April 21, 1925. 1,534,164

F. G. CREED

PRINTING APPARATUS SUITABLE FOR PRINTING TELEGRAPHIC MESSAGES

Filed Aug. 7, 1920 4 Sheets-Sheet 1

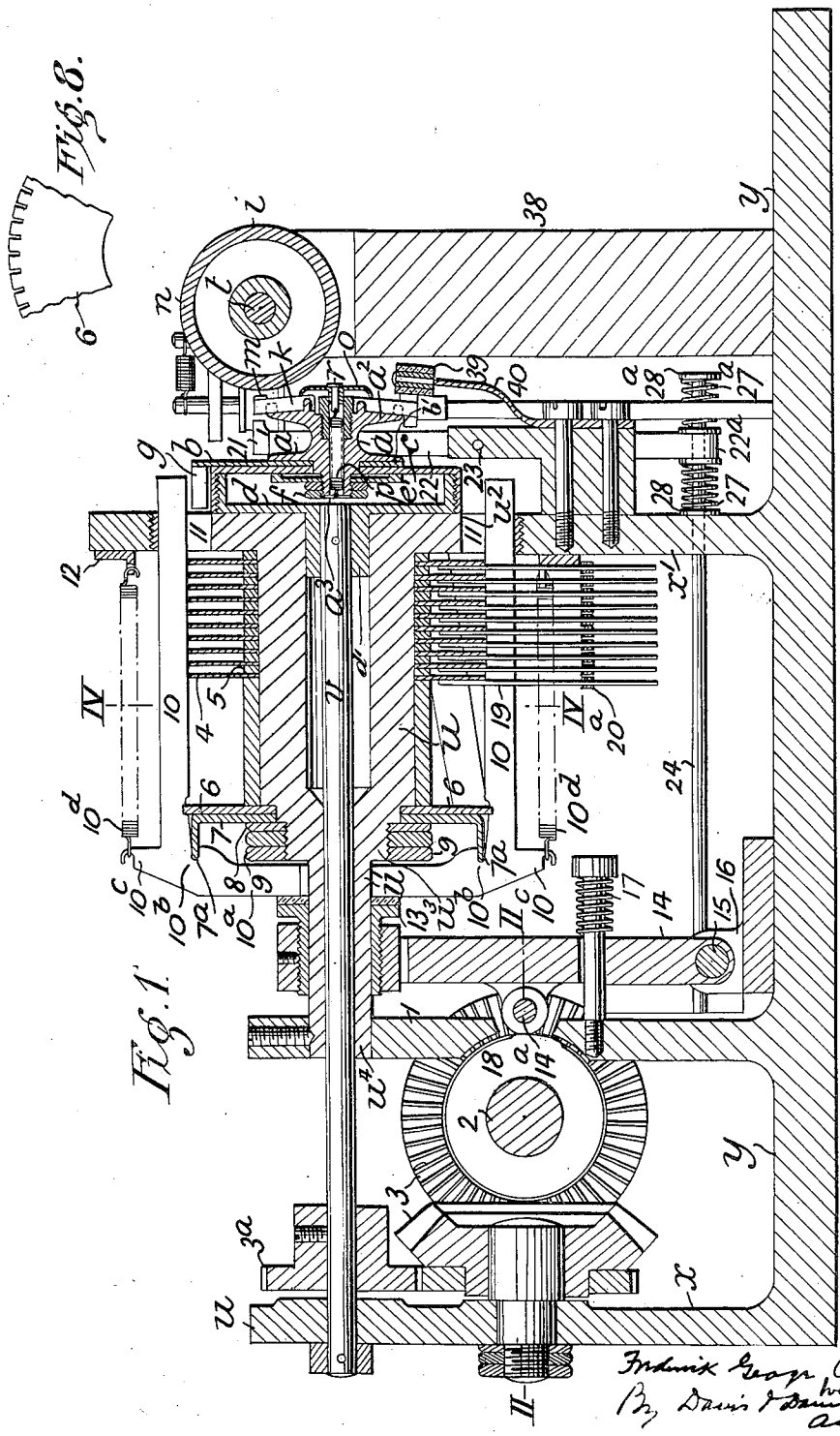


Fig. 1.

Fig. 8.

