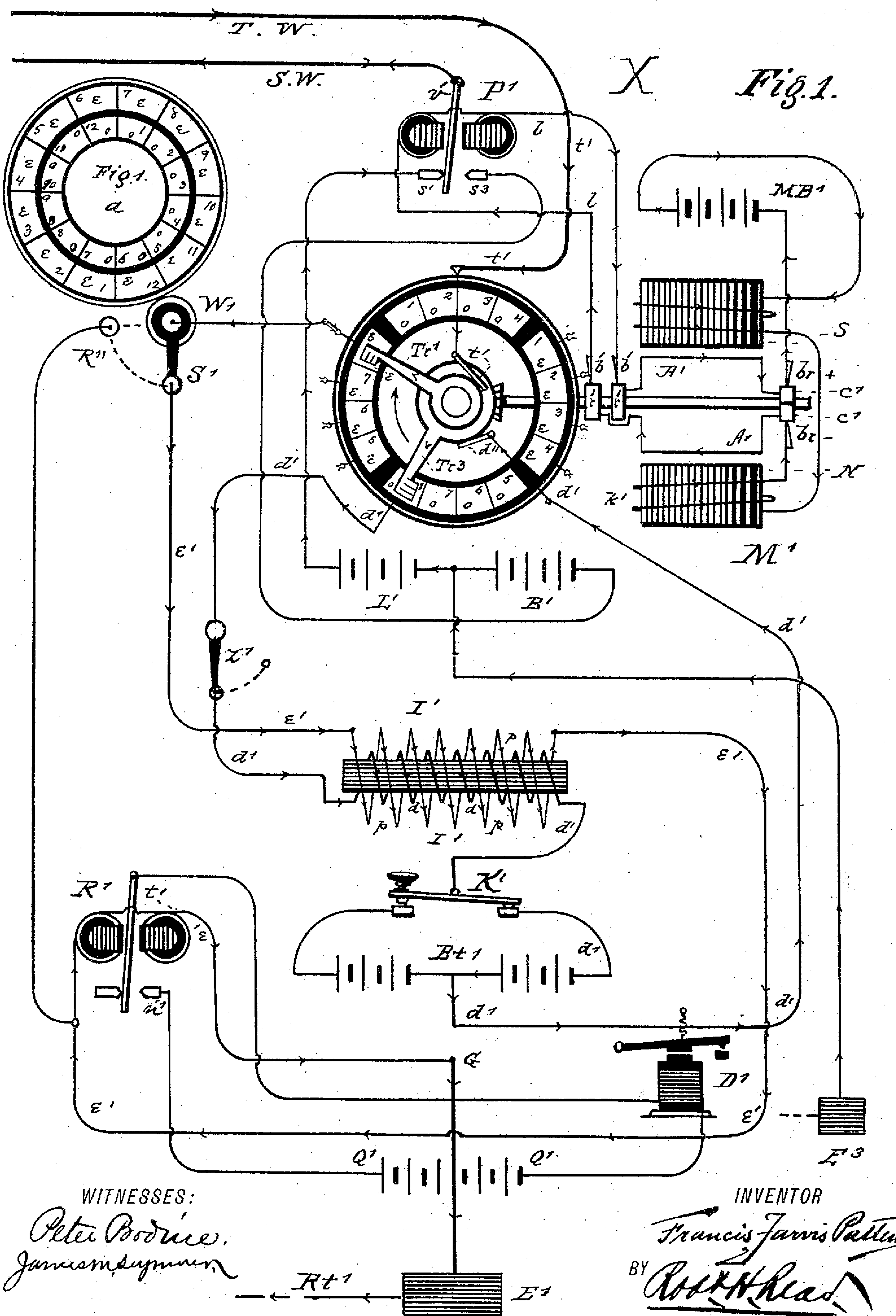
(No Model.) 2 Sheets—Sheet 1.

F. J. PATTEN.

MULTIPLEX TELEGRAPHY.

No. 395,509. Patented Jan. 1, 1889.



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(No Model.) 2 Sheets—Sheet 2.

