

Aug. 22, 1961

JIN INOUE

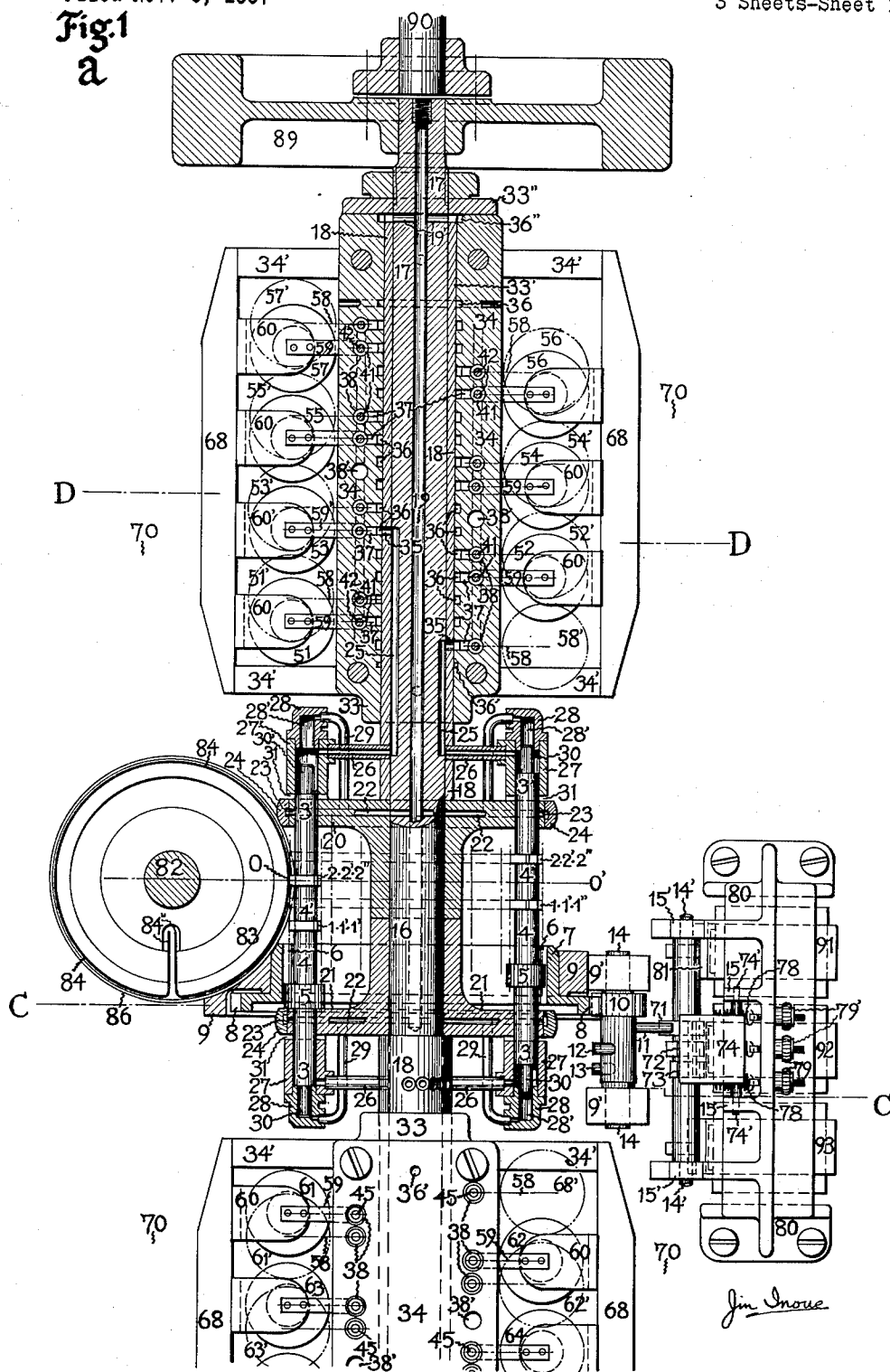
2,997,542

HIGH SPEED TELE-PRINTER

Filed Nov. 6, 1957

3 Sheets-Sheet 1

Fig. 1
a



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Fig.1
b

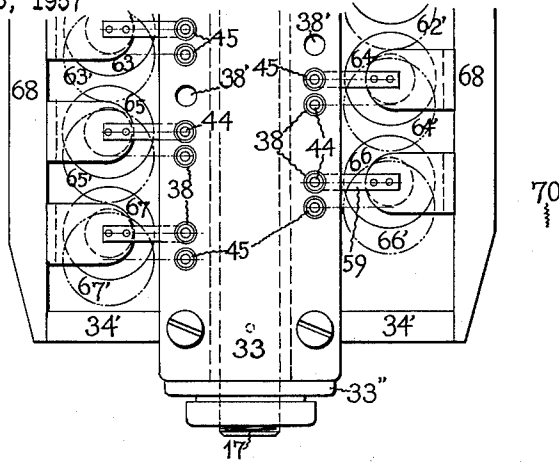