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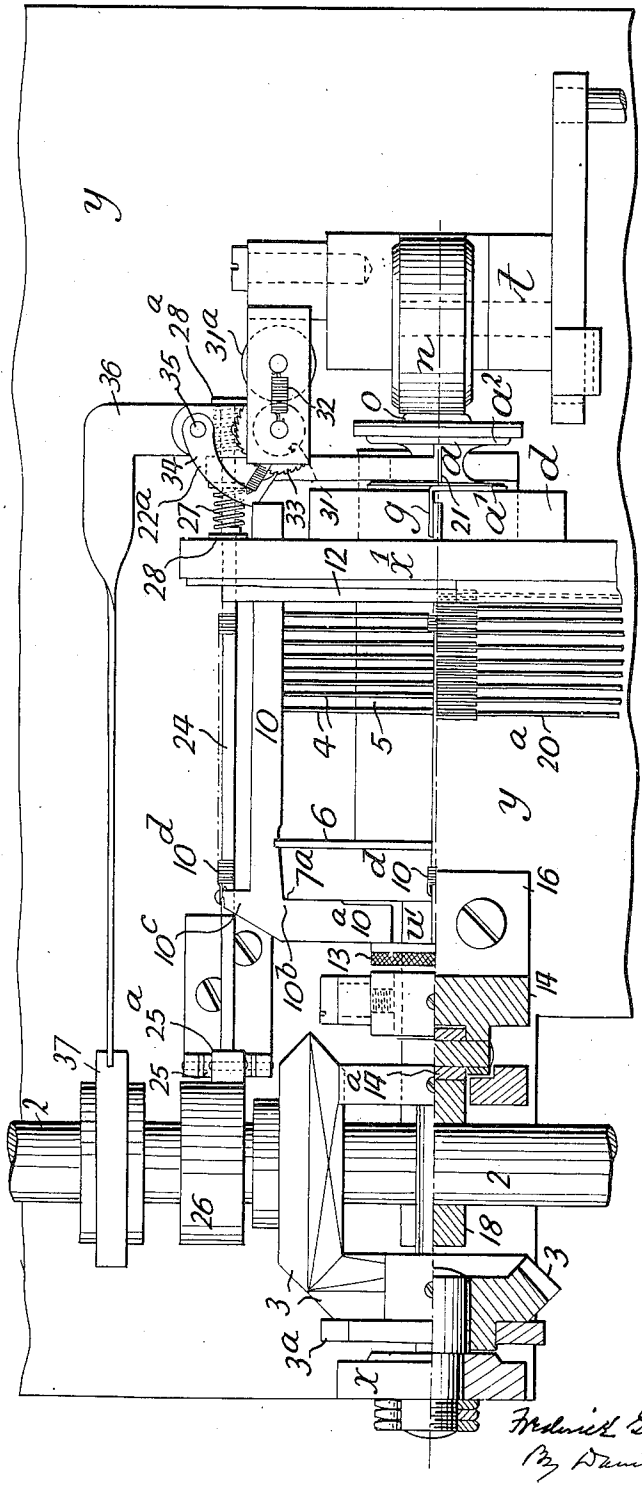
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Fig. 2.



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Fig. 4

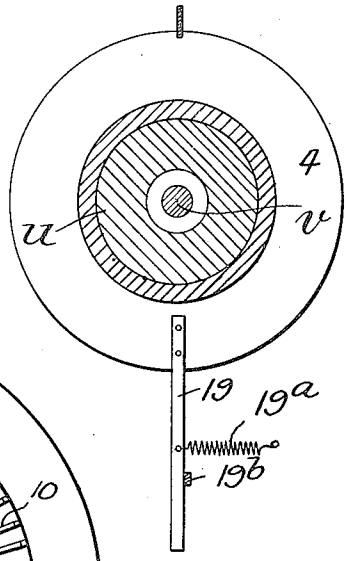
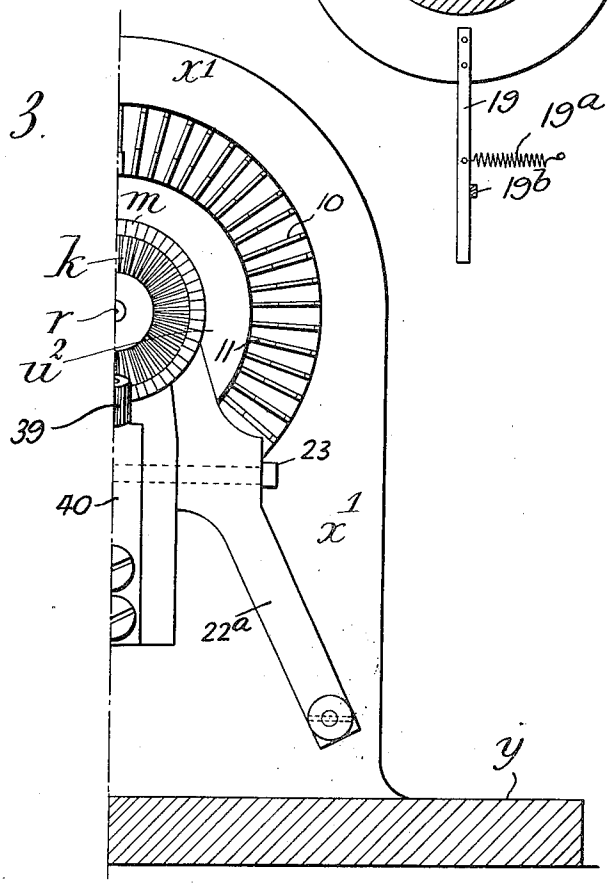


Fig. 3.



