No. 675,380. Patented June 4, 1901.

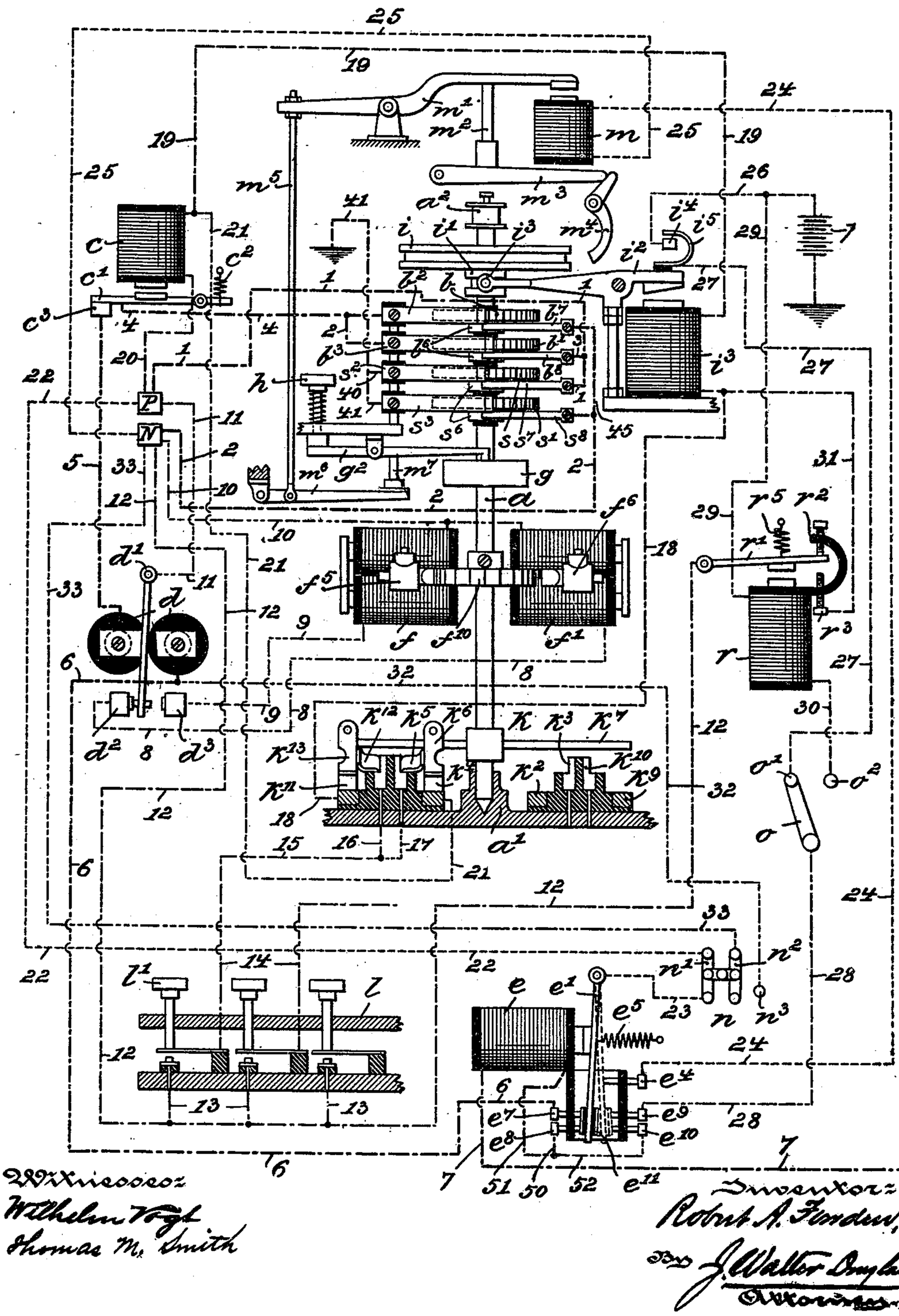
R. A. FOWDEN.

PRINTING TELEGRAPH.

