Fig. 5, a side view of one with its positively-returning armature being shown in Fig. 4. The wheel Z is driven by the motor of the instrument, and in unison with the circuit-closer. To each magnet is given a circuit-connector, a^3, connecting with a conductor on one-third of the periphery of the wheel Z. The armatures Y are counterpoised, so that the least power of the magnets will cause them to drop. The impulses which pass the circuit must affect the magnets successively as the wheel Z turns on its axis. A cam, S, is placed upon the under face of the wheel Z; and, if any one of the armatures is caused to drop by its magnet, the cam strikes the armature-lever, and gives it a positive return movement before the power of the magnet is diminished enough to be overcome by a spring or the like. The wheel, driven very rapidly, will thus record, by the return movements of the armatures, very rapid electric pulsations. One of the magnets is being affected while another is losing its magnetism, and so on.

XII. Fig. 6 shows a magnetic indicator for the receiver when operated by very rapid pulsations, which is very sensitive, not only to rapid pulsations, but to those electric pulsations which are very weak. It is constructed of a wheel, T, which may be very carefully balanced and hung on finely-jeweled points. An indicating-scale is shown marked upon this wheel, and a pointer to indicate how far it turns at each movement. The wheel X is covered with hairs of fur, or fine silk, or the like. This wheel is driven by a motor, and the fine hairs turn the wheel T by very light frictional contact, which is easily overcome by the slightest effect of the retarding-magnet shown below wheel T, and placed very near to its periphery, the rim of the wheel being made of soft iron. If the pulsations through the circuit are not too rapid, their length may be easily read by the means of the seal and pointer, and their number counted. If, however, the electric pulsations are too rapid for such reading, I use two magnets, as in case of Fig. 5, and also three wheels, T. I make the wheel X to correspond to the wheel Z, with conductor and connectors for the magnets acting in rotation. I have now

divided up the impulses among the other magnets, and each wheel T stops less frequently. Now I read from all the wheels in combination. I give the wheel X the time of a dash for its revolution. If the first wheel of the order makes a stop, it is a dot; if the third next stops, it is a second dot; if the first succeeds the first, it is read a "dot, a space, and a dot;" and if the entire number stop, one after the other, apparently together, it is read as a dash. In this manner very rapid and very faint electric pulsations can be made to indicate properly, and be easily read.

XIII. By examining Fig. 4 it may be seen that the duration of the return movements of the armature will be in proportion to the incline of the cam or cams S acting upon it. If the cam be long and its incline gradual, the return movement will be lengthened thereby. A circuit is shown passing into the support of the armature-lever to a connector, which, during the return movement, closes the circuit, with a line passing into the shafts of wheel Z. Thus the short pulsations of the magnets may be repeated by pulsations corresponding to the duration of the return movements of the armatures, and caused thereby.

XIV. In a multiplex instrument using only certain intervals for its receiver, it is desirable that the paper should move only on the receiving-interval. To accomplish such result, I either slip or connect a gear for the movement in the register by means of a local circuit arranged with the circuit-closer for the receiving-interval in similar manner to the local key-circuit for the transmitting-interval; or I use a partial gear, connected with the motor. Such partial gear is shown in Figs. 11 and 12, the wheel M^2 being the driver, and the wheel L^2 connecting with the paper-motor. The different intervals occupy different portions of the spaces between the teeth of wheel M^2. The device is set to its proper interval as follows: An extended hub or thimble is shown on the wheel M^2, Fig. 12. This hub has in it a diagonal slot, in which is a pin entering the shaft. The wheel and hub are loose on the shaft, which may be moved to the right or left by moving the shaft longitudinally, so as to cause the pin to take the positions in the slot represented by the dotted lines. The relative positions of the gears will be set to any of the four intervals.

XV. In similar ways and with similar means I give to a type-wheel its revolution on the proper interval to which it is set.

If a printing-register is used, it should also be understood that the number of conductors in each transmitting-segment of the circuit-closer should be equal to the number of characters upon the type-wheel, and that each operating-key should connect only with one of the group representing the letter indicated by the key.

XVI. The sixteenth part of my invention, on which I shall make claim, has already been fully explained in connection with the operation of other parts.

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

1. An automatic circuit-closer having a group of conductors representing the short dashes of a telegraphic alphabet, and sufficient in number to fill a space equal to the length of the longest letter of such alphabet, in combination with transmitting-keys, each key connecting with such a selection or combination of the conductors of said group as to produce any letter of the alphabet indicated by such key.

2. In a line of instruments arranged for multiplex transmission by allotting to different instruments different intervals of time for operation, the combination, with a transmitter or receiver, of devices for changing such transmitter or receiver from one interval to another, thus setting the instrument to any unemployed interval desired, substantially as specified.

3. A transmitter having in connection therewith an automatic circuit-closer with an interval-circuit, cutting out the transmitter during the intervals not allotted to it for transmission, in combination with devices for allowing the working of the operating-keys during an interval or intervals allotted to other instruments, and holding such key or keys until their proper interval of transmission has arrived, substantially as specified.

4. The combination, with a line of multiplex instruments, of call-receivers, arranged upon a given interval or intervals, allowing all the stations of the line, or any part of the line, to be in constant communication with each other, for calls or explanations, without interrupting the message-intervals, substantially as specified.

5. The combination-key G^2, in connection with its conductors, substantially as specified.

6. The magnetic latch-escapement G *d* D F, or equivalent, for tripping the circuit-closer and correcting its time of revolution without affecting the motor.

7. A circuit-closer made of conductors separated by non-conducting material, having non-conducting bearings for the connector or connectors, which bearings are separated from the conductors by intervening trenches, substantially as set forth.

8. In combination with an automatic circuit-closer, a receiving conductor or conductors, occupying a space equal to a group of transmitting-conductors, from which group combinations are made for producing different characters.

9. The combination, with a transmitter and receiver arranged for a multiplex system of intervals, of devices for securing one interval to the transmitter while another is being used by the receiver, substantially as set forth.

10. The combination of an armature with a number of magnets operating therewith, substantially as specified.

11. The armature of a magnet, in combination with a device which applies positive mechanical force for the return movement of the

armature after it has been attracted by the magnets, substantially as specified.

12. A magnetic indicator consisting of a wheel moved by slight friction-power, and stopped or retarded for its indications by means of a magnet.

13. The combination, with a telegraphic transmitter or receiver, of a relay or repeater, which gives its repeated pulsations by means of the return movements of its armature, which impulses are measured by the duration of such return movement, substantially as set forth.

14. The combination, with a register, of devices for setting the same for movement of the paper at appointed intervals, corresponding with the intervals on which it is to receive, when connected with a multiplex instrument, substantially as set forth.

15. In multiplex instruments, a type-wheel and motor combined with a device for securing to such type-wheel its revolutions only for the receiving-interval, substantially as specified.

16. The operating-keys, each having its group of connectors, by means of which it selects from a common group of conductors the proper number and order to produce any letter indicated by such key, substantially as specified.

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