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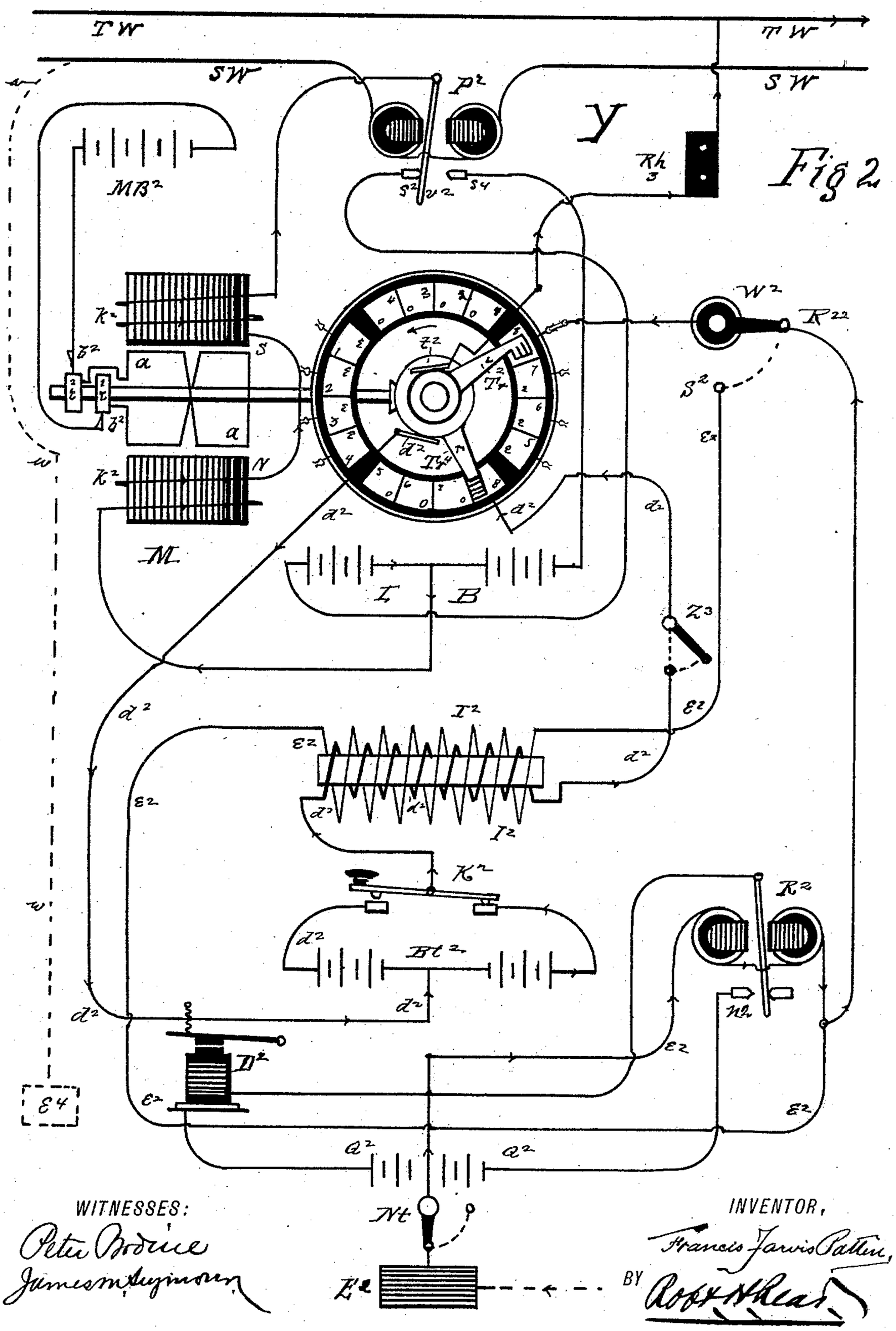

Fig 2.

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MULTIPLEX TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 395,509, dated January 1, 1889.

Application filed October 17, 1888. Serial No. 288,294. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS JARVIS PATTEN, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Multiplex Telegraphy, (for which I have filed an application for Letters Patent in France, dated November 13, 1888;) and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to telegraphy, and particularly to that class of telegraphic systems known as "multiplex," in which a number of operators may simultaneously use the same line-wire. Among the many systems of this character heretofore proposed some—as duplex and quadruplex systems—depend for their operation on the use of receiving-instruments adapted to respond to different strengths or polarity of current. Others depend on the use of current-distributing apparatus known as "sunflowers" at the several stations, rotating brushes being kept in synchronous rotation by electrically-controlled step-by-step devices, which apparatus gives each of a series of local stations the use of the line for a portion of each increment of time during which the apparatus is in use. My invention belongs generically to the latter type, the synchronism of the distributing apparatus being effected in a novel way and the signaling being accomplished by the use of currents of a character distinctive in effect from the synchronizing-currents, these signaling-currents being used on a different line-wire.

The object of my invention is to insure accurate synchronism and the transmission of every signal at the instant when made, and to increase the capacity of the system, so that a large number of messages may be sent over the same line-wire.