(Application filed Nov. 2, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

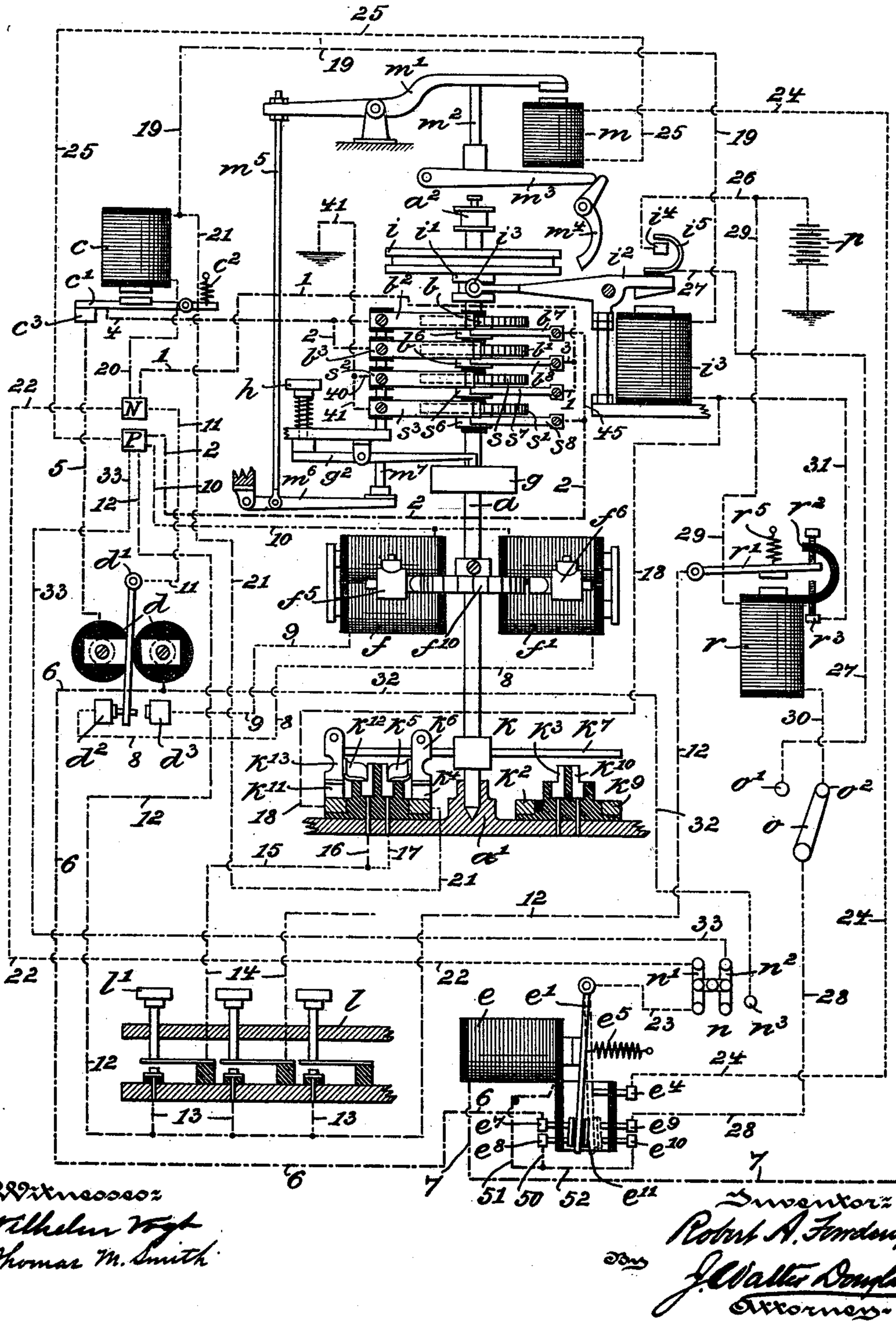

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Fig. 3.

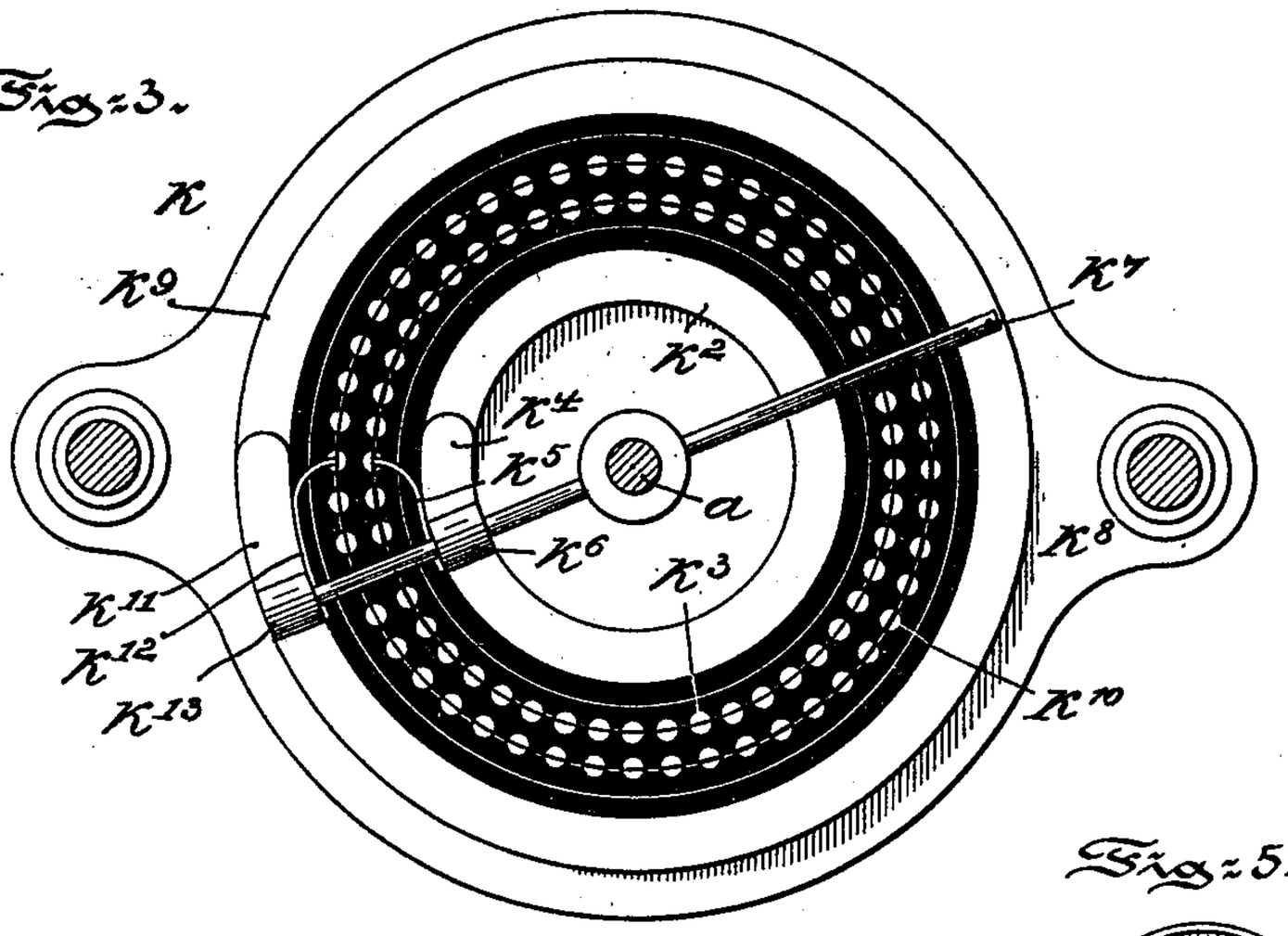


Fig. 4.