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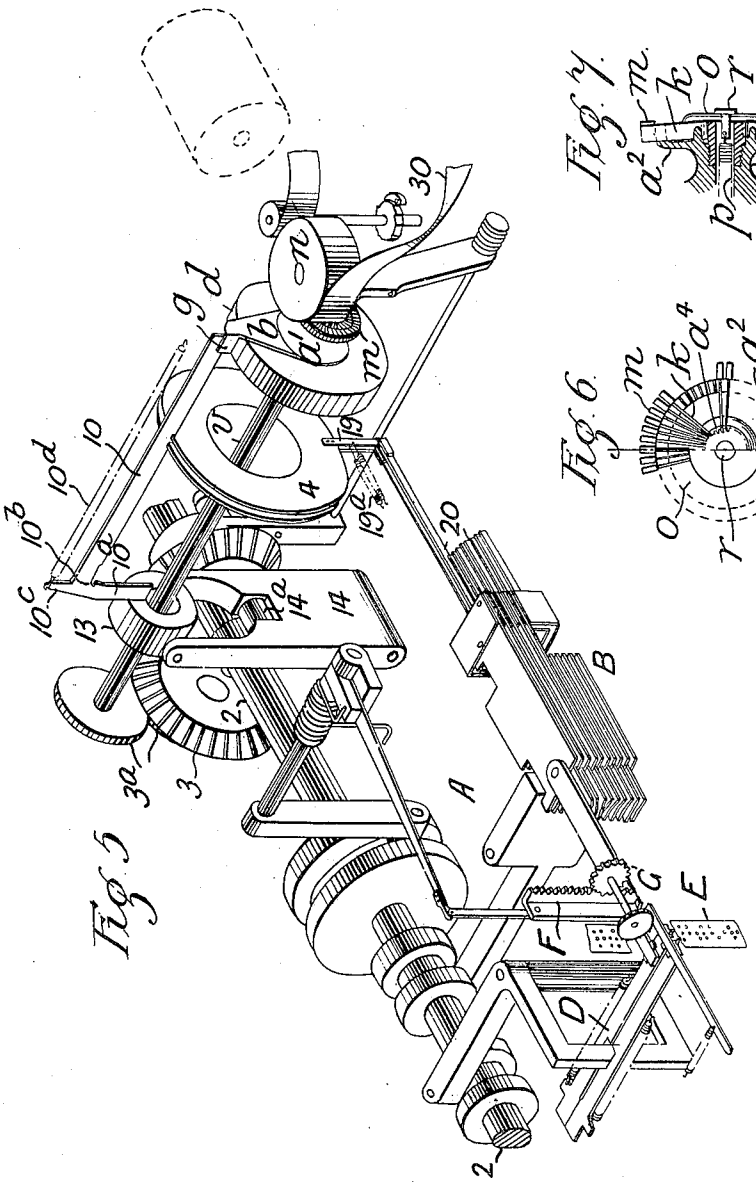


Fig. 5

Fig. 7.

Fig. 6.

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Patented Apr. 21, 1925. 1,534,164

UNITED STATES PATENT OFFICE.

FREDERICK GEORGE CREED, OF CROYDON, ENGLAND.

PRINTING APPARATUS SUITABLE FOR PRINTING TELEGRAPHIC MESSAGES.

Application filed August 7, 1920. Serial No. 401,991.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, FREDERICK GEORGE CREED, a subject of the King of Great Britain and Ireland, residing at Croydon, in the county of Surrey, England, have invented Improvements in or Relating to Printing Apparatus Suitable for Printing Telegraphic Messages (for which I have filed application in Great Britain Aug. 6, 1919, No. 19,424, Patent No. 164,370 sealed 1921), of which the following is a specification.

In printing telegraph systems or apparatus, it has heretofore been proposed to use in conjunction with a rotary printing wheel or carrier provided with type characters, means, comprising selecting mechanism, whereby the printing wheel or carrier can be arrested in the correct printing position and caused to print a character corresponding to the electric signal received and driving mechanism for afterwards moving it forward rapidly.

The present invention has reference to printing apparatus specially suitable for use in connection with selecting mechanism designed for the reproduction, in ordinary printed characters, of telegraphic messages in the form of perforations in a tape but parts of which apparatus are also suitable for use in connection with selecting mechanism designed to be operated under the direct control of electric signal impulses.

The object of the invention is to simplify the construction and improve the working of printing apparatus for the purpose referred to and also of the selecting mechanism and operating mechanism used therewith, so as to enable such apparatus to work at high speed and with great precision.