My invention consists in a current-distributer which determines not only the proper time for sending the signaling-current, but assures also the development of an induced impulse for signal transmission at a time when the line is connected with the stations holding communication.

My invention also embodies the use of apparatus and circuits adapted to respond to the induced impulses, and certain details which will be hereinafter fully described in this specification and definitely indicated in the appended claims.

In the accompanying drawings, Figures 1 and 2 show a system embodying my invention, Fig. 1 showing the apparatus and connections at a sending-station and Fig. 2 the apparatus and connections at a receiving-station, but one sending and receiving local being connected at the distributer. Fig. 1ª shows a modified form of distributing disk or table.

The synchronizing apparatus used in the present system is in all respects similar to that illustrated and described in another application filed by me and numbered 275,787. As its mode of operation was fully and clearly set forth in said application, it will only be necessary to describe it here briefly.

At the sending-station X is an ordinary direct-current electric motor, M′, driven by an independent battery, MB′, and provided with an armature, A′ A′, of the ordinary Siemens H type. This armature is connected through the commutator c' and brushes $br+$ $br-$ to the motor-battery. The armature A′ A′, instead of being a simple closed coil, is broken at its middle point, and the two terminals thus formed are secured to two insulated contact-rings, r' r', upon which the brushes b' b' bear. To these brushes an external loop, 11, including the coils of a polarized relay, P′, is connected. The armature-circuit is therefore closed through this independent external loop. From the operation of such machines it follows that a reversed current will circulate in the loop 11, a reversal occurring at each half-revolution of the armature, this reversal being an incident of the two-part commutator c' c', for it is evident as the armature-spindle turns each segment of the commutator will be brought into alternate engagement with the brushes $br+$ $br-$. These re-

versed currents cause the armature v' of the polarized relay to vibrate between the two contact-stops s' s^3, the armature being swung to one side or to the other at each reversal of current in the armature and loop l. The pivotal point of the armature v' is in circuit with a main line SW, connecting station X with a distant station or stations. The contact-stops s' s^3 are connected to the opposite poles of a battery, L' B', the middle point of which is grounded at E^3. It will be evident, therefore, that as the motor M' operates the relay-armature v' will throw reversed currents alternately over the line SW, and that each impulse sent over the line will correspond to a half-revolution of the armature A' A'. The line-wire SW passes to a distant station or stations, the coils of a polarized relay, P^2, being interposed in the circuit at each station, and the armature v^2 of this polarized relay will be actuated by the reverse impulses sent to line and will vibrate in unison with and respond to the vibrations of the relay-armature at station X, the relay P^2 at station Y thus beating the half-revolution of the armature of the motor M' at station X. The relay at the distant station Y has its armature v^2 playing between two contact-stops, s^2 s^4, which contact-stops are electrically connected with the opposite poles of the battery LB, the middle point of which is electrically connected with the pivotal point of the relay-armature through the field-magnet coils l^2 l^2 of a motor, M, at station Y, as shown in Fig. 2. From these connections it follows that as the tongue of the relay P' at the station X vibrates to and fro it will send alternate reversed currents through the field-coils of the motor M at station Y, and that the field magnetism will be reversed at each vibration of the tongue of the polarized relay P'. The armature aa of the motor M is supplied with a continuous current from an independent source, MB^2, the terminals of the armature-coils being connected to contact-rings t' t^2, on which bear brushes b^2 b^2, connected to the poles of said battery. Having thus a direct current in the armature and an alternating field, this motor will revolve and its armature will turn precisely one-half a revolution at each reversal of current in the field-magnet coils; but as the reversals of current are simultaneous with the vibrations of the tongue of the relay P', which are controlled by the motor M', it follows that the two motors at X and Y must revolve in unison with each other, the half-revolutions in the armature of one machine corresponding precisely with the half-revolutions of the armature in the other.

At each station there is a current-distributing apparatus driven by or geared to the station-motor. As is shown in the present embodiment of my invention, this consists of a rotating trailer or brush geared to the armature-spindle co-operating with the table of segmental contacts. The trailer is provided with two bearing-surfaces, Tr' Tr^3, placed at an angle covering less than a quarter of a circumference, for a reason which will presently be described. In the path of the trailer lies a series of contact-segments insulated from each other. As shown in the drawings, these are numbered from 1 to 4 in the top and the right-hand quadrants, and from 5 to 8 in the bottom and left-hand quadrants. Brushes l' and d^{11} bear on the hub of the trailer, the former being connected to a line-wire and the latter being connected to the middle point of a split battery, Bl'.

The distributers shown in the drawings will accommodate a system involving eight or a less number of stations.