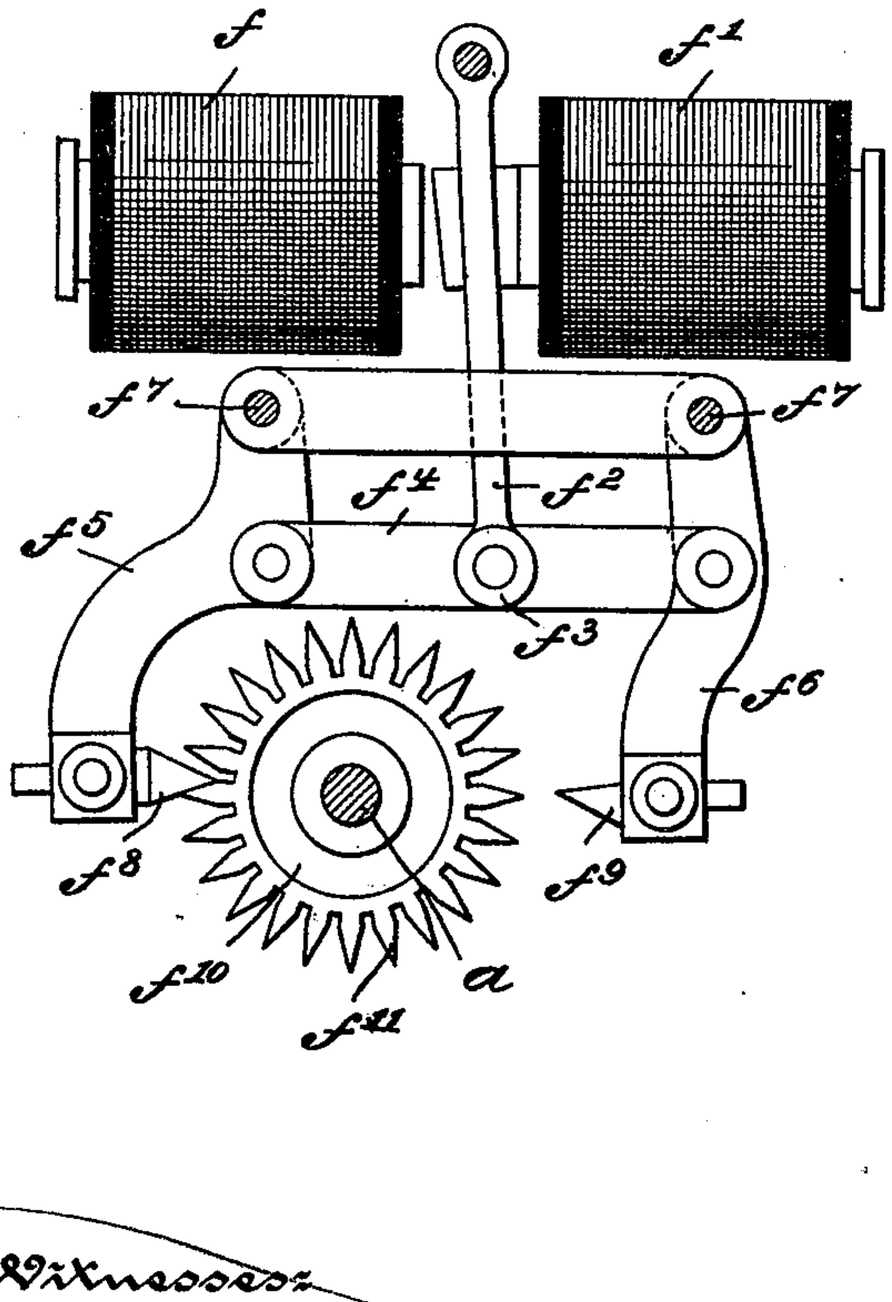


Fig. 5.

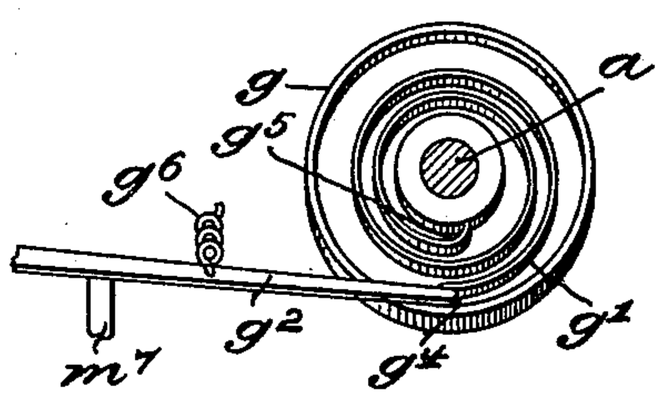
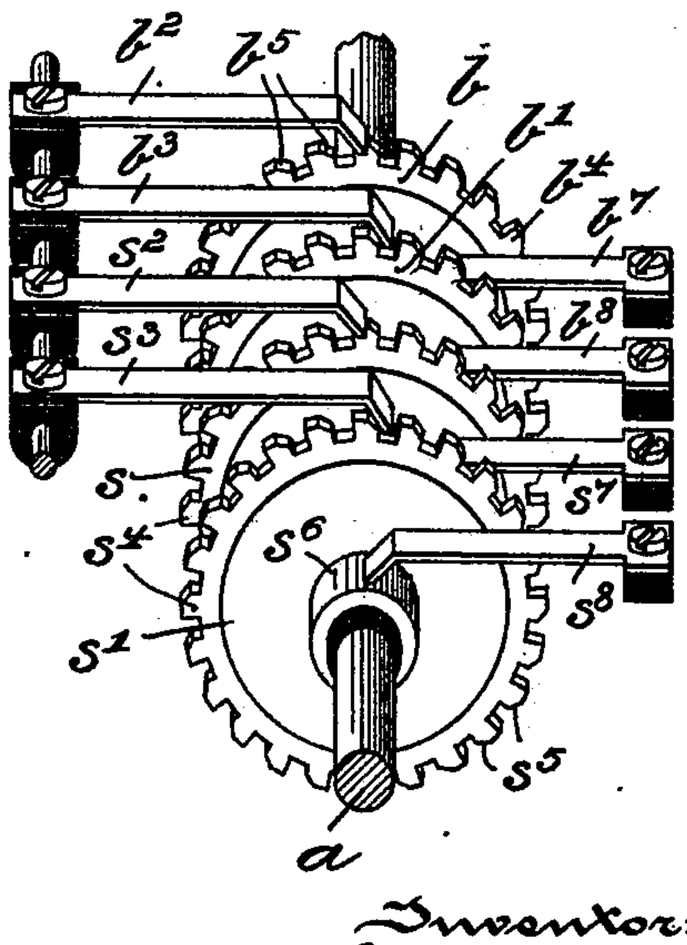


Fig. 6.



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UNITED STATES PATENT OFFICE.

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PRINTING-TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 675,380, dated June 4, 1901.

Application filed November 2, 1899. Serial No. 735,568. (No model.)

To all whom it may concern:

Be it known that I, ROBERT A. FOWDEN, a citizen of the United States, residing at the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Printing-Telegraphs, of which the following is a specification.

The principal objects of my invention are, first, to provide a printing-telegraph in which the instruments are connected by a single line and operated by alternating currents traversing the line; second, to provide means controlled by polarized relays in a single line to alternate the current sent over the line and to ground the same, whereby perfect unison or synchronism of the instruments in line is insured; third, to provide a switching device for testing the distant instruments for unison and to bring the same back to the unison position before operating the instruments in line; fourth, to provide a printing-telegraph with a double sunflower, one of the segments of each of which is in electrical connection with a single key of the keyboard of the instrument, but differently located in said sunflowers to lessen the distance of travel of contact-brushes thereover to establish a circuit in the instrument through the sunflower device; fifth, to provide in a printing-telegraph a type-wheel which is loosely mounted on a type-wheel shaft and having two rows of characters, with means for raising said type-wheel and controlled by the keys of the keyboard and one of the segments of the sunflower device, so as to bring the lower row of characters of the type-wheel into the printing position, whereby in conjunction with the double sunflower double speed in printing is insured; sixth, to provide in a printing-telegraph a special-battery circuit which passes through the single line connecting the instruments when the main line is broken to raise the printing-wheel in the receiving instrument and to bring the lower row of characters of said wheel into the printing position; seventh, to provide in a printing-telegraph an electric motor which is controlled by polarized relays arranged in the main line, which motor is adapted to operate the type-wheel shaft by means of two levers alternately engaging a star-wheel secured to the type-wheel shaft to impart to said shaft a step-by-step movement in one direction, and, eighth, to provide in a printing-telegraph a circuit closer and breaker or pole-changer and alternator or grounding device with inclined faced teeth adapted to be brought into and out of engagement with contact-springs to close and break a circuit and at the same time to alternate the current passing through the line-circuit.

