

(No Model.)

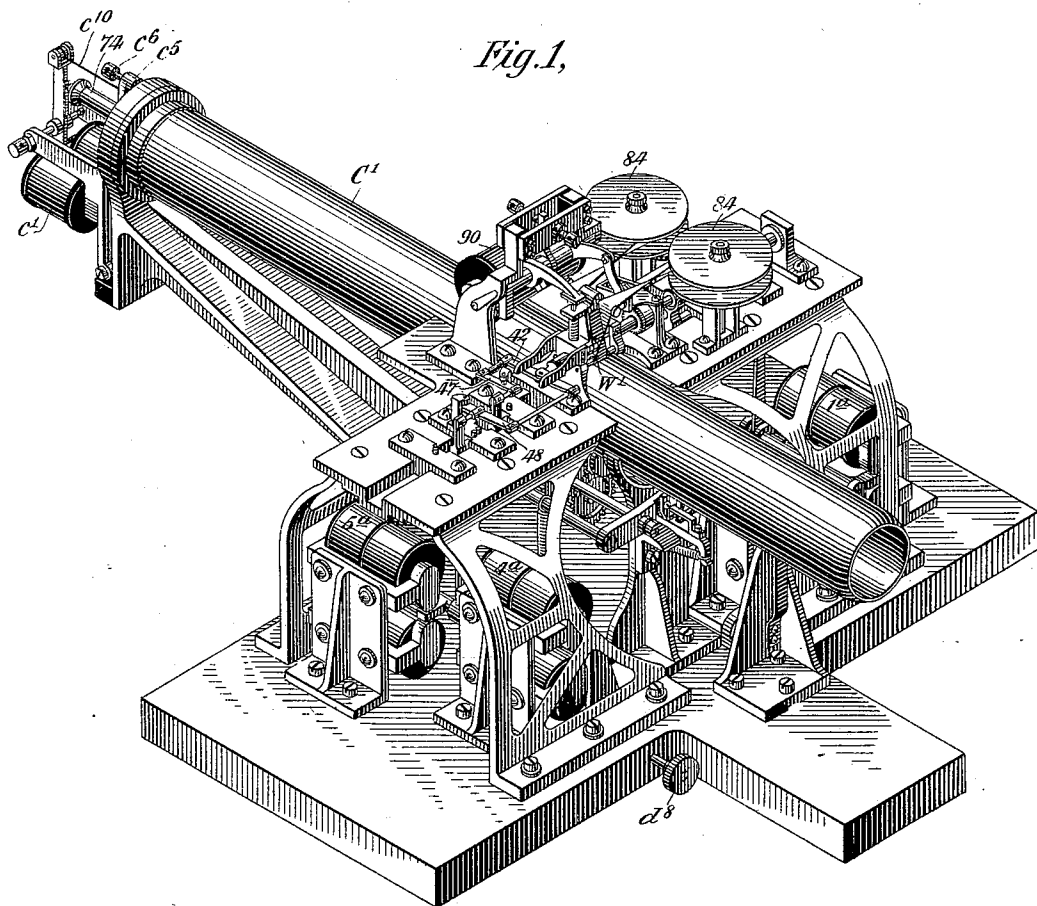
17 Sheets—Sheet 1.

C. L. BUCKINGHAM & E. GERMANN.

PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.



Witnesses
C. E. Ashley
Henry F. Brock

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
H. E. Townsend

(No Model.)

17 Sheets—Sheet 2.

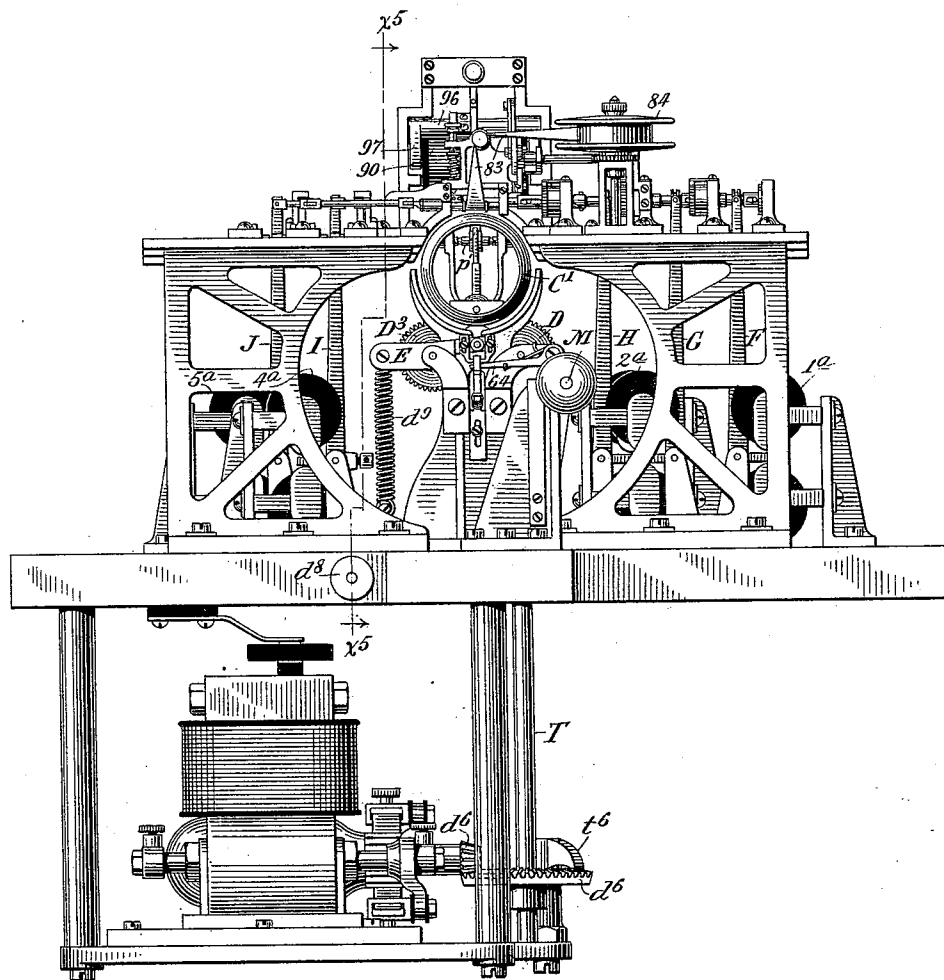
C. L. BUCKINGHAM & E. GERMANN.

PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.

Fig. 2.



Witnesses

C. E. Ashley
H. W. Lloyd

Inventors:
Charles L. Buckingham and
Emil Germann.

By their Attorney

H. L. Townsend

(No Model.)

17 Sheets—Sheet 3.

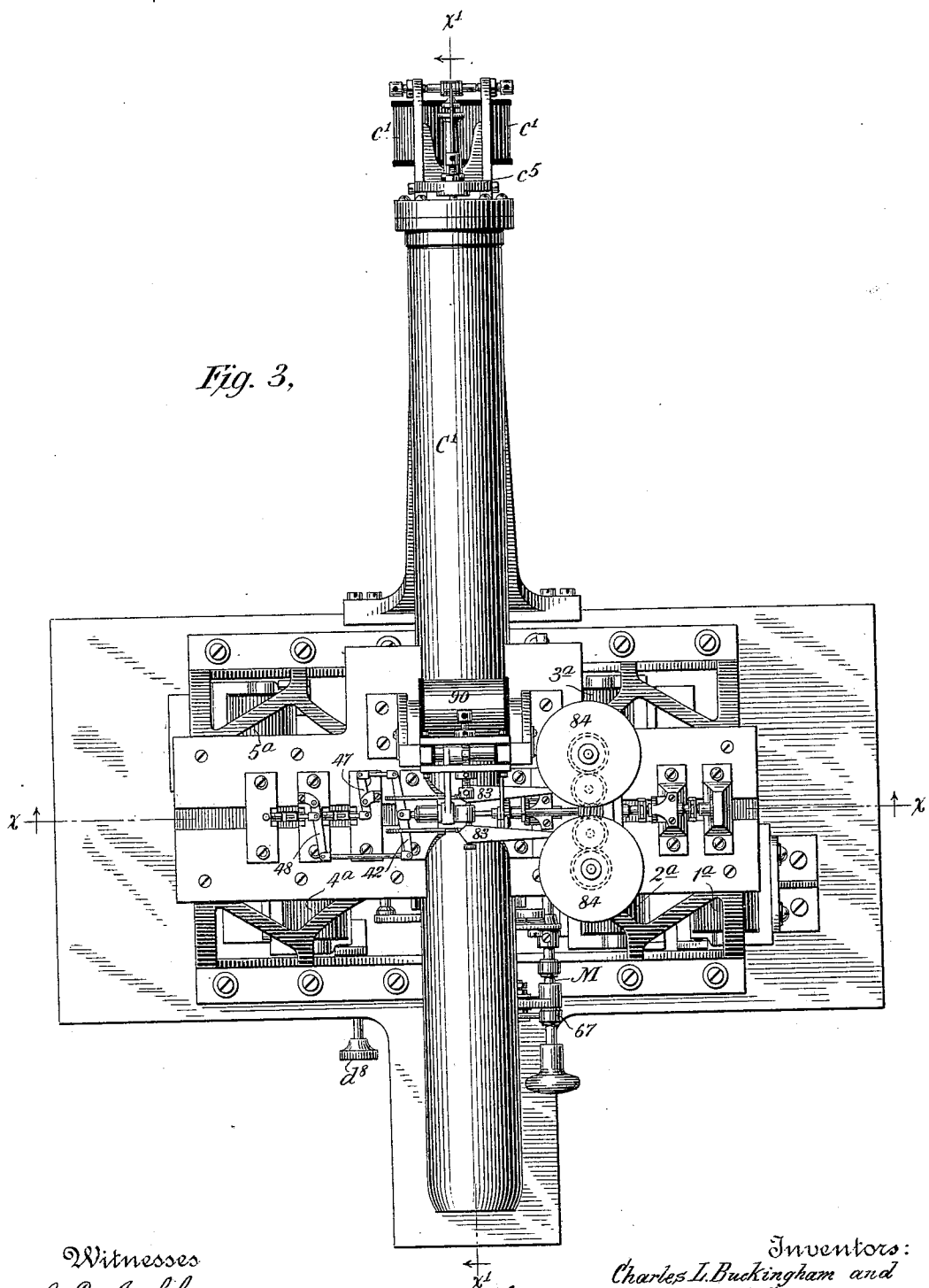
C. L. BUCKINGHAM & E. GERMANN.

PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.

Fig. 3,



Witnesses
C. E. Ashley
H. W. Lloyd

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
H. C. Townsend

(No Model.)

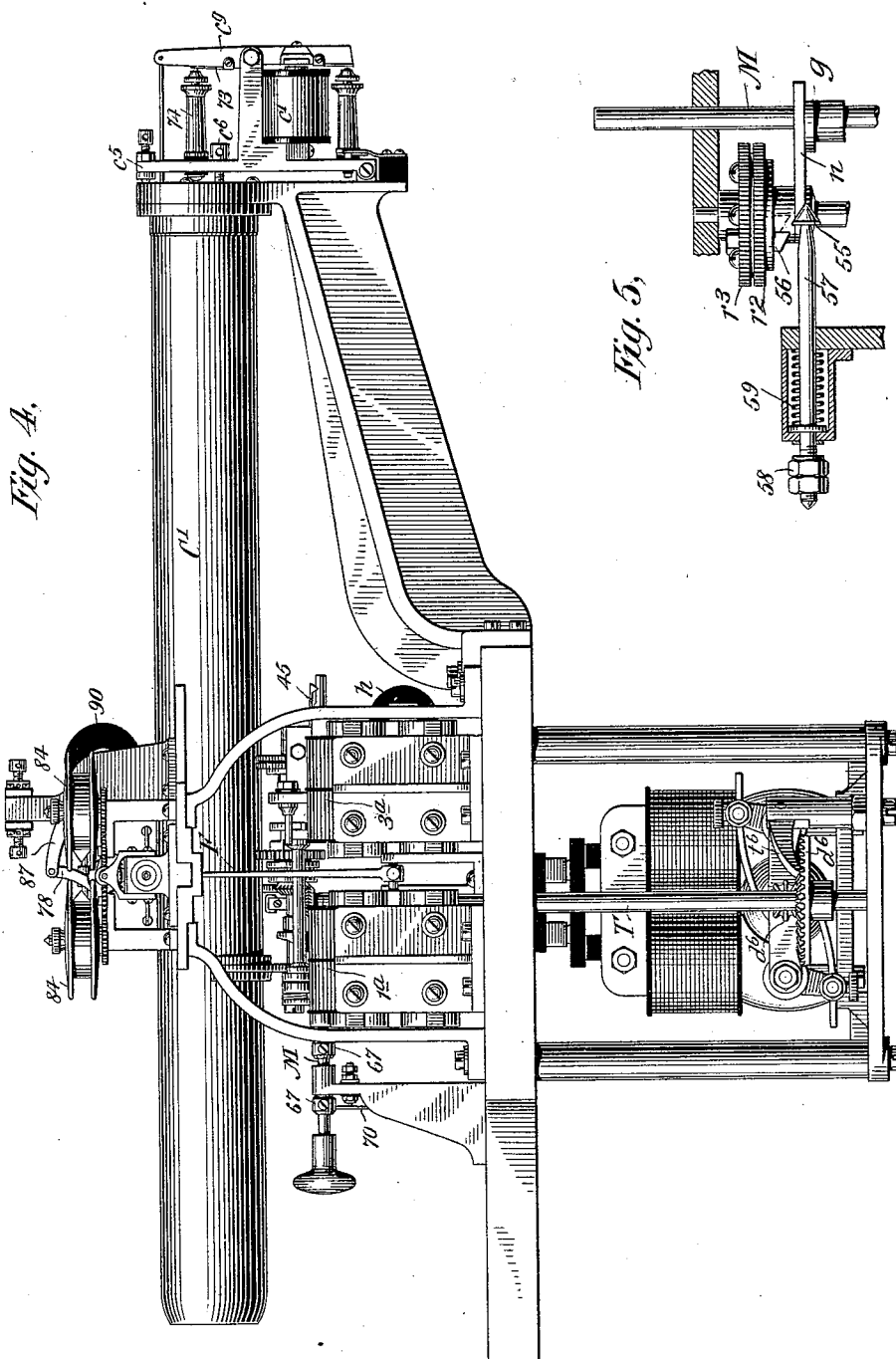
17 Sheets—Sheet 4.

C. L. BUCKINGHAM & E. GERMANN.

PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.



Witnesses:
C. E. Ashley
H. W. Lloyd

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney *A. C. Townsend*

(No Model.)

17 Sheets—Sheet 5,

C. L. BUCKINGHAM & E. GERMANN.

PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.

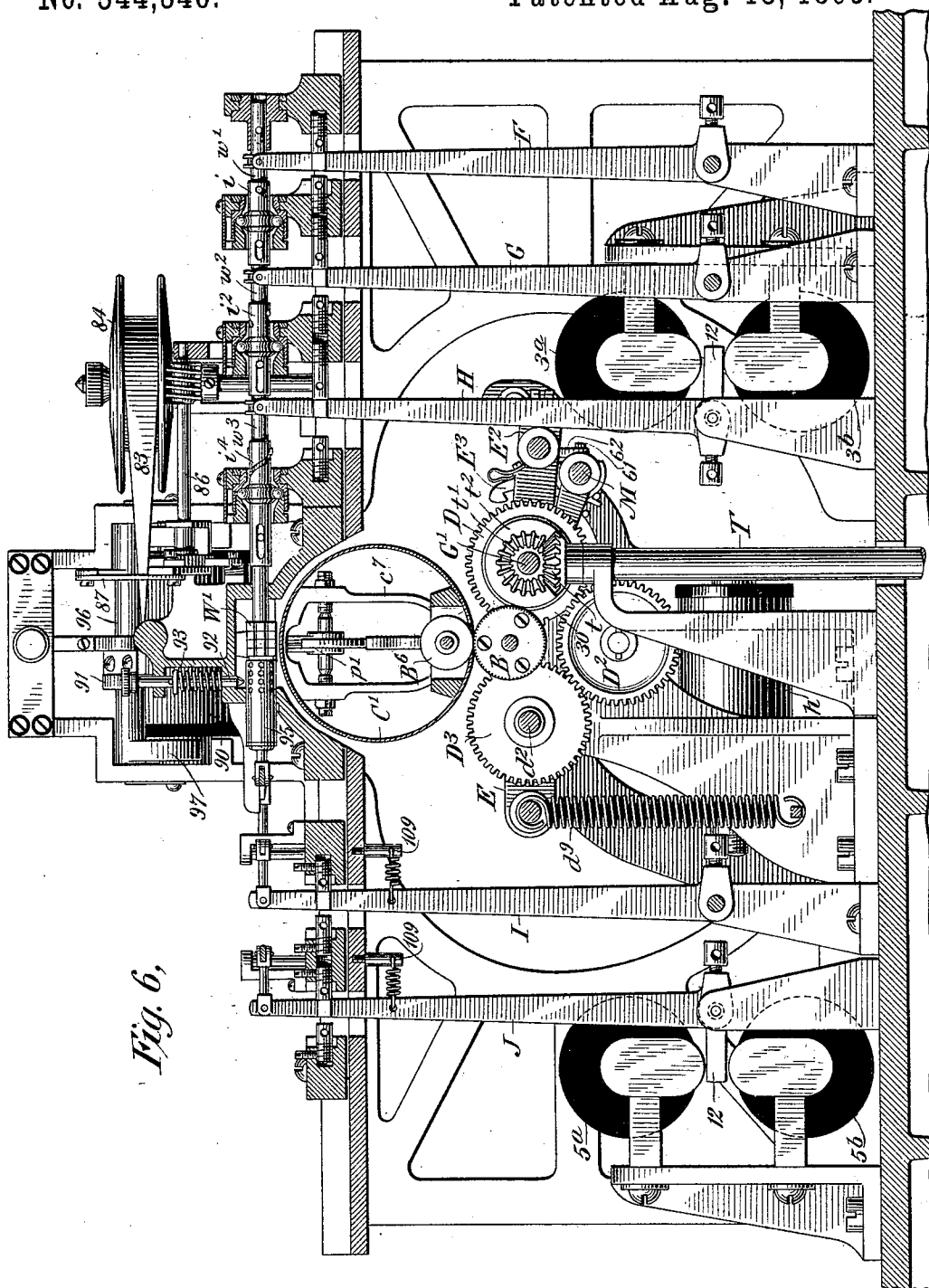


Fig. 6,

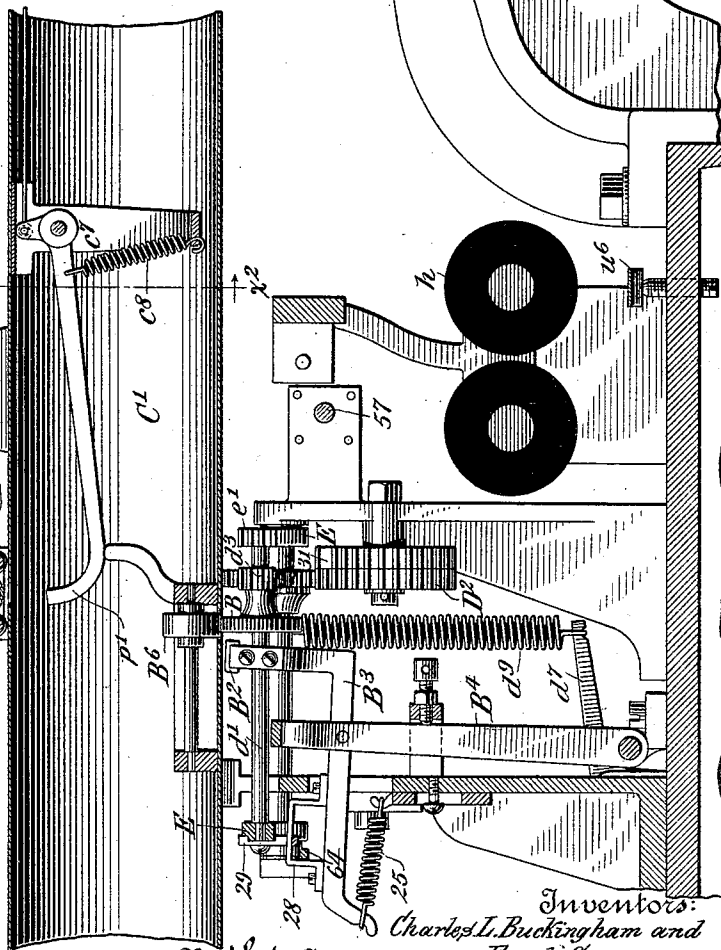
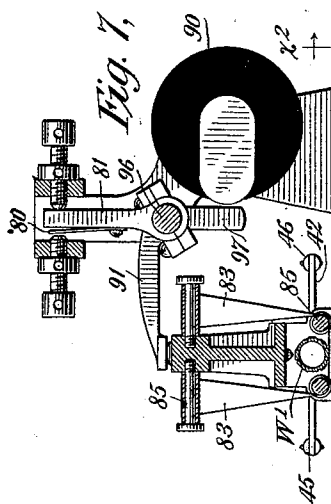
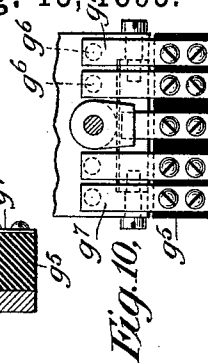
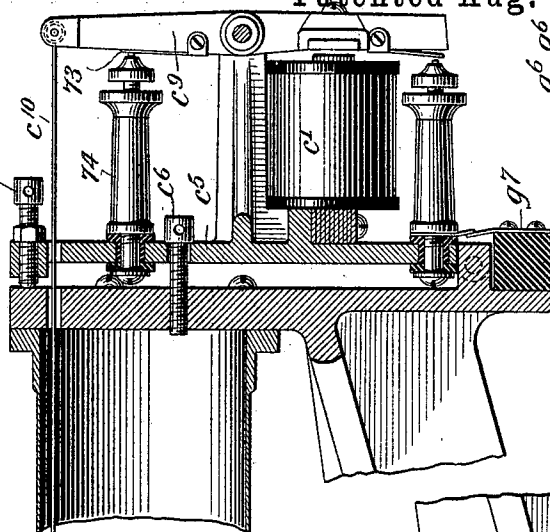
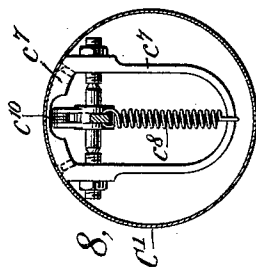
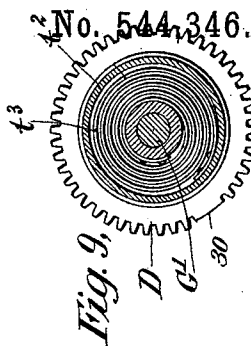
Witnesses
C. E. Ashley
H. L. Lys.

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
J. B. Townsend

17 Sheets—Sheet 6.

PRINTING TELEGRAPH.

Patented Aug. 13, 1895.



Witnesses
C. E. Ashley
J. W. Lloyd

By their Attorney

Inventors:
Charles L. Buckingham and
Fried. Hermann.

14 *Emil Hermann.*
H. G. Townsend

17 Sheets—Sheet 7.

No. 544,346.

Patented Aug. 13, 1895.

Fig. 11.

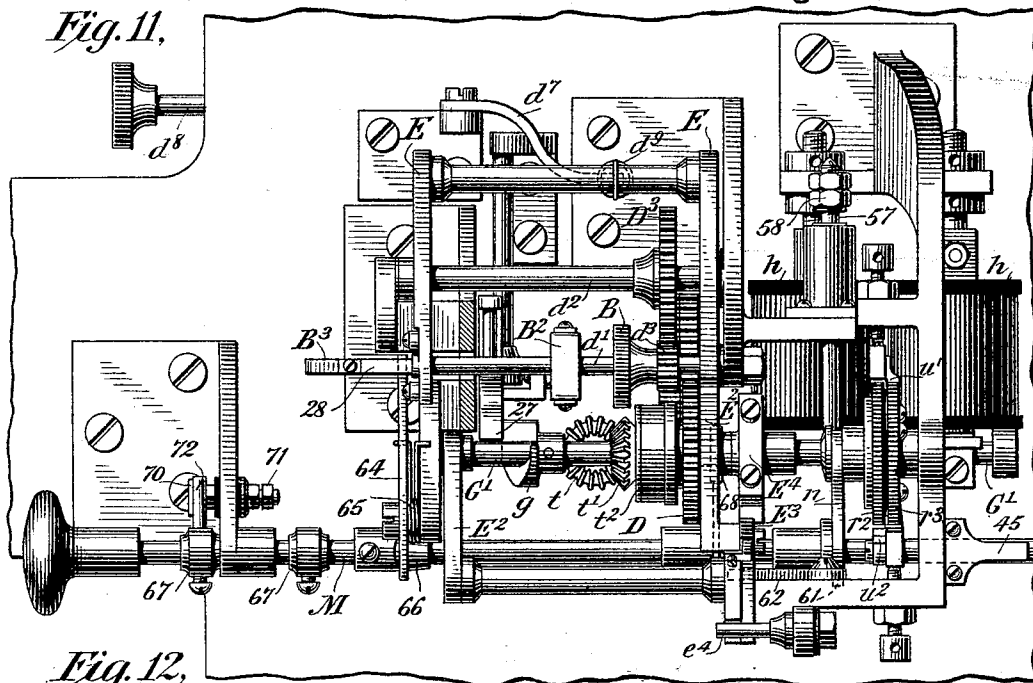
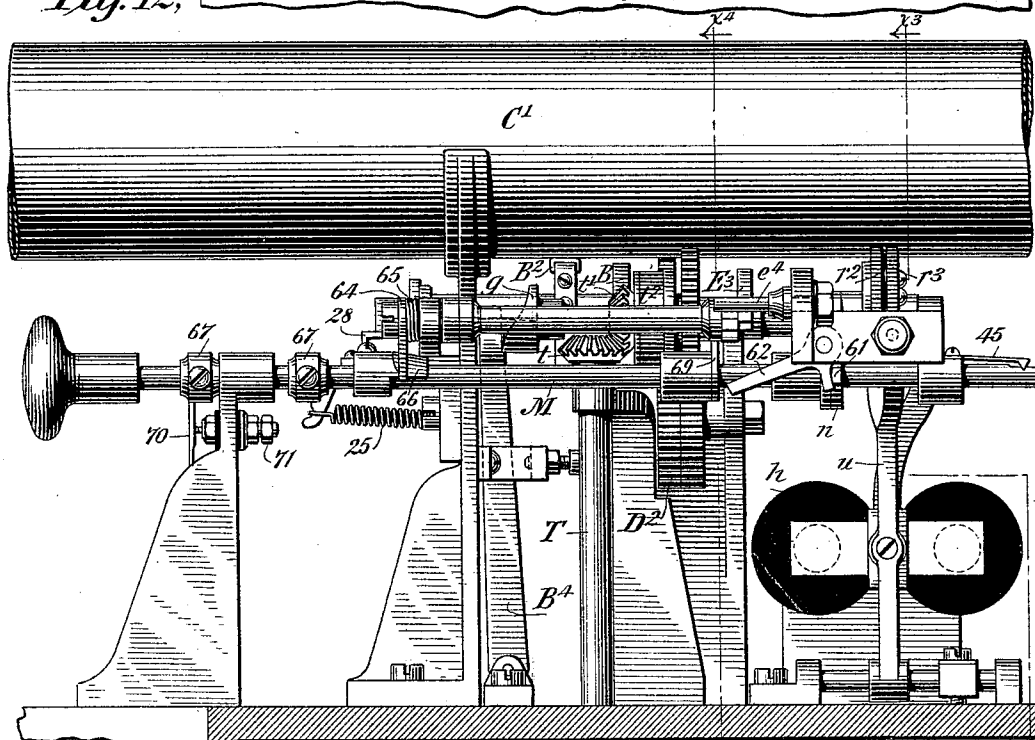


Fig. 12,



Witnesses

C. E. Ashley
14. W. Lloyd

Inventors: $\frac{\leftarrow}{\rightarrow}$

Charles L. Buckingham and
Emil Germann.

By their Attorney

H. B. Townsend

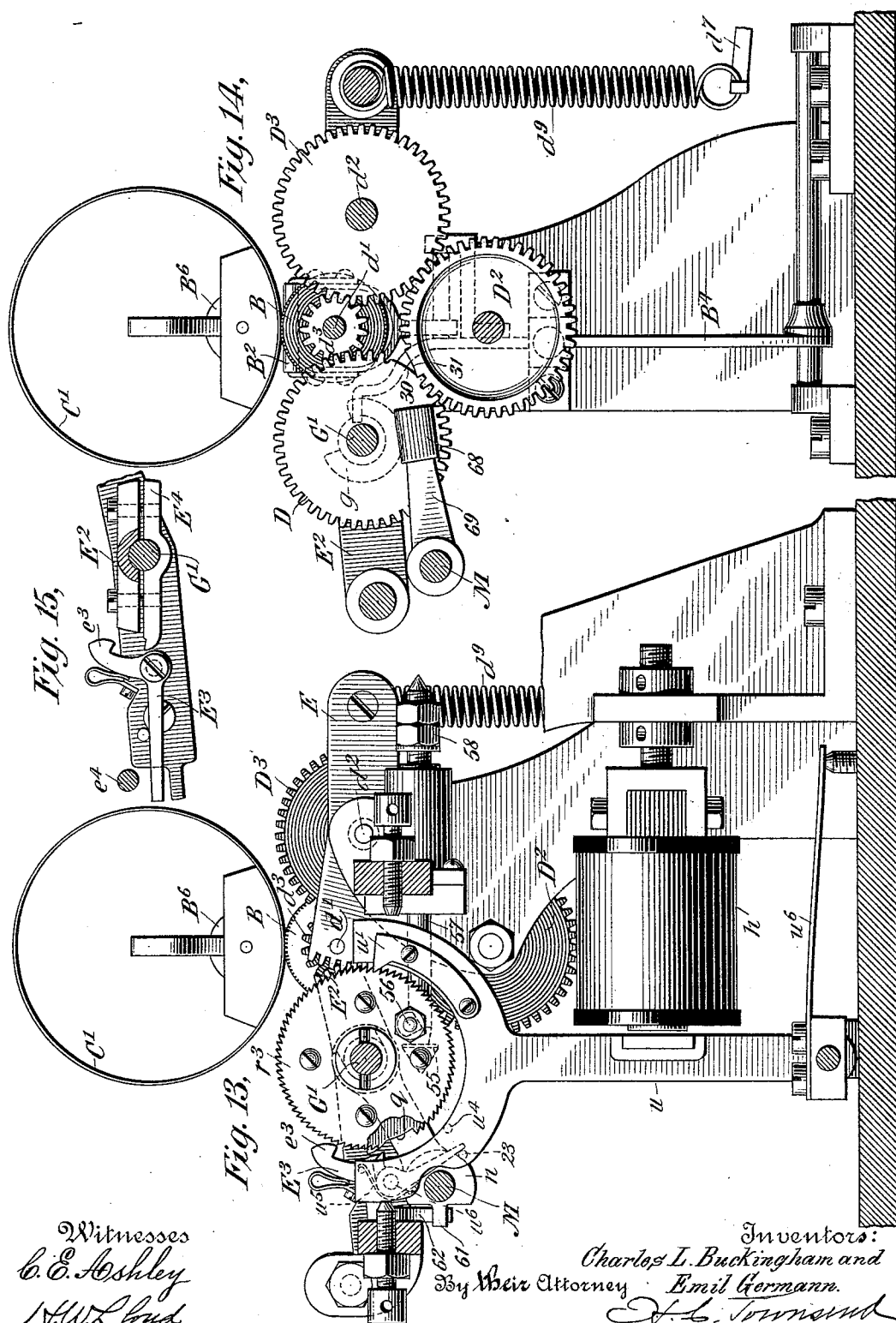
(No Model.)

17 Sheets—Sheet 8.

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.



Witnesses
C. E. Ashley
H. W. Lloyd

Inventors:
Charles L. Buckingham and
Emil Germann.
By Their Attorney
J. L. Townsend

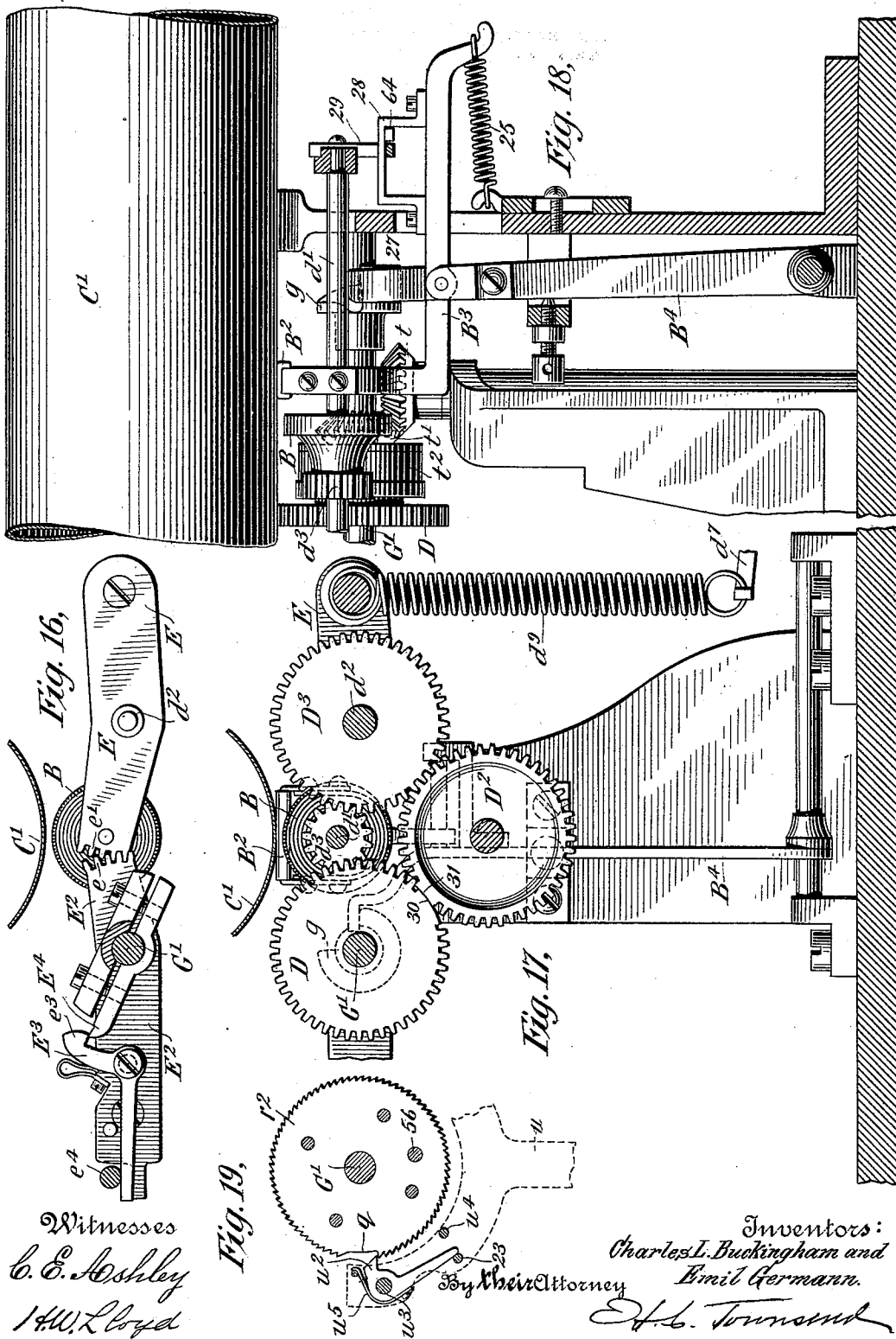
(No Model.)

17 Sheets—Sheet 9.

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.



Witnesses
C. E. Ashley
140 W. Lloyd

Inventors:
Charles L. Buckingham and
Emit Germann.
By their Attorney
J. C. Townsend

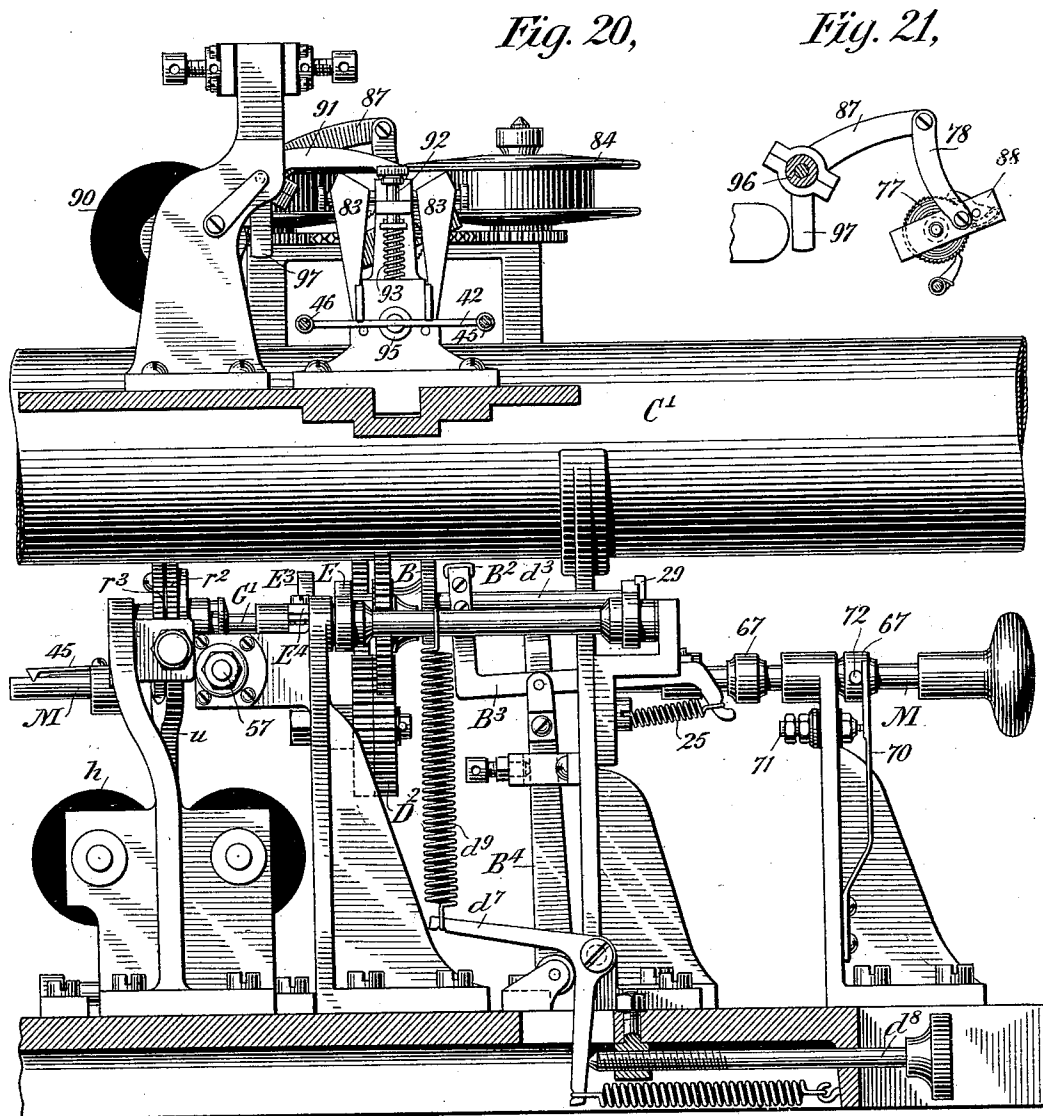
(No Model.)

17 Sheets—Sheet 10.

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.



Witnesses
C. E. Ashley
W. W. Lloyd

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
H. Townsend

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.

Fig. 22,

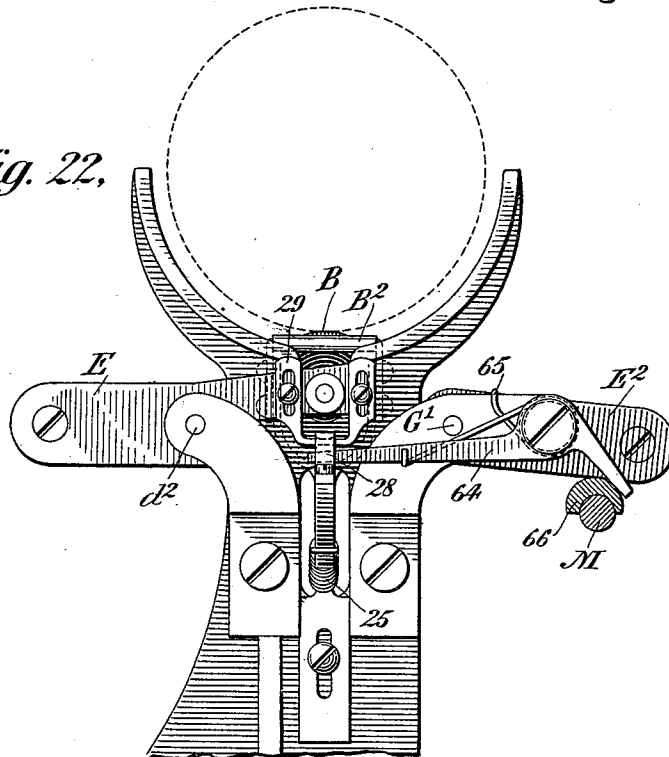


Fig. 23,

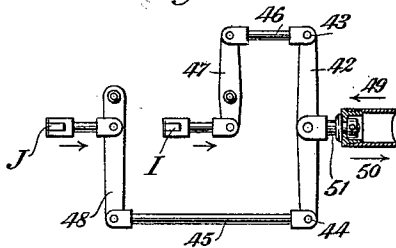


Fig. 24,

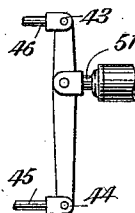


Fig. 25,

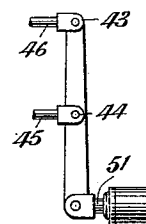


Fig. 26,



Witnesses
C. E. Ashley
H. W. Lloyd.

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
H. L. Townsend

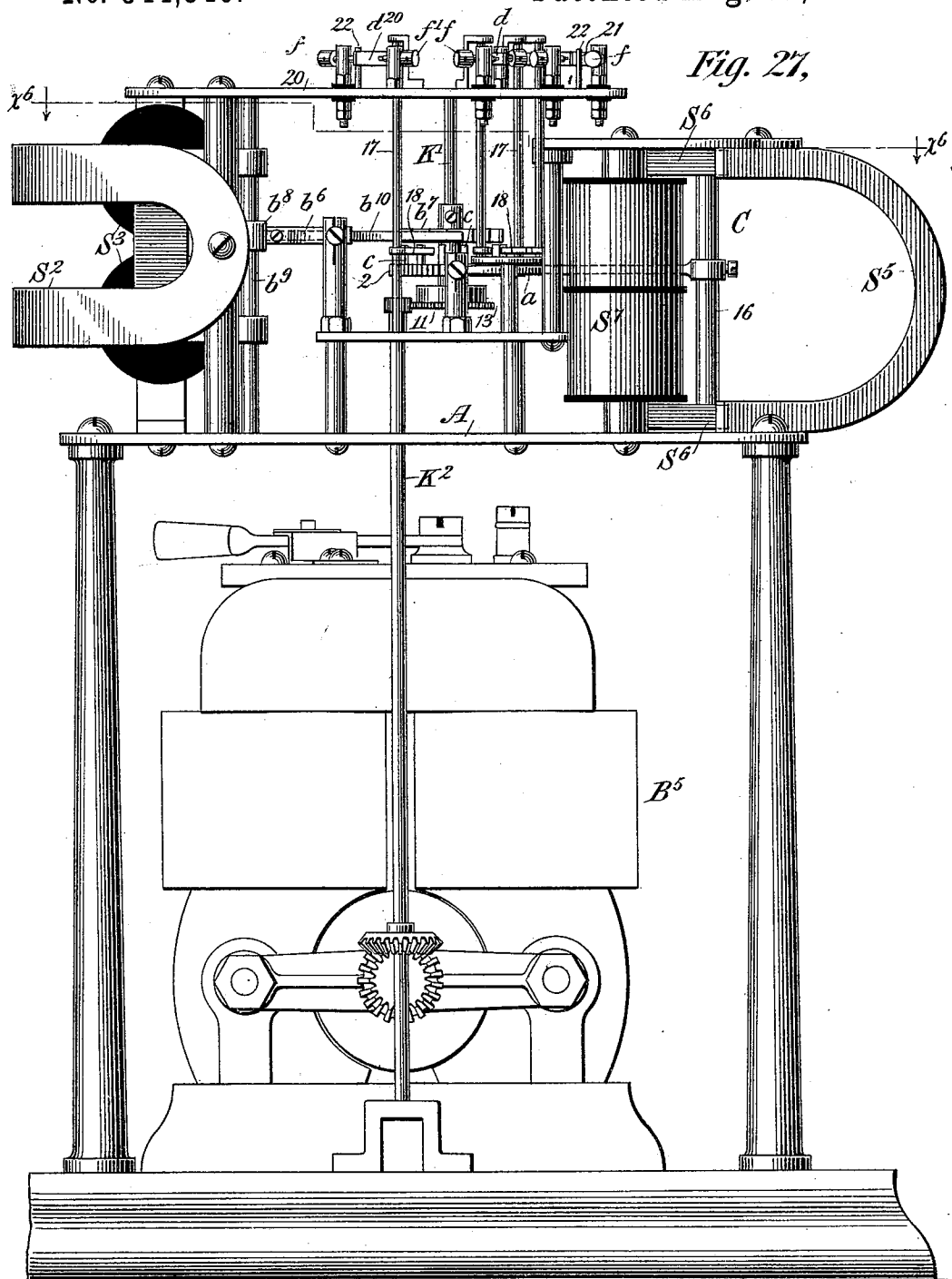
(No Model.)

17 Sheets—Sheet 12.

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.



Witnesses
C. E. Ashley
H. W. Lloyd.

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
J. B. Townsend

(No Model.)

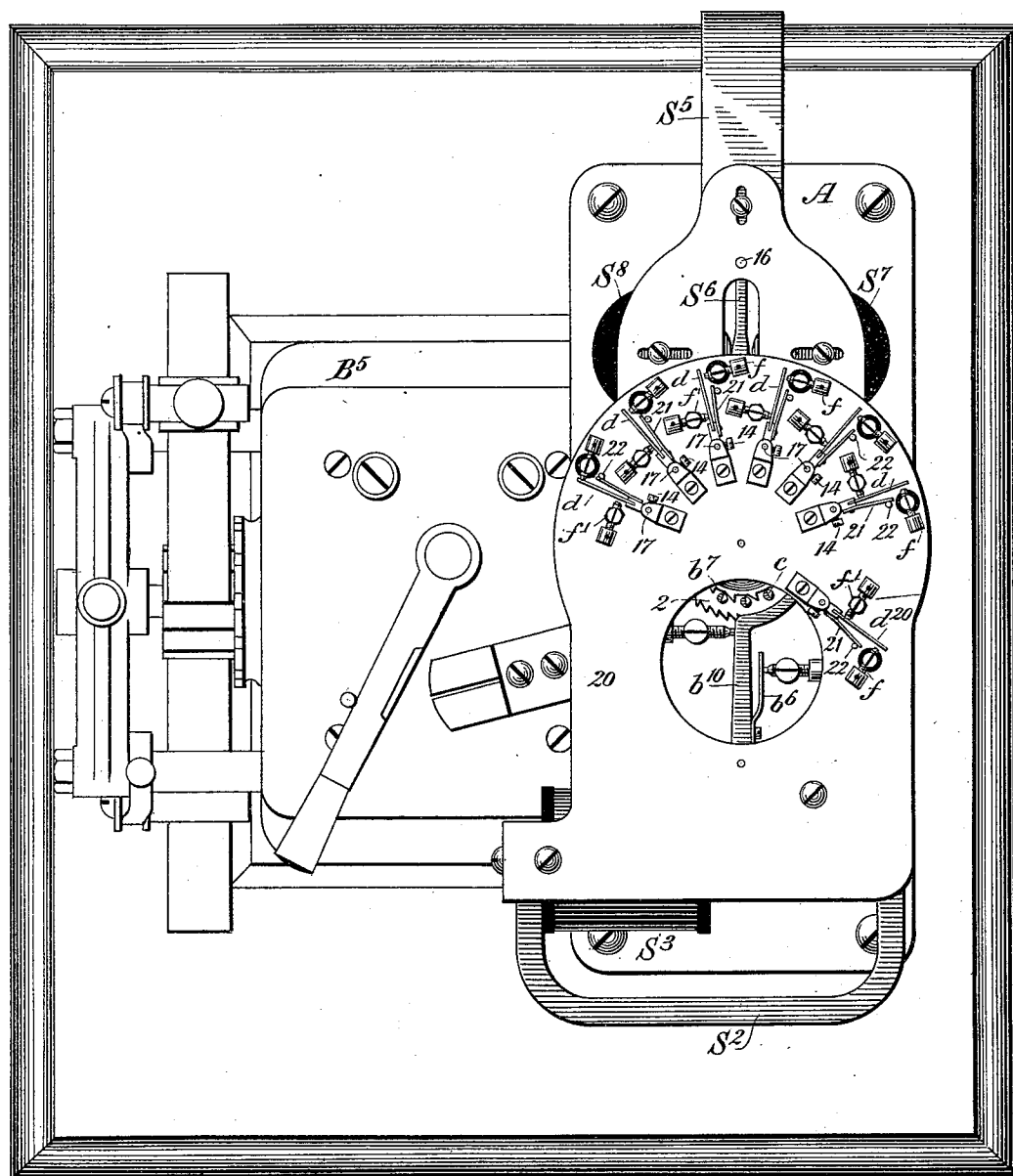
17 Sheets—Sheet 13.

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.

Fig. 28,



Witnesses
C. E. Ashley
H. W. Lloyd.

Inventors:
Charles L. Buckingham and
By their Attorney Emil Germain.
H. Townsend

(No Model.)

17 Sheets—Sheet 14.

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.

Fig. 30

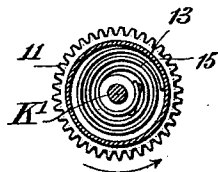
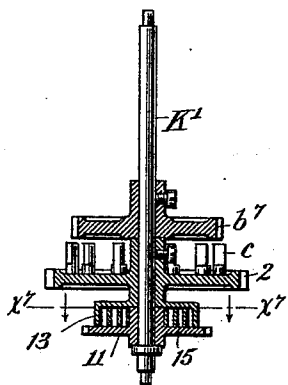


Fig. 31.

Fig. 29,

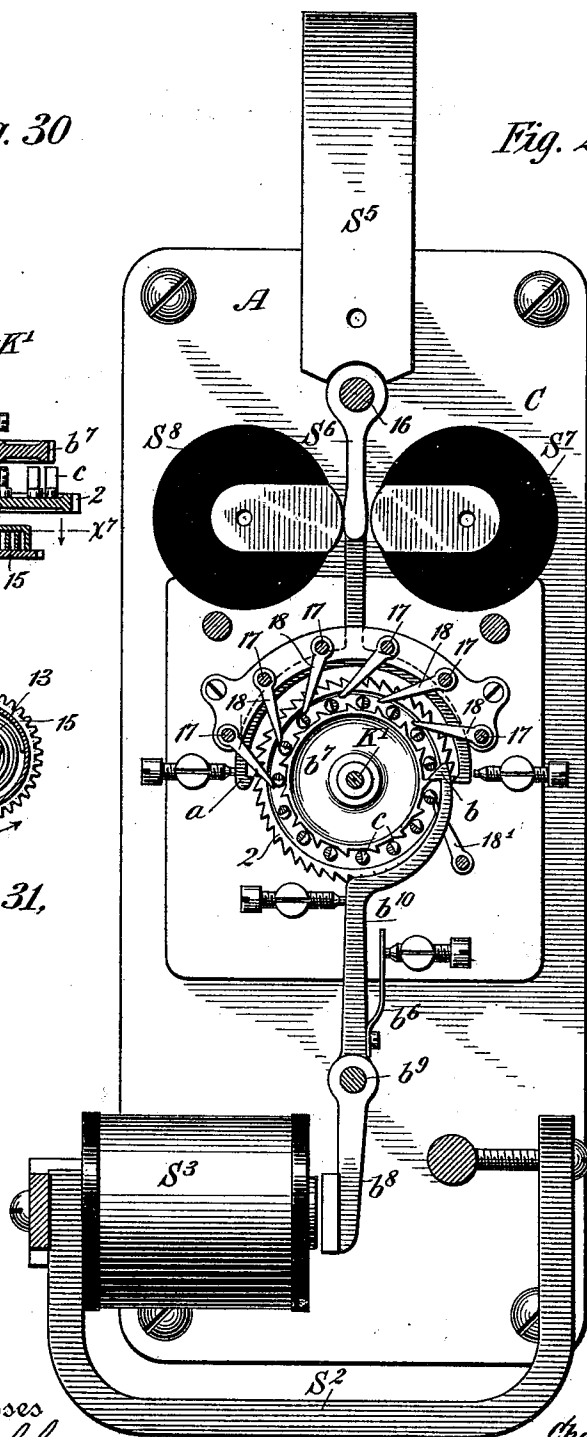
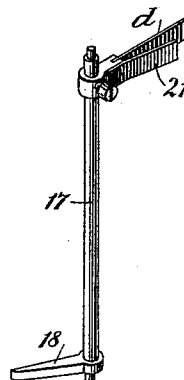


Fig. 32,



Witnesses
C. E. Ashley
J. W. Lloyd.

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
H. B. Townsend

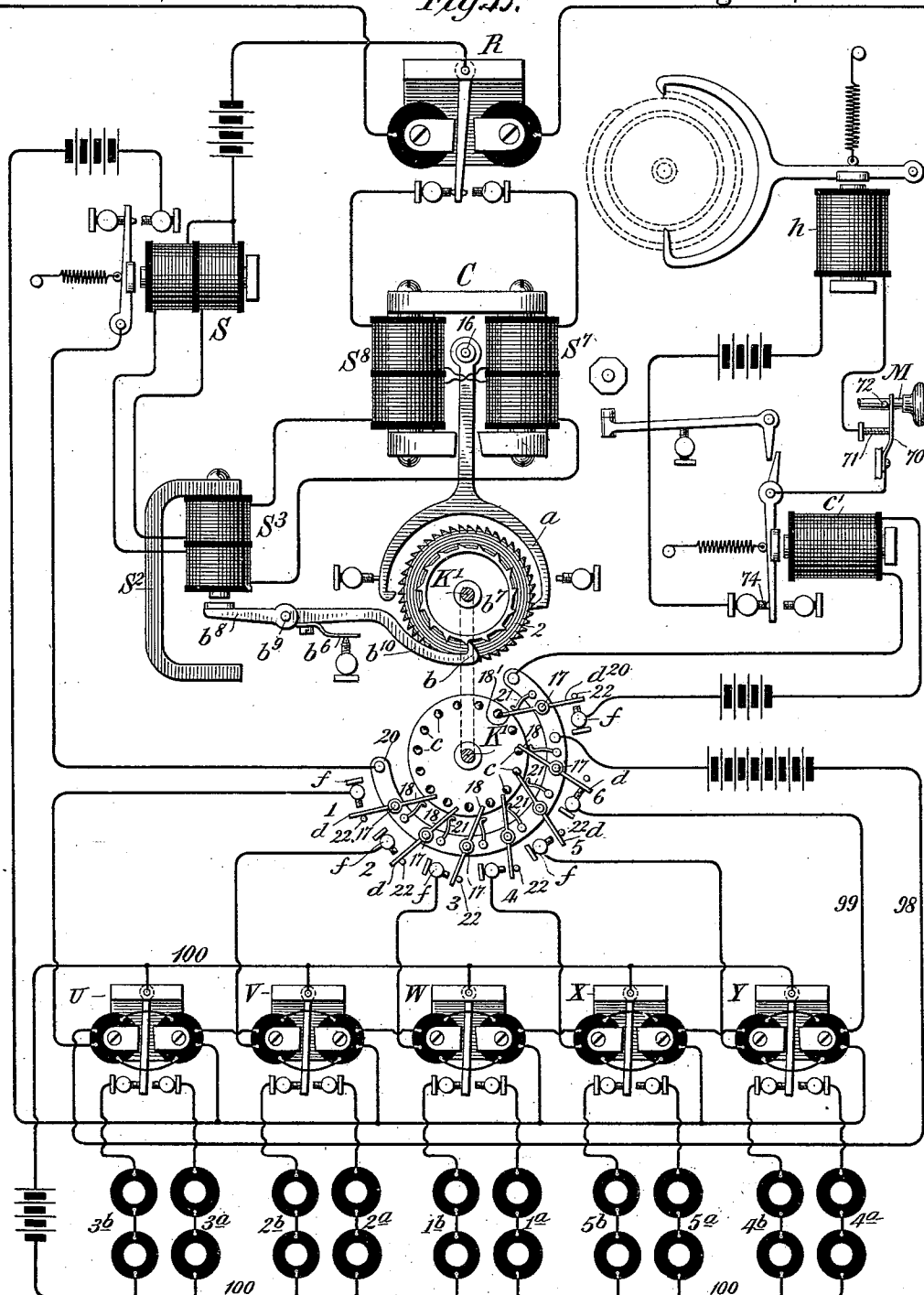
(No Model.)

17 Sheets—Sheet 15.

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Fig. 33. Patented Aug. 13, 1895.



Witnesses
C. E. Ashley
14. W. Lloyd.

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
J. H. Townsend

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.

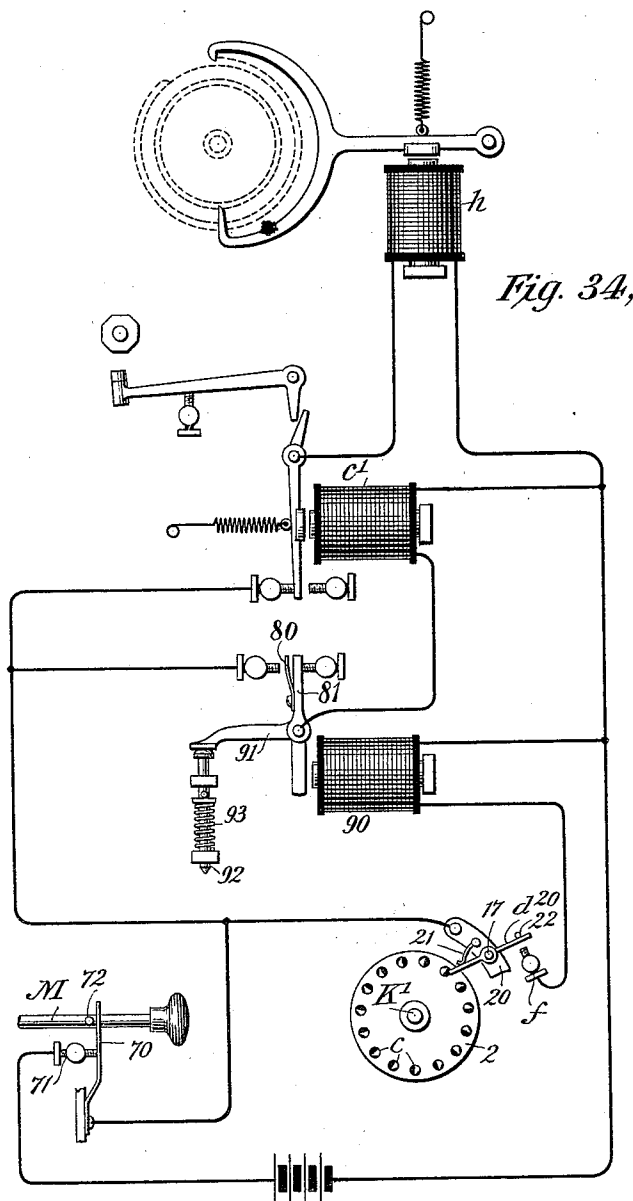
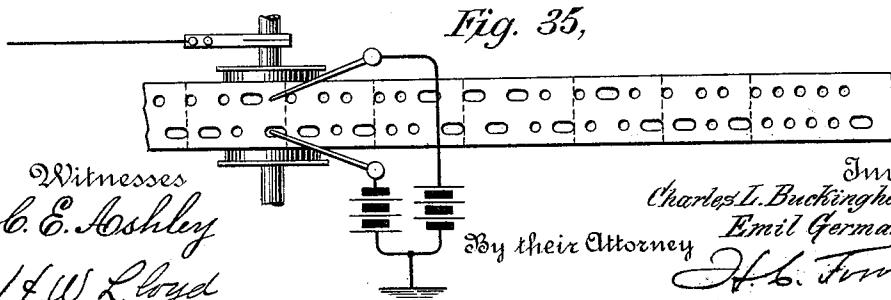


Fig. 34,



Witnesses
C. E. Ashley
H. W. Lloyd

Inventors:
Charles L. Buckingham and
Emil Germann.
By their Attorney
J. B. Townsend

(No Model.)

17 Sheets—Sheet 17.

C. L. BUCKINGHAM & E. GERMANN.
PRINTING TELEGRAPH.

No. 544,346.

Patented Aug. 13, 1895.

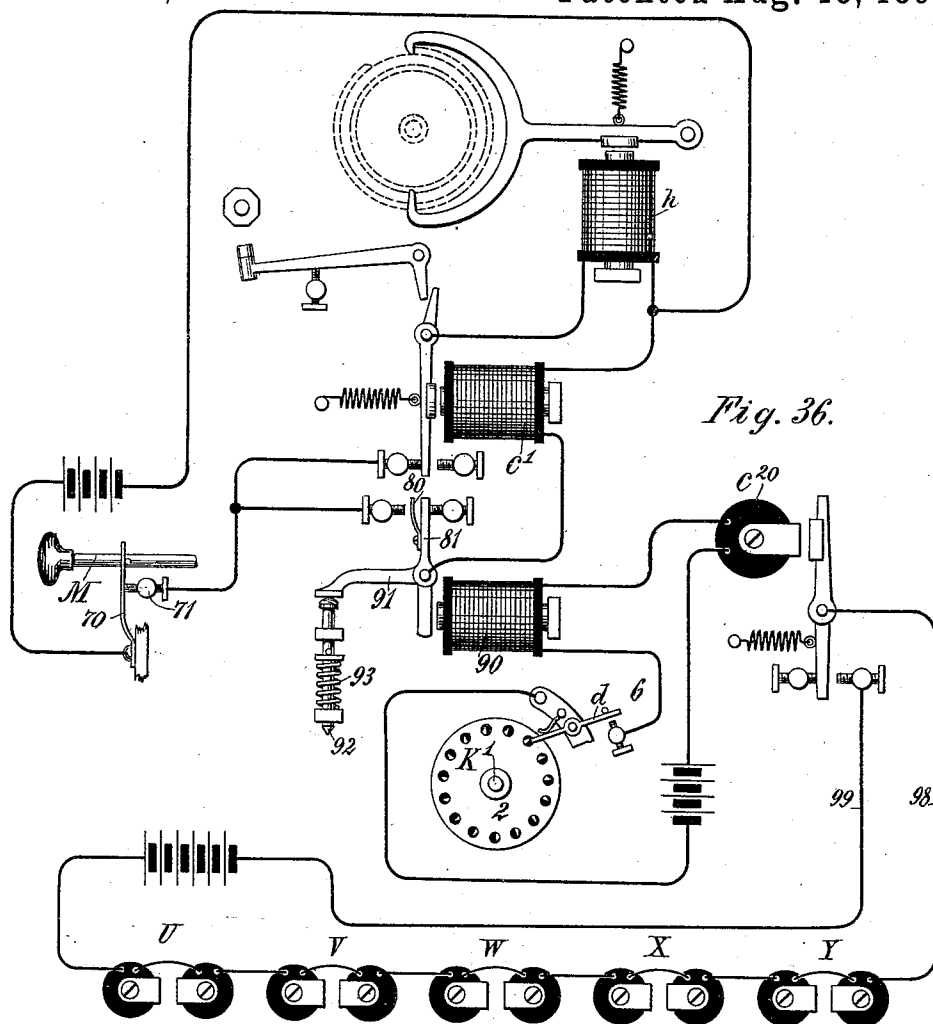


Fig. 36.

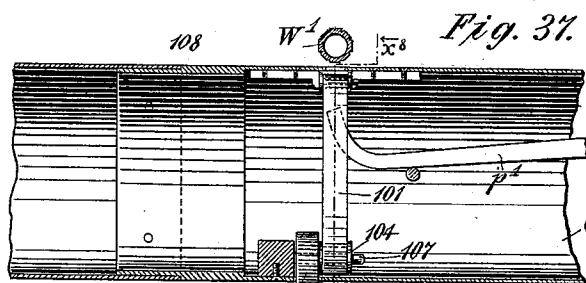


Fig. 37.

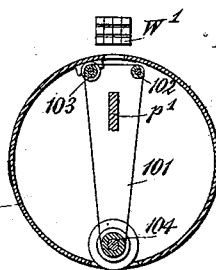


Fig. 38.

WITNESSES:

Henry T. Hirsch
Jm. H. Capel.

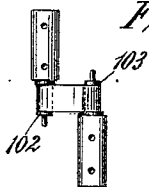


Fig. 39.

INVENTORS:
Charles L. Buckingham and
Emil Germann.

BY

H. C. Townsend
ATTORNEY

UNITED STATES PATENT OFFICE.

CHARLES L. BUCKINGHAM, OF NEW YORK, AND EMIL GERMANN, OF BROOKLYN, NEW YORK; SAID GERMANN ASSIGNOR TO SAID BUCKINGHAM.

PRINTING-TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 544,346, dated August 13, 1895.

Application filed January 10, 1895. Serial No. 534,479. (No model.)

To all whom it may concern:

Be it known that we, CHARLES L. BUCKINGHAM, a resident of New York, in the county of New York, and EMIL GERMANN, a resident of Brooklyn, in the county of Kings, State of New York, citizens of the United States, have invented certain new and useful Improvements in Printing-Telegraphs, of which the following is a specification.

This invention relates to apparatus for printing letters or characters type by type, and is designed more particularly as an improvement upon apparatus in which the characters are printed in page form upon a sheet or blank which is formed into an endless band or tube upon which the lines are printed circumferentially and in which the position of the type-wheel for printing the various characters is controlled by a series of adjusting devices operating singly or in different combinations according to the character to be printed.

The improved apparatus herein described is especially applicable for use as a telegraph-receiver in the system of telegraphy heretofore invented by Charles L. Buckingham, wherein the letters are transmitted each by a definite number of pulses, (preferably positive and negative alternately,) the letter brought into position for printing being determined by prolonging, strengthening, or otherwise modifying one or more of said pulses. It is also useful in systems wherein the adjuster-magnets which control the position of the type-wheel are brought into operation singly or in the proper combinations by transmitting and receiving appliances working either by the Harmonic system, as in Patent No. 487,985, dated December 13, 1892, granted to Charles L. Buckingham, or by the multiple synchronous system, as in Patent No. 487,986, of the same date, to the same party. Some of the features are useful also in connection with other systems or apparatus for printing, as will become apparent from the following description.

The present invention relates mainly to the means for producing a proper feed of the paper tube upon which the lines are printed circumferentially and to mechanism used to facilitate the application of a new tube or

blank without interruption in the continuity of the printing operation when the messages succeed one another immediately or the same message covers two or more pages or blanks. It also relates to the electrical means for controlling the operation of the various type-wheel-adjusting devices.

The paper tube upon which the matter is printed in page form is rotated always in the same direction during the operation of printing, the space between the end of one line and the beginning of the next being covered by rotation in the direction of the letter and word space feed instead of turning the tube back to begin a new line. The space between lines is covered by feeding or moving the tube axially the proper distance at the end of a line. The enlarged or amplified circumferential feed required in passing the margins of the paper from the end of one line to the beginning of the next is preferably accomplished by modifying the letter and word space feed mechanism so that it shall have an enlarged or amplified feed once for each revolution of the paper tube or cylinder. This manner of using and operating the paper tube is the subject of a prior application of Charles L. Buckingham, filed April 16, 1894, Serial No. 507,673, and the present invention is an improvement thereon in the features hereinafter described and claimed.

The present invention consists in the special construction and combinations, hereinafter more particularly described, of two separate but coacting feed devices, one operating the paper tube to turn it on its axis for letter and word spaces and the other a step-by-step feed device which moves the tube axially and automatically on the completion of a line.

Other features of the invention relate to the means for adjusting the type-wheel to various positions to bring different letters in position for printing; and it consists, essentially, in moving the wheel by adjusters which are actuated positively in both directions by an electro magnet or magnets operating alternately.

The invention consists further in combinations of devices and details of construction more particularly hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a perspective view of apparatus embodying our invention. Fig. 2 is an elevation of the same. Fig. 3 is a general plan. Fig. 4 is a general side elevation. Fig. 5 is a detail plan and partial section of the automatic unison-stop for the paper-feed escapement-wheels. Fig. 6 is an enlarged longitudinal cross-section on the line $x x$, Fig. 3, taking in section the mechanism for adjusting the type-wheel circumferentially. Fig. 7 is an enlarged longitudinal cross-section on the line $x' x'$, Fig. 3, through the cylinder on which the paper tube rotates and showing in elevation the paper-feed mechanism. Fig. 8 is a cross-section through the tube on the line $x^2 x^2$, Fig. 7. Fig. 9 is a section through the spring connection between the driving-shaft of the feed mechanism and the motive power. Fig. 10 shows a set of contact-springs secured to the frame and adapted to complete the connections of the press-magnet and the circuit controlled thereby when the press-magnet is fastened to the frame. Fig. 11 is an enlarged plan of the paper-feed mechanism. Fig. 12 is a rear elevation of the same. Fig. 13 is a vertical cross-section on the line $x^3 x^3$, Fig. 12. Fig. 14 is a vertical cross-section on the line $x^4 x^4$, Fig. 12. Fig. 15 is a detail side elevation of the actuating mechanism, which swings the frame carrying the paper-feed wheel at the end of each line of printing. Fig. 16 shows the same device in position to withdraw the feed-wheel at the end of the line. Fig. 17 is a detail view of the paper-feed gear. Fig. 18 is a detail elevation of the device for feeding the paper tube axially and shows the same in position at the end of the feed stroke. Fig. 19 is a detail view of one of the escapement-wheels for the paper-feed mechanism and its corresponding escapement-pallet. Fig. 20 is an enlarged section of the apparatus on the line $x^5 x^5$, Fig. 2. Fig. 21 is a detail of the devices for actuating the feed mechanism of the ink-ribbon. Fig. 22 is an enlarged side view of the devices which control the position of the pad that feeds the paper tube axially. Fig. 23 is an enlarged plan of the mechanism for moving the type-wheel axially and shows in longitudinal section the connection of the said device with the type-wheel shaft. Figs. 24 and 25 illustrate modifications of said mechanism. Fig. 26 illustrates the relative position of two paper tubes at about the end of the printing of the page upon one of them. Fig. 27 is a general side elevation of the distributor or sunflower. Fig. 28 is a plan of the same. Fig. 29 is a sectional plan on the line $x^6 x^6$, Fig. 27. Fig. 30 is a vertical section through the escapement and other wheels of the distributor, and shows the spring connection of the same with their shaft. Fig. 31 is a longitudinal section on the line $x^7 x^7$, Fig. 30, through the barrel containing the spring. Fig. 32 is a perspective view of one of the circuit-closer rock-shafts in the distributor.

Fig. 33 is a general diagram of the connections of the apparatus. Fig. 34 is a diagram of a modification in the manner of controlling the press, paper-feed, and dogging magnets. Fig. 35 is a diagrammatic plan of a perforated paper strip and its connections, whereby positive and negative pulses suitable for operating the apparatus may be transmitted over a line. Fig. 36 is a diagram of a preferred arrangement of the circuits for controlling from the distributor the dogging-magnet, printing and paper-feed mechanisms, and resetting-circuits. Fig. 37 is a detail section through the paper-supporting tube, showing in detail an elastic strip and means for feeding the same between the press and paper. Fig. 38 is a cross-section on the line x^8 , Fig. 37. Fig. 39 is a plan of the means for supporting the elastic strip beneath the paper.

W' indicates the type-wheel that is furnished preferably with three or more rings of type, (here shown with four rings,) as described in the prior patents of Charles L. Buckingham, Nos. 487,981 and 487,982, dated December 13, 1892, and is adjusted into the proper positions for printing the several characters or letters by adjusting mechanisms, different ones of which operating singly or in different combinations serve to determine the presentation of the proper character opposite the press-pad. (Indicated at p' .)

C' is a tubular support, of brass or other suitable material, having a smooth exterior surface. This tube serves as a support for a tubular blank upon which the lines are printed circumferentially around the said blank, the blank being fed or moved circumferentially and axially for the purpose. The blank itself is a sheet formed into a paper tube by cementing the edges together by any suitable means. The formed tube is slid endwise upon the supporting-tube C' . The latter, as shown in Figs. 3, 4, and 26, is preferably of such length as to support two paper tubes at the same time, one of such tubes being that upon which the printing is being done, while the other is arranged in close proximity thereto, so as to be capable of being slipped quickly into position when or about when the first paper tube is filled.

In the drawings, Fig. 26, two tubes are indicated, that one at the right being the one upon which the characters are being printed and that at the left the one which is in position to slide beneath the type-wheel as soon as the last line on the first one has been printed. The end of the supporting-tube is made slightly conical, as shown, to aid in the ready application of the formed paper tube. Sufficient space should be left at the right-hand end of the tube C' , from which end it is supported, to permit the blank when printed to be quickly slipped to one side and a fresh blank to take its place. After the latter has been moved into position for printing the first is removed from the tube by opening it on the line where the edges of the sheet are

joined. The second is then fed along over the tube in the same manner from left to right; Fig. 26, this being the axial movement of the paper tube corresponding to the feed which is necessary to make the vertical space between lines on the printed page.

The press-pad p' works through an opening in the supporting-tube C' beneath the type-wheel W' . This pad is supported on the long arm of a bell-crank lever which is pivoted in a bracket or frame c' , fastened within the supporting-tube C' , as shown in Fig. 7, and has its short arm connected with the armature-lever c^9 of the press-magnet c' by a rod or wire c^{10} extending outside the tube C' through the end thereof at which it is supported on the frame of the apparatus. The magnet is operated in any suitable manner as soon as the letter is brought into position for printing, but by preference through the action of a circuit-controller which causes said magnet to be energized once for each cycle of changes produced by a sunflower or distributor that governs the operation of the adjusting devices by which the type-wheel is fed into the desired positions, and as will be described farther on. The press-lever is retracted by a spring c^8 applied directly thereto, instead of to the armature-lever.

By connecting the press-pad and magnet in the manner described, the use of a magnet of considerable size is rendered expedient and the adjusting devices for the same rendered accessible. This would not be the case if the attempt were made to support the press-magnet within the tube near to the press-pad, since in practice the dimensions of the tube are limited and a magnet of considerable size would not be permissible if the same were placed within the tube. The press-magnet is mounted on a pivoted frame c^5 provided with adjusting-screws c^6 whereby the positions of the magnet may be changed to take up slack in the wire c^{10} and adjust the throw of the press-lever. The armature of the press-magnet is also provided with a suitable contact-spring 73, whereby when the magnet is not energized it may close the circuit by a contact-post 74, and when the magnet is energized to operate the press it will break said circuit.

In the normal position of the press the circuit by spring 73 is closed. This circuit, as will be presently described, includes the escapement-controlling magnet for the paper-feed devices, which are preferably so energized that the feed will be allowed upon a movement of the escapement devices due to the excitation of said controlling-magnet, but not by a movement of the armature thereof, which is produced by breaking the circuit of said magnet at the contact 73. Hence the feed of the paper will take place when the press-pad moves back after making the impression.

At its lower end the armature-lever c^9 is shown provided with an extra contact-spring and stop, whereby, if so desired, the said le-

ver may be made to close a local circuit when the magnet is excited.

Mounted on the frame of the instrument is an insulating-block g^2 , carrying the set of contact-springs g^7 , insulated from one another and adapted to be engaged by contact-pins, (indicated in dotted lines at g^6 , Fig. 10,) the latter being carried by the frame of the magnet c' , and being connected with the two terminals of the magnet and with the post 74 and armature-lever or frame. The springs g^7 being connected to the local circuit in any desired manner, said circuits will be completed through the contacts and through the coils of the magnet when the magnet is placed in position upon the frame of the instrument. The pins g^6 at the extreme right and left may be connected with the terminals of the coils of c' , and the two pins next to them may be connected one with the post 74 and the other be an electrical connection with the frame c^5 . The middle spring g^7 is adapted for engagement by a projection from the contact-post beneath the magnet c' , as clearly shown in Figs. 7 and 10.

To produce the circumferential feed of the paper tube it is preferable to employ a friction device directly engaging with the paper tube. This device is also, by preference, a wheel which remains in engagement with the paper during the printing of a line and is turned intermittently to produce the letter and word spaces.

The axial feed is produced by a device which is normally disengaged and is brought into operative engagement at the end of a line and before the beginning of the next line, the circumferential feed device being automatically withdrawn during such axial feed operation. The axial feed device also, by preference, engages directly with the paper and consists of a friction-pad made to reciprocate after the manner of a pawl and in a line parallel to the axis of the paper tube.

B is the circumferential feed-wheel mounted on a shaft d' whose bearings are in any suitable support adapted to withdraw the feed-wheel from engagement with the paper. This support is herein shown as consisting of the rocking frame E, which for convenience is made to rock on the shaft d^2 of a gear-wheel D^3 in the train of wheels between the feed-wheel B and the devices, by which its intermittent motion is produced. To insure the proper feeding of the paper tube, an idler friction-wheel B^6 may be mounted within the tubular support C' with its edge arranged to rotate in an opening in said tube opposite feed-wheel B. The paper is grasped between the wheels B and B^6 . A spring d^9 , connected to a cross-bar at the rear of frame E, causes the feed-wheel to grasp the paper tube with a yielding pressure. By adjusting the tension-spring and thus varying the pressure the extent of feed at each of the intermittent movements of the wheel may be varied. With a lighter pressure a longer feed will be produced,

and vice versa. A means of adjustment is afforded by a set-screw d^8 , bearing against one arm of an elbow-lever d^7 , the other arm of which is connected to the spring d^9 , as shown in Fig. 20.

D is a wheel fixed to the main or driving shaft G' of the apparatus and gearing with a wheel D², which in turn gears with wheel D³. The latter wheel gears with the pinion d^3 on the shaft carrying the feed-wheel B. The main shaft G' being governed in its movement by a feed-escapement device secured to it, the desired movement of the paper is obtained both for feeding from letter to letter and from word to word, as well as from the end of one line to the beginning of the next.

The escapement devices, which are constructed to allow or produce an enlarged or amplified feed movement of the feed-wheel automatically at the end of a line, thereby covering the margin of the page both at the end and beginning of lines, will be presently described.

The main driving-shaft G' for the paper-feed devices receives motion from any suitable motive power exerting a constant torque—as, for instance, an electric motor of the usual continuous-current rotary type, as indicated—driven by a bevel-gear d^6 , Figs. 2 and 4, the shaft indicated at T, which carries a bevel-gear t , meshing with a gear t' , that is loose upon the main shaft G'. The wheel D, which transmits motion to the feed-wheel that rotates the paper tube, is keyed to said shaft and carries or is fastened to a barrel t^2 , containing a spiral spring t^3 , Fig. 9. One end of said spring is fastened to the barrel t^2 and the other end to the hub of the bevel gear-wheel t' . The motive device which turns the shaft T keeps the spring t^3 under tension, its power being adjusted, however, to that of the spring, so that it shall not wind the spring tightly; but when the spring has acquired a certain tension the power of the spring is sufficient to prevent further movement of the motor. The power stored up in the spring keeps shaft G' under constant or practically constant tension irrespective of any irregularities of movement in the driving-motor and also produces a quick or prompt movement thereof when it is released by the action of the escapement devices. By this means an electric motor can be used to supply the power for driving the apparatus and the difficulty which would arise from the inertia of the motor in stopping and starting if connected directly to the shaft G' can be avoided. A pawl t^6 , applied to one of the bevel gear-wheels at d^6 , prevents the spring from running down when the current is shut off from the motor.

The shaft G' carries or is connected to an escapement-wheel that is released step by step to produce the step-by-step feed of the paper tube through the wheel D and the intermediate gear. It is so constructed as to permit an enlarged or amplified feed movement of the wheels when the end of a line is

reached. The main shaft G' carries also a cam g , that operates upon or controls the devices for giving an axial feed to the paper, as will be presently described.

As an example of a feed-controlling escapement which may be employed for producing a step-by-step feed of the paper tube circumferentially and an enlarged or amplified feed at the end of a line, an escapement of the same general character as that described in an application of Charles L. Buckingham, filed April 16, 1894, Serial No. 507,673, has been shown.

An anchor-escapement lever u , Figs. 12, 13, 19, and 20, is vibrated by the operation of a magnet h , whose armature is secured to said lever, the lever being provided with a suitable retracting-spring u^6 or other suitable device, as shown. The anchor-escapement has two pallets engaging respectively with escapement-wheels indicated at r^2 r^3 . These wheels are connected with the shaft G', so as to be rotated by the power of the spring t^3 when the teeth are released by the pallets of the anchor. Owing to the peculiar construction of the escapement devices two toothed escapement-wheels r^2 r^3 are employed. One pallet u' of the anchor engages with the teeth of wheel r^3 and the other pallet u^2 engages with the teeth of the wheel r^2 . The latter pallet is movable on the arm of the anchor by which it is carried. For this purpose it is properly pivoted at u^3 on one prong of the lever u . Against the tail of the pallet bears a spring u^5 the office of which is to move the toe of the pallet backward in a direction opposite to that in which the escapement-wheel rotates, so as to clear the tooth with which it was last engaged when it comes forward to be engaged by the next tooth of the wheel. A stop u^4 limits the movement of the pallet when it is engaged with the wheel and the latter is permitted to rotate through disengagement of the pallets u' . At 23 is a back-stop for the pallet u^2 .

In order to provide the amplified or enlarged feed at the end of a line, whereby the paper may be fed circumferentially to the beginning of the next line, a blank space q is provided in the wheel r^2 . The effect of this, as will be seen from the explanation to be presently given, is that when the pallet u^2 has been disengaged from the tooth at the forward end of the space q and by the action of the magnet is moved into said space the wheel which is at the same time by such movement released may turn until the tooth at the rear end of the space q engages the toe of the pallet and is stopped thereby. This enlarged or amplified feed-space is adjusted to be sufficient to cover the space or margin (proceeding in the direction of the ordinary feed) from the end of one line circumferentially to the beginning of the next line, the proper vertical space being produced in any proper way.

Normally the lever u stands in position to hold the pallet u^2 in engagement with a tooth

of the wheel r^2 , being held in such position by the attraction of the magnet h . The pallet u' is disengaged. Simultaneously with the operation of the press-pad the circuit of the magnet h is broken and the anchor u is thereby allowed to move backward, in which movement it brings the pallet u' into the space between the teeth of the wheel r^3 and in such position as to allow no or very little movement thereof when the pallet u^2 leaves the teeth of the wheel r^2 , with which it is engaged. In this movement the pallet u' engages before the pallet u^2 is disengaged. At the instant the pallet u^2 is freed from its tooth the spring acting thereon moves its point slightly in the arc of a circle around its pivot to such distance that when the lever u moves forward again under the action of the magnet the point of the pallet instead of moving into position to stop the tooth with which it was last engaged will come into position to catch the next tooth as soon as the wheels are freed by the movement of the pallet u' . As will be seen, therefore, the backward movement of the lever u allows no movement of the wheels, but on the forward movement thereof the wheels are freed by the pallet u' and allowed to rotate a small distance until again locked by the pallet u^2 . This latter movement is confined by the stops for the pivoted pallet u^2 , and in this movement a proper feed of the paper is allowed to take place. The magnet h retains the parts in this position until the next operation of the press, when the action is repeated.

It will be understood that the first action of the press is to discharge the magnet h and allow the lever u to recede, but in this action no feed of the paper takes place. The instant, however, the impression has been effected and the press is restored or makes its backward stroke then the magnet h is excited and a release of the wheels takes place to produce the feed of the paper. The action of the devices is, therefore, to allow the feed to take place on one movement only of the vibrating armature-lever, and yet to secure a positive control of the escapement-wheel.

The action of the magnet may be controlled by any suitable devices or arrangements of circuits, one of which will be hereinafter described and is indicated in the diagram.

When the wheels have rotated to bring the blank space q around opposite pallet u^2 , then the amount of movement will be greatly increased when the magnet h allows the wheels to rotate, the amount being then that of the blank space q plus the amount of movement allowed after the edge of the tooth at the right of the space has engaged the yielding pallet u^2 , as already explained. This position is the zero position or position for beginning a new line of printing on the paper tube.

The magnet h is preferably excited on each back movement of the armature-lever for the press-magnet c' , said armature-lever controlling through its back-stop 74 the circuit of

magnet h , as clearly shown in the diagram, Fig. 33. At each such excitation the escapement-wheels move one tooth and a corresponding movement of the paper tube circumferentially on its support is produced. The gears are so proportioned that the large blank space on the escapement-wheel shall be reached once for each whole revolution of the paper tube, and the tube then moves a long feed-step to cover the margin between the end of one line of printing and the beginning of the next line. At the completion of the movement across the edge of the paper sheet the feed-wheel B is automatically withdrawn from engagement with the paper by the following devices timed to operate in the proper manner upon the support E for said feed-wheel, and the axial feed device then operates.

E^2 is a rocker-frame swung on the main shaft G' or other suitable support, and having on one of its arms a segmental gear e , which engages with a similar segmental gear e' on an arm of the rocker E. Secured to the rocker E^2 , but on the opposite side of its center of swing, is a hook E^3 , pivoted on the side of the frame and having a toe e^3 in position to be engaged by a lifter E^4 , connected with the escapement-wheel or other portion of the mechanism and timed to engage the hook and lift it, together with the end of the rocker to which it is secured at the conclusion of the movement of the escapement feed device by the amplified or enlarged feed already referred to. The effect of lifting the hook, as described, will obviously be to depress the feed-wheel B, thus disengaging it from the paper tube and leaving the latter free to be moved axially the adjusted vertical space between lines on the printed page, immediately after which the hook E^3 is released and the parts permitted to return to normal position and bring the wheel B again into engagement with the paper.

The lifter E^4 is conveniently clamped upon the main shaft G' or other shaft, which carries the feed-escapement, as shown in Figs. 15 and 16, and its time of engagement with the hook may be adjusted by loosening the clamping devices and setting the lifter at any desired position circumferentially on said shaft. The prompt disengagement of the lifter and hook is insured by means of a pin e^4 on a fixed portion of the framework and with which the tail of the hook engages to release the hook just previous to the time when the escapement devices reach the zero-point and the desired axial feed has been produced.

To insure the stoppage of the paper tube always at the same point after the enlarged or amplified feed, so that the new line shall always begin at the same distance from the margin, a suitable locking device is employed to automatically lock the feed-wheel at the end of the required amplified or enlarged feed movement. This locking obviously must take place once for each whole revolution of the tube and of the escapement-wheels and should

be made to occur at or just before the lifter engages with the devices by which the paper-feed wheel itself is moved away from engagement with the paper. The paper-feed wheel being thus positively stopped while engaged with the paper, the latter will always stop at absolutely the same point, which it might not otherwise do if the paper-feed wheel were moved away from it while the said wheel is rotating. Under such circumstances the slight momentum acquired by the paper tube might carry it beyond the proper position, which it must have in order that each line may begin at exactly the same distance from the margin.

The cessation of rotary movement of the feed-wheel is provided for by a lost movement in the train of gear between the wheels D and D² at each whole revolution, the gear-wheels D and D² being for this purpose provided with a blank space which allows movement of the wheel D practically one tooth without moving wheel D². During this lost movement the wheel D², and consequently feed wheel B, are positively locked from movement. The blank on wheel D is indicated at 30 and that on D² at 31, Figs. 7, 14, and 17. Wheel D² is in two parts, one part of which has the blank space, while in the other part, where it engages with wheel D³, there is an unbroken line of teeth around its whole periphery. The blank 30 is formed on the arc of a circle whose center is the axis of rotation of the wheel D, while the blank 31 describes practically the same arc, but forms a depression in wheel D², so that when the two blanks come to coincidence the wheel D may turn a short space without imparting motion to D², but the latter will also be positively locked from movement by the interlocking of the wheels at the blank space. As soon as the wheel D has moved the space of one tooth, more or less, with its part 30 engaged with 31, a new tooth on D will engage with a tooth on wheel D² and the movement will be taken up again.

This blank or lost space is near the end of the blank in the escapement devices, so that the feed-wheel will be brought to rest after the proper circumferential feed has been produced. When this point is reached, but not until then, the operation of withdrawing the feed-wheel B will take place through the operation of the lifter. Just as soon as it is withdrawn it may be allowed to begin to rotate again under the operation of the driving mechanism, while the latter is producing the axial feed. It should be understood that the wheels D and D² have the same number of teeth, but the pitch of the teeth on D is smaller than on D², so that D may always leave and take up D² at the same point.

While for the sake of convenience and simplicity the means for locking or positively stopping the feed-wheel just prior to its disengagement from the paper are made a part of the gear by which power is applied to turn the wheel, it will be readily understood that the said means might be otherwise construct-

ed or applied without departing from the invention, it being only necessary that they should be timed to come into action as described, so as to positively stop the paper before and at the instant it is freed from the control of the feed-wheel. When the feed-roll is mounted and connected with the driving-train, as shown, the torque of the wheel D³, which gears with the wheel d³, mounted on the rocker-frame carrying the feed-roll, is exerted upon the frame in a direction to tend to lift and hold the roll against the paper. This we find in practice to be very desirable, for when the torque is in a direction to depress the wheel the feeding action is irregular and uncertain, even though a spring of considerable tension be applied to the rocker to hold the wheel up.

The axial feed device operates by frictional engagement with the paper tube and is composed preferably of a pad of soft rubber B² or other suitable material, such as cork, mounted on an arm of lever B³, which in turn is carried by lever B⁴, or other suitable reciprocatory support. The support B⁴ is engaged at its upper end by the cam g on the main shaft G' or other suitable shaft, and is moved by said cam in a direction to take a fresh hold upon the paper. This cam may be made adjustable circumferentially on the shaft for the purpose of adjusting the time of operation of the axial feed. When the feed of the paper is to take place the cam releases the lever and the latter, under the influence of a spring in which power has been stored by the action of said cam in moving the lever backward, now moves forward and feeds the paper by the action of the pad B², which has been brought up into engagement with the paper automatically through devices connected with or timed to operate with those by which the feed-wheel B has been lowered. The spring 25, which actuates the support B⁴, may be applied thereto in any desired way. It is here shown as connected to one arm of the lever which carries the feed-pad and in such manner as to tend to lift the pad up to engage with the paper. The spring indicated at 25 is fastened at one end to the frame and at the other to the arm of lever B³, Fig. 18. As will be obvious the movement of the lever B⁴ to the right will put the spring under additional strain. In order to insure a cessation of this rearward movement of the lever and pad before the feed-pad B² is permitted by proper devices to engage the paper, the end of the cam g just before the releasing-shoulder is reached is made straight, as shown at 27, Fig. 11.

The movement of the axial feed-pad upward into engagement with the paper is controlled by means of a connection of lever B³ with one or the other of the rockers in such way that when the latter are operated to lower wheel B the spring 25 will be permitted to swing the lever B³ and raise the pad. The latter will, as is apparent, describe an upward

and backward movement, thereby causing it to wedge itself slightly on the paper, and so as to have a good grip when the lever B^4 is released by the cam. The connection of the lever B^3 and the rocker is shown as consisting of a yoke 28, fastened to the lever, and a link or hanger 29, carried by an arm of rocker E^2 and vertically adjustable thereon, as indicated in Fig. 22. When the latter is operated by the lifter on shaft G' , the right hand of lever B^3 is permitted to drop under the action of the spring which lifts the pad. Normally the right-hand end of B^3 is held up by the rocker, which is provided with a proper spring or retractor d^9 , as already explained, which restores it to normal position when the lifter leaves hooks E^3 . The connection of the axial feed pad or pawl with the devices which lower it are, as seen, such as not to interfere with the backward movement of the feed device preparatory to moving the paper another step or with its movement forward to feed the paper.

The general operation of the paper-feed devices thus far described is as follows: After each impression of a letter or character by the press-pad, the escapement-magnet h allows the escape-wheels to rotate one step, thereby permitting the shaft G' and wheel D to move and to move the circumferential paper-feed wheel B the required distance between letters. At the termination of each word it may be moved one or more spaces by repeating the operation of the press-pad on the blank of the type wheel. This movement is repeated during the printing of the line, during which operation the axial feed-pad remains out of engagement with the paper being held there, owing to the fact that the rockers are held in position by the action of their retractors with the right-hand end of the lever B^3 carrying the axial feed-pad raised, its opposite end being thereby depressed. The same retractor by holding the end of the rocker E down lifts the inner end and holds the paper-feed wheel B against the paper. As soon as the escapement devices reach the amplified feed or blank space in the escape-wheels, the extent of which blank space is determined by the total margin to be covered at both edges of the page, the shaft G' is permitted to move the required distance without interference from the escape-wheel, which movement takes place in a very short instant of time, as the shaft G' is under the stress of the spring d^3 . This movement quickly turns the wheel D , and with it the feed-wheel B , a long space. At the beginning of this movement there is no change in the relative position of the other parts of the mechanism, and the feed-wheel continues its movement, rotating the paper tube past the end of one line and across the margin between the edge of the paper and the beginning of the next line on the page. At this point the blank space in the gear-wheels D D^2 is reached, positively locking the feed-wheel from further movement, although the

shaft G' is free to continue its movement. This point of locking is reached shortly before the blank space or enlarged feed-space g in the escapement-wheel is covered, thereby permitting a slight further movement of the shaft G' for the completion of the operation of feeding the paper before a new line is begun. The feed-wheel being thus positively brought to a stop, the lifter E^4 , coincidently with said stoppage or immediately thereafter, takes against the hook E^3 , thereby operating the rockers and moving the feed-wheel B from engagement with the paper, while at the same time permitting the spring 25 to turn the lever or arm B^3 on which the feed-pawl is mounted, thereby moving said pawl upward and slightly backward to engagement with the paper. This movement of the two feed devices takes place in the slight movement of shaft G' , permitted before the end of the blank space on the escape-wheels is reached. As soon as the axial paper-feed B^3 is engaged, the lever B^4 escapes from the cam and the axial feed is produced. During the movement of the rockers the shaft G' is revolving and the hook on the rocker is engaged and continues in engagement until the hook is dropped by the tail of its lever engaging with the pin on its frame. As soon as this has taken place and practically coincidently with it the escape-wheel will have reached the zero position or point of rest at the end of the enlarged or blank space g thereon and ready for the beginning of a new line. The passage of the actuating-arm by the hook on the rockers allows the latter to return to normal position, thereby bringing the paper-feed wheel into engagement with the paper and lifting the right-hand end of the lever B^3 , so as to withdraw the axial feed device from engagement, the same having now completed the axial feed. The revolution of the shaft G' now begins in the printing of a new line, and the cam g in its revolution moves the lever B^4 back to position for producing another axial feed movement after completion of the line. The tube C' is provided with a proper index-mark with which the joined edges of the paper sheet formed into the tube should coincide when the paper tube is slipped upon the tube C' , in order that the printing of the line may begin at the proper distance from the margin of the page.

In order to allow a new paper tube to be instantly slipped under the type-wheel when or about when the end of the last line of a tube is reached, we provide means for withdrawing the feed-wheel B from engagement with the paper, and at the same time holding down the axial feed pad away from engagement with the paper. This may be done by the operation of a single slide-rod or manually-operated device under the control of the operator, and which governs both paper-feed mechanisms at the same time, in the manner described. Coincidentally, or practically coincidentally, with the manipulation of said

manual device the fresh tube is moved axially upon the tube C' into position beneath the type-wheel, the tube previously printed upon being by such movement slipped to one side.

5 There is also provided a suitable mechanism, also actuated or controlled by the same manual controlling devices for disengaging the escapement-wheel for the paper-feed devices from the escapement-pallets, thereby permit-

10 ting said wheel to run freely under the action of the motive power to the zero or starting position, so that the printing on the new page may begin at the proper marginal distance from the edge next the beginning of

15 lines. This additional device for freeing the escapement-wheels is rendered necessary by the fact that in the rapid operation of the apparatus when used as a telegraph-receiver it is impossible for the operator to time the ac-

20 tion of slipping a fresh tube into position with the arrival of the escapement devices at the blank space or space for producing the enlarged feed. By, however, freeing the said wheel from the escapement device at any

25 point and by the provision of an additional automatic stop properly located to come into action when the wheel is thus freed from the escapement, the apparatus may be caused to begin upon the new page always at the same

30 point. Apparatus constructed in detail as will be now described may be used for these operations.

M is a suitable actuating slide rod or bar provided with an operating-handle, and n is

35 an arm attached to said bar and engaging by means of a fork with the hub of the escapement-wheels r^2 r^3 , said hub being provided with a circumferential slot with which the ends of the fork engage, whereby the wheels

40 may at all times revolve freely, but may by means of the said slide-rod be moved axially on their driving-shaft. To permit them to be so moved the said wheels are connected with the said shaft G' by a spline or feather con-

45 nection, whereby they are rotated positively by said shaft, but may slide longitudinally thereon. A check-spring 45 may be provided to hold the actuating-slide in normal position, so as to prevent accidental sidewise

50 movement of the said escapement-wheels. The check-spring 45 is secured at one end to the frame and at the other end is provided with a dog entering the groove or notch in the side of the slide-rod. A forcible application

55 of power to the slide-rod, however, disengages the spring.

When the escape-wheels are moved to one side they are, as will be obvious, disengaged from the escapement-pallets which control the

60 movement of said wheels, and said wheels might therefore revolve freely under the action of driving power for shaft G'. Their movement of rotation, however, when thus freed is controlled by an automatic zero-stop indicated at 55, Fig. 5, which is arranged in

65 position to be engaged by a pin 56 on the side of the escape-wheels when the wheels rotate

freely in the new axial position into which they are placed by the operation of rod M. The stop and pin 56 are relatively arranged 70 so that the wheel will be stopped in the zero position or position which practically coincides with the end of the enlarged or amplified feed-space thereon.

The stop 55 is preferably constructed as a 75 spring or automatically retractible stop, for which purpose it may be formed or mounted on the end of a rod 57, Figs. 5 and 11, adapted to move in suitable bearings, as indicated, and furnished at one end with a limiting-collar 58 80 that limits its movement under the influence of the escape-wheels when the latter are moved to zero position. This collar 58 might be made adjustable on the rod 57, and is in any case arranged to stop the movement of the 85 rod 57 at the proper or zero position of the escapement-wheels. The retracting action is provided by means of spring 59, which surrounds the rod 57 and is held within a suitable case, as clearly indicated in the sectional 90 view, Fig. 5.

The slide M is moved by hand backward in a direction to return the escapement-wheels to their position on the shaft G', where they will engage with the pallets of the escape- 95 ment. The stop and the escapement are properly arranged in such relative position to the escapement that in this reverse or return movement the wheel shall be in position to engage the pallet before the pin 56 leaves the 100 edge of the stop 55. By the retracting action of the spring the stop is withdrawn out of the way of the stop-pin 56 just as soon as the latter leaves the stop on movement backward to position for engagement by the escapement 105 devices. Hence it will be out of the way of the pin if after the printing of a few letters at the beginning of a line the slide should be operated to draw the wheel back again, as would be done if the message should end with 110 such few letters and it should be desired to reset the apparatus for beginning a new message. The stop when retracted is, however, in proper position to be engaged by the pin 115 56 when the latter has been rotated nearly the whole circle of rotation and is moved by the slide M axially, as before stated.

The rod M operates upon the wheel B to withdraw it by means of a pin 61, Figs. 12 and 13, or other device which engages with 120 the vertical arm of a bell-crank lever 62, thereby lifting the long or horizontal arm of said lever which engages the rocker E² in a manner to operate it in the same direction that the lifter E⁴ and hook E³ move it. 125

In order to keep the axial feed device from engaging with the paper when the circumferential feed is withdrawn by the operation of the slide M, said rod may be made to operate upon the lever B³ by means of the lever 64, Fig. 130 18, which takes under the yoke 28 carried by said lever and tends to raise the yoke end thereof when the slide M is operated, thus depressing or holding the end B² of the lever B³

down. The lever 64 is conveniently controlled in its operation by a cone-shaped cam 66, Figs. 11 and 12, on the slide which normally holds the rear end of the lever lifted, and the end 5 which takes into the yoke 28, Fig. 18, depressed so as not to interfere with the normal operations of the axial feed device. When, however, the slide is operated the cam 66 allows the lever 64 to move under the action of a suitable spring 65, and to thereby engage with the yoke and hold the lever B³ out of operative position. Suitable stops 67 applied to the rod M limit the motion thereof in both directions. There is also provided a suitable brake 68 10 which is attached to an arm 69 secured to said rod and is adapted to engage with a portion of the train of wheels when the rod is operated to disengage the escapement-wheels from their escapement-pallet, Fig. 14. This brake is 20 provided to prevent the wheel-work from running too rapidly to the zero-point. The brake may be applied to any wheel of the train, but preferably to the wheel D, as shown. The arm 69 is made as a spring to give a yielding 25 action when the rod is operated.

It will be obvious that other mechanical devices of well-known construction might be interposed between the slide M or other controlling device and the two feed devices for 30 holding them out of action, and that other mechanical connections would be suitable for moving the escapement-wheels longitudinally to free them from the escapement.

As many such variations are within the domain of ordinary mechanical skill, we wish it to be distinctly understood that we do not limit ourselves to the special devices shown, as the invention consists so far as this part of the apparatus is concerned broadly in the 40 simultaneous control of the various devices in the proper manner as described to permit a new paper tube to be slipped onto the support and at the same time to allow the escapement-wheels to move freely to the zero position. 45

To further assist in the operation of slipping a new tube into place, we may combine with the latter a circuit-controller which is operated by or at the same time with the said manual controller, so as to cut off current from the magnets *h* and *c'*, one or both. Such a circuit-controller may operate as a simple circuit-breaker placed in the direct circuit of the magnet or in the circuit of any device controlling said circuit. The circuit-controller 55 shown, Figs. 11, 12 and 20, consists of a spring 70 that normally closes the circuit of the magnet by bearing against a stop 71. A pin 72 on the slide engages with the spring and draws it away from its stop when the slide is drawn back to free the escape feed-wheel, thus breaking the circuit of the magnet. This circuit-controller serves to stop the operation of the printing-pad, which, being a rapid succession of blows and forming at each blow a projection outside of tube, might prevent a new paper tube being slid into posi-

tion. It also effectually stops the paper-feed magnet from being actuated. Other forms of circuit-breaker could obviously be used for 70 the same purpose. In the manipulation of these devices the operator draws the slide M by one hand and at the same time slips the fresh paper tube forward by the other hand to position under the press-pad. In this action the new paper tube displaces the one in 75 use by sliding along the metal tube from which it is subsequently removed. As the whole operation may be accomplished in the fraction of a second no material interruption 80 to the printing of the message need occur.

In the diagram, Fig. 33, the circuit-breaker 70 is shown in the direct circuit of the magnet. It might be placed in other positions—as, for instance, in the position indicated in 85 the diagram, Fig. 34—where it would also operate to prevent any action of the press-magnet when the transfer of paper tubes is made, thus insuring freedom from interference by the press with the sliding movement of the 90 tube into position for printing.

The type-wheel W', to the control of which the distributor just described may be applied, is preferably constructed with a number of rings of type, as described in prior patent of 95 Charles L. Buckingham, No. 487,981, and may be adjusted circumferentially and axially to the different positions required for printing its characters by means of various impelling devices brought into operation successively 100 or simultaneously in proper combinations, as described in that patent and in Patent No. 487,982. By the axial movement any desired ring of type is brought into line with the press-pad, and by the circumferential movement any desired type of that line is brought 105 to position. By these movements singly or in combination any type of the several rings may be brought into position.

F G H I J, Figs. 2 and 6, are adjuster 110 levers or arms operated by connection with the armatures 12 of corresponding adjuster-magnets or pairs of magnets numbered 1^a 1^b 2^a 2^b 3^a 3^b 4^a 4^b 5^a 5^b. These arms operate upon drivers and followers of any proper construction, as described in those patents, some 115 to rotate the wheel and others to move it axially. The means herein shown for rotating the wheel are substantially those of Patent No. 487,981; but those for procuring the axial movement are somewhat modified, being simplified particularly in their manner of operation upon the type-wheel shaft. 120

w' *w*² *w*³ are the axially-moving drivers, upon which the arms F G H operate to rotate 125 the type-wheel to different positions circumferentially, while *i* *i*² *i*³ are the corresponding followers with which the drivers engage. Each of the drivers is provided, as shown, with a collar having a groove within which 130 project pins extending from prongs of the impelling-levers F G H, thereby allowing rotation of each driver under the action of other impelling-levers. Each follower *i* *i*² *i*³

is provided with a spiral slot into which takes a pin of the corresponding driver w' w^2 w^3 , so that when the driver is moved axially by the impelling-lever the follower will be compelled to rotate and thereby rotate the type-wheel. Each follower is held from endwise motion in a ball-bearing in which it is adapted to rotate freely. Each driver w^2 w^3 is provided, as shown, with a pin which takes into a straight slot in the follower to the rear, whereby the driver may be moved axially without rotating the follower to the rear, while if the follower to the rear be rotated the driver ahead will be compelled to rotate with it. The extreme driver w' to the right has a pin which takes into a straight slot in the fixed bearing and by which it is thereby held from rotation when actuated axially by its impelling-lever. The extreme follower i^4 to the left is connected with the type-wheel shaft or extension thereof by a straight slot and pin, as shown, whereby the type-wheel will be compelled to rotate with the follower i^4 , but may be nevertheless itself moved axially by devices to be presently described, for the purpose of presenting different rings of type to the impression-pad. By preference the spiral slots in the followers upon which the impelling-levers F G operate are cut in one direction and reversely to the spiral slots in the follower i^4 upon which impelling-lever H operates, so that F and G will move the type-wheel in one direction of rotation from position of rest and H will move it in the other direction in case any one of said levers be moved by itself. As explained in the Patents Nos. 487,981 and 487,982, above referred to, it is by this means rendered unnecessary to rotate the wheel more than half-way in either direction to bring any type of a ring into position for printing. By a combination of the movements of the levers the type-wheel may be caused to take any one of the positions required for printing from any particular type of a ring. The follower i^4 is adapted to turn the type-wheel one-half a revolution and under the impulse of the impelling-lever II, while the followers i^2 and i turn the wheel in the opposite direction respectively one-quarter and one-eighth of a revolution. This proportion and combination of followers provides for bringing any one of eight types in a ring to position for printing and by a revolution of the wheel in no case more than one-half from the normal position of rest.

The impelling or adjusting levers I J operate upon mechanism which serves to adjust the type-wheel axially to positions for printing from different rings of type-wheel. When both are at rest in normal position, the ring next to the right-hand side of the type-wheel, Fig. 6, can be printed from. When the lever I operates, the wheel is moved axially to the left to bring the next or extreme right-hand ring into position opposite the press-pad. Lever J, operating alone, moves the wheel

the axial space of two rings to the right to bring the extreme left-hand ring into position, while if lever I be operated at the same time the wheel will be adjusted axially backward from position to print from the extreme left-hand ring, so as to bring the next ring or left of the two inner rings into position, which latter is the position shown in the figure. As will be understood, these axial adjustments may take place simultaneously with the operation of turning the wheel by the followers at the other end of the shaft or may take place while said followers are stationary. For producing these different adjusted positions of the wheel axially by the action of the levers singly or in combination, any means—such, for instance, as those described in the prior patents herein referred to—may be employed. We prefer, however, to employ the following simplified means devised by us, which insure certainty and rapidity of action, but which we do not claim herein, as they form the subject of another application for patent filed by us, wherein we have set forth the use of the device for producing not only the axial but the circumferential adjustment also. The distinguishing feature of this device is an arm or lever both ends of which are movable singly or together under the action of the two impelling devices, respectively, and each around the other as a fulcrum, while said arm or lever is itself connected to the axially-movable wheel. By moving one end of the lever about one fulcrum the wheel may be moved axially a certain distance. By moving the opposite end about the other as a fulcrum the wheel may be moved axially another certain required distance, preferably different in extent from the first. If the extent of movement be made greater in one case than in the other, the simultaneous movement of both ends each at the same time about the other as a fulcrum will cause the point of attachment to the type-wheel axis to move to an intermediate extent or position, which is the resultant of the combined movements.

By preference we cause one impelling device to move the wheel in one direction and the other to move it in the opposite direction, since by this means we limit the extent of the movement which it is necessary to give in order to secure the three adjusted positions of the type-wheel axially. Preferably we connect the type-wheel axis to the center of the lever and secure different extents of movement accompanying the action of the impelling devices singly by moving the impelling devices themselves different distances; but it would obviously be within our invention to connect the type-wheel to one side of the center of the lever or to some part thereof such that the impelling devices at their point of attachment to the bar should have different mechanical advantage, so that the same extent of movement of the opposite ends thereof would produce different extents of

movement at the point of attachment of the type-wheel axis.

Figs. 23 and 24 show the arrangement wherein the type-wheel is connected to the center of the lever. 42 is the lever, and 43 44 the two fulcrums formed by the pivotal connections of the links 45 46 with said lever. Through the latter links the adjusting or impelling devices I J operate upon the lever 42, I being connected to a lever 47, to which 46 is joined, and J to a lever 48, to which 45 is joined. The type-wheel axis is connected to 42 by a short rod or piece 51, which is pinned at one end to the lever 42 and at the other connected to the shaft or axis in such way as not to interfere with the free rotation thereof, while at the same time being adapted to move it positively backward and forward. For this purpose the piece 51 is turned down so that it may pass through the end of a bushing tapped into the hollow end of the type-wheel axis, and within the end has a head fastened to it, as shown in Fig. 23, the whole forming a simple coupling adapted to the purpose stated. Adjuster I turns the end 43 of lever 42 about 44 as a fulcrum, so as to move the shaft the space of one ring of type in the direction of the arrow 49. Adjuster J moves the end 44 of lever 42 about 43 as a fulcrum a distance sufficient to adjust the axis in the direction of the arrow 50 two rings of type in obvious manner. When both adjusters operate, the end 44 moves about 43 as a fulcrum a distance sufficient to carry the type axially two rings of type in the direction of arrow 49, but the end 43 is at the same time moved about 44 as a fulcrum, so as to carry the point of attachment of the type-wheel shaft backward in the direction of arrow 50 axially the space of one ring, and the resultant of the action is the movement of the type-wheel in the direction of arrow 49 one ring. As will be seen, the wheel may thus be moved from the normal position in which the second ring from the right, Fig. 6, is in position to print into position to bring either of the three other rings into position over the pad. If the ring at the extreme right or left were normally in position, it would obviously be necessary to give the wheel an extreme axial movement over three rings, and the movement of both ends of the lever 42 acting singly would in that case have to be in the same direction; whereas in the arrangement shown the two ends move in opposite directions, and the greatest extent of movement required is over the space of two rings. It will be obvious that the type-wheel axis might be attached at one side of the center between the fulcrum 43 44, as indicated in Fig. 24, in which case the same extent of movement of the ends 43 44, under the action of the impelling devices, could be employed to secure the three different adjusted positions, the movements of 51 from the normal position being either all in the same direction from normal or in opposite directions, according to the movement given

to the ends 43 44 by the impelling devices, and as may be required by the normal position of the pad—that is to say, whether over one of the inner rings of type or one of the outer rings. Instead of connecting 51 between the fulcrums it might be connected outside the same, as indicated in Fig. 25, the same principle of operation existing in this case, however, as in the others, the movement in any case depending upon the well-known principles governing the relative positions of power, work, and fulcrum in levers.

We do not limit ourselves to the application of the lever with double fulcrum to a type-wheel bearing four rings of type, as the same device would be applicable to one with three rings requiring but two changes of position of the wheel axially. In this case a simultaneous or combined action of the adjuster-magnets would not be required.

The forward motion of each arm F G H I H is produced by the electromagnets $1^a 2^a 3^a$, &c. Its backward or return movement is produced by the electromagnets $1^b 2^b 3^b$, &c., which take the place of retracting-springs by acting upon the armatures in the opposite direction to magnets $1^a 2^a 3^a$, &c., and are energized at the end of the transmission of each character. These magnets $1^b 2^b$, &c., insure by a positive action the restoration of the impelling devices and type-wheel to normal position. By so controlling their circuits that they shall be cut out of action when the magnets $1^a 2^a$, &c., are cut in, and vice versa, the adjuster-magnets are relieved of the work of overcoming the retractor-springs heretofore employed, and a much more rapid and satisfactory operation of the adjuster mechanism may be obtained. This control of the restoring adjuster-magnets is well attained by placing them in local circuits from the back contacts of selector-magnets, which at their front contacts close the circuits of the adjuster or actuating magnets $1^a 2^a 3^a$, &c. In the normal position of the selector-relay levers the circuits of magnets $1^b 2^b$, &c., are closed and of $1^a 2^a$, &c., are open. When any selector-relay is operated the armature breaks circuit of 1^b or 2^b and closes circuit of 1^a or 2^a , thus moving the corresponding adjuster mechanism. When the selector magnet or relay returns to normal position by the closure in any proper manner of a restoring-circuit, including coils upon it, then the local of 1^a is opened and of 1^b is closed.

It will be obvious to electricians that instead of employing two separate magnets for operating on each armature 12 a single magnet doubly wound might be employed and the armatures be polarized, in which case the coils being reversely wound and connected respectively to the front and back contacts of the relay each would operate in the required way, one to throw the armature and impelling device in one direction and the other to restore it to normal position. It will likewise be obvious that each local circuit might in-

clude coils on both electromagnets 1^a 1^b 2^a 2^b, &c., and the armature polarized, so as to be moved positively by the conjoint action of the two magnets, the coils of one circuit being in such case wound oppositely to the coils of the other. These being all well-known equivalent ways of actuating an arm or lever positively in both directions by electromagnetism need not be more particularly described.

The local circuits of the adjuster-magnets which are controlled by the selector-relays are clearly shown in the diagram.

The several magnets 1^a 2^a 3^a 4^a 5^a may be brought into action in the proper combinations and either consecutively or simultaneously, but for illustration we shall herein describe them as brought into operation successively, as set forth in Patent No. 487,982, the magnets being controlled in their operation by a series of selecting-relays U V W X Y connected severally to the several contacts or branches governed by the sunflower or distributor.

In connection with the type-wheel an automatic dogging or locking device which shall come into action as soon as the wheel is adjusted to position for printing any letter and positively lock or hold it in such position during the impression, as well as prevent it from being thrown out of such position in the adjusting operation. This dogging device may be controlled over a circuit governed by the sunflower or distributor or by any other portion of the mechanism whose action is timed to bring the dog into position just at the instant the type-wheel reaches the adjusted position for the character. The particular mechanical construction of the dog may be very greatly varied without departing from our invention, as may also the form of magnet. As shown in Figs. 1, 2, 3, 4, 6, 7, 20, and 34, we may employ an electromagnet 90, whose circuit is closed toward the end of the cycle of changes in which the adjuster-magnets are required to set the type-wheel to position for printing any particular letter. The electromagnet 90 has an armature consisting of a rock portion 96, pivoted in the frame above it and having at the opposite ends of the magnet the arms 97, adapted to move to and from the poles of said magnet in a line transverse to the axis of the magnet's core. Practically the same construction of armature is used for the armatures 12 of the electromagnets 1^a 1^b 2^a 2^b, &c. A form of dog which we may employ consists of a pin 92, upon the head of which bears an arm 91 projecting from the rock-shaft 96 of the electromagnet 90, while a spring 93, surrounding the pin, operates to hold the pin raised, as well as to retract the armature-lever. Mounted preferably on the same shaft with the type-wheel, so as to rotate and move axially with the wheel, is a suitable dogging-cylinder having depressions or seats adapted to co-operate with the dogging-pin for locking the

wheel in each of its adjusted positions. At 95 is shown such a cylinder. The point of the dog or pin is adapted to enter the holes or depressions in said cylinder 95, which forms a portion of the type-wheel shaft, and has dogging points or depressions corresponding in number and position of the characters on the type-wheel, so that when the type-wheel is in position to print any character one of the seats or holes will be beneath the point of the dogging-pin. The point of the pin normally just clears the surface of the cylinder in which the holes are formed. The point of the pin is conical in form, so that when the dog is forced downward it may find the hole and will operate to adjust the wheel both axially and circumferentially to precise position for printing should it for any reason be slightly out of position in any direction when the dog is operated.

In the operation of the type-wheel the cylinder 95 moves freely under the point of the dog, but on the instant the adjuster devices complete their action upon the type-wheel the dogging-magnet is energized and the point of the dog is thereby forced down with the result already stated. The conical dogging-pin provides, as will be obvious, not only for any failure of the adjusting devices themselves to give the precise axial or circumferential movement desired, but also corrects any inaccuracy of position due to any cause in all intermediate directions or on lines between the two lines at right angles to one another on which the adjusting mechanisms work. This magnet may be controlled as indicated in the diagram and as will be described farther on. The armature of the dogging-magnet may also have an arm 81, carrying a contact-spring 80, by which said magnet may, if desired, be made to control the operation of the press-magnet, hereinafter described, though said press may also be controlled quite independently of the dogging-magnet.

The type-wheel may be inked by any desired means, but we prefer to employ an inked ribbon which shall be automatically fed between the type-wheel and the paper. Such a ribbon is indicated at 83, and is automatically fed from one to the other of the two rotating ribbon-spools 84 over rollers 85, Fig. 7, properly mounted on the frame over the type-wheel to guide the ribbon in passing from one spool 84 to the other. This ribbon is conveniently fed by the action of a magnet of the apparatus, preferably one which operates at each impression.

In the present apparatus the dogging-magnet is made to operate upon the driving-shaft 86 (which turns the bobbins 84) through a ratchet-wheel 77, Fig. 21, secured to said shaft and actuated step by step by a pawl carried by the rocker 88, turning loosely on the shaft and connected through a link 78 with an arm 87 fastened to the rocking armature-bar 96. The driving-shaft 86 is furnished with a worm

which operates upon two worm-wheels placed at opposite sides of it and carrying, respectively, gears which gear with wheels fastened to the bobbins 84, as shown in Fig. 3. As will be seen, the rotation of the shaft 86 step by step imparts a movement to the bobbins 84 in proper direction to wind the inking-ribbon from one bobbin onto the other.

For controlling the operation of the selecting-relays U V W X Y and the other magnets described, we prefer to use a sunflower or distributor shown in Figs. 27, 28, &c., and constructed and operating as follows. This sunflower or distributor is not herein claimed, as it forms the subject of claims in another application for patent filed by us.

A is the main frame, in which the various parts of the distributor are mounted, and B⁵ is the driving-motor, by which power is applied to the escapement of the distributor or sunflower. The motor may be an electric motor or any other driving-power.

K² is a vertical shaft, to which B⁵ is geared through a bevel-gear, as indicated.

K' is the escapement-wheel shaft of the distributor, and 2 the escapement-wheel mounted thereon.

Shaft K² carries a pinion that gears with wheel 11, loose on shaft K', but frictionally connected therewith by means of a spiral spring 15, one end of which is fixed to wheel 11, while its other end rubs against the inside of a barrel 13, fixed to shaft K'. By this means the driving-power is frictionally connected with the actuating-wheel for the distributor and with the escapement-wheel. The latter is of any desired character. An anchor-escapement is shown, *a* being the anchor, which is vibrated by an electro magnet or magnets C, to be presently described. The anchor is attached to the rock-shaft 16, which carries the armature or armatures S⁶ for said electromagnet.

The improved distributor herein described is especially constructed for rapid operation and for accessibility and certainty of action. To obtain rapidity of operation the cycle of circuit changes which the distributor is required to produce should be repeated a comparatively large number of times in one whole revolution of the sunflower. It is found in practice that under conditions of actual use a trailer, as heretofore employed, is not satisfactory for the purpose. The distributor or sunflower herein described dispenses with a trailer, gives accessibility for repair and adjustment, and admits of very rapid operation. To these ends a number of rock-shafts are employed, each carrying two arms, one of which is a circuit closing and breaking arm, the other of which is the actuating-arm engaged or operated by pins or lugs on a wheel carried by the shaft K'. By preference the pins are secured in the face of the escape-wheel 2, as indicated at *c*. The rock-shafts (indicated at 17) are mounted in suitable bearings on the frame. At the lower end they

are provided with the arms 18, for engagement by the pins *c*. At their upper ends they carry the circuit-closing arms *d*. Each of the latter is preferably made as a blade-spring projecting from a collar fastened to the shaft 17 by a screw 14 and circumferentially adjustable, whereby the relation of the circuit-closing arms to the actuating-arms below may be adjusted for the purpose of obtaining a closure of circuit at the proper time in the operation of the rocker by the lugs acting on the arms below. Contact-pins, upon which the arms *d* close and break circuit, are indicated at *f*, the latter being mounted in posts set in insulating-bushings in the plate 20. The pins *f* form, respectively, the terminals or poles of circuits to be closed one at a time in rapid succession after the manner of the ordinary sunflower circuits or branches. The arms *d* form the other terminals or poles, being in electrical connection with the plate or frame on which they are mounted, or otherwise connected to the local circuits. Retractor-springs for the rockers are indicated at 21, these being blade-springs fastened to the collars carrying the arms and being kept in tension by engagement with pins or stops 22, through which the circuit of the arms is also made independently of the bearings for the rock-shafts. Back-stops for the circuit-closing arms are indicated at *f'*. The pins *c* engage with the beveled ends of arms 18, as shown, and in the movement of the escapement-wheel one-half tooth or space consequent upon the movement of the anchor in one direction pass into and out of engagement with an arm 18 and thereby produce a make and break of circuit by one arm *d*. For each whole movement of the anchor to and fro two local circuits are made and broken, and on the movement of the escape-wheel three whole teeth all the rockers are operated.

It will be noticed that in the same arc of revolution of the distributor there is a differential number of operating pins or lugs and rocker-arms, the space between pins being less than that between the rockers and such that the rockers will be actuated in regular succession by the pins in turn. The angular space between the pins is less than that between the ends of the rocker-arms, and is such that in the revolution of the actuating-wheel for the angular distance covered by the pins all the rockers will be operated.

In the arrangement of the pin shown in Fig. 29, the left-hand rocker-arm in the range of six at the top of the figure is supposed to be the first one operated in a cycle of six changes starting with the wheel in the position shown, and the next one to the right thereof to be the last one of the six operated. In this case the one at the extreme right would be the second in the cycle. As will be seen, the first one of the cycle has a pin in position to operate it when the wheel moves a one-half tooth, while other pins of the wheel are in such position that on the successive move-

ments of the wheel the No. 1 rocker at the extreme right will be the next one operated, and so on proceeding in the direction of revolution to the rocker, which is the one next to the left-hand end of the range. In the arrangement shown, this last or sixth rocker is the one which has just been left by the pin, and, as will be seen, is also the one which is farthest from the next pin proceeding in the reverse direction to the direction of revolution, so that it will be the last to be operated.

It will be obvious that any rocker might be taken as the first of the cycle, the automatic unison-stop, however, being properly disposed to hold the wheel, as will be presently described, so that each cycle may begin at the same point.

Omitting for the time being the consideration of the position of the unison-stop and taking the rocker at the right as the first in the cycle, it will be seen that the wheel is about to operate upon the rocker which is last in the cycle. At the beginning of the new cycle the No. 1 rocker will be operated by its pin, while the next five pins proceeding in the direction of revolution are in position such that the rockers will be successively actuated, the second of them by the second pin at the next step of the wheel, and so on until finally on the sixth step the last one of the six pins would actuate the final rocker. As soon as this has taken place the next pin to the right of the one that has started this cycle of actions will have moved up into position to cause the first change of circuit in a repetition of the cycle, but the last one of the six concerned in the first cycle will not be engaged in the operation, because at the last change of circuit in said cycle it will have moved out of range of the series of rocker-arms. As will be seen, the rockers of the series are well spaced and the circuit-changer parts are readily accessible for inspection and adjustment, but the six changes of circuit are produced by a movement of the wheel equivalent only to the distance from one rocker or pin to the next.

On the assumption that the distributor is to be used in the system described in the prior patent of Charles L. Buckingham for controlling five local circuits by which type-wheel adjusting devices may be operated singly or in various combinations, and a sixth local circuit for restoring the devices to normal or for other purpose, we have shown the distributor as provided with six circuit-changers, but it will be readily understood that the apparatus is adapted for use with a greater or less number of circuits. With an escapement-wheel having forty-five teeth and an anchor-escapement, it will be seen that the cycle of changes produced by the distributor will be repeated fifteen times for each whole revolution of the wheel, and if each main-line pulse produces one movement of the anchor-escapement then the revolution of the wheel will cover ninety main-line pulses. If the

distributor be used with the system of the patent before referred to, then fifteen letters or characters could be printed for each whole revolution of the shaft and wheel K', 2.

In order to obtain a powerful and extremely-rapid operation of the magnet which actuates the escapement lever for the distributor, a double winding of the core or cores of the magnet is employed, and said windings are alternately traversed by a proper current, so as to cause the said magnet or magnets to alternate in polarity. The armature or armatures are polarized. Preferably two armatures are employed and both are actuated in both directions by simultaneously coacting magnet-cores.

S⁶ indicates two soft-iron armatures oppositely polarized from any desired source. Preferably they are polarized by mounting them in the opposite poles of a permanent magnet S⁵. The armatures are fastened to the rock-shaft 16, which carries the anchor-escapement *a*.

S⁷ is an electromagnet whose core is provided with a double winding and whose opposite poles are presented, respectively, to the armatures S⁶ at one side thereof. Through these windings currents are caused to flow alternately and in rapid succession by the action of the main-line pulses, but in each coil the current flows in an opposite direction to the flow in the other, so that the cores will be reversed in polarity at each pulsation. This is conveniently accomplished by placing the two windings, respectively, in the two branches of the local circuit of a battery controlled, respectively, by the local contacts of relay R, as shown in Fig. 33, said relay being the main-line relay through which the pulses sent by the transmitter flow.

S⁸ is a magnet the pole ends of whose cores are presented, respectively, to the armature, but at the opposite sides of the poles of S⁷. The magnet S⁸ is also double wound and currents are made to flow in the windings alternately, but simultaneously with the flow of currents in the two windings of S⁷. The direction of flow in each winding of S⁸ is such that the poles of the magnet will conspire with those of S⁷ when excited at the same time to move the armatures, the poles of one attracting said armatures and the poles of the other repelling at the same time. When the current ceases in the one set of windings and flows in the other set on the two cores, the armatures are moved in the opposite direction.

The two windings of S⁸ are connected to the local similarly to those of S⁷. It is convenient to connect one of the two windings of one core into series circuit with one of the two windings in the other, but in such way that the polarities when the current flows through the connected windings shall conspire to move the armatures. The other two coils of the two cores are connected together in a similar way into the other branch of the local. As

the armature of the relay R moves in obedience to the reversed pulsations in the line, the armature will be caused to be moved correspondingly and vibrate the escapement, the latter moving in one direction for a pulsation of one polarity in the main line and in the opposite direction for a pulsation of the opposite polarity.

Six alternations of current on the main line will produce one cycle of changes by the distributor, since, as already explained, each six vibrations of the escapement will rotate the wheel three teeth and produce the six local connections through the distributor.

The unison-stop devices, whereby the distributor may be caused to always begin its cycle of changes or connections to the local circuits always at the same point in relation to the succession of main-line pulses, may be of any desired mechanical construction, but are preferably controlled by a magnet provided with two coils wound differentially or reversely. Through these coils currents are caused to flow rapidly in alternation until a pulse is prolonged or otherwise modified, so that a change may be effected therein sufficient to permit the operation of its armature. So long as the pulses are short and follow in rapid succession the current through each coil only overcomes the effect of current through the other, and as a result the core remains unaffected. When the current is prolonged in one of them the armature is affected. This prolongation is made at the termination of any number of or of every cycle or series of main-line pulses by which the distributor is moved in order to produce a cycle of changes in the local connections controlled by it. Preferably the prolonged pulse is made to follow every series of pulses by which a character or letter is transmitted. There being six pulses required to produce a complete cycle of changes of the sunflower or distributor and five pulses for each letter or character transmitted, the prolonged synchronizing-pulse would be the sixth pulse of a series. The unison-magnet may be polarized and will then be found to respond with great certainty and rapidity, so that no time shall be lost in making one series of pulses follow close upon another. When each letter or character is transmitted by a definite number of pulses, positive and negative, the synchronizing-pulse which is prolonged is of always the same polarity. In practice it may be found desirable at intervals to transmit from time to time a number or series of short pulses, none of which are prolonged, each series being succeeded by the prolonged pulse. The short pulses in each series may be five or more in number and insure the movement of the apparatus to the unison point. As the unison-stop is normally in position to engage, each series of pulses for a letter or character should be followed by the prolonged pulse. The prolonged or sixth pulse following the transmission of each character, besides

operating on the synchronizing-magnet affords, also, a slightly-prolonged space or interval of time in which the operation of the paper feeding and printing devices and the dogging-magnet and the resetting of the armatures for the selecting-relays or of other devices which are instrumental in setting the type-wheel to position for printing a character may be effected.

S⁸ is the unison-magnet. Its two soft iron cores are polarized from the permanent magnet S², to whose poles the coils are respectively attached. Each core is wound with two coils, through which currents are made to flow alternately in rapid succession by connecting said coils into the local circuits of the stops for the main relay, as indicated in the diagram, or by other means. Two coils, one on each core, are connected in series in one circuit and the remaining two are similarly connected in the other circuit, and the coils are so wound or connected that each pulse in one set will assist the permanent magnetism, and each pulse in the other will tend to cut it down. The effect of the latter upon the armature is *nil*, the retractor simply holding the armature more strongly in retracted position. The effect of the former is to momentarily increase the magnetism, which would attract the armature, but the short pulses do not have time to sufficiently charge the core to pull up the armature. When prolonged, however, the armature will be drawn up and remove the unison-catch, symbolized at *b*, from the path of the stop devices connected to the sunflower. In the present case the stop is shown arranged in the path of unison-pins consisting of teeth upon a wheel *b*⁷, connected to the escapement-wheel for the distributor. Inasmuch as a movement of the escapement-wheel three whole teeth produces a complete cycle of local circuit-changes, the teeth upon *b*⁷ are made one-third in number of the teeth upon the escapement-wheel, though there might be a less number of such teeth—so that, for instance, a tooth on wheel *b*⁷ would reach position to be locked by the unison-stop after movement of the escapement-wheel equivalent to the space of six or nine teeth of said escape-wheel. The catch or stop *b* is mounted on an arm *b*¹⁰, attached to a rock-shaft *b*⁹, to which are secured arms *b*⁸ holding the armature for electro magnet S⁸. A blade-spring *b*⁶, attached to arm *b*¹⁰ and engaged by a tension-adjusting screw, serves as a retractor for the armature-lever and to hold the catch in position to engage the unison-teeth of the wheel. If the transmission be by the perforated or embossed strip described in prior patent, No. 487,982, each sixth pulse would be prolonged to make a synchronizing-pulse, as indicated in Fig. 35 of the drawings, and allow the wheel to pass the unison to begin the new cycle. At intervals a series of short pulses, preferably limited in number to the number in a letter or character transmission followed by the long pulse, could be used

from time to time to insure synchronism, as indicated, at the end of the section of perforated strip. The prolonged pulse would in each case be that which causes the receiver
 5 to put an impulse through that one of the differential coils on S^3 that strengthens the magnetism thereof, thereby withdrawing the stop b simultaneously with the movement of the escapement, which allows the wheel to
 10 move and carry the stop-tooth past the tooth. The next pulse at the beginning of the next series allows the armature to fall back and the tooth to move in toward the wheel in position to catch the next unison-tooth, which,
 15 however, it is prevented from doing by the final prolonged pulse of proper polarity ending up such series as the tooth gets around to position to engage the catch.

S in the diagram Fig. 33 is the controlling-magnet for the several selecting-relays $U V W X Y$, whose circuits are consecutively closed by the distributor. This magnet is preferably a double-wound magnet and the circuits of its two coils are closed alternately and in
 25 rapid succession by the action of the relay R , which is operated by the main-line pulses. For each main-line pulse a current is caused to flow through one of the coils of magnet S . On the prolongation or strengthening of an
 30 impulse through one or the other of said coils the said magnet S becomes excited, so as to operate its armature and close the circuit of the selecting-relay whose circuit is at such time closed at the distributor. If the pulses
 35 are short and follow each other in rapid succession, the current through one coil only overcomes the effect of a current through the other, and as a result the core remains insufficiently magnetized. When, however, the cur-
 40 rent in either coil is prolonged, its effect will quickly overcome the effect of magnetism due to the other coil, and as a result the relay is brought into action.

The controller-magnet S has its two coils
 45 included, respectively, in series circuit with the two coils of the unison-magnet S^3 and with the two coils of the electromagnet which operates the escapement of the distributor, all these said magnets being thus included in
 50 practically the same local circuit controlled from the two contacts forming, respectively, the front and back contacts of the main-line relay R . These several magnets may be thus operated all in the same local circuit without
 55 confusion, each performing the duty required of it exactly.

The several selecting-relays $U V W X Y$, which control the operation of the adjuster-magnets, have their circuits connected to the
 60 contacts f of the distributor in the order indicated. Relay U controls by a local circuit 100 adjuster H , V controls adjuster G , W controls adjuster F , X controls adjuster J , and Y controls adjuster I . This special order of
 65 connection and operation is such that the adjuster-magnet whose follower has the greatest distance to move shall be brought into action

first in the cycle of changes produced by the distributor, and so on in regular order, that adjuster-magnet whose armature has to move
 70 the least distance being controlled by the selector-relay connected to contact No. 5, which is the last one of the contacts for the distributor over which circuit is closed in any cycle excepting the final contact 6. The latter is the
 75 one which may be employed for closing a restoring-circuit 98 99, that is closed at the termination of each cycle of operations for the purpose of restoring the armature-levers of the selecting-relays to normal position. The
 80 current on this restoring-circuit does its work through another set of coils on said relays, as described in the patent of Charles L. Buckingham, No. 487,982.

The press-magnet c' , as before stated, is
 85 operated once for each cycle of changes corresponding to that by which a character or letter of the type-wheel is set into position. Preferably this action is produced by a circuit-controller connected to the distributor itself, as
 90 described in application of Charles L. Buckingham, Serial No. 507,673. The closure of the circuit for the press-magnet might take place at any stage of the cycle of changes produced by the distributor, but the particular point in
 95 the operation of the distributor where this circuit is closed would be determined by the time required to bring the pad against the paper after the closure of circuit. This would
 100 of course depend, among other things, upon the sluggishness of the press-magnet. In any case the time of closure should be such that the press will do its work just before the resetting devices come into action to move the
 105 type-wheel back to the zero position and (if a dogging device is employed) before the dogging device frees the type-wheel.

In practice the controlling-circuit for the press-magnet might be closed at the end of the fourth or the beginning of the fifth change
 110 of circuit produced thereby, the said fifth change being that which corresponds to the adjusting mechanism which has the least distance to move and is always the last to be brought into operation on any cycle of actions.
 115 If the circuit of the press be closed even on the fourth, the delay in the operation of the press may in some cases be found sufficient to allow the adjustment of the type-wheel corresponding to the fifth closure of circuit to
 120 take place before the circuit will reach the paper, but if the action of the press be quick the closure of its circuit might be coincident with the fifth change. By preference, however, we control the press-magnet coincidently
 125 with the sixth change of circuit produced by the distributor, so that the action of the adjusting devices will certainly precede that of the press-magnet, and the press cannot at any
 130 time strike the paper until all the adjustments of the type-wheel have been made. The controlling-circuit for the press is conveniently closed by one of the actuating-pins of the distributor, which is made to operate on

a circuit-closer composed of a rock-shaft having circuit closing and actuating arms similar to those already described. This circuit-closer may be a supplemental circuit-closer, the actuating-arm for which is indicated at 18', and the circuit-closing arm at d^{20} , though by proper arrangements, as will be described, one of the six circuit-closers already mentioned may be utilized. The actuating-arm of the supplemental circuit-closer may be in position to be operated by a pin at or about the fifth change of circuit in each cycle of changes produced by the distributor, and is so shown in Fig. 33, though, as already described, it might be and preferably is operated on the sixth change.

The circuit of the press-magnet might be closed directly by the distributor mechanism, but as ordinarily the press-magnet requires a rather heavy current it may be found desirable to interpose a relay between the circuit-controller and the press-magnet, the latter being in such case operated from a second local closed by the relay. As this might further delay the action of the press, it might be found desirable to operate the circuit-controller earlier in the cycle of changes than on the fifth change. Usually the dogging-magnet will be operated from the distributor and it will be utilized as the relay, as will be presently described. In the diagram, Fig. 33, however, the simpler arrangement is shown, wherein the press-magnet c' has its circuit closed directly at the contact f' of the distributor, there being also in this case an independent circuit for the press-magnet independent of the other circuits of the apparatus. The press-magnet in turn controls another local circuit for the paper-feed escapement-magnet h , such local being also independent of the others and being controlled through any suitable contacts governed by the press-magnet armature, as already explained. In this diagram the dogging-magnet is not shown, and it is to be understood that the use of such dogging-magnet is optional, though, in case it be not employed, it will be understood that some other means would be used for operating the inking-ribbon.

As will be presently described, the dogging-magnet, press-magnet, and escapement-magnet for the paper-feed may be operated in branches of the same general local circuit supplied from the same generator. The general operation of the apparatus will be described, however, with reference to the diagram, Fig. 33, the parts being connected as already described and as clearly indicated in said diagram.

The six pulses, alternately positive and negative, which accompany the transmission of each letter, produce six vibrations of the distributor-escapement and one whole cycle of changes in the connections thereof, thereby closing in turn the connection to all the selector-relays U V W X Y and winding up with the closure at contact No. 6 of the re-

storing-circuit 98 99, which includes coils on the relays, whereby any tongue which may have been moved forward to bring into operation a type-wheel adjuster will be moved back ready for the next transmission. If any one of the first five pulses be prolonged, the relay whose connection at the sunflower is closed by that pulse will be operated, because the prolongation will operate magnet S and complete the break in the local connection of that relay. No other relays excepting those whose closure of connection at the sunflower is accompanied by a prolonged pulse will be operated. The relay or relays operated will close the circuits of the corresponding adjuster-magnets, and thereby set the type-wheel to the desired position. The circuit of the press is closed, as already described, toward the termination of the cycle of changes and at such time that the press will not be thrown until the setting of the wheel into position for printing is accomplished.

At the termination of each operation of the press—that is to say, on the back movement of its actuating-armature—it closes the circuit of the escapement-magnet h and produces a feed, as already explained, of the paper. Before the beginning of the next cycle the restoring-circuit comes into play to throw back the adjusters to normal position by bringing the selector-relays back to their normal contacts, thereby breaking the connection of the adjuster-magnets $1^a 2^a$ &c., and closing those of magnets $1^b 2^b$ &c.

Fig. 34 shows diagrammatically an arrangement that may be employed when the dogging-magnet is used. Here the press is controlled by the dogging-magnet which operates as a relay therefor. The dogging-magnet is brought into operation by a circuit-closer of the distributor, as shown, so as to dog the type-wheel when it reaches proper position for printing. The circuit-closer is here shown as being a supplemental circuit-closer, which is to be arranged so as to close circuit practically coincidently with the sixth change of circuit produced by the distributor or at such instant of time that the adjusting devices will have all done their work before the dogging-magnet forces the dog down to hold the type-wheel in its new adjusted position. The re-setting-circuit is supposed in this case to be closed as before by the No. 6 circuit-closer. The dogging-armature closes the circuit of the printer-magnet by its spring 80 just an instant before the dog reaches position to stop or hold the wheel, so that by the time the dog reaches position the printing-pad will be under way to strike the paper. The circuit-closing spring 80 yields after closing the circuit of the press-magnet, so that the armature of the dogging-magnet may complete its full movement necessary to the complete movement of the dog 92. The press-magnet armature controls the circuit of the paper-feed magnet through its back-stop, as already

explained, so as to first discharge the magnet as the lever comes up to operate the press-magnet and then charge the magnet when the lever drops back. The feed-wheel is released 5 by the latter charging of the release-magnet, but not by its discharge. In this diagram the three magnets 90 $c' h$ are shown as operated in multiple from the same battery or generator. The circuit-breaker 70, actuated 10 by the paper-transfer slide M, is here shown placed in the common return for said generator, so that it will throw out of action not only the escapement feed-magnet, but also the press-magnet and the dogging-magnet, so that 15 no action of the press can take place at the time of transfer.

Fig. 36 shows a preferred arrangement of circuits and devices for controlling the dogging-magnet, resetting-circuit, &c. In this 20 case the supplemental circuit-closer may be dispensed with and the No. 6 circuit-closer of the distributor employed both for the resetting operation and for controlling the dogging-magnet. The local circuit closed 25 by the No. 6 circuit-closer includes the dogging-magnet 90 and a supplemental magnet c^{20} , which operates as a relay to close the resetting-circuit 98 99, including the selector-relays. The relay c^{20} is timed to bring the resetting-circuit into action as soon as the dogging device has taken hold, so as to secure the type-wheel in its adjusted position. The 30 closure of the resetting-circuit 98 99 throws over the relay-armatures of the selecting-relays U V W X Y, thereby closing the circuits of the magnets which operate to restore the adjusting devices. As before explained the relay-armatures of the selecting-relays will retain the position in which they are put by 35 the action of the resetting-circuit. When, therefore, the connection is opened at the No. 6 contact of the distributor no effect will be produced upon the said relays, but the moment the dogging-magnet 90, which is discharged by the opening of circuit at the contact 6 frees the dog 92 from the type-wheel 45 shaft the adjuster devices will be free to resume their normal position under the action of the magnets which are in the circuits from 50 the back contacts of the selecting-relays.

Instead of operating the several magnets h , c' , and 90 all in branches from the same local battery-circuit, it is preferable in most cases to operate each in an independent local, 55 though we find in practice that satisfactory results are obtained by operating magnets h and c' in branches from the same local while 90 is in an independent circuit, as indicated in the diagram, Fig. 36.

60 The operation of the magnets 90 $h c' c^{20}$ and of the restoring-circuit 98 99 are produced, as will be understood, in the prolonged sixth pulse accompanying each letter transmission by the tape indicated in Fig. 35 or 65 other means, the prolongation affording time for the various actions.

In order to obtain a clear impression and a

certain and positive action of the press-pad, we sometimes employ between said pad and the paper an elastic cushion, which operates 70 by its elasticity or resiliency to cause the pad to rebound sharply and quickly. For this purpose we employ a band of rubber or other elastic material which is fed between the hammer or press-pad p' and the paper in any suitable 75 manner through connection with the paper-feed mechanism. For the sake of simplicity we have illustrated this device detached from the other mechanisms, as shown in Figs. 37, 38, and 39. The band of soft rubber or similar elastic material is indicated at 80 101. At 102, 103, and 104 are suitable rollers upon which it is fed or moved beneath the opening in the tube C' , through which the press-pad p' operates upon the paper. The 85 roller 104 is fastened to the paper-feed roll B^6 , before described, the latter in this case being mounted to turn upon a stud or pin 107, fixed to a block secured inside the tube. The rollers 102 103 revolve on pins projecting 90 from blocks secured on the inner side of the tube at opposite sides of the opening through which the press-pad works, as clearly shown. As the roll B^6 rotates it feeds the band 95 beneath the opening, thus presenting fresh surface constantly for impingement of the press-pad. The tube C' is in this instance preferably jointed at 108 to allow ready access for removal or attachment of a rubber band or strip. 100

We have hereinbefore described the use of a paper-feed device specially constructed to feed the paper one long step at the end of the line, the escapement-wheel for the paper-feed being for such purpose provided with a long 105 space or blank q . It is obvious, however, that we might dispense with the long step or space in the escapement-wheel for the feed mechanism, which rotates the paper tube and feeds the tube past the lap or from the end of 110 one line circumferentially to the beginning of the next by a series of short steps. In this case a series of blank-transmissions would be sent during the interval between the termination of one line and the beginning of the next, 115 the number of such transmissions being sufficient to feed the paper over the space which, with the form before described, is covered by the long space q in the wheel r^2 . To this end it would only be necessary in preparing 120 messages to place at intervals on the tape a series of blank perforations—that is to say, perforations which would cause the press and feed to operate with the type-wheel in a position to strike a blank in the type-wheel. 125 As will be readily understood, the blank in the wheel r^2 would in such instance be filled out with teeth like those in the remainder of the periphery of said wheel.

It will be seen that when the adjuster devices which operate the type-wheel are controlled by a sunflower or distributor that closes the controlling-circuits for the several 130 adjusters in succession, those adjuster-mag-

nets which come into operation late in the cycle of changes will have less time to do their work in setting the type-wheel than do those which operate earlier in the cycle, and in a rapid operation of the apparatus they are therefore at a disadvantage in the operation of setting the wheel. In operating in the opposite direction or in a way to resume normal position, those adjusters which are called into action last in the cycle will have some time before they will be called again into action and may move more slowly in their reverse movement. We therefore propose to increase the speed of operation of the whole apparatus by giving to the adjusters which act toward the end of a cycle a bias by means of a spring or other auxiliary device which will assist their action in the operation of setting the type-wheel, although it will retard or oppose the resetting movement of the adjuster. By thus giving a bias to the adjuster operating against the magnet which restores it to normal position, we secure also the distinct advantage that the said adjuster may be made to move the moment its selector-relay lever leaves its back or normal stop through which the restoring-circuit is closed and before the relay-lever has moved over to close contact on the opposite stop which closes circuit for the actuating-magnet which adjusts the type-wheel to position for printing. In fact, with the arrangement of selecting relays and adjuster-magnets shown, the latter actuating-magnets, which are brought into operation at the end of a cycle, may in some cases be dispensed with and their operation made to depend upon the breaking of the normal circuit through the restoring-magnet of the adjuster. Although the bias in such case would be strong, this would be compensated for in the restoring operation by the fact that there is more time in the case of the adjuster near the end of the cycle in which to effect the change back to normal. In Fig. 6 we have shown at 109 the application of these biasing-springs to the adjuster-levers J J. The device is especially useful, however, in connection with adjuster I, which is supposed to be the one that is last called into operation in any cycle of changes produced by the distributor.

What we claim as our invention is—

1. In a type by type printer, the combination of the paper tube blank, a cylinder upon which the same slides longitudinally and circumferentially, means engaging with the surface of the tube for turning it in the same direction for letter and word spaces as well as across the space from the end of one line to the beginning of the next, and an intermittent or step-by-step axial feed device operated at the end of each line and also engaging with the paper surface.

2. In a type-by-type printer, the combination of a tubular paper blank on which the characters are printed in circumferential lines, a stationary cylinder upon which the

said tube is adapted to slide longitudinally, and a step-by-step axial feed device engaging with the surface of the tube and operated automatically at the end of each line.

3. In a type-by-type printer, the combination, with the paper tube and its circumferential feed mechanism, of an axial feed device normally out of contact with the tube, and means for automatically bringing it into engagement at the end of each line.

4. The combination in a type-by-type printer, of a paper tube on which the lines are printed circumferentially, and a friction pad normally out of contact with the paper tube and adapted to feed the same axially and automatically at the end of each line.

5. In a type by type printer, the combination with the paper tube and its circumferential feed mechanism, of an axial feed, an actuating spring therefor in which power from the driving power of the circumferential feed mechanism is stored during the movement of the same in printing a line, and means for releasing said spring at the end of the line.

6. The combination in a type-by-type printer, of a paper tube fed circumferentially in the printing of a line, an axial feed device normally disengaged, an actuating spring therefor in which power is stored during the printing of a line, mechanism for bringing the axial feed devices into engagement on the completion of the line, and an automatic release for the spring timed to operate on engagement of the axial feed.

7. The combination in a type-by-type printer, of a paper tube fed circumferentially in the printing of a line, an axial feed device normally disengaged, an actuating spring therefor, mechanism for bringing the axial feed devices into engagement on the completion of the line, and an automatic release for the spring timed to operate on engagement of the axial feed.

8. In a type by type printer, the combination with a paper tube, of a friction feed wheel engaged with the paper for rotating the said tube, and a reciprocating friction pad adapted to engage the paper directly and reciprocating in the direction of the tube's axis.

9. In a type by type printer, the combination with the paper tube and its circumferential step-by-step feed mechanism, of an axial feed mechanism, and means for disengaging the circumferential feed mechanism during the axial feed operation.

10. In a type by type printer, the combination with the paper tube and its rotary feed mechanism normally engaged with the tube, of a reciprocating axial feed device normally disengaged, and an operating cam therefor connected with the rotary feed, as and for the purpose described.

11. In a type by type printer, the combination with the paper tube and its circumferential feed device, of an axial feed device and mechanism for simultaneously throwing both

devices out of action when a new tube is to be slipped into printing position upon the support.

12. In a type by type printer, the combination with the paper blank fed circumferentially step-by-step, of means for withdrawing the paper feed device at the end of a line, and a locking device timed to lock said paper feed device before the withdrawal movement begins.

13. In a type by type printer, the combination, substantially as described, in a type-by-type printer, of a blank formed as a paper tube upon which the lines are printed circumferentially, a feed wheel moving intermittently and step-by-step to rotate the paper tube, and a driving gear two wheels of which are formed as described to have a lost motion one with relation to the other at the end of the feed by which the margins on the page are covered.

14. The combination, substantially as described, in a type-by-type printer, of a paper tube upon which the lines are printed circumferentially, a paper feed wheel engaging with said tube to rotate it around its longitudinal axis, means for withdrawing the wheels at the end of a line, and a driving gear having a blank which permits a lost movement of the gear with respect to the feed wheels.

15. In a type by type printer, the combination with the paper tube and the feed wheel engaging therewith to rotate it around its longitudinal axis, of a driving gear having a lost movement, as described, and a locking device for bringing the feed wheel to a positive stop in the lost movement.

16. In a type by type printer, the combination, substantially as described, of the paper tube upon which the lines are printed step-by-step circumferentially, a feed controlling mechanism having an enlarged or amplified movement at the end of each line, and devices actuated by said driving power for removing the wheel from engagement with the paper at the end of each line, said devices being adjusted to come into operation in the latter part of the enlarged or amplified feed movement of the escape devices.

17. In a type by type printer, the combination, substantially as described, of the paper tube and its feed wheel, an escapement device having an enlarged or amplified feed for every whole revolution of the tube, and mechanism for withdrawing the feed wheel from engagement with the tube in the latter part of the enlarged or amplified movement of the escape wheel, as and for the purpose described.

18. In a type by type printer, the combination, substantially as described, of the paper tube on which lines are printed circumferentially, a feed wheel driven by any suitable power and controlled step-by-step, an escapement having an enlarged or amplified feed adjusted to come into action at the termination of each line, and an actuating device for

withdrawing the feed wheel from engagement with the paper, said device being operated by the power which drives the escapement wheel.

19. In a type by type printer, the combination, substantially as described, with a paper tube on which the lines are printed circumferentially, of a paper feed wheel, a driving wheel for turning the same intermittently, mechanism for withdrawing the wheel from engagement with the tube once in every whole revolution thereof, and an intermediate gear between said wheel and driving wheel having a lost movement, as and for the purpose described.

20. In a type by type printer, the combination, substantially as described, of a main driving shaft, a tube, an escapement mechanism having an enlarged or amplified feed movement for every revolution of the tube driven from said shaft, an actuating arm secured to the shaft for throwing the circumferential feed mechanism out of action at the end of each line, and an axial feed mechanism operated from said shaft, as and for the purpose described.

21. The combination, substantially as described, with the paper tube upon which the lines are printed circumferentially, of a driving shaft, a gear wheel secured thereto, a circumferential paper feed device connected with said wheel through a mechanism having a lost movement, an escapement device having an enlarged or amplified movement for each revolution of the tube and secured to said shaft, and mechanism operated from said shaft for depressing or removing the feed wheel from engagement with the paper prior to the beginning of each line.

22. The combination with the paper tube fed circumferentially step-by-step for printing letters or characters around its circumference, a driving shaft, a wheel secured to said shaft and connected with the circumferential feed devices, an escapement wheel having an enlarged or amplified movement at every whole revolution of the tube and secured to said shaft, a movable support for the paper feed wheel, an arm carried by the driving shaft for operating upon said support, an axial feed device, and a controlling device for the latter secured to the shaft and timed to operate the same after the wheel has been withdrawn from engagement with the paper.

23. The combination with the paper tube on which the lines are printed circumferentially, of a rotary feed wheel for producing a circumferential feed of the paper, an escapement device having an enlarged or amplified feed movement for each revolution of the tube, an axial feed device, and mechanism actuated from the driving power of said circumferential feed for temporarily withdrawing the circumferential feed device and bringing the axial feed into engagement and then operating it, as and for the purpose described.

24. In a type by type printer, the combination with a paper tube upon which the lines

are printed circumferentially type-by-type, of an axial feed pad engaging directly with but normally out of contact with the paper, a spring actuated lever supporting said pad, and a cam actuated support for said lever.

25. In a type by type printer, the combination, substantially as described, with a paper tube, of the paper feed pad mounted on a swinging arm, a reciprocating support carrying said arm, and a spring connected to the arm for bringing the pad into engagement with the paper when the end of the arm is lowered.

26. The combination, substantially as described, with the paper tube, of a circumferential feed wheel mounted on a movable support and continually engaged with the paper during the printing of the line, an axial feed pad supported on the swinging arm, and mechanism for withdrawing the feed wheel and then bringing the axial feed pad into engagement with the paper and giving it a feed movement while the feed wheel is withdrawn.

27. In a type by type printer, the combination with the paper to be fed, of the paper feed wheel mounted on a swinging support, an axial feed device mounted on a swinging support and normally held out of engagement with the paper, and mechanism operated by the feed power for simultaneously withdrawing the feed wheel and permitting the axial feed pad to engage the paper.

28. In a type by type printer, the combination, substantially as described, of the tube, the feed wheel rotating the paper tube circumferentially, a driving power therefor, an axial feed device, a cam connected to the driving power for the feed wheel, a spring, and means for withdrawing the feed wheel and releasing the spring to operate the axial feed pad.

29. The combination with the paper tube upon which the lines are printed circumferentially, of an escapement having an enlarged or amplified feed movement at the end of each line, a feed wheel engaged with the paper, and an actuating device moving with the escapement wheel and timed to move the feed wheel out of engagement with the paper during the latter part of the enlarged or amplified feed movement.

30. In a type by type printer, the combination with the paper tube and its feeding devices movable into and out of operative engagement, of means for positively stopping the paper tube just before or at the instant it is freed from the control of said feed devices.

31. In a type by type printer, the combination with the tubular blank fed circumferentially, of a tubular support therefor, a feed wheel exterior to the support, and a friction wheel mounted within the same and engaging with the inside of the paper tube opposite the said feed wheel.

32. In a type by type printer, the combination, substantially as described, with the paper feed and its escapement mechanism, of means

for simultaneously withdrawing the paper feed devices and freeing the escapement wheel.

33. In a type by type printer, the combination, substantially as described, with the paper feed and the escapement wheel, of means for simultaneously withdrawing the paper feed and freeing the escapement wheel, and a zero stop engaged by said wheel when thus freed.

34. The combination, substantially as described, with a paper tube on which lines are printed circumferentially, of a feed wheel, an escapement wheel governing the action of said feed wheel, means for withdrawing the feed wheel from engagement with the paper, and mechanism operating simultaneously with said withdrawal to free the escapement wheel from its escapement and allow it to move without impediment to its zero position.

35. The combination, substantially as described, with a paper tube on which lines are printed character-by-character circumferentially, of a circumferential feed mechanism, an escapement controlling the action thereof, and means for disengaging the escapement mechanism and freeing the escapement wheel from its detent or stop devices to allow it to rotate freely to the zero position.

36. In a type by type printer, the combination, substantially as described, of the paper tube, a circumferential feed wheel, a driving power therefor, an escapement wheel connected to said driving power, means for withdrawing the feed wheel from engagement with the paper, and means for simultaneously freeing the escapement wheel from its escapement to allow it to rotate freely to the zero position.

37. In a type by type printer, the combination, substantially as described, of a paper tube, a feed wheel for rotating it step-by-step circumferentially, an axial feed device for moving it step-by-step in the direction of its axis, and means for simultaneously withdrawing the circumferential feed device and holding the axial feed device out of engagement.

38. In a type by type printer, the combination, substantially as described, with the paper tube and its circumferential feed wheel normally engaged therewith, of an axial feed for moving it step-by-step at the end of each line, an escapement wheel governing the action of the circumferential feed wheel, and means for simultaneously withdrawing the feed wheel, holding the axial feed out of operation and freeing the escapement from its detent devices to allow it to rotate to zero position.

39. In a type by type printer, the combination, substantially as described, with the paper tube, of a circumferential feed wheel, an axial feed device, means for withdrawing the circumferential feed and bringing the axial feed into operation automatically at the end of each line, and a manually controlled device for withdrawing said circumferential feed wheel and holding the said axial feed out of operative position.

40. In a type by type printer, the combination, substantially as described, with the circumferential feed wheel and its controlling escapement wheel driven from any suitable power and having periodically an enlarged or amplified feed movement, of means for withdrawing the said circumferential feed device and at the same time freeing the escapement wheel from its escapement.

41. The combination, substantially as described, with a paper tube having a circumferential as well as axial feed movement, of an escape wheel governing the circumferential feed, and means for simultaneously throwing out of action the escapement devices and freeing the escapement wheel to allow it to rotate to zero position.

42. The combination, substantially as described, with the paper tube on which the lines are printed circumferentially, of a feed wheel mounted on a movable support, an escapement wheel governing the action thereof, a driving power operating on said movable support at the end of each line, and a manual device operating also on said support and adapted to move the escapement wheel out of engagement with its escapement devices to permit it to rotate freely to zero position.

43. The combination, substantially as described, with the paper tube on which the lines are printed circumferentially letter by letter, of the feed wheel, the driving power therefor, a movable support for said feed wheel, a hook connected to said support, an arm connected to the driving power, and a release pin engaged by the hook for releasing the support and allowing the feed wheel to return to engagement with the paper.

44. The combination, substantially as described, with the feed wheel engaging with the paper tube, of a driving power, and an escapement device therefor having an enlarged feed movement, a movable support carrying said feed wheel, an arm operated by the driving power for moving said support and disengaging the wheel from the paper, an axial feed device mounted on a movable support, and a manual actuator engaging with the devices which operate the support for the feed wheel and with means for holding the axial feed out of engagement with the paper.

45. The combination with the paper tube and its circumferential feed wheel, of an axial feed, means for withdrawing the feed wheel from the paper at the end of each line, and a gear wheel between the feed and its driving power having a space 31, with which a controlling tooth 30, engages previously to the operation of the mechanism which withdraws the wheel.

46. In a type by type printer the combination with the paper feed mechanism and its escapement wheel, of a manual controller for freeing the wheel from its escapement, and an automatically retractible cushioning zero stop, as and for the purpose described.

47. In a type by type printer the combination with the paper feed mechanism of an escapement wheel adjusted to move axially, an escapement magnet, a manual controller for moving the wheel axially to free it from the escapement, and a circuit controller governed by said manual controller for simultaneously discharging the magnet.

48. The combination with the escapement wheel movable axially on its shaft, of a zero stop, a rod carrying the same, and a spring engaging the said rod, as and for the purpose described.

49. The combination with the step-by-step paper feed mechanism, of a manual device for freeing the same to allow the feed train to rotate to zero position, and an automatic brake connected with the manual device, as and for the purpose described.

50. The combination with the type-wheel, a press magnet, a paper feed mechanism, and the manual device for freeing the paper feed escapement, of a circuit controller actuated by said manual devices and adapted to throw out of action both the escapement and the press magnet.

51. The combination with the type-wheel having a dogging magnet, of a press magnet, a step-by-step paper feed magnet, a manual controller for throwing the step-by-step mechanism out of action to permit the feed to rotate to zero, and a circuit breaker controlled by the manual device and placed in a circuit common to said magnets, as and for the purpose described.

52. The combination in a type-by-type printer, of a feed mechanism and controlling escapement therefor, and a motor exerting a constant torque and connected with said escapement devices through a spring which is kept under uniform tension by said motor to drive the escapement.

53. The combination, substantially as described, in a type-by-type printer, of a paper feed mechanism, a driving wheel fastened to a shaft, an escapement device also secured to said shaft, a driving motor, exerting a constant torque and an intermediate spring one end of which is connected to the shaft and the other to a wheel loose upon the shaft and in continuous operative connection with the constant driving power.

54. The combination, substantially as described, in a type-by-type printer, of a paper feed, a driving wheel therefor, an escapement connected to said wheel, a driving motor, exerting a constant torque and a spiral spring kept under constant tension by said motor and interposed between the motor and said driving wheel.

55. The combination with the type-wheel and its impelling or adjusting devices operating singly or in various combinations according to the letter to be printed, of a series of selecting relays, and two circuits controlled by each relay, one to move the impelling device

from position of rest and the other to restore it to normal position.

56. The combination with a type-wheel and an impelling or adjusting device having positive mechanical connection therewith, so as to move it positively in opposite directions, of a pair of actuating magnets, operating on the impelling device oppositely and means for energizing the same alternately.

57. The combination with the type-wheel and impelling devices operating singly or in various combinations to adjust the type-wheel to its various positions for printing, of an electro-magnet or magnets for actuating each of said impelling devices positively by a magnetic pull or push in both directions, and means for alternately energizing the magnet or magnets to cause said impelling devices to move to and fro.

58. The combination with the type-wheel and its impelling devices operating singly or in various combinations to adjust the wheel to its various positions for printing, of two actuating magnets for each impelling device acting alternately on the same one to move the same in a direction to set the type-wheel into position for printing the desired character and the other to restore the impelling device to position preparatory for the next transmission.

59. The combination with the type-wheel and the series of positively acting impelling devices, of a corresponding series of selecting relays, a back contact for each relay controlling the circuit of an electro-magnet which operates on the impelling or adjusting device in a direction to hold or restore the same to normal position, and a front contact for each relay controlling a circuit by which the impelling device is moved in a direction to set the type-wheel to position for printing.

60. The combination of a type wheel and a series of adjusting devices operating singly or in various combinations to move the type-wheel into position for printing its various characters, actuating magnets therefor each in a separate circuit, a distributor for closing in succession the controlling circuits of said actuating magnets, a dogging device normally disengaged from the type-wheel shaft, an actuating magnet therefor, and means for automatically operating the same when the type-wheel has reached any one of its positions.

61. The combination with a type-wheel having two or more rings of type axially and circumferentially adjustable for bringing its various characters into position for printing, of a conical dogging pin, and a perforated or recessed cylinder on the type-wheel shaft having holes corresponding in number and relative position to the type-wheel characters.

62. In a type-by-type printer, a fixed paper supporting cylinder supported from one end only and adapted to permit a tubular blank to be slipped endwise upon its free end,

said cylinder having sufficient space at its supported end for a filled blank to be slid endwise away from position for printing in the operation of sliding a fresh blank into position, as and for the purpose described.

63. The combination with a type-wheel, of a dogging magnet, and a press magnet in a local controlled by said dogging magnet.

64. The combination, substantially as described, of a type-wheel, a series of adjusting devices and a distributor, of a dogging magnet controlled from a circuit of the distributor, and a press magnet controlled by the dogging magnet.

65. The combination, substantially as described, of a type-wheel dogging magnet, a press magnet in a local controlled by the dogging magnet, and a paper feed magnet locally controlled by the press magnet.

66. The combination with the type-wheel, a series of selecting relays, a corresponding series of adjusters, magnets for restoring the same to normal position, a dogging magnet, and a restoring circuit through said relays controlled by the dogging magnet circuit.

67. The combination with a type-wheel having its characters arranged in two or more rings of type, of a stop or lock cylinder movable therewith and having two or more corresponding rings of locking points or seats and a conical dogging pin or lock.

68. The combination of a type-wheel having two or more rows of type, adjusting devices for adjusting it by a single movement into position for printing any character of the row, means for moving the type-wheel axially for shifting it to position to print from the desired row, a dogging device, and means for actuating said dogging device on the completion of each adjusted movement of said type-wheel axially or circumferentially, as and for the purpose described.

69. The combination with a type-wheel and a series of adjusting devices operating singly or in various combinations, of a conical dogging device, an actuating magnet therefor, and means for bringing the latter into action at the conclusion of each adjusting operation by one or more of said adjusting devices.

70. The combination with a type-wheel, of a series of adjusting magnets in separate circuits, a distributor closing the circuits of said magnets in succession, a dogging device for holding the wheel in each of its adjusted positions, and a controlling magnet therefor brought into action at the conclusion of each cycle of circuit changes in which any adjustment takes place.

71. The combination, substantially as described, of a type-wheel, a series of adjuster magnets operating singly or in various combinations to control the position thereof, a distributor or sunflower which closes the circuits of said magnets in succession, and a dogging magnet whose circuit is closed by the said sunflower at the conclusion of each

cycle of changes in which the adjuster magnets are controlled.

72. The combination with a type-wheel having two or more rings of type and axially and circumferentially adjustable as described, of a conical locking dog, and a cylinder upon the same shaft with said type wheel and having corresponding rings of locking points or seats to receive the dog, as and for the purpose described.

73. The combination with a type-wheel having two or more rings of type, of a series of adjuster magnets, a dogging magnet, and a sunflower or distributor whose cycle of changes includes the circuits for controlling the said adjusting magnets and concludes with the circuit which controls the action of the said dogging magnet.

74. The combination with a type-wheel, of a series of adjuster magnets, a dogging magnet, a sunflower or distributor for closing in succession controlling circuits of said adjuster magnets and dogging magnet, and a press circuit controlled by said dogging magnet.

75. The combination with the type-wheel having two or more rings of type, of a series of adjuster magnets, a sunflower or distributor, a dogging circuit closed at the conclusion of each cycle of changes in which said adjuster magnets are brought into operation, and a press magnet in a local circuit controlled from said dogging circuit.

76. The combination with the type-wheel having two or more rings of type, of a locking cylinder moving coaxially therewith, a locking dog or pin for holding the wheel against rotation and a magnet for actuating the locking dog or pin at the conclusion of each circumferential movement of the type-wheel by which a character is brought into position for printing.

77. The combination with a type-wheel having two or more rings of type and adjustable circumferentially and axially as described, of a series of adjusting magnets, a sunflower or distributor, a dogging magnet, a restoring circuit, and a relay controlling the latter circuit and placed in a circuit with the dogging magnet, as and for the purpose described.

78. The combination of a type-wheel, a series of adjuster magnets, a distributor, and an auxiliary device for assisting the adjusting action of the magnet or magnets which are called into action at the latter part of the cycle of actions produced by the sunflower.

79. The combination with the type-wheel and a series of adjusting magnets brought into action consecutively to produce the desired adjusted positions of the type-wheel, of an auxiliary power for aiding the operation of those magnets which come into operation toward the close of each cycle of actions in which each adjustment is effected.

80. The combination of a type-wheel or platen, a press pad, and a strip of elastic material

fed between the pad and wheel and of sufficient thickness as described to act as a resilient cushion to assist in the recoil of the pad.

81. In a type-by-type printer, the combination with the type and the pad, of an endless band or strip of elastic material fed between the pad and the paper.

82. In a type-by-type printer, the combination with the press pad, of a strip of elastic material fed between the pad and the paper, and means for feeding said strip from the paper feed mechanism.

83. The combination with the cylinder carrying the paper tube, of a press pad within the same, a paper feed roll projecting outside the cylinder to engage the paper, and a band of elastic material passing over the rolls mounted within the cylinder at opposite sides of the pad and over a third roll mounted to revolve with the feed roll.

84. The combination with the paper tube and its supporting cylinder, of a press pad mounted on a bell-crank lever within the tube, and an operating magnet mounted exteriorly to the cylinder and having its armature connected with the said bell-crank lever by a rod or link, as and for the purpose described.

85. The combination with the paper supporting cylinder, of the press pad mounted within the cylinder, an operating magnet mounted outside the cylinder on an adjustable frame, and means for connecting said magnet and press pad as and for the purpose described.

86. The combination with a type-wheel and an adjusting device positively connected thereto for adjusting it by a single movement to position for printing, of an electro-magnet in a normally closed circuit for holding the adjuster in normal position, and means for giving said adjuster a bias in a direction against the power of the magnet, as and for the purpose described.

87. The combination with a type-wheel, of a series of adjusters, a distributor by which the same may be successively called into action, and means for giving a bias to one or more of those adjusters which operate late in the cycle of changes produced by the distributor, as and for the purpose described.

88. The combination with a type-wheel, of a series of adjusters operating in succession in a cycle of actions in which the desired adjustment of the type-wheel to position for printing is effected, the adjuster which operates last in the cycle having a bias which tends to move it away from normal position or position of rest, as and for the purpose described.

89. The combination with the type-wheel and its impelling or adjusting devices operating singly or in various combinations according to the letter to be printed, of a series of selecting relays, a distributor, magnets for moving said adjusters in opposite directions, and means for assisting the action of those

adjusters which are at a disadvantage in point of time in producing the necessary movement of the type-wheel.

90. The combination with the series of adjusters, of a distributor, a series of relays controlling the action of said adjusters, and biasing springs for assisting the action of the adjusters called into action by the distributor at the end of its cycle of changes, as and for the purpose described.

Signed at New York, in the county of New York and State of New York, this 8th day of January, A. D. 1895.

CHARLES L. BUCKINGHAM.
EMIL GERMANN.

Witnesses:

WM. H. CAPEL,
HENRY T. HIRSCH.