As the connections from the distributer-segments to the respective local stations are precisely the same, it will only be necessary to describe these connections for any single pair of stations. In the drawings these connections are made with the segment numbered 8. The segment is electrically connected with a switch, W', by a conductor secured to the edges of the segments, adapted to be thrown on either of two contacts, R^{11} S', the former putting the local station into a condition for receiving and the latter putting it into a condition for transmitting messages.

At each station is placed an induction-generator (shown in the drawings as a simple induction-coil) the terminals of the induced circuit of which are connected, respectively, with the contact S' and with earth, E^2, through the coils of a polarized relay, R', or other suitable instruments adapted to respond to induced current. The inducing-coil of the induction-generator has its terminals connected through a switch, Z', with a segment, 8, a quarter of a circumference distant from the segment above mentioned and with a double contact-key, K'. The key K' co-operates with two contacts connected to the opposite poles of the above-mentioned split battery Bl'. It will thus be seen that normally there is, when the switch Z' is in the position shown in Fig. 1, a closed circuit through the induction-coil of the generator I' each time the arm Tr^3 of the trailer sweeps over the segment 8, the polarity of the current being dependent on the position occupied by the key K'. At such a time the induced current is provided with a path through the other segment 8, the arm Tr' of the trailer, and the brush t' to line. In the normal condition of a local station the switch W' is on the receiving-contact. Suppose, now, an operator at X desires to communicate with an operator at Y. He would throw his switch W' to the sending-contact S' and manipulate the key K'. The trailers at the two stations are constantly sweeping over the tables of contacts, and the segment 8 at X and 8 at Y are simultaneously swept by the trailers. The motors are driven at such a speed that each signaling-segment will be swept once at least in the shortest period occupied by the operator in

using any element of the Morse code. It will therefore be seen that the trailer will bear on the local segment at least once for each dot and twice for each dash. As shown at station X, the key is in its normal position. Each time the arm T^3 reaches the contact on which it bears, as shown in the drawings, a local circuit is closed through the inducing-coil of the induction-generator as follows: from the key to the coil, through the coil to the segment, through the arm T^3 to the brush d^{11}, and thence to the middle point of the battery Bt', through the right section of the battery to the key. The connecting-wires of circuit are marked throughout by the letter d'. The moment this circuit is closed by the arm T^3 of the brush an induced wave is set up in the other coil of the generator and a current proceeds to line from the earth-plate E′ to G through the coils of the relay R′, over the connections marked e', through the secondary coils of the generator to the switch W′, thence by way of segment 8 and the arm T' of the trailer to the brush t' and the transmitting-line TW, thence over said line to station Y, through a rheostat, Rh^3, to brush t^2, arm T^2 of the trailer at Y, segment 8, switch W^2, relay R^2, to earth, E^2. The relays are so wound that the impulses sent over the transmitting-line by the circuit just described will throw the relay-armature on the open contact of a local circuit including a battery and a sounder at each station. When, however, the transmitting-key K′ is depressed by the operator, a wave or series of waves of opposite polarity will be thrown on line by reason of the reversal of current in the inducing-circuit at the transmitting-station, the right section of the battery being then brought into action. These waves will throw the armatures of the relays R′ R^2 to the stops n' n^2, respectively, and the sounder D′ at station X and D^2 at station Y will be actuated, the former through a local circuit, including the local battery Q′ Q′, and the latter through a local circuit including the battery Q^2 Q^2. It will thus be seen that at each station there are two segments, one to create an induced impulse by closing the inducing-circuit of the induction-generator and the other to close a path for the induced current to line. In order to make this occur at precisely the proper moment, the two arms of the brush have a fixed relation to each other and cover an angle less than ninety degrees; and it results from this that the arm T^3 will leave its segment before the arm T' has left its segment—a condition which insures the induction-wave from the generator I′ proceeding to line. Various ways of accomplishing this might be adopted, the only essential feature being that the trailer shall have two parts adapted to close the two circuits at the proper time. For example, another way in which the same object might be effected is shown in Fig. 1^a, where two sets of segments between the same radial planes are placed concentrically to each other.

It will be evident that if one of the outer segments were connected with the switch W′ and the corresponding inner segment with the switch Z′ a radial brush or trailer bridging the two segments would accomplish the same result. As, therefore, the operator at X manipulates his key, the polarized relays will respond to such manipulations and the sounders at the respective stations be operated. We have thus all the essential elements for reliable telegraphic communication.