My invention, stated in general terms, consists of a printing-telegraph system when constructed and arranged in substantially the manner hereinafter described and claimed.

The nature, general features, and scope of my present invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, in which—

Figure 1 is a diagrammatic view illustrating a printing-telegraph instrument embodying features of my invention arranged as a transmitter. Fig. 2 is a similar view of a printing-telegraph instrument embodying my invention and arranged as a receiver. Fig. 3 is an enlarged detail view illustrating in elevation the double sunflower device of my invention. Fig. 4 is an enlarged detail view in elevation of the electric motor and the star-wheel secured to the type-wheel shaft, said electric motor and star-wheel adapted to impart to the type-wheel shaft a step-by-step movement in one direction. Fig. 5 is a perspective view showing a unisoning device for arresting the type-wheel shaft of the respective instruments in the unison position, and Fig. 6 is a perspective view of the toothed disks adapted to change the polarities of the current traversing the main line of two or more connected instruments and to alternately ground said polarized currents.

In the drawings, a is a type-wheel shaft, preferably carried by bearings a' and a^2, to which is imparted a step-by-step movement in one direction by mechanism hereinafter more fully described. The type-wheel shaft a is provided with two pairs of toothed disks b and b' and s and s', insulated from each other and from said shaft, as illustrated in Figs. 1, 2, and 6 of the drawings. Each of said toothed

disks b and b' and s and s' is engaged by the free ends of the contact-springs b^2 and b^3 and s^2 and s^3 in such a manner that if one of each pair of the said contact-springs—for instance, the contact-springs b^2 and s^2—are in engagement with the teeth b^4 and s^4 of the disks b and s the other contact-springs b^3 and s^3 will at the same time at their free ends occupy a position in a space between two teeth of the toothed disks b' and s' and will be held out of contact with said disks b' and s', as well as the teeth thereof, as fully illustrated in Fig. 6 of the drawings. The disks b and b' and s' and s^2 are furthermore provided with collars b^6 and s^6, engaged by the contact-springs b^7 and b^8 and s^7 and s^8. The step-by-step movement imparted to the shaft a, and thereby to the toothed disks b and b' and s and s', will cause one of the contact-springs b^2 and b^3 and one of the contact-springs s^2 and s^3 to engage a tooth of one of their respective disks, whereas at the same time, as described, the other contact-spring will occupy a space between two teeth of the other disks. If, therefore, the disks b and b' act as electrical conductors, a current passing through the same will be closed by one of the disks and at the same time broken through the other disk, whereas one of the disks s and s' will always establish a connection to ground. In order to insure the perfect breaking of the current in the one instance, the teeth b^4 of the disks b and b' and s and s' are provided at one side with beveled faces b^5 and s^5, so that the teeth at this beveled portion are reliably held out of contact with their respective contact-springs. The air surrounding the end of the contact-springs in a space between two teeth has proved to be a more perfect insulator than insulating material, such as hard rubber, hitherto employed. This is due to the fact that through the rapid rotation of a disk provided with insulating-segments the same becomes in a comparatively short time carbonized about the surface engaged by a contact spring or brush and forms in this carbonized condition a conductor which seriously interferes with the proper operation of a printing-telegraph. This obstacle throwing the printing-telegraph into disorder has been fully overcome by the contact-disks above described. In the present instance the contact-springs b^8 and s^7 by the conductors 3 and 1 are connected with the positive pole or terminal P of a source of electric energy, and the contact-springs b^7 and s^8 are connected by the conductors 45 and 2 with the negative pole or terminal N of the source of electric energy, whereas the contact-springs b^2 and b^3 and the disks b and b' are connected with each other by conductors 2 and 4, and with the armature-lever c' of an electromagnet c, and the contact-springs s^2 and s^3, contacting with the disks s and s', are connected by the conductors 40 and 41 with the ground or earth. The purpose of such connections will be hereinafter fully described. The armature-lever c' by means of a spring c^2 is held in contact with a contact-piece c^3, which by a conductor 5 is connected with the coils of a polarized relay d, which coils by a conductor 6 are connected with the coils of an electromagnet e by means of contact-bolts e^7 and e^8, the armature-lever e', and conductors 50 and 51 of the transmitter, as illustrated in Fig. 1. This transmitter by a conductor 7 is connected with an electromagnet e of a receiver, as illustrated in Fig. 2 of the drawings, in which the conductors 51 and 50, bolts e^8 and e^7, and the armature-lever e', as well as conductors 6 and 5, connect the same with the coils of a similar relay d, and the armature-lever c' of the electromagnet c, which by the conductors 4 and 2 is in electric connection with the contact-springs b^2 and b^3 of the receiver and through the contact-springs b^7 and s^8, contact-springs s^7 and b^8, and conductors 3 and 1 in electric connection with the positive and negative poles of the source of energy of the receiver and by the contact-springs s^2 and s^3 and conductors 40 and 41 is connected to ground or earth at the receiver. Should, therefore, the contact-springs b^2 and s^2 of the transmitter, as illustrated in Fig. 1, be in contact with a tooth of the contact-disks b and s thereof, an electric current from ground or earth at the transmitter will flow through the conductors 40 and 41 to the contact-spring s^2, contact-disk s, contact-spring s^7, conductor 1 to the positive pole or terminal P, from thence to the negative pole or terminal N, conductors 2 and 45, contact-spring b^7, contact-disk b^6, toothed disk b, contact-spring b^2, and conductor 4 to the armature-lever c' of the electromagnet c, contact-piece c^3, conductor 5, coils of the polarized relay d, conductor 6, contact-bolts e^7 and e^8, armature-lever e', and conductors 50 and 51 to the coils of the electromagnet e, acting as an energizer for a printing-magnet, and from thence through a conductor 7 to the receiver, as illustrated in Fig. 2, in which the current will travel through the same conductors in reverse direction to a contact-spring b^2, disk b, collar b^6, contact-spring b^7, conductors 45 and 2 to the positive pole or terminal P, from thence to the negative pole or terminal N of the source of electric energy of the receiver, and by conductor 1, contact-spring s^7, collar s^6, disk s, contact-spring s^2, and conductors 40 and 41 to ground or earth. The forward movement of the type-wheel shaft a of the transmitter will cause the breaking of the circuit through the contact-disks b and s of the same and to close at the same time the circuit through the contact-disks b' and s'. The circuit so closed will now flow in an opposite direction from ground or earth of the receiver to ground or earth of the transmitter. The polarities of the current through the rotation of the toothed disks b and b' will in the described manner be alternately changed, and the disks producing said alternation in the current from the transmitter and receiver and from the same back to the

transmitter will be hereinafter called the "pole-changers," whereas the disks *s* and *s'* will be called the "alternator" or "grounding device." The circuit connecting the transmitter with the receiver in the above-described manner will hereinafter be termed the "main-line circuit," in which are included the polarized relays *d* and the electromagnets *e*, controlling the printing-magnets, hereinafter more fully described. This circuit is controlled by the armature-lever *c'* of the electromagnets *c*, which when energized will attract its lever *c'* and will break said main-line circuit, to be presently fully explained. The electromagnet *c*, for the sake of clearness, will hereinafter be termed the "interrupting-magnet."

The alternation in the main-line circuit produced by the pole-changers *b* and *b'* and alternators or grounding devices *s* and *s'* in passing through the coils of the polarized relays *d* of the transmitter and receiver will vibrate the armature-levers *d'* thereof and will bring the same alternately into contact with the contact-pieces d^2 and d^3. These contact-pieces by conductors 8 and 9 are connected with the coils of the electromagnets *f* and *f'*, which by means of a conductor 10 are connected with the negative terminal N of the transmitter and with the positive terminal P of the receiver, whereas the positive pole or terminal P at the transmitter and the negative pole or terminal N at the receiver are connected by a conductor 11 with the armature-lever *d'* of the polarized relay *d*, establishing a local circuit in the transmitter and receiver. If, for instance, the armature-lever *d'* is in contact with the contact-piece d^2, as illustrated in Figs. 1 and 2, the current will pass from the positive pole or terminal P of the transmitter and from the negative pole N of the receiver through the conductor 11, armature-lever *d'*, contact-piece d^2, conductor 8 to the coils of the electromagnet *f'*, and from the same through a conductor 10 to the negative pole or terminal N at the transmitter and positive pole or terminal P at the receiver. If the armature-lever *d'* through the reversed flow of the main-line circuit is brought into contact with the contact-piece d^3, the current passes from the positive terminals P of the transmitter and negative pole N of the receiver through the conductors 11 and 9, coils of the electromagnet *f*, and conductor 10 to the negative pole or terminal N of the transmitter and positive pole or terminal P of the receiver. The local circuit passing through the coils of the electromagnets *f* and *f'* is therefore alternated continuously, which alternation of the current is dependent upon the alternation of the current in the main-line circuit. The armature-lever f^2 of the electromagnets *f* and *f'* swings, therefore, backward and forward in perfect synchronism with the armature-lever *d'* of the polarized relay *d* in the main-line circuit. This armature-lever f^2 at its free end f^3 is provided with a connecting-link f^4, connecting arms f^5 and f^6, which are fulcrumed at the point f^7. The arms f^5 and f^6 are provided with wedge-shaped projections f^8 and f^9, between which a star-wheel f^{10} is arranged, rigidly secured to the type-wheel shaft *a* of the transmitter and receiver, as fully illustrated in Fig. 4 of the drawings. Through the vibration of the armature-lever f^2 the wedge-shaped projections of the arms f^8 and f^9 are brought into engagement with the wedge-shaped teeth f^{11} of the star-wheel f^{10}, which impart to the same by engaging the inclined sides of the teeth of the star-wheel alternately from opposite sides thereof a uniform step-by-step movement in one direction, which movement of the type-wheel shaft will naturally be in perfect unison or synchronism with the impulses of the alternating current passing through the main line. Should, therefore, through any cause whatsoever, the pole-changer of the receiving instrument be one tooth ahead or behind the pole-changer of the transmitter, this would result in like polarities being sent through the main line without operating the polarized relays. The instrument in line would in this instance come to a complete standstill, indicating to the operator that unison must be established before the instrument will operate. The controlling of the local motor-circuits and electric motors imparting to the type-wheel shaft the step-by-step movement by the alternating current traversing the main line insures absolute unison of all the instruments in said line, which instruments may be connected with a central station of any of the known types and will automatically cease to operate if any of them in line are thrown out of the unison position. However, instruments which accidentally or otherwise are thrown out of unison position can be brought back into such position by a double switch *n*, the arrangement and operation of which will be hereinafter fully explained.

To the type-wheel shaft *a* of the transmitter and receiver is secured a unison device *g* of the usual construction. The spiral groove *g'* thereof allows a double revolution of the shaft by the electric motor, hereinbefore described, before the same is brought to a standstill by a lever or unison-latch g^2 coming into engagement with the end g^4 of the groove *g'*, as fully illustrated in Fig. 5 of the drawings. This unison-latch g^2 arresting the rotation of the type-wheel shaft after completion of two revolutions will hold the same in the unison position until released by a special space-key *h* engaging the free end of the unison-latch g^2. By depressing said end the unison-latch is lifted and released from engagement with the end g^4 of the spiral groove *g'* and by the intervention of a spring g^6 is immediately brought back into engagement with the spiral groove *g'* at the starting-point g^5 thereof, thus allowing the rotation of the shaft by the electric motor, as hereinbefore described. The

unison-latch g^2 of the unison device g is also released by the armature-lever of an electromagnet m operating a printing-hammer m^4, as hereinafter explained. To the type-wheel shaft a is secured and slidable in a longitudinal direction a type-wheel i, provided with two superposed rows of characters. (Not shown.) The upper rows of characters are held opposite a printing-hammer, while the lower row is raised to a position opposite said hammer. For this purpose the type-wheel is provided with a grooved collar i', engaged by the forked end i^3 of an armature-lever i^2, the electric magnet of which is energized by a special sunflower. This sunflower device k consists of two sunflowers properly insulated from each other, but in conducting connection with each single key l' of the keyboard l of the transmitting and receiving instruments. The inner sunflower k' is provided with a conducting-annulus k^2 and an annulus composed of insulated segments k^3, which are in contact with contact springs or brushes k^4 and k^5, carried by a bracket k^6, insulated from a rod k^7, secured to the type-wheel shaft a. The outer sunflower k^8 consists of a similar conducting-annulus k^9, an annulus composed of insulated segments k^{10}, and contact-springs k^{11} and k^{12}, carried by a bracket k^{13}, insulated from the rod k^7, as fully illustrated in Figs. 1, 2, and 3 of the drawings. As hereinbefore described, one of each segment k^3 and k^{10} of the double sunflowers k' and k^9 is connected with a single key l' of the keyboard l, but in the present instance thirteen points apart, which number of segments can be changed *ad libitum*. It will therefore be readily understood that by sweeping the contact-brushes k^5 and k^{12} over the segments k^3 and k^{10} of the sunflower by the rotation of the type-wheel shaft a one of the contact-springs will be brought into contact with a segment connected with a certain key in advance of the other contact-spring reaching the segment connected with the same key of the keyboard l. It follows, therefore, that by shortening the travel of the contact-brushes over the segments k^3 and k^{10} double speed in printing is obtained without in any way increasing the speed of rotation of the type-wheel shaft a. If one of the keys l' of the keyboard l is depressed at the transmitter, a local circuit will be closed, starting from the negative pole or terminal N at the transmitter, by the conductors 12 and 13 to the base of the keyboard l, thence through the key depressed and the conductors 14, 15, and 16 if the brush k^{12} on the outer segments k^{10} of the sunflower k^8 contacts first, and through the conductor 17 instead of the conductor 16 if the brush k^5 on the segments k^3 of the inner sunflower k' contacts first. The current flowing through the conductor 16 is continued through the segment k^{10} connected with the depressed key l', contact-brush k^{12}, bracket k^{13}, contact-brush k^{11}, conducting-annulus k^9, and through a conductor 18 to the coils of the type-wheel-lifting magnet i^3, thence through the conductor 19 to the coils of the main-line-interrupting magnet c, and thence through the conductor 20 to the positive pole or terminal P of the source of electric energy. If the current flows through the conductor 17, it will pass through the segment k^3 connected with the key depressed, contact-brush k^5, bracket k^6, contact-brush k^4, annulus k^2 of the inner sunflower k', and thence through the conductor 21 to the coils of the main-line-interrupting magnet c, and from thence through a conductor 20 to the positive terminal P of the source of electric energy. The local circuit so closed through the inner and outer sunflower device k will always energize the line-interrupting magnet c, which by attracting its armature-lever c' against the tension of the spring c^2 will carry the same out of contact with the contact-block c^3 and will interrupt the main line at the transmitter, stopping thereby the rotation of all the instruments in line by demagnetizing the polarized relays d and electromagnets f and f', forming part of the electric motor, operating the type-wheel shafts a at the transmitter and receiver and will bring the character of the type-wheel similar to the character carried by the key depressed into the printing position opposite the printing-hammer m^4. As hereinbefore explained, the type-wheel i will be raised and the lower row of characters brought into the printing position if the current passes through the outer sunflower k^8 first, in which instance the local circuit is closed through the coils of the wheel-lifting magnet i^3, which by attracting its armature-lever i^2 raises the type-wheel i and brings the character carried by the key depressed, arranged in the lower row of characters of the type-wheel i, into the printing position. The breaking of the main-line circuit by the line-interrupting magnet c demagnetizes the electromagnets e, which energizes the printing-magnet m, allowing the armature-lever e' thereof to be brought into contact with a contact-screw e^4 by the intervention of the springs e^5, which close a local printing-circuit at the transmitter and also at the receiver. This local printing-circuit, closed by the deënergized magnet e, passes in the transmitter from the positive terminal P and in the receiver from the negative terminal N through the conductor 22, the arm n' of the switch n, adapted to bring the instruments, if out of unison, back to the unison position, thence through the conductor 23, armature-lever e', contact-screw e^4, conductor 24, to the coils of the printing-magnet m, and from thence through a conductor 25 to the negative terminal N of the transmitter and to the positive terminal P of the receiver, completing the circuit. The printing-magnet m, energized by the so-called "local circuit," will attract its armature-lever m', which by means of a rod m^2 actuates a lever m^3, which in turn operates the printing-

hammer m^4. The printing-hammer makes an impression (not shown) from the character of the type-wheel i held in the printing position in a well-understood manner. The armature-lever m' operating the printing-hammer m^4 also releases the unison-latch g^2 by means of a rod m^5, lever m^6, and arm m^7, which latch g^2 by the intervention of the spring g^4 will always be brought into engagement with the point g^5 of the spiral groove g' of the unison device g. It follows, therefore, that as long as keys are depressed the type-wheel shaft a will not be arrested by the unison-latch g^2. By releasing the key l' depressed the instrument proceeds as before until another key is depressed or the unison position is reached. In case the instruments are arrested in their rotation by the unison-latch g^2 the space-key h must be depressed to release the unison-latch g^2 before any of the character-keys l' can be depressed. If the instruments are arrested in the unison position by the unison device g in the above-described manner, the same will arrest the type-wheel shaft a at the completion of only half the stroke of the electric motor f and f'. Assuming that at this position the contact-spring b^2 of the pole-changer b is in contact with the disk b' while the instruments occupy the unison position the operation of starting all instruments in line is as follows: By depressing the unison or space key h at the transmitter the transmitting instrument now completes its full stroke, which turns the disk b', and causes the contact-spring b^2 to be released from contact with a tooth of the said disk. At the same time by the movement of the type-wheel shaft a the disk b' will be brought into contact with the contact-spring b^3, thus giving like polarities over the line, as the receiving instrument has not yet moved. As soon as like polarities are thrown over the line the main-line circuit is opened, deënergizing the magnets e in all instruments, which magnets now close a local circuit through the printing-magnet m. The printing-magnet will now release the unison-latch g^2 of the receiving instrument or instruments. As soon as the unison-latch is released the receiving instrument completes its stroke, which causes the same to be brought into exactly the same or unison position with the transmitting instrument, which latter restores the line to its normal condition, and the instruments proceed as hereinbefore explained.

In order to lift the type-wheel at the receiving instrument when the type-wheel is lifted at the transmitter, there is employed a special-battery circuit, which passes over the main line when the same is broken and passes at the receiver through the coils of a special relay r, which by a switch o is cut out of the special-battery circuit in the transmitting instrument. By energizing the wheel-lifting magnet i^3 at the transmitter and attracting its armature-lever i^2 this special-battery circuit is closed by a contact-arm i^5, secured to the armature-lever i^2, and brought into contact with a contact-block i^4. The current flows from earth at the transmitter to a special battery p, conductor 26, through the contact-block i^4, from thence to the contact-arm i^5, secured to the armature-lever i^2, thence through the conductor 27, contact-point o', contact-switch o, conductor 28, contact-screw e^9, contact-block e^{11} of the armature-lever e', occupying the position indicated in dotted lines, contact-screw e^{10}, conductors 52 and 51, through the coils of the electromagnet e, and from thence to the main line 7, to the receiving instrument, as illustrated in Fig. 1, and passes thence in opposite directions through the main-line conductor 7, coils of the electromagnet e, conductors 51 and 52, contact-screw e^{10}, contact-block e^{11}, contact-screw e^9, conductor 28, contact-switch o, contact-point o^2, and conductor 30, through the coils of the special relay r, and from thence through conductors 29 and 26 to the special battery p, and passes from the same to earth at the receiving instrument, completing said special-battery circuit. Although, as illustrated in Figs. 1 and 2, this special-battery circuit in passing through the coils of the electromagnet e is too weak to energize said magnet for this reason, although tapping the main line at the transmitter and receiver beyond the polarized relays d in the main line, the special-battery circuit prevents a possible magnetization of said relay d. Through the energizing of the special relay r at the receiving instrument by the special-battery circuit the armature-lever r' is brought under the tension of its spring r^5 into contact with a contact-screw r^3, carried by an arm r^2, which closes a local circuit at the receiver through the coils of the wheel-lifting magnet i^3 in the following manner: From the positive terminal P the current flows through the conductor 12 to the armature-lever r' of the special relay r, and from thence through the contact-screw r^3, conductor 31, coils of the wheel-lifting magnet i^3, and conductor 19, through the coils of the main-line-interrupting magnet c, and from thence by a conductor 20 to the negative terminal N of the receiver. The type-wheel i of the receiver will by the magnetization of the wheel-lifting magnet i^3 be raised and a character of the lower row of characters brought into the printing position, as hereinbefore described. When the operator at the transmitter releases the key depressed, the type-wheel i at the same time drops immediately into its normal position, breaking thereby the special-battery circuit, which instantly causes the armature-lever r' of the special relay r at the receiver to fall back, breaking thereby the local circuit through the wheel-lifting magnet i^3 of the receiver, and the instruments then proceed as before.

The double contact-switch n is employed to bring the distant instruments back to the

unison position, one arm n' of which switch is in the local printing-circuit and controlled by the electromagnet e in the main-line alternating circuit. This circuit is closed as follows: The current flows from the positive terminal or pole P at the transmitter through the conductor 22 to the switch-arm n' of the double switch n, thence through the conductor 23, armature-lever e', contact-screw e^4, conductor 24, to the coils of the printing-electromagnet m, and through the conductor 25 to the negative terminal N of the transmitter. The other arm n^2 of the double switch n is connected from the negative terminal feeding the lower pole-changer b and lower alternator s' at the transmitter to the main line, but outside of the polarized relay d, in the following manner: from the terminal N at the transmitter through the conductor 33 to the contact-arm n^2, and if the same is brought in contact with the contact-point n^3 through the same and the conductor 32 to the main-line conductor 6 to the coils of the magnet e, and through the main-line conductor 7 to the receiver of Fig. 2.

The operation for bringing the distant instrument back to unison or for testing to determine whether occupying unison position is effected as follows: The double switch n is first placed in a central position on the transmitter, which throws all switch-points out of contact, as will be readily understood from Fig. 1 of the drawings. This shifting of the switch cuts out the printing-magnet m at the transmitter, making it impossible to release the unison-latch g^2 at the same, with the double switch n in this position. The transmitter will now run until the unison-latch g^2 engages the end g^4 of the spiral groove g' of the unison device g and will then stop. The switch n is then shifted into a position in which the switch-arm n^2 is in contact with the contact-point n^3, which point is connected by the conductor 32 with the main-line conductor 6, cutting out the polarized relay d at the transmitter. This will cause the receiver to operate independent of the transmitter, for the reason that the transmitter is held at the unison position, with the upper circuit-breaker or pole-changer b in contact with its brush b^2. The switch n will therefore be coupled to the lower pole-changer brush b^3 at the transmitter, thus keeping both polarities closed at the transmitting ends until the unison position is reached at the receiver, when the same stops. The switch at the transmitter is now shifted to the normal position illustrated in Fig. 1, and the machines are ready for operation.

Having thus described the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a printing-telegraph system, printing instruments included in a single line, driving and printing mechanisms for each instrument, a single source of electric energy for each printing instrument and adapted to operate both the driving and printing mechanisms of said instrument, an alternating current traversing said line and derived from said single source of energy, a single polarized relay arranged in said line at each printing instrument and actuated by said alternating current, substantially as and for the purposes described.

2. In a printing-telegraph system, printing instruments included in a single line, driving and printing mechanisms for each instrument, a single source of electric energy for each printing instrument and adapted to operate both driving and printing mechanisms of said printing instrument, an alternating current traversing said line and derived from said single source of electric energy, a polarized relay in said line arranged at each printing instrument, a type-wheel shaft forming part of the driving mechanism for said printing instrument and controlled by said polarized relay, and means connected with said shaft and adapted to alternate the current sent over said line, substantially as and for the purposes described.

3. In a printing-telegraph system, a single line in which the printing instruments are included, a single source of electric energy controlling both the printing and driving mechanisms of each printing instrument, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, a type-wheel shaft forming part of the driving mechanism of each instrument and an electric motor included in a local circuit controlled by said polarized relays and positively driving and controlling said type-wheel shaft, substantially as and for the purposes described.

4. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, a motor included in a local circuit and controlled by said polarized relays, a type-wheel shaft, a double sunflower, and a keyboard, each key whereof is connected with a segment of each row of segments of said double sunflower, substantially as and for the purposes described.

5. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and controlled by said alternating current, an electric motor controlled by said polarized relays and actuating a type-wheel shaft, a type-wheel having double rows of characters, a double sunflower, a keyboard, each key whereof is connected with a segment of each row of segments of said double sunflower, a type-wheel magnet in electric connection with one of the sunflowers and said keyboard adapted to raise said type-wheel on said type-wheel shaft, substantially as and for the purposes described.

6. In a printing-telegraph system, a transmitter and a receiver connected by a single

line and positively operated by motors, local circuits controlled by polarized relays and actuating said motors, said relays actuated by a current alternately passing in opposite directions through said line, a double sunflower, a magnet controlled by said sunflower, a single wheel with multiple characters controlled by said magnet and a special-battery circuit connected with said single line and adapted to pass through said single line when said alternating current is broken and said wheel is actuated by said magnet, substantially as and for the purposes described.

7. In a printing-telegraph system, a transmitter and a receiver connected by a single line and operated by motors and local circuits controlled by polarized relays, said relays actuated by an alternating current passing over said line, a special-battery circuit connected with said single line, type-wheel-raising magnets controlling said special-battery circuit at the transmitter, and special relays included in said special-battery circuit adapted to control the type-wheel-raising magnet at the receiver, substantially as and for the purposes described.

8. In a printing-telegraph system, a transmitter and a receiver included in a single line, a single source of electric energy for each transmitter and receiver, polarized relays included in said single line and actuated by an alternating current passing over said line and derived from said single source of electric energy, an energizing-magnet included in said single line and controlling a local circuit, printing-magnets included in said local circuit and adapted to be energized when said alternating current is broken, a special-battery circuit connected with said single line outside of said polarized relays, a type-wheel-raising magnet, and an energizing-magnet for the printing-magnets adapted to control the type-wheel-raising magnet of the receiver, substantially as and for the purposes described.

9. In a printing-telegraph system, a transmitter and a receiver connected in a single line and actuated by an alternating current passing over said line, polarized relays, energizing-magnets included in said line, said energizing-magnets adapted to close a local printing-circuit at the transmitter and receiver, and a double switch, one arm whereof is located in said local printing-circuit and adapted to close and break said circuit and the other arm thereof is adapted to shunt the main line beyond the polarized relay of the transmitter so as to actuate the receiver independent of the transmitter, when said local printing-circuit at the transmitter is broken, substantially as and for the purposes described.

10. In a printing-telegraph system, a single line, printing instruments included in said line and provided with driving and printing mechanisms, a single source of electric energy controlling both the printing and driving mechanism for each printing instrument, an alternating current traversing said line and derived from said single source of electric energy, a polarized relay included in said line at each instrument and actuated by said alternating current, an electric motor included in a local circuit controlled by said relay, a type-wheel shaft forming part of the driving mechanism of said printing instrument and a star-wheel secured to said shaft and adapted to be engaged by said electric motor to positively rotate and control said type-wheel shaft, substantially as and for the purposes described.

11. In a printing-telegraph system, a single line, printing instruments included in said line provided with driving and printing mechanisms, a single source of electric energy controlling both the printing and driving mechanisms of each printing instrument, an alternating current traversing said line and derived from said single source of electric energy, a polarized relay included in said line at each instrument and actuated by said alternating current, an electric motor included in a local circuit controlled by said relay, a type-wheel shaft forming part of the driving mechanism of said printing instrument, a star-wheel and arms operated by said motor adapted to engage alternately said star-wheel to impart a step-by-step movement to said shaft, substantially as and for the purposes described.

12. In a printing-telegraph system, a single line, printing instruments included in said line provided with driving and printing mechanisms, a single source of electric energy controlling both the driving and printing mechanisms of each printing instrument, an alternating current traversing said line and derived from said single source of electric energy, a polarized relay included in said line at each instrument and actuated by said alternating current, printing-magnets, a local circuit closed by said polarized relay, and an energizing-magnet included in said single line and adapted to break a local circuit through said printing-magnets, substantially as and for the purposes described.

13. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, a type-wheel shaft, a double-sunflower device, a keyboard, the keys whereof are connected with said sunflower device and adapted to close a local circuit through said device, and a magnet adapted to break said alternating current traversing said single line, substantially as and for the purposes described.

14. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, a type-wheel shaft indirectly controlled by said polarized relays, double sunflowers, a keyboard, the keys whereof are in electrical connection

with each of said double sunflowers, a local circuit closed by said keys through each of said sunflowers and through an electromagnet breaking said single-line alternating circuit and demagnetizing said polarized relays and an electromagnet which closes a local printing-circuit of both a transmitter and a receiver, substantially as and for the purposes described.

15. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, a type-wheel shaft indirectly controlled by said polarized relays, double sunflowers, the segments of which are connected with the keys of a keyboard, and a local circuit closed by a key through one of the sunflowers, the type-wheel-raising magnet and line-interrupting magnet, substantially as and for the purposes described.

16. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, a type-wheel shaft indirectly controlled by said polarized relays, and double sunflowers, whereof one of the segments of each of said sunflowers is connected in advance of the other with a key of a keyboard, whereby double speed in printing is obtained without increasing the speed of said type-wheel shaft, substantially as and for the purposes described.

17. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, a type-wheel shaft, an electric motor controlled by said relays and actuating said shaft, brushes carried by said shaft, double sunflowers, whereof one of the segments of each of said sunflowers is connected in advance of the other with a key of a keyboard, a type-wheel provided with two rows of characters, a local circuit closed by the keys of said keyboard through one of said sunflowers, and a type-wheel-raising magnet to bring the lower row of characters of said type-wheel into the printing position, substantially as and for the purposes described.

18. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, an electric motor included in a local circuit controlled by said relays, a type-wheel shaft, brushes carried by said shaft, double sunflowers, each of which is connected with the keys of a keyboard, a local circuit closed by said keys through one of said sunflowers and a type-wheel-raising magnet, said magnet closing a special-battery circuit, a special relay included in said special-battery circuit and adapted to close a local circuit at a receiving instrument to energize the wheel-raising magnet of said instrument, substantially as and for the purposes described.

19. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, an electric motor actuated by said polarized relays, a type-wheel shaft, brushes carried by said shaft, double sunflowers in electrical connection with the keys of a keyboard, a local circuit closed by said keys, a type-wheel-raising magnet and a line-interrupting magnet included in said local circuit, said line-interrupting magnet breaking the single alternating-current circuit and said type-wheel-raising magnet adapted to raise said type-wheel at the transmitter to close a special-battery circuit, and a special relay included in said circuit and adapted to be energized by said special-battery circuit at a receiver to close a local circuit at said receiver and thereby to energize a type-wheel-lifting magnet of said receiver, substantially as and for the purposes described.

20. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, an electric motor included in a local circuit controlled by said relays, a type-wheel shaft, brushes carried by said shaft, double sunflowers, each of which is connected with the keys of a keyboard, a printing-magnet, a printing-hammer, and a local circuit closed through both of said sunflowers and said printing-magnet, said printing-magnet operating said hammer and releasing the unison-latch of a unison device, substantially as and for the purposes described.

21. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, a type-wheel shaft controlled by said polarized relays, toothed disks mounted on said shaft and adapted to permit of the change of polarity and reversing of the grounds simultaneously of said single-line alternating-current circuit at a transmitter and receiver, and spring-contacts adapted to engage said teeth, substantially as and for the purposes described.

22. In a printing-telegraph system, a single line, relays included in said line, a shaft, disks mounted on said shaft and provided with inclined teeth adapted to permit of the change of polarity and for reversing the grounds at transmitter and receiver simultaneously of said line, and spring-contacts adapted to engage spaces between teeth of said disks at certain intervals and to contact with the upper surfaces of said teeth at certain other intervals, substantially as and for the purposes described.

23. In a printing-telegraph system, printing instruments included in a single line, driving and printing mechanisms for each instrument, a single source of electric energy for each printing instrument and adapted to op-

erate both driving and printing mechanisms of said printing instrument, an alternating current traversing said line and derived from said single source of electric energy, a polarized relay in said line arranged at each printing instrument, a type-wheel shaft forming part of the driving mechanism for said printing instrument and controlled by said polarized relay and a combined alternating pole-changer and grounding device adapted to alternate and ground the current sent over said line, substantially as and for the purposes described.

24. In a printing-telegraph system, a single line, an alternating current traversing said line, polarized relays included in said line and actuated by said alternating current, an electric motor actuated by said polarized relays, a type-wheel shaft, brushes carried by said shaft, double sunflowers in electrical connection with the keys of a keyboard, a local circuit closed by said keys, a type-wheel-raising magnet and a line-interrupting magnet included in said local circuit, said line-interrupting magnet breaking the single alternating-current circuit and said type-wheel-raising magnet adapted to raise said type-wheel at the transmitter to close a special-battery circuit, and a special relay included in said circuit and adapted to be energized by said special-battery circuit at a receiver controlled by the armature-lever of an electromagnet at transmitter to close a local circuit at said receiver and thereby to energize the type-wheel-lifting magnet of said receiver, substantially as and for the purposes described.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

ROBERT A. FOWDEN.

Witnesses:
J. WALTER DOUGLASS,
RICHARD C. MAXWELL.