For this purpose in printing apparatus according to the invention, the printing wheel or carrier provided with type characters, is driven by friction from a shaft arranged to be rotated in such a manner and at such a speed relatively to the main operating or controlling shaft that for each operation or cycle of operations of the apparatus, the printing wheel or carrier (hereinafter called the printing wheel) can, under the control of selecting mechanism and without affecting rotation of the main shaft, be arrested in such a position as to admit of a character corresponding to a particular set of perforations in punched tape, or of direct signal impulses, to represent a letter or other character, being printed, or of a space being left, on a strip or sheet of paper, and afterwards released and caused to be moved forward rapidly by the shaft to enable it to be again arrested in position for the next required printing or spacing operation. By this arrangement the printing wheel with type characters can be made very light and, being free to be stopped independently of its driving shaft, it can be arrested in the correct printing or spacing position, even when moving very rapidly, in such a manner that little or no shock, jar or vibration will result, thus enabling the apparatus to be worked rapidly and good printed impressions to be obtained.

The type characters can be arranged in various ways on the printing wheel. Thus, according to one example, they may conveniently be provided on a series of separate blades mounted to oscillate on the printing wheel after the manner of type levers, and each adapted, after being brought into and held in the correct printing position by the action of selecting mechanism, to be moved into position to make an impression on a strip or sheet of paper by a striker adapted to be brought into action for each rotation or operation of the apparatus.

For arresting the printing wheel in the correct angular position for printing, it may be provided with an arm arranged at right angles to its axis and so as to revolve in a path into which one or other of a series of selector bars, corresponding to the type characters, or to a space, can be moved so as to arrest the rotation of the printing wheel without arresting its driving shaft, owing to the slip which then takes place between the two. The selector bars are arranged to be brought into the operative position under the control of selecting mechanism that can be of various kinds but which may conveniently be of the kind comprising differentially notched combs, preferably of annular or disc form arranged parallel and co-axially and adapted to be set relatively to one another by operating or setting means under the control of perforated tape, or of mechanism under the

direct control of the electric signalling impulses received, to suit the character to be printed, or the space to be formed. When the combs are of annular or disc form they may be set by turning any one or more of them relatively to the others to the desired extent.

The operating or setting means referred to, may advantageously comprise a series of parallel blades each arranged to operate, or to permit of the setting of one of the combs and to be itself operated or set by mechanism under the control of punched tape, or of electric signalling impulses acting through electro-magnetic devices. In the former case, the printing apparatus is operated and controlled entirely by mechanically operated means. In the latter case, the printing apparatus is operated and controlled partly by mechanical means and partly by electro-magnetic means under the control, it may be, of electric relays.

The spacing of the paper without printing a character thereon, that is to say, to form spaces, can be provided for in various ways, as for instance by preventing relative movement between the printing wheel or a type lever and the paper when the printing wheel is arrested by the selector bar corresponding to a space.

In each case the arrangement is such that with the exception of the operations of finding the selector bar and arresting the printing wheel to enable the printing of a character, or the forming of a space, to take place, the whole cycle of operations namely effecting the printing or spacing, withdrawing the selector bar used for arresting the printing wheel, returning and re-setting the discs or combs, or equivalent, and setting a new selector is carried out very quickly, say in one-fifth of a revolution of the main shaft. It will thus be seen that if the secondary shaft used for directly driving the printing wheel be arranged to revolve say about 30% to 35% faster than the main shaft of the apparatus and this is a feature of the invention, there will always be time for the radial arm of the printing wheel, after it has been released by one selector, to engage the next selector that is set in its path, and be held thereby until printing or spacing has again taken place and thus for the mechanism to print a letter or form a space at each revolution of the main shaft.

The very rapid resetting of the notched discs or combs or equivalent, which is also a feature of the invention is rendered possible by allowing that disc or comb, or those discs or combs, or equivalent used in the last selection to snap back under the pull of its or their spring or springs, on the withdrawal of the selector from their notches during the small fraction of time that the operating or setting means, for instance the bifurcated ends of the parallel blades above referred to, are coming forward with the new selection or arrangement set up by the perforated tape, or it may be by electro-magnetic means under direct control of line signals. After resetting the combs or discs or equivalent, the parallel blades are immediately free to be returned to their normal position ready to take part in a new selection. A method of such selection of the parallel blades is explained in the previous specifications hereinafter referred to.

From the foregoing description it will be understood that printing apparatus embodying the invention can be constructed, operated and controlled in various ways.

In the accompanying illustrative drawings, Fig. 1 shows in central vertical section and Fig. 2 partly in plan and partly in horizontal section on the line II—II of Fig. 1, one construction of printing apparatus according to the invention. Fig. 3 shows part of the apparatus in end elevation. Fig. 4 is a cross section of part of the selecting mechanism on the line IV—IV of Fig. 1. Fig. 5 is a diagrammatic view showing the printing apparatus combined with operating or setting mechanism controlled by perforated telegraphic tape. Figs. 6 and 7 are detail views at right angles to one another showing a printing wheel. Fig. 8 is a view of another detail.