From what has been described it will be evident that the rotating spindle of the distributing apparatus carries two contact-brushes, one of which co-operates with the segmental contacts, so as to form a current-distributer for the respective local branches, and the other of which is a circuit-closer for the primary circuit of the induction-coil. By the term "distributer" used in this specification I mean an apparatus embodying a series of contacts progressively engaged by a contact device or brush for successively connecting local branch circuits to line.

Each main station at which more than one local station is connected is provided with means for connecting said locals to any desired station of the system. This may be done by an ordinary plug and flexible connection or other well-known devices.

The motors are driven at such a speed as to cause the trailers to sweep the table of segments a definite number of times during the period occupied by a rapid operator in sending the shortest signal of the code used, and as each segment is traversed by the trailer once during each revolution of said trailer it will be evident that each operator of the system is given the use of line for a definite period during each revolution, and that it is only necessary to multiply the number of segments of the distributer and the number of branch circuits corresponding thereto to increase its capacity—that is to say, to make a system of higher order than an octuplex—a limit only being reached when the angle covered by a segment becomes so small that synchronism of the motors cannot be relied upon. The reversed currents used for the synchronizing clear the line of static charge at each reversal and prevent any lagging in the relays which control the actuating-motors for the distributer.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a telegraph system, the combination of a line-circuit connecting different stations, synchronously-moving current-distributers at the respective stations, local branches successively connected to line by said distributers, a source of induced current, electric connections between the line and the induced circuit of said source, a circuit-closer in the inducing-circuit of said source, contacts engaged by said circuit-closer simultaneously with the connection of a branch to line, and

receiving-instruments adapted to respond to the induced currents.

2. In a telegraph system, the combination of a line-circuit connecting different stations, synchronously-moving circuit-distributers at the respective stations, local branches successively connected to line by said distributers, an induction-generator, the induced circuit of the generator being connected to line when a local branch is closed, and a rotating circuit-closer driven by the same synchronizing device for simultaneously varying the current in the inducing-circuit of said generator.

3. In a telegraph system, the combination of a line-circuit connecting different stations, synchronously-moving current-distributers at the respective stations, local branches successively connected to line by said distributers, signal transmitting and receiving instruments in operative relation to the local branches, an induction-coil having its high-resistance circuit connected to line when the local branch is closed, and a rotating circuit-closer driven by the same synchronizing device for simultaneously varying the current in its low-resistance circuit.

4. In a system of telegraphy, the combination of a line-circuit connecting different stations, an induction-generator, synchronously-moving current-distributers at the respective stations, and electrical connections from the distributer-segments to the inducing and induced circuits of said generator, each distributer simultaneously closing the two circuits pertaining to each local branch, the induced circuit being periodically connected to line and the inducing-circuit to a controlling-key by said distributer.

5. In a telegraph system, the combination of a line-circuit connecting different stations, an induction-generator, a synchronously-moving current-distributer having its trailer in both the inducing and the induced circuits of the generator, and contacts in the path of said trailer corresponding to the inducing and the induced circuits of the generator, the trailers simultaneously bearing on said contacts, whereby the inducing-circuit is varied and the induced circuit connected to line simultaneously.

6. In a system of multiplex telegraphy, the combination of a series of synchronously-moving current-distributers located at different stations, a controlling line-circuit for said distributers, an independent signaling line-circuit, local branch circuits successively connected to the signaling-circuit, an induction-generator having its induced circuit in operative relation to line, its inducing-circuit including a key, revolving circuit-closer, and a source of energy, and a receiving-instrument to respond to the induced current.

7. In a system of multiplex telegraphy, the combination of a series of synchronously-moving current-distributers located at different stations, a controlling line-circuit for said distributers, local branch circuits at the stations successively connected by said distributers, a source of high-tension current electrically connected through a key with the local distributer-segment, a polarized relay at each station to respond to the high-tension currents, and a sounder controlled by said relay.

8. In a system of multiplex telegraphy, the combination of a line-circuit connecting different stations, synchronously-moving current-distributers at the respective stations, local branches successively connected to line by said distributers, an induction-generator, a pole-changing key controlling said generator and normally throwing a current of one polarity to line, and polarized receiving-instruments in the local branches at the stations adapted to respond to a current of the other polarity.

9. A current-distributing apparatus for a multiplex-telegraph system, comprising a series of insulated contact-segments and a trailing arm successively engaging said segments, said trailing arm being in two circuits, one from a local branch through its insulated segment to line and the other including the primary of an induction-coil and a controlling-key, the secondary of the induction-coil being connected with the line through a switch, as and for the purpose set forth.

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

FRANCIS JARVIS PATTEN.

Witnesses:

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AUGUSTUS MERRITT.