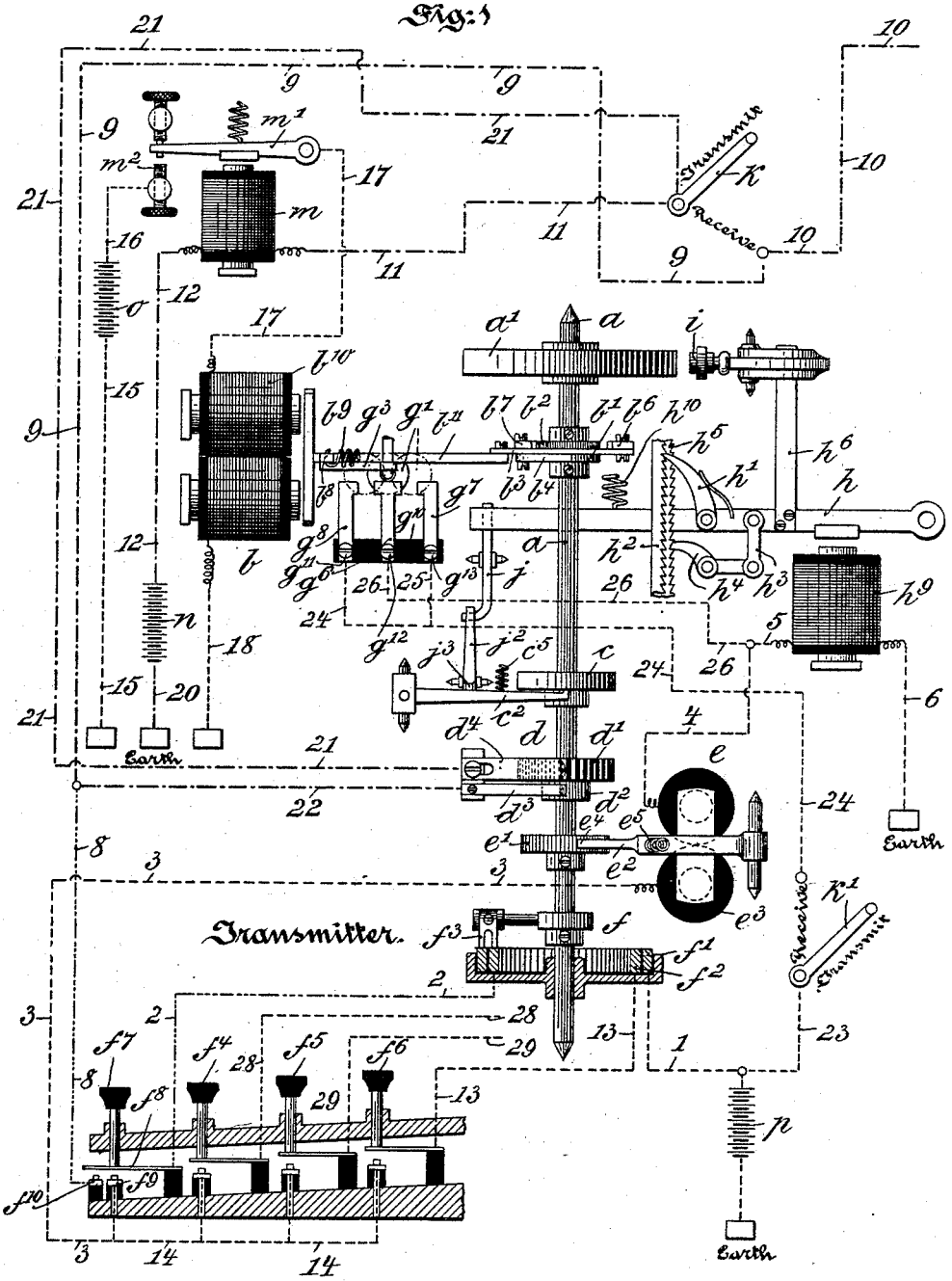
(No.Model.) 3 Sheets—Sheet 1.

R. A. FOWDEN.

PRINTING TELEGRAPH.

No. 524,711. Patented Aug. 21, 1894.

Fig: 1



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(No Model.) 3 Sheets—Sheet 2.

R. A. FOWDEN.

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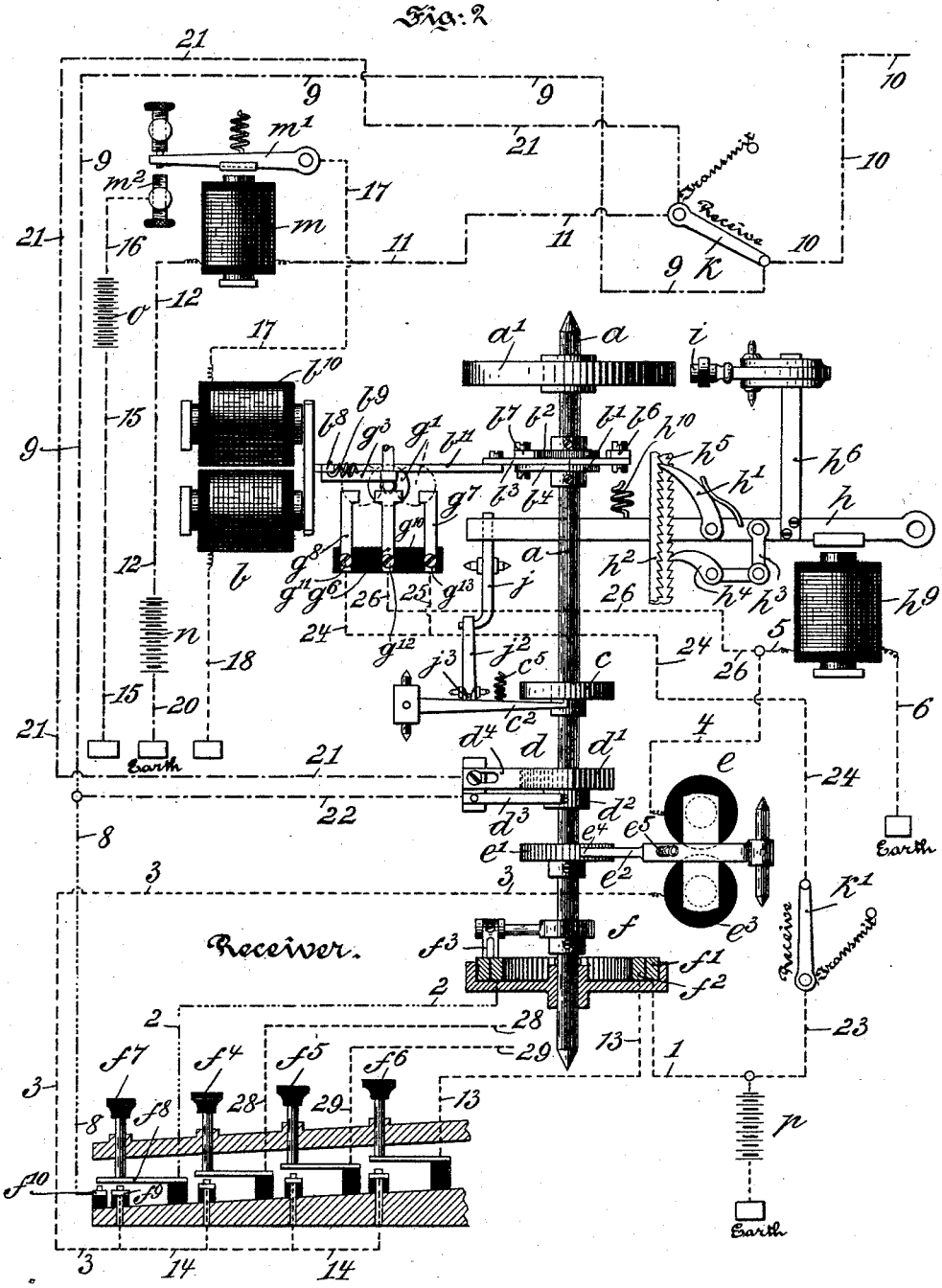
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

R. A. FOWDEN.

PRINTING TELEGRAPH.

No. 524,711. Patented Aug. 21, 1894.

Fig: 3.

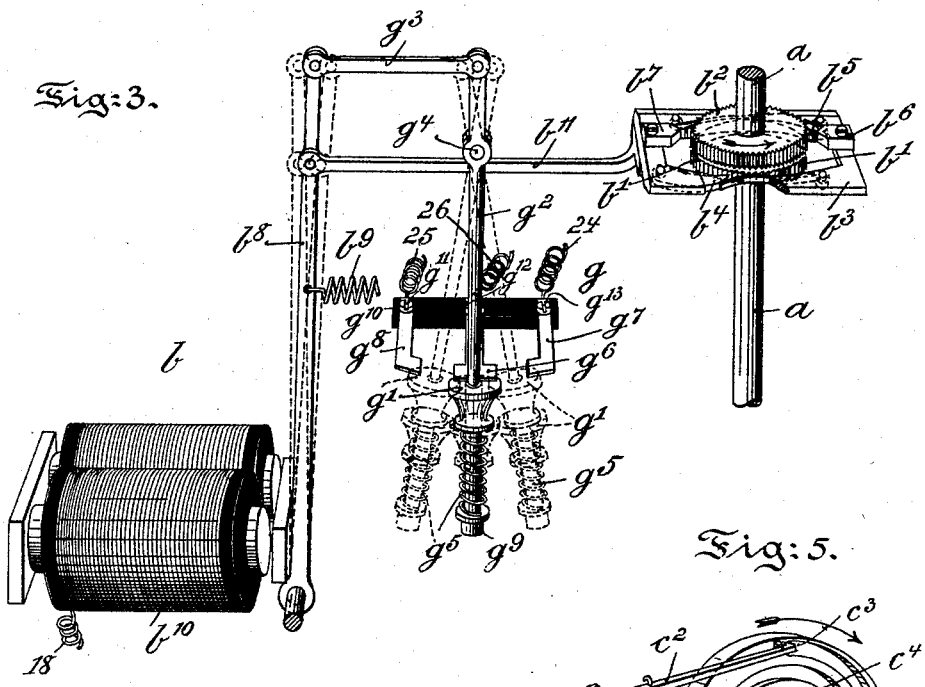
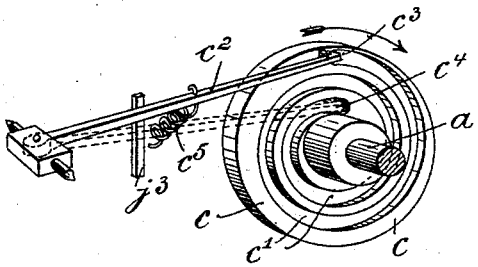


Fig: 5.



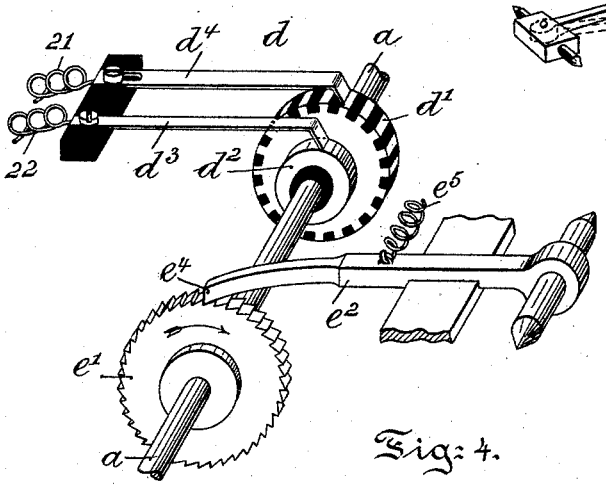
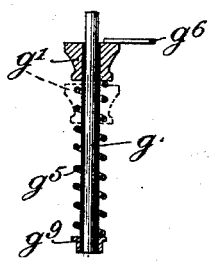


Fig: 4.

Fig: 6.



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UNITED STATES PATENT OFFICE.

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PRINTING-TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 524,711, dated August 21, 1894.

Application filed December 22, 1893. Serial No. 494,461. (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.

My invention has relation in general to a printing telegraph system for which Letters Patent of the United States No. 509,430 were granted to me under date of November 28, 1893; and it relates more particularly to certain improvements in the construction, arrangement and operation of the mechanical and electrical devices and circuits of such system.

The principal objects of my present invention are, first, to provide an efficient, reliable and inexpensive printing telegraph instrument; second, to reduce the number of parts and to simplify the general construction and arrangement of the mechanical as well as the electrical devices thereof; third, to increase the efficiency and to lessen the number of circuits and circuit connections in such a printing telegraph system; fourth, to provide compact mechanical and electrical circuit controlling devices adapted to be operated so as to increase the efficiency of a printing telegraph instrument or a series of instruments looped together in circuit and to lessen the number of circuits, electro-magnets and relays in such instrument or instruments; fifth, to insure perfect synchronism in the movement of the type-wheel shafts of the transmitting and mechanical appliances, whereby double duty is performed by them; and sixth, to construct and arrange the circuit connections of the line conductor or conductors in such manner as that accidental interruption or cutting out of the same arrests both the receiver and the transmitter, whereby the operator at each instrument is apprised of the occurrence of an accident or any want of synchronism in the movement of the instruments in circuit connected with each other.

In a printing telegraph system embodying features of my invention, use is made of instruments connected together by a single line conductor and provided with duplicate mechanical and electrical devices operated synchronously by means of two sets of local circuits and switches, whereof one set is employed for transmitting and the other in receiving and by means of two line circuits of which one is employed for releasing and starting the type-wheel shafts and the other for effecting the printing operations and both of the line circuits traversing a single line conductor. The mechanical and electrical devices at each instrument comprise a type-wheel shaft, an electric motor operated by the armature-lever of an electro-magnet and a retracting spring and adapted to revolve said shaft and to control the vibrating actions of a mechanical circuit closer and breaker, a unison latch for stopping the shaft and holding the retracting spring of the motor in tension at the unison position to permit of the subsequent starting of the instrument under the influence of the retracting spring of the motor, a circuit interrupter, that is, an automatic circuit maker and breaker adapted to break the normal line circuit through the coils of relay electro-magnets of the transmitter and receiver at the unison position, and also adapted to alternately make and break the normal line circuit at positions other than unison to operate the motors and drive the shafts, a detent, toothed wheel and locking electro-magnet for locking the shaft at the unison position and in each printing position with the circuit interrupter in a position for preventing the completion of the stroke of the motor, whereby the motor is adapted to subsequently complete its stroke and proceed in its customary manner; a sunflower device, brush, printing keys and double contact unison key; a mechanical circuit closer and breaker tending to effect an impression when the type-wheel shaft is arrested at a position other than the unison position; and a printing electro-magnet having an armature lever for effecting impressions, feeding the paper and transferring the unison latch from the outermost portion of its spiral to the innermost portion thereof.

The set of local unison circuits that is employed in connection with the unison line cir-

cuit and with said electrical and mechanical devices will now be described.

The local unison circuit at the transmitter passes from earth through a generator to the unison contact of the sunflower device, then to one set of contacts of a normally open double contact unison key, then through the coils of the locking electro-magnet and through the coils of the unison and printing electro-magnet to earth. It may be here remarked that the unison line circuit passes from earth through a generator, the unison contact of the sunflower device to the other set of contacts of the normally open double contact unison key, and then through a conductor of high resistance to line; the conductor of high resistance serving to effect a proper distribution of the current in the local and line unison circuits. From the line the unison line circuit passes through the coils of a relay electro-magnet and through a generator to earth at the receiver. The local unison circuit of the receiver passes from earth through a generator and through the armature lever of the relay electro-magnet and then through the coils of the motor electro-magnet to earth.

The set of local printing and motor circuits that is employed after the unison line circuit has been broken and in connection with the normal printing line circuit, and the above described mechanical and electrical devices will now be described.

At the transmitter the normal line circuit passes from earth through a generator and the coils of a relay electro-magnet, whose armature-lever controls and closes the local motor circuit through a generator and the coils of the motor magnet. Then the normal line circuit passes through the circuit interrupter to line, and the coils of the relay electro-magnet at the receiver and to earth through a generator. At the transmitter the local printing circuit is from earth through a generator, the sun-flower device, contacts of the character keys, and the coils of the locking, printing and unison electro-magnets, to earth. At the receiver the local motor circuit is controlled by the armature-lever of the relay electro-magnet and is closed through the motor electro-magnet; and the local printing circuit passes from earth through a generator and the contacts of a mechanical circuit closer and breaker and then through the coils of the printing and unison electro-magnet, to earth.

Assuming that the instruments are in the unison position, the operation of starting the instruments and of printing are as follows:—The double contact unison key is depressed at the transmitter, thus closing the local unison circuit through the coils of the locking electro-magnet and coils of the printing and unison electro-magnet, whereby the unison latch is released and the printing pallet is caused to contact with a blank space on the type-wheel, the paper fed forward and the locking bar or detent brought into a position for locking the shaft. The depression of the unison key also closes the unison line circuit, thereby energizing the relay electro-magnet at the receiver. The relay electro-magnet at the receiver being thus energized attracts its armature and closes the local unison circuit through the coils of the motor electro-magnet and by means of the mechanical circuit closer and breaker through the coils of the printing and unison electro-magnet, whereby the unison latch at the receiver is released and the shaft is locked by the locking-bar or detent as at the transmitter, so that both shafts are locked in position for holding the retracting springs of their motors in unison. The unison key at the transmitter is then released, thereby breaking the local unison circuit through the coils of the locking electro-magnet and through the coils of the printing and unison electro-magnet of the transmitter and also breaking the unison line circuit, so that the relay at the receiver is demagnetized and its armature-lever falls back and breaks the local unison circuit through the coils of the locking electro-magnet and through the coils of the printing and unison electro-magnets, of the receiver. Under these conditions the unison latches at both instruments are permitted to return under the influence of their retracting springs to the innermost portions of the spiral grooves of the unison disks and the tension in the respective retracting springs of the motors is such as to cause the type-wheel shafts of both instruments to be slightly rotated under the influence of the motor springs. Such rotation of the shafts causes at the transmitter the normal line circuit to be made through the coils of the relay electro-magnets of both instruments and to be subsequently broken and the repeated makes and breaks in the normal line circuit due to the operation of the interrupter at the transmitter will cause the motor circuits to be made and broken at the relay electro-magnets, thereby causing the motors to actuate the type-wheel shafts, to insure perfect synchronism of movement, because each motor is controlled by its relay and both relays are controlled by the circuit interrupter at each transmitter. The depression of a letter key causes the local printing circuit to be closed through it, at the transmitter as soon as the sunflower brush sweeps onto its corresponding contact, and then through the coils of the locking electro-magnet and the coils of the printing and unison electro-magnets, whereby the former operates to arrest the type-wheel shaft and the latter to release the unison latch, feed the paper and effect an impression of the character on the type-wheel corresponding with the character of a depressed key. The locking electro-magnet at the transmitter, however, arrests its type-wheel shaft just before the motor has completed its full stroke, so that upon the release of the key, the motor will first complete its stroke and then proceed in the same manner that it did before the key was depressed. The arrest of the type-wheel shaft at the trans-

mitter at a character in the manner above described causes its circuit interrupter to come to rest in position for permitting the normal line circuit to present the relay electro-magnet at the receiver in a condition corresponding with that of the relay electro-magnet at the transmitter. Under these circumstances, the relay electro-magnet at the receiver acting through its armature lever arrests the motor and the latter arrests the receiver type-wheel shaft, whereupon the circuit closer makes the circuit through the coils of the printing and unison electro-magnet and effects an impression at the receiver. When the printing key is released at the transmitter, the motor completes its stroke so that both instruments are automatically set in motion; and inasmuch as the unison latch is returned to its initial position during the printing operation, it follows that the other letter keys may be depressed, in order to print other characters. If this is not done both instruments run to unison and may be again operated in the manner hereinbefore explained.

My invention stated in general terms consists of the improvements in a printing telegraph system, hereinafter described and claimed.

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

Figure 1, is a diagrammatic view illustrating a printing telegraph instrument embodying features of my invention and arranged as a transmitter, and showing also the parts of said instrument in the unison position with the retracting springs of the motor held in tension by the unison-latch and a motor. Fig. 2, is a similar view of a printing telegraph instrument embodying features of my invention and arranged as a receiver. Fig. 3, is a perspective view of the mechanical circuit closer and breaker of the local printing circuit, showing in full lines the same in the unison position, whereof the local printing circuit is interrupted and in the positions shown in dotted lines, whereof the local printing circuit is closed. Fig. 4, is a diagrammatic view illustrating portions of the type-wheel shaft provided with a toothed wheel and with a circuit interrupter controlling the circuit of an electric-motor adapted to drive the shaft and showing a contact sweeping over the segment of the circuit maker and breaker, and a detent for locking the type-wheel shaft before the contact has passed off a segment over which it is traveling, in order that the motor may be arrested before the completion of its stroke. Fig. 5, is a perspective view, showing the unison device for arresting the type-wheel shafts of the respective instruments in the unison position; and Fig. 6, is a sectional detail view of the swinging or vibrating mechanical circuit closer and breaker.

In the drawings a, is a type-wheel shaft afforded a freedom of rotary motion in suitable bearings, not shown, and provided with a type-wheel a', having in the present instance upon its rim or face forty characters and two blank spaces, not shown.

b, is an electric-motor adapted to drive the type-wheel shaft a, with a uniform step by step movement and comprising a ratchet wheel b', and a star or stop-wheel b^2, secured to the shaft a, a bar b^3, provided with spring controlled pawls b^4 and b^5, for rotating the ratchet-wheel b', and with stops b^6 and b^7, for engaging the star-wheel b^2, at or near the completion of the stroke of each pawl, an armature-lever b^8, a retracting spring b^9, and motor electro-magnet b^{10}, for reciprocating the bar b^3, connected by an arm b^{11}, with the armature-lever b^8.

When the motor electro-magnet b^{10}, is energized, its armature lever b^8, by means of the arm b^{11}, shifts the bar b^3, toward the left in Fig. 3, thereby causing the pawl b^5, to engage the ratchet-wheel b', and rotate the shaft a, in the direction of the arrow, until the stop b^6, meshes with a tooth of the star wheel b^2, and arrests the shaft a, in such position that one of the characters on the type-wheel a', is in proper position for permitting an impression to be taken therefrom. When the motor electro-magnet b^{10}, is demagnetized the retracting spring b^9, shifts the bar b^3, toward the right in Fig. 3, thereby causing the pawl b^4, to engage the ratchet-wheel b', and rotate the shaft a, in the direction of the arrow until the stop b^7, meshes with a tooth of the star-wheel b^2, and arrests the shaft a, in such position that the next character of the type-wheel a', is in proper position for permitting an impression to be taken therefrom. Subsequent magnetization and demagnetization of the motor electro-magnet b^{10}, causes the bar b^3, to be shifted backward and forward and with the result that the pawls b^4 and b^5, and stops b^6 and b^7, rotate the type-wheel shaft a, with an intermittent motion and in such manner that successive characters on the type-wheel a', are brought into printing position by the actions of the motor.

c, is a disk mounted on the type-wheel shaft a, and provided with a spiral groove c'.

c^2, is a spring controlled unison latch adapted to engage the outer end of the spiral groove c', and thus arrange the type-wheel shaft a, when a blank space on the type-wheel a', is in the position hereinbefore designated, the printing position, and when the retracting spring b^9, is in tension. In this connection it may be remarked that the arrest of the type-wheel shaft a, by the unison latch c^2, causes the ratchet-wheel b', to hold the pawl b^5, and thus prevent the movement of the bar b^3, whereby the retracting spring b^9, is held in tension, so as to permit of the subsequent starting of the motors as will be hereinafter fully described.

The type-wheel shafts a, of both transmit-

ter and receiver, it should be borne in mind, make two revolutions and are then arrested by the unison latch c^2, in the outer end of the spiral groove c', of the disk c.

d, is a circuit interrupter adapted to produce makes and breaks in the coils of the relay electro-magnet m, to which the motor electro-magnet b^{10}, responds and is composed of a conducting disk d', insulated from the shaft a, and provided with insulating segments corresponding in position with the divisions on the type-wheel a', a second conducting disk d^2, insulated from the shaft a, and in electrical connection with the disk d', a contact spring d^3, for the disk d^2, and an adjustable contact spring d^4, for the disk d'.

e, is a type-wheel shaft locking and releasing device comprising a toothed-wheel e', having spaces corresponding in number and position with the divisions on the type-wheel a', an armature lever e^2, provided with a spring e^5, for controlling the same and with a detent e^4, adapted to engage in a space between the teeth of the toothed-wheel e'. In this connection it may be remarked, that in use the contact spring d^4, is adjusted in such manner that when the shaft a, is arrested by the armature-lever e^2, the spring d^4, will occupy a position at or near the edge of one of the segments of the disk d', upon which it is traveling as illustrated in Fig. 4, so that the armature lever of the electric motor b, cannot complete its stroke; and moreover, because when the spring d^4, rests on a conducting segment of the disk d', the line circuit will be closed, and when the spring d^4, rests on an insulating segment, the line circuit will be interrupted. However, when the type-wheel shaft a, is arrested by the unison latch c', the spring d^4, will rest upon an insulating segment of the disk d', and thus the line circuit will be interrupted. These adjustments or peculiarities of construction and arrangement are productive of advantageous results which will be hereinafter fully explained.

f, is a sunflower device comprising a rigidly supported conducting annulus f', an annulus f^2, composed of insulating and conducting segments as illustrated in section in Figs. 1 and 2, and a conducting brush f^3, adapted to sweep over the sunflower and carried by an insulated arm projecting from the type-wheel shaft a.

f^4, f^5 and f^6, are printing keys corresponding to the characters on the type-wheel a', and f^7, is a double contact unison key.

h, is a spring controlled printing and unison electro magnet armature-lever having a spring controlled pawl h', adapted to feed the rack h^2, of a paper carriage, not shown, and with a link h^3, for operating a pivotal detent h^4, that co-operates with a rack h^5, and thus regulates and limits the feed imparted by the pawl h', to the paper-carriage. The intermediate portion of this armature lever h, is provided with a vertical projecting arm h^6, which actuates a pivotally supported printing hammer in such manner that when the armature lever h, is pulled up the printing pallet i, comes in contact with the paper and takes an impression from one of the characters on the type-wheel a'.

The armature lever h, is provided at or near its free extremity and upon its under side with a wedge, not shown, that engages one extremity of a pivotal lever j, the other extremity of which engages one arm j^2, of a bell crank-lever having its other arm j^3, in range of the spring controlled unison-latch c^2, so that when the armature-lever h, is pulled up the wedge operating through the instrumentality of the levers j, j^2 and j^3, causes the unison latch c^2, to be thrown out of the outer end c^3, of its spiral groove c', and when the armature lever h, falls back under the influence of its retracting spring h^{10}, the unison latch c^3, is again permitted to move under the influence of its spring c^5, into engagement with the inner end c^4, of the spiral groove c', of the disk c. By such described actions the pulling up of the armature-lever h, effects impressions, feeds the paper, and releases the unison latch.

g, is a mechanical circuit closer and breaker comprising a tapering stud or disk g', as illustrated in Fig. 3, loosely mounted on and insulated from a shaft or rod g^2, which by means of a link g^3, is pivotally connected with the upper end of the armature-lever b^8, of the motor electro-magnet b^{10}. This rod or shaft g^2, is pivotally connected at g^4, to a frame, not shown. The movement of the armature-lever b^8, of the motor electro-magnet b^{10}, is simultaneously transferred to the arm g^2, and contact stud or disk g', which as shown in full lines in Fig. 3, is held to required position by means of a delicate helical or coiled spring g^5, mounted on the rod or shaft g^2, to cause the stud or disk g', to contact with one or more of the spring metal strips g^6, g^7 and g^8, of the circuit closer and breaker g, secured to an insulating block or bar g^{10}, provided with binding posts g^{11}, g^{12} and g^{13}, for a purpose to be presently fully explained. The delicate coiled or helical spring g^5, engages respectively the lower extremity of the stud or disk g', and a flanged cap g^9, secured to the lower extremity of the rod or shaft g^2.

In dotted lines in Fig. 3, are indicated the different positions which the movable stud or disk g', of the mechanical circuit closer and centrifugal acting breaker is adapted to respectively assume by the actuation of the armature-lever b^8, by means of the electro-magnet b^{10}, when one of the character keys of the transmitter is depressed to close a local printing circuit at the receiver and which circuit is interrupted at unison position with the movable stud or disk g', of said device g, caused thereby to assume the position indicated in full lines in Fig. 3, hereinafter more fully explained in connection with the operation of the instruments. It may, however, be here remarked that the above described

mechanical circuit closer and centrifugal acting breaker g, is operative only at the receiving instrument, while at the transmitting instrument by means of a manual switch it is rendered inoperative for the reason that the printing circuit is closed thereat by the depression of one of the character keys.

The set of local unison circuits that is employed in connection with the unison line circuit for starting the instruments from unison position will now be described and traced with special reference to Figs. 1 and 2, and in this connection it may be remarked that each instrument is provided with two manual switches k and k', that are turned into open position as shown in Fig. 1, when the instrument is used as a transmitter and into closed position as shown in Fig. 2, when the instrument is used as a receiver. At the transmitter, Fig. 1, the local unison circuit passes from earth through a generator p, by the conductor I, through the outer annulus f', of the sunflower device, through the brush f^3, and the unison contact segment of the inner annulus f^2, of the sunflower device f, to the contact spring f^8, of the normally open double contact unison key f^7, by a conductor 2. When the unison key f^7, is depressed the local circuit branches, one branch constitutes the unison line circuit to be hereinafter more fully described, and the other passes through one of the contacts f^9, of the unison key f^7, then by conductor 3, to and through the coils of the locking electro-magnet e^3, then by conductors 4 and 5, to and through the coils of the printing and locking electro-magnet h^9, and by a conductor 6, to earth. When the unison key f^7, is depressed the branch constituting the unison line circuit passes from the other contact f^{10}, of the normally open double contact unison key f^7, by a conductor 8, of high resistance to a conductor 9, to the single line conductor 10, and by the manual switch k, and conductor 11, through the coils of the relay electro-magnet m, Fig. 2, and then by a conductor 12, through a generator n, by a conductor 20, to earth at the receiver. The local unison circuit of the receiver, Fig. 2, passes from earth by a conductor 15, through a generator o, and by a conductor 16, and back stop or post m^2, through the armature-lever m', when the relay electro-magnet m is energized by the line unison circuit, then the local unison circuit of the receiver passes by a conductor 17, through the coils of the motor electro magnet b^{10}, by a conductor 18, to earth. The motor electro magnet b^{10}, is thereby energized and attracts its armature-lever b^8, as above described. The position of the armature-lever b^8, in this instance has made but a half stroke, so that the spring b^9, holds the same momentarily in such position with the movable stud or disk g', in contact only with the spring strip g^6, and in which position the local printing circuit at the receiver is interrupted. When the armature-lever b^8, is attracted the frame b^3, of the motor by means of the link b^{11}, is shifted toward the left as illustrated in Fig. 3. Before the pawl b^5, engages a tooth of the ratchet-wheel b', the movable stud or disk g', maintained in required position by its spring g^5, and controlled as to its vibratory movement by the armature-lever b^8, when the electro-magnet b^{10}, is magnetized will contact with the spring strip g^7, and close thereby the local printing circuit at the receiver, as illustrated in Fig. 2. This local printing circuit passes from earth by a conductor through the generator p, then a conductor 23 and manual switch k', occupying the closed position to the conductor 24, and by a conductor 25, to the mechanical circuit closer and breaker g, then the local circuit passes through the spring strip g^7, and the movable stud or disk g', in contact therewith and through the center contact spring strip g^6, and then by the conductors 26 and 5, through the coils of the printing electro-magnet h^9, and by a conductor 6, to earth.

It should be borne in mind that the pawls b^4 and b^5, of the motor frame b^3, engage with the teeth of the ratchet-wheel b', mounted on the type-wheel shaft a, only near the end of the stroke of the armature-lever b^8, so that the movement of the motor frame b^3, in the present instance serves only to cause the contact stud or disk g', of the mechanical circuit closer and breaker to vibrate or swing to the left sufficiently as illustrated in Figs. 1, 2 and 3, to permit the disk or stud g' thereof to contact with the spring strip g^7, so as to close the local printing circuit at the receiver, and at the same time to prevent the type-wheel being moved. It will thus be observed that the type wheel shaft a, cannot be rotated at this moment at the receiver for the reason that the unison latch c^2, as illustrated in Fig. 5, occupies a position at the end c^3, of the spiral groove c', of the unison disk c, thereby preventing the actuation of the type-wheel shaft a, until the unison latch, is released.

The set of local printing and motor circuits that is employed in connection with the normal printing line circuit, that is, after the unison line circuit has been broken, will now be traced and described.

At the transmitter, Fig. 1, the normal line circuit passes from earth by a conductor 20, through the generator n, by a conductor 12, through the coils of the relay electro-magnet m, and by conductors 11 and 21, to the line circuit closer and breaker d, through the contact spring d^4, a conducting segment of the disk d', through the hub d^2, and contact spring d^3, and by the conductors 22 and 9, to the line conductor 10. The normal line then passes by the manual switch k, of the receiver, Fig. 2, and conductors 11, 12 and 20, through the coils of the relay electro-magnet m, and generator n, to earth.

The local printing circuit at the transmitter is from earth through the generator p, conductor 1, sunflower device f, conductors 13 and 28 or 29, contacts of the keys f^4, f^5 or f^6,

conductors 14 and 3, through the coils of the locking electro-magnet e^3, by the conductors 4 and 5, through the coils of the unison and printing electro-magnet h^9, and then by the conductor 6, to earth. At the receiver the motor circuit comprises a generator o, and conductors 15, 16, 17 and 18, and is controlled by the armature lever m', of the relay electro-magnet m. This circuit is closed by means of the armature lever m', through the coils of the motor electro-magnet b^{10}, and the local printing circuit passes as previously described from earth through the generator p, by the conductor 23, manual switch k', and conductors 24 and 25, through the contacts g^8, g', g^5 or g^5, g', g^7, of the mechanical circuit closer and centrifugal acting breaker g, and then by conductors 26, 5 and 6, to earth through the coils of the printing and unison electro-magnet h^9. However, at unison position this circuit is broken by reason of the fact that the stud or disk g', of the vibrating or swinging mechanical circuit closer and breaker g, is in contact with the center spring strip g^6, and consequently breaks said circuit thereat.

Assuming that the instruments are in the unison position as shown in Figs. 1 and 2, the starting of the instruments and effecting of the printing are, as follows:—The double contact unison key f^7, is depressed at the transmitter to close the local unison circuit 1, 2, 3, 4, 5 and 6, through the coils of the locking electro-magnet e^3, and through the coils of the printing electro-magnet h^9, it being understood that the normal line circuit is broken at the armature lever m', by reason of the fact that the spring d^4, of the circuit interrupter d, of the transmitter rests upon an insulating segment. The magnetization of the locking electro-magnet e^3, causes its armature-lever e^2, to be pulled down into position for locking the toothed wheel e', and type-wheel shaft a, and the magnetization of the printing and unison electro-magnet h^9, causes its armature-lever h, to be pulled down with the result that the pawls h' and h^4, are brought into position for feeding the paper-carriage, the printing pallet i, brings the paper into contact with the blank space on the type-wheel a', and the unison latch c^2, is shifted out of engagement with the outermost portion c^3, of the spiral groove c', of the unison disk c. The depression of the double contact unison key f^7, of the unison line circuit 1, 2, 8, 9, 10, k', 11, 12 and 20, thus energizing the relay electro-magnet m, at the receiver. In this connection it may be remarked that the conductor 8, of high resistance causes a proper distribution of the current from the generator 1, to line through the coils of the locking electro-magnet e^3, and through the coils of the printing and unison electro-magnet h^9, of the transmitter. The relay electro-magnet m, at the receiver being thus energized pulls up its armature lever m', and closes the local unison circuit 15, 16, 17 and 18, through the coils of the motor electro magnet b^{10}, and by means of the mechanical circuit closer and breaker g, through the coils of the printing and unison electro-magnet h^9, whereby the unison latch c^2, at the receiver is released. The double unison contact key f^7, at the transmitter, is then released, thus breaking the local unison circuit 1, 2, 3, 4, 5 and 6, through the coils of the locking electro-magnet e^3, and through the coils of the printing and unison electro-magnet h^9, of the transmitter and also breaking the unison line circuit 1, 2, 8, 9, 10, k', 11, 12 and 20, so that the relay electro-magnet m, at the receiver is demagnetized and its armature-lever m', is permitted to break the local unison circuit 15, 16, 17 and 18, through the coils of the motor electro-magnet b^{10}, and the coils of the printing and unison electro magnet h^9, of the receiver. In this connection it may be here remarked that by releasing the double contact unison key f^7, the unison latch c^2, at the receiver is released simultaneously with the unison latch c^2, of the transmitter, so that the type-wheel shafts of the transmitter and receiver are maintained in unison by reason of the fact that the retracting springs b^9, of the motor armature levers b^8, are of like tension and retractive force and actuate the type-wheel shafts a, of both instruments upon the release of the double contact key f^7, synchronously and so as to operate in unison. The unison latches at both instruments are permitted to move under the influence of their retracting springs into engagement with the innermost portions c^4, of their spiral grooves c', and the armature-levers e^2, are shifted into position for releasing the shaft a', at the transmitter so that the tension in the respective retracting springs b^9, of the motors causes the type-wheel shafts a, of both instruments to be slightly rotated; it being understood that the unison latches c^2, always arrest the type-wheel shafts in such position that the retracting springs b^9, are in tension as shown in Figs. 1, 2 and 3. This rotation of the shafts a, causes the contact spring d^4, and circuit interrupter d, at the transmitter to be brought into contact with a conducting segment of the disk d', to close the normal line circuit 20, 12, 11, 21, 22, and 9, as illustrated in Fig. 1, and 10, k, 11, 12 and 20, as illustrated in Fig. 2, through the coils of the relay electro-magnets m, of both instruments and to subsequently break and again make the same. The repetition of these makes and breaks in the normal line circuit due to the ordinary operation of the circuit interrupter at the transmitter, acting through the armature levers m', of the relay electro-magnets m, and in connection with the retracting springs b^9, and motor electro-magnets b^{10}, will cause the motors b, to propel the type-wheel shafts a, and perfect synchronism of movement is insured, because each motor is controlled by its relay and both relays are controlled by the circuit interrupter at the transmitter. This is important, because accidental breakage in the line con-

ductor 10, would result in a stoppage of the transmitter, as well as of the receiver, so that the operator at the transmitter would be apprised of the accident and would not attempt to transmit messages until the necessary repairs had been effected.

It may be here remarked that the stud, disk or circuit closer or breaker g', at the receiver by the magnetization and demagnetization of the motor electro-magnet b^{10}, by means of its retracting spring b^9, is adapted to impart intermittent or vibratory motion by which centrifugal force is engendered to cause the stud or disk g', to be pressed downward against the force of the delicate helical or coiled spring g^5, as shown by the dotted lines in Figs. 3 and 6. The contact disk g', will occupy such position until the type-wheel shaft a, of the transmitter is arrested, whereby the spring g^5, will raise the swinging contact disk or circuit closer g', in such manner as to assume again its normal position as illustrated in Figs. 3 and 6, and until the stud or disk g', by means of the spring g^5, causes it to contact with the strips g^7 and g^6 or g^6 and g^8, as fully illustrated in dotted lines in Fig. 3. It will thus be understood that the local printing circuit at the receiver will be interrupted during the swinging or vibratory movements of the stud or disk g', of the circuit closer and breaker g. The contact stud or disk g', it will be seen has for nearly one half of its upper surface a range of movement beneath and between the contact strips g^6, g^7 and g^8, during the swinging or vibratory movement thereof, thereby forming a sufficient surface for contact with the spring metal strips g^6, g^7 and g^8, when the swinging or vibratory motion imparted thereto is permitted to cease. At the transmitter, however, the contact stud or disk g', operates in precisely the manner hereinbefore described, but thereat the local printing circuit is not closed thereby, because the manual switch k', occupies an open position.

The depression of a character key at the transmitter, for example, the key f^6, causes the local printing circuit 1, 13, 14, 3, 4, 5 and 6, to be closed through it as soon as the sunflower brush f^3, sweeps onto the contact connected with the conductor 13, whereupon the locking electro-magnet e^3, and printing and unison electro-magnet h^9, are energized. Under these circumstances the locking electro-magnet e^3, attracts its armature and arrests the type-wheel shaft, and the printing and unison electro-magnet feeds the paper, throws the unison latch out of engagement and effects the impression of a character from the type-wheel, corresponding with the character of the depressed key. The locking electro-magnet e^3, at the transmitter, however, arrests its type-wheel shaft a, before the spring d^4, has passed off the segment of the disk d', over which it is traveling, as shown in Fig. 4, and before the motor has completed its full stroke. Consequently upon the release of the key f^6, the unison-latch c^2, will be returned to its initial position and then proceed in the same manner as it did before the key f^6, was depressed. The arrest of the circuit interrupter at the transmitter in the manner above described, that is, with the contact spring at or near the edge of a conducting segment over which it is traveling, causes the normal line circuit 20, 12, 11, 21, 22, 9, 10 of Fig. 1, and 11, 12 and 20, of Fig. 2, to be thereby closed to energize the relay electro-magnet m, at the receiver, and through the armature lever m', of the said magnet when pulled up, the motor circuit is closed through the coils of the motor electro-magnet b^{10}. This electro-magnet consequently attracts completely its armature lever b^8. Under these circumstances the relay at the receiver acting through its armature lever m', arrests its motor and the latter arrests the receiver type-wheel shaft, whereupon the contact stud or disk g', of the circuit closer and breaker g, is elevated by means of the spring g^5, into contact with the spring strips g^6 and g^7, thereby closing the local printing circuit 23, k', 24, 25, 26, 5 and 6, through the printing and unison electro-magnet h^9, effecting thereby an impression at the receiver of a character corresponding to the character of the depressed key, and also releases the unison latch and feeds the paper. When the printing key f^6, is released, the motor at the transmitter completes its stroke, the unison latches of both instruments are permitted to return to their initial positions and hence both instruments are again set in motion. Inasmuch as the unison latches c^2, are returned to their initial positions every time an impression is taken, it follows that another letter key, as f^4, may be depressed at the transmitter before the shafts are permitted to run to unison.

When a character key is depressed at the transmitter and the type-wheel shaft a, is arrested by means of the locking electro-magnet e^3, the contact spring d^4, is in such position as to rest upon the edge of an insulating segment of the disk d', of the line circuit interrupter d, and before the motor has completed its full stroke the line circuit will be interrupted. In such a case at the receiver the motor electro-magnet b^{10}, will be demagnetized and the contact disk g', of the vibrating mechanical circuit closer and centrifugal acting breaker g, by means of the retracting spring b^9, will be brought in contact with the metal spring strips g^6 and g^8. The local printing circuit 23, 24, 26, 5 and 6, will be thereby closed, the unison and printing electro-magnet h^9, at the receiver will be energized at the same time with the unison and printing electro-magnet h^9, at the transmitter, and on both instruments an impression will be effected corresponding to the character of the depressed key; and moreover, the paper will be fed. Upon the release of the depressed key, the unison latches c^2, of both instruments will return to their initial posi-

tions, as hereinbefore fully explained. Whenever it becomes necessary or desirable to bring the instruments to unison, this result may be accomplished by releasing all the keys, and afterward the instruments may be again operated in the manner above described, or the switches *k* and *k'*, in Fig. 1, may be closed, and those in Fig. 2, opened, with the result that the instrument of Fig. 2, becomes the transmitter and the instrument of Fig. 1, the receiver.

From the foregoing description it will be observed that an impression is made even though the normal line circuit is interrupted, so that the speed of printing is increased and depends in the present instance not alone from a closed line circuit or from an impulse sent over the line. The mechanical circuit closer and breaker *g*, such as hereinbefore fully described and shown is adapted for use in connection with a local printing circuit and to close and interrupt the same, but it is manifestly obvious that such can be employed to close and interrupt any of the other circuits and still be within the scope of my present invention. Moreover, it will be obvious that use may be made of a plurality of instruments operated by a single transmitter or from a central station, whereby two instruments may be operated independently of the others connected in circuit therewith; and also that modifications may be made in the arrangement of the circuits and in the number and location of the generators, without departing from the spirit of the invention; and hence I do not wish to be understood as confining myself to the precise arrangements hereinbefore explained; but

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, a printing circuit, an electric motor, and a vibrating mechanical and centrifugal acting circuit closer and breaker operating to close and interrupt said circuit, substantially as and for the purposes set forth.

2. In a printing telegraph system, a circuit, an electric motor included therein and connected with a shaft controlling a type-wheel, and a vibrating mechanical and centrifugal acting circuit closer and breaker substantially as described, operating to close and interrupt said circuit, substantially as and for the purposes set forth.

3. In a printing telegraph system, a circuit, an electric motor included therein and connected with a shaft controlling a type-wheel, and a spring controlled vibrating mechanical and centrifugal acting circuit closer and breaker operating to close said circuit and to interrupt the same by the centrifugal action thereof, substantially as and for the purposes set forth.

4. A printing telegraph system, comprising a generator and line circuit, an electric motor included in a local circuit and controlling a shaft provided with a type-wheel, and a spring controlled and centrifugal acting circuit closer and breaker operating to effect printing from said type-wheel by the closing and interrupting of said line circuit, substantially as and for the purposes set forth.

5. A printing telegraph system, comprising a receiver and a transmitter normally operated by motors and local circuits controlled by relay electro-magnets responding to makes and breaks produced in line by a circuit interrupter on the type-wheel shaft of the transmitter, a local printing circuit, a spring controlled and centrifugal acting mechanical circuit breaker and closer operating by the depression of a key at the transmitter to effect an impression and arrest the type-wheel shaft before the completion of the stroke of the motor thereat and before the circuit interrupter makes and breaks the line circuit, whereby the relay electro-magnet through the spring controlled armature lever causes the motor to arrest the receiver type-wheel shaft, and whereby the motors of both instruments are permitted to again start upon the release of said key at the transmitter and by the completion of the partial stroke of the motor thereat, substantially as and for the purposes set forth.

6. A printing telegraph system, comprising a transmitter and a receiver each having a relay electro-magnet responding to makes and breaks in the normal line circuit produced by an interrupter on the type-wheel shaft of the transmitter, a motor operating the driving shaft and controlled by the armature-lever of said relay electro-magnet through circuit connections, a vibrating spring controlled mechanical and centrifugal acting circuit closer and breaker, and a unison-latch adapted to arrest its type-wheel shaft with the retracting spring of the motor in tension and with the circuit interrupter in position for breaking the normal line circuit, whereby the motors are permitted to start under the influence of their retracting springs and by the release of the type-wheel shafts, substantially as and for the purposes set forth.

7. A printing telegraph system, comprising a transmitter and a receiver and each provided with a motor responding to makes and breaks in a line circuit and adapted to drive the type-wheel shaft, a vibrating spring controlled mechanical and centrifugal acting circuit closer and breaker, a unison device for locking the type-wheel shaft in such position that the retracting spring of the motor tends to start it, a detent locking said shaft, electro-magnets for operating said unison-latch and detent, a double contact unison key at the transmitter for controlling the local printing circuit to release said unison-device and lock and unlock the transmitter type-wheel shaft and for controlling the unison line circuit to release said unison device and lock and unlock the receiver type-wheel shaft through the intervention of a relay electro-magnet

and a local circuit, substantially as and for the purposes set forth.

8. A printing telegraph system, comprising a single line conductor adapted to be included in a unison line circuit, a transmitter and receiver normally operated by motors responding to makes and breaks in said circuit and provided with means for automatically closing the same at the unison position and at other positions, local motor circuits at each instrument, a local printing circuit, a spring controlled vibrating mechanical and centrifugal acting circuit closer and breaker controlled by a key at the transmitter and a local printing circuit controlled by the motor electro magnet of the receiver, a local unison circuit and devices controlled by a unison-key at the transmitter and a local unison circuit and devices controlled by a relay and its spring controlled armature-lever at the receiver, substantially as and for the purposes set forth.

9. A printing telegraph system, comprising a single line conductor, combined transmitters and receivers normally operated through relay electro-magnets controlling the local circuits of motors and responding to makes and breaks in said line circuit and provided respectively with two sets of local unison and printing circuits, a spring controlled mechanical and centrifugal acting circuit closer and breaker adapted to include one set of local circuits at unison position and the other set at the other positions, and manual-switches for changing the circuits to cause the instruments to operate as transmitters and receivers, substantially as and for the purposes set forth.

10. A printing telegraph system, comprising a receiver and transmitter having printing and locking electro-magnets and devices, relay electro-magnets, a mechanical and centrifugal acting circuit closer and breaker at the receiver adapted to control a local unison circuit through the armature-lever of said relay electro-magnet and the coils of the printing electro-magnet of the receiver, a double contact unison key adapted to close a local unison circuit through the coils of said printing and locking electro-magnets of the transmitter and to close a unison line circuit through the coils of the relay electro-magnet at the receiver, substantially as and for the purposes set forth.

11. A printing telegraph system, comprising a receiver and a transmitter having printing and locking electro-magnets and devices, a relay electro-magnet at the receiver adapted to control a local unison circuit through its armature-lever and the coils of said printing electro-magnet at the receiver, a mechanical circuit closer and centrifugal acting breaker, a double contact unison key adapted to close one branch of said circuit through the coils of the printing and locking electro-magnets of the transmitter and to close the other branch through a resistance and the coils of the relay electro-magnet at the receiver, substantially as and for the purposes set forth.

12. In a printing telegraph system, a receiver provided with a unison electro-magnet, a local circuit through the coils of said magnet and adapted to be made and broken by the armature-lever of a relay magnet responding to makes and breaks in line, a motor, a vibrating mechanical circuit closer and breaker controlled thereby and adapted to close said local circuit through the unison magnet only at unison position, substantially as and for the purposes set forth.

13. In a printing telegraph system, a transmitter provided with a local printing circuit independent of the line circuit, keys and a type-wheel shaft locking magnet interposed in said local circuit, a receiver provided with a local printing circuit and its accessories, a motor, a vibrating mechanical and centrifugal acting circuit closer and breaker adapted to automatically permit of the printing upon the arrest of the receiver type-wheel shaft, electrical and mechanical devices and circuits independent of the local circuits and keys operating upon the arrest of the type-wheel shaft of the transmitter to stop said motor of the receiver, substantially as and for the purposes set forth.

14. In a printing telegraph system, the combination of a revoluble shaft provided with a type-wheel having characters and blank spaces, means for arresting said shaft with the divisions of the type-wheel in the printing position, mechanical and electrical devices, a local printing circuit, a motor, a mechanical swinging circuit closer and centrifugal acting interrupter, a wheel on said shaft provided with recesses in alignment with the characters on the type-wheel and the blank spaces thereof, substantially as and for the purposes set forth.

15. In a printing telegraph system, an armature lever provided with printing, feeding and unison latch actuating devices and having an electro-magnet and local circuit connections independent of the line circuit and controlled by keys at the transmitter and by a mechanical swinging circuit closer and centrifugal acting interrupter at the receiver, substantially as and for the purposes set forth.

16. In a printing telegraph system, a spring controlled unison-latch, a system of levers for operating said latch, a printing and paper feeding armature-lever provided with a wedge in sliding engagement with one of said levers, a mechanical swinging circuit closer and breaker, and an electro-magnet and circuit connections for actuating the same, substantially as and for the purposes set forth.

17. In a printing telegraph system, a unison latch, levers for operating said latch, an armature lever actuating printing devices in sliding engagement with one of said levers, a mechanical vibrating and centrifugal acting circuit closer and breaker, and an electro-magnet and circuit connections for control-

ling said circuit closer and breaker, substantially as and for the purposes set forth.

18. In a printing telegraph system, a spring controlled unison latch, a system of levers for operating said latch, a pivotal printing hammer, an armature-lever provided with an arm having a projection in range of a rod on the printing hammer and with a wedge for operating the system of levers, a vibrating circuit closer and centrifugal acting breaker, and an electro-magnet and circuit connections for controlling said circuit closer and breaker, substantially as and for the purposes set forth.

19. In a printing telegraph system, a unison latch, levers for operating said latch, a printing hammer, an armature-lever provided with pawl-and-ratchet connections for feeding a paper-carriage and operating said levers, a projection on said armature-lever disposed in range of a rod on the printing-hammer, a mechanical vibrating and centrifugal acting circuit closer and breaker, and an electro-magnet for actuating said armature-lever, substantially as and for the purposes set forth.

20. In a printing telegraph system, a printing mechanism, a paper-carriage, a type-wheel shaft provided with a unison spiral and with ratchet and stop-wheels, a reciprocating-bar provided with pawls and detents co-operating with said ratchet and stop-wheels, a spring controlled armature-lever connected with said bar, a motor electro-magnet interposed in a local motor circuit controlled by the armature-lever of a relay electro-magnet responding to makes and breaks in line, a printing and unison electro-magnet and circuit connections having an armature-lever provided with devices for actuating the unison latch, printing mechanism and paper-carriage, and a mechanical vibrating circuit closer and breaker included in said local motor circuit, substantially as and for the purposes set forth.

21. A printing telegraph system, comprising a double contact unison key, circuit connections, a type-wheel and a type-wheel shaft, a relay electro-magnet and its circuit connections, a motor, and a mechanical swinging circuit closer and centrifugal acting breaker adapted to synchronously release the type-wheel shaft through said relay and circuit connections, substantially as and for the purposes set forth.

22. In a printing telegraph system, transmitting and receiving instruments, relay electro-magnets for controlling said instruments, a line through the coils of said relay electro-magnets, circuit interrupters on the type-wheel shaft of each instrument, a manual-switch at each instrument for controlling line and local circuits and for permitting an instrument being used either as a transmitter or receiver, a mechanical swinging and centrifugal acting circuit maker and breaker, and mechanical and electrical devices adapted to effect impressions upon the arrest of one of the instruments on makes and breaks of current at the transmitting and receiving instruments, substantially as set forth.

23. A printing telegraph system, comprising a transmitter and a receiver each having an electro-magnet to reciprocate a spring controlled bar provided with pawls and detents co-operating with ratchet and stop wheels mounted on type-wheel shafts of both instruments, a line circuit formed out of a local circuit at the transmitter, a relay electro-magnet included in said line circuit and adapted to close the local motor circuit at the receiver and to partially move said motor bar without actuating said type-wheel shaft of the receiver and at the same time to move a mechanical vibrating and centrifugal acting circuit closer and breaker out of unison position so as to close a local printing circuit through the coils of said printing electro-magnet at the receiver, whereby the unison latch of the unison spiral device is liberated and the type-wheel shaft of the receiver is simultaneously released with the type-wheel shaft of the transmitter and permitted to operate in unison with each other upon the release of a unison key at the transmitting instrument, substantially as and for the purposes set forth.

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

ROBERT A. FOWDEN.

Witnesses:
THOMAS M. SMITH,
RICHARD C. MAXWELL.