In this example, the printing wheel comprises a hollow hub a provided with two annular flanges a^1 a^2. The inner flange a^1 has connected to it a radial arm b and is pressed, it may be, as in the example shown, through the boss b^1 of the radial arm, into frictional contact with the outer side of the outer end wall or cap c of a hollow head piece d. This may conveniently be done by a spring plate e that bears against the inner face of the said end wall c, encircles an axial prolongation a^3 of the wheel hub a extending into the said head, and is set up by nuts f screwed on the said hub prolongation.

The radial arm b is provided at its outer end with a lateral blade g arranged to rotate around the periphery of the hollow head d. The outer flange a^2 of the printing wheel is provided on its outer side, near its periphery, with an annular series of radial grooves h forming an annular comb, and towards its centre with an annular rib or seat i to serve as a fulcrum ring. Into the radial grooves extend a series of levers k in the form of short thin blades each notched on its rear or inner edge, near its inner end, and seated on the annular fulcrum ring i. As shown more clearly in Figs. 6 and 7, the wheel hub a is also provided on its outer side with an inner annular series of notches a^4 to receive the inner ends of alternate levers k, the remaining levers being arranged between the other and adjacent to the annular series of

projections or teeth between the said notches. Each of the levers k is provided on its outer side, near to its outer end, with a type character m and is hereinafter called a type lever. The type levers are normally held in their inoperative positions by a spring device but are each capable of being independently turned in an outward direction on the fulcrum ring i towards a paper supporting platen n. The spring device may conveniently be a recessed disc c having its edge pressed against the said type levers k by a coiled spring n that extends through the hollow hub a of the printing wheel and is connected to the central portion of the recessed disc as by a headed pin r and to the axial prolongation a^3 of the said hub, as by a transverse pin s. A printing wheel constructed as described is very light and can be moved quickly and stopped easily without undue shock of jar, whilst each of the independent type levers is very light and has only a very small operative movement, namely a small fraction of an inch, so that it can take place in a very short time.

The platen n may, as shown, conveniently be in the form of a roller mounted on a horizontal shaft t arranged at right angles to the axis of the printing wheel with its axis at a height corresponding substantially to the centre of the height of each type character m when in its uppermost printing position.

The hollow head d is provided with a boss d^1 journalled in a hollow stationary cylinder u and fixed to a horizontal driving shaft v (herein called the secondary shaft) also journalled in the said cylinder at u^1 and in an end bearing w in a standard x carried by a base plate y. The cylinder u is provided at one end with a flange u^2 supported within another standard x^1 on the base plate. The other end of the cylinder is stepped at u^3 and provided with a tubular extension u^4 held in another standard l on the base plate y. The secondary driving shaft v is driven from the main driving shaft 2 of the apparatus through toothed gearing, for instance bevel and spur gear gearing 3 and 3^a respectively, in such manner that its speed is, for the purpose hereinbefore explained, greater say 30% to 35% greater, than that of the main driving shaft 2, which is designed to make one revolution for each complete operation or cycle of movements of the apparatus.

The selecting mechanism used for arresting the printing wheel a, a^1, a^2 in correct position for stopping the appropriate type lever k in its uppermost or printing position comprises, according to the example now being described, a series of differentially notched annular discs or combs 4 (hereinafter referred to as combs) mounted to turn to a small extent upon the stationary hollow cylinder u. These combs are spaced apart and held in position axially by distance and spacing rings 5 between the end flange u^2 of the cylinder u and a removable radially notched annular end plate 6 which, in conjunction with an outer plate 7, having an axially arranged annular rim 7^a and a washer 8, is fixed in place on the stepped portion u^3 of the cylinder by nuts 9 screwed on such stepped portion. Arranged around the notched combs 4 are the horizontal arms 10 of an annular series of L-shaped selectors 10—10^a in the form of levers that extend through the radial slots in the removable plate 6 and at their forward ends through radial slots 11 cut in the flange u^2 at the opposite end of the cylinder. The selector levers, which are made as steel blades, are notched at 10^b to admit of their being fulcrummed on the annular rib 7^a of the said outer plate 7 and have their other and shorter arms 10^a extending radially inward towards the tubular axial extension u^4 of the stationary cylinder u. Each of the selector levers 10—10^a normally is pressed against an unnotched portion of one or more of the combs 4 by a coiled spring 10^d connected to an extension 10^c of the lever and to a ring 12 fixed to the standard x^1 carrying the flanged end of the stationary cylinder u, so that when the discs or combs are set under the action of punched tape as hereinafter described, or of electric signal controlled mechanism, one or other of the long arms 10 of the said selector levers 10—10^a can descend into an aligned set of notches in the combs, formed by the relative setting of the combs, and bring its forward free end into the path of the lateral blade extension g of the radial arm b connected to the printing wheel a, a^1 so as to arrest the wheel with the corresponding printing lever k in position for printing. The long arms 10 of the selector levers 10—10^a are moved away from the peripheries of the notched combs, 4, to allow of re-setting of these combs, by a sleeve 13 that is moved endways on the extension u^4 of the cylinder u at the predetermined times and caused to press against the shorter arms 10^a of the selector levers. The sleeve is moved endways by the forked upper end of a lever 14 that is pivoted at its lower end at 15 to a bracket 16 on the base plate y and is moved into its operative position, against the action of a returning spring 17, by a rotary cam 18 fixed to the main driving shaft 2 and acting on the lever through a roller 14^a.

As above indicated the means for setting the notched combs 4 to correspond to the character to be printed or for spacing, can be variously constructed. According to the arrangement shown, each comb 4 is provided with a depending lever arm 19 that is normally held by a spring 19^a against a fixed

abutment 19^b (Fig. 4), and is adapted to be engaged by the bifurcated end of one of a series of parallel blades or plate 20 adapted to be reciprocated and set after the manner and by means such as described for example in the specifications of British Letters Patent No. 22653 of 1902 and No. 25861 of 1905, for reciprocating and setting, under the control of punched tape, the notched bars or combs *a* and 36 respectively described in those specifications, or after the manner and by means such as described in the specifications of British Letters Patent Nos. 8999 of 1907 and 1947 of 1908 for reciprocating and setting, under the control of punched tape, the series of perforated valve plates *i* and their extensions l^x described in these latter specifications.

Apparatus of the type described and shown in the last mentioned specifications is shown diagrammatically and collectively at A in Fig. 5 of the accompanying drawings, B being a series of suitably guided slide plates connected to the respective parallel blades 20 used for setting the notched combs 4 and adapted to be themselves set in the required relative positions by a series of links C adapted to be brought into an operative position by selector bars D under the control of perforated telegraphic tape E and to be then moved endways by lateral movement of a vertically movable rack F in gear with tape feeding mechanism G. The arrangement is such that the parallel blades 20 will at each rotation of the main driving shaft 2 of the apparatus be adjusted endways to occupy relative positions corresponding to the letter or other character, or to a space, in the portion of the perforated tape E being dealt with at each operation of the apparatus and which character is to be reproduced as a printed character on a strip or sheet of paper by the printing wheel *a* a^1 a^2 and the corresponding type lever *k*, or which space is to be left on the printed strip or sheet between or after characters thereon. Or the said series of parallel blades 20 may be reciprocated and set by electro-magnetically controlled mechanism under the direct action of electric signalling apparatus after the manner for instance in which parallel notched or permutation bars have been reciprocated and set in various known arrangements of electro-magnetically controlled telegraph printing apparatus. Whatever means be used for reciprocating and setting the parallel blades 20, one or more of the notched combs 4 will, for each complete rotation of the main driving shaft 2 and operation of the apparatus, be partly rotated so as to cause alignment of notches in the respective combs and enable the corresponding selector lever arm 10 to enter the aligned notches and bring its forward free end into the path of the lateral projection *g* on the radial arm *b* attached to the printing wheel *a*, a^1, a^2 and arrest this wheel with a type lever *k* in proper position for use.

Each type lever *k* when brought into and held in its uppermost position for printing, is moved laterally to print the corresponding character on a strip or sheet of paper by a striker, operated at the appropriate moment from a moving part of the apparatus. For this purpose the striker may be constituted by a projection 21 carried by the bent upper arm 22 of a two armed lever 22—22^a mounted to turn about a horizontal axis at 23. The lower arm 22^a of the lever is connected to one end of a link 24 the outer end of which is connected to a lever 25 arranged to be operated at the appropriate moment through a roller 25^a by a cam 26 on the main driving shaft 2. The connection of the link 24 to one of the levers, conveniently to the two-armed lever 22—22^a carrying the striker 21, may be effected through two springs 27—27^a encircling the link and arranged at opposite sides of the lever arm 22^a and between adjustable collars 28, 28^a on the link. The arrangement is such that the striker 21 will be operated through an elastic or yielding connection and that the position of the striker in relation to the printing wheel and the strength of the blow, can be adjusted to suit requirement.

For leaving spaces between printed characters, and for spacing generally, the printing wheel *a*, a^1, a^2 may be formed with a blank space or opening which, when brought opposite the striker 21 by the action of that one of selector levers 10 10^a representing the space selector lever, will enable the striker to make an idle forward movement. Or other device may be adopted to enable spaces to be formed at the required times.

The paper on which the characters are printed, and spaces left, may be in the form of a paper strip 30 arranged to be drawn, in a step by step manner, across the cylinder or roller *n* forming the platen hereinbefore referred to, by a pair of drawing or feed rollers 31—31^a that are pressed together sideways by springs 32 and rotated in a step by step manner by feed mechanism operated at the appropriate times. The feed mechanism may comprise a ratchet wheel 33 fixed to one end of the rollers 31 and a spring pawl 34 fixed to a vertical spindle 35 arranged to be rocked, as through a lever 36, from a cam 37 on the main driving shaft 2. The roller or platen *n* is carried by a standard 38 from the base plate *v* and can be turned by hand from time to time, or it may be revolved automatically by gearing.

The inking of the type characters *m* can be effected by an inking roller 39 carried by a spring blade 40 mounted on a stationary part of the apparatus, the roller bearing

against the annular set of type characters m as the printing wheel a a^1 a^2 is rotated. Or, if desired, an inking ribbon may be associated with the paper strip 30 against which the type characters act.

For page printing a platen carrying carriage may be employed, moved as regards letter feed, line shift, line feed and message feed, in any known or suitable way.

The arrangement of the machine described is such that each time the arm 10 of a selector lever 10 10^a is allowed to enter an aligned set of notches in the combs 4 under the control of punched tape or electric impulses as described, its free end will enter the path of the lateral blade g on the radial arm b connected to the printing wheel a a^1 a^2 and arrest this wheel with the corresponding type lever k in its uppermost position, slip taking place between the printing wheel and the hollow head d on the secondary driving shaft v carrying the latter, so that the head and shaft continue their rotation. After the printing or spacing is effected, the selector lever 10 10^a that was effective is moved into its inoperative position by the sliding sleeve 13, the combs 4 are immediately reset for the next printing or spacing operation by the parallel blades 20, and the printing wheel is again moved forward by the said head and shaft by friction until it is again arrested by a selector lever 10—10^a as described. The whole cycle of operations is effected very quickly and during a small part only of a revolution of the main driving shaft 2 as and for the purpose hereinbefore explained.

What I claim is:—

1. Printing apparatus of the kind herein referred to, comprising a main driving shaft, a secondary driving shaft driven from said main shaft but at a greater velocity than that of said main shaft, a printing device in frictional driving connection with said secondary shaft and provided with type characters, type selecting mechanism comprising a series of differentially notched combs and a series of selector bars adapted to co-operate therewith, each of said selector bars being adapted, when moved into its operative position, under the control of said combs, to arrest the said printing device in proper printing position without stopping the secondary shaft, means for setting said combs in accordance with the particular type character to be printed, or a space to be left on sheet material, signal controlled mechanism actuated at each rotation of the main shaft adapted to operate the comb setting means in accordance with the particular signal character to be printed, or a space to be left, means adapted to be quickly operated at each rotation of the main shaft to cause a printing character that may be in position, rapidly to make an impression on said sheet material and means actuated at each rotation of the main shaft for causing the selector bar quickly to return to its inoperative position and allow displaced combs to return towards their normal position after each printing operation.

2. Printing apparatus of the kind herein referred to, comprising a main driving shaft, a secondary driving shaft driven from said main shaft but at a greater velocity than that of said main shaft, a printing wheel in frictional driving connection with said secondary shaft, type selecting mechanism comprising a series of differentially notched combs and a series of selector bars adapted to cooperate therewith, each of said selector bars being adapted, when moved into its operative position, under the control of said combs, to arrest the said printing wheel in proper printing position without stopping the secondary shaft, means for holding said combs in normal position, means for moving one or more of said combs in relation to the others so as to set them in accordance with the particular character to be printed, mechanism actuated at each rotation of the main shaft under control of signal indications representing characters to be printed or spaces to be formed on sheet material and adapted to operate the setting means and combs accordingly and permit the corresponding selector bar to move into its operative position, means operated from said main shaft for causing the printing wheel to print, and means, also operated from the main shaft, during each rotation thereof, for returning the operative selector bar to its inoperative position and allow displaced combs to return to their normal position.

3. Printing apparatus of the kind herein referred to, comprising a main driving shaft, a secondary driving shaft driven from said main shaft but at a greater velocity than said main shaft, a printing device in frictional driving connection with said secondary shaft, type selecting mechanism adapted to be set to hold said printing device in proper printing or spacing position, means for setting said selecting mechanism, signal controlled mechanism operated at each rotation of said main shaft to operate said setting means and means for causing said selecting mechanism suddenly to return to normal position after each printing or spacing operation, said setting means being adapted to move into its operative position whilst the selecting mechanism is moving into its normal position for the purpose set forth.

4. Printing apparatus of the kind herein referred to, comprising a main driving shaft, a secondary driving shaft driven from said main shaft but at a greater velocity

than said main shaft, a printing wheel in frictional contact with said secondary shaft, selecting mechanism comprising a series of differentially notched combs and a series of spring controlled selector bars adapted to cooperate therewith, each of said selector bars being adapted, when moved into its operative position, under control of said combs, to arrest the printing wheel in proper position for printing or spacing without stopping said secondary shaft, means for returning said selector bars to their inoperative position against their spring controlling means immediately after each printing or spacing operation and releasing said combs, means for suddenly returning displaced and released combs to normal position, a series of bars adapted to set the combs for printing particular characters or for spacing, and signal controlled mechanism operated at each rotation of said main shaft and adapted to move said setting bars into their operative position to form the proper selection of combs to correspond with the signal being dealt with by the signal controlled apparatus, whilst displaced combs are being returned to normal position.

5. Printing apparatus of the kind herein referred to, comprising a main driving shaft, a secondary driving shaft driven from but at a greater speed than said driving shaft and provided with a driving head, a type carrying printing wheel in frictional driving connection with the said head and provided with a radial arm, a platen for supporting sheet materials to be impressed, a stationary cylindrical support, a series of differentially notched annular combs mounted to turn to a small extent upon the cylinder, spring means for holding each of said combs in normal position, an annular series of spring actuated selector levers arranged around and adapted to bear against and co-act with the notched combs and each of which when permitted to enter an aligned set of notches in the combs will come into a position to arrest the radial arm and printing wheel, means operated from the main driving shaft to cause the selected type on the printing wheel to make an impression on sheet material on said platen, means operated from the driving shaft whereby all the selector levers can at each rotation of the main shaft, be moved from the combs so as to release the latter immediately after each printing operation and enable a displaced comb or combs to be immediately returned to normal position by the associated spring means, and means actuated from the main driving shaft but under the control of punched tape, for immediately causing resetting of the combs to enable the next character to be printed or space to be formed, substantially as described.

6. Printing apparatus of the kind herein referred to, comprising a horizontal main driving shaft, a horizontal secondary shaft driven from said main shaft but at a greater velocity than said main shaft and having a driving head, a printing wheel coaxial with said secondary shaft and in frictional driving contact with the driving head thereon, said wheel having a radial arm thereon, a horizontal cylindrical support for said secondary shaft, a series of differentially notched annular combs rotatably mounted on said support, a series of spring actuated selector levers supported around said combs and adapted to bear against and co-act with them and each of which when permitted to enter an aligned set of notches in said combs will come into position to arrest the radial arm and printing wheel, means for causing said printing wheel to print at the required times, means for moving said levers from said combs at the required times, a set of resetting bars adapted to co-act with said comb and set them in the relative positions to enable desired characters to be printed or spaces to be left on sheet material and perforated tape controlled mechanism adapted to be operated at each rotation of the main shaft and to readjust the resetting bars in accordance with the signal perforations in the tape being dealt with.

7. Printing apparatus of the kind herein referred to, comprising horizontal main and secondary driving shafts arranged at right angles to one another and geared together so that the secondary shaft rotates at a greater speed than the main shaft, a horizontal cylindrical support through which said secondary shaft extends, a driving head on said secondary shaft, a printing wheel coaxial with said secondary shaft in frictional contact with the driving head thereon, means operated from said main shaft for causing type on said printing wheel to print a corresponding character, a series of annular differentially notched combs rotatably mounted on said support, a series of selector levers mounted on said support around said combs, springs acting to hold said combs in normal position, springs acting to force said levers against said combs, a sleeve movable on said secondary shaft and adapted to act against and move said levers from said combs, means for reciprocating said sleeve on its shaft, and tape controlled means operated from said main shaft and adapted to reset said combs, at each operation of the apparatus, in accordance with the signal perforations in the tape being dealt with.

8. Printing apparatus according to claim 2, wherein the printing wheel comprises a boss having two annular flanges one of which is held in frictional driving connection with the secondary shaft and an annular series of independently movable type characters mounted on the second flange and held in

normal position thereon by spring means.

9. Printing apparatus according to claim 2, wherein the printing wheel is held in frictional connection with the secondary driving shaft and has an annular series of radial notches therein and a fulcrum ring, an annular series of levers arranged in said notches, fulcrumed on said ring and each carrying a type character and a spring device holding all the type levers normally in position but adapted to admit of any one of them being displaced for printing.

10. Printing apparatus according to claim 2, wherein the printing wheel comprising a boss held in frictional driving connection with the secondary driving shaft and having an annular series of radial notches thereon and a fulcrum ring, an annular series of type levers mounted on said ring and extending into all of said notches except one so as to leave a space or gap at the empty notch and a spring device holding all the type levers in normal position in said notches but adapted to admit of any one of them being displaced for printing.

11. A printing wheel comprising a body having on its outer side an annular series of radial notches therein and a fulcrum ring, an annular series of levers arranged in said notches, fulcrumed on said ring and each carrying a type character on its outer surface, said type levers extending beyond the outer periphery of said body, and spring means bearing upon said type levers between their outer ends and said fulcrum ring and acting to hold all of the type levers normally in position but adapted to admit of any one of them being displaced for printing by means acting from the rear side of said.

12. A printing wheel comprising a body having on its outer side an annular series of radial notches therein and a fulcrum ring, an annular series of type levers mounted on said ring and extending into all of said notches except one so as to leave a space or gap at the empty notch said type levers having type characters on their outer faces and extending beyond the outer periphery of said body and a spring device bearing upon said type levers between their outer ends and said fulcrum ring and acting to hold all of the type levers in normal position in said notches but adapted to admit of any one of them being displaced for printing by means acting from the rear side of said body.

Signed at London, England, this 21st day of July, 1920.

FREDERICK GEORGE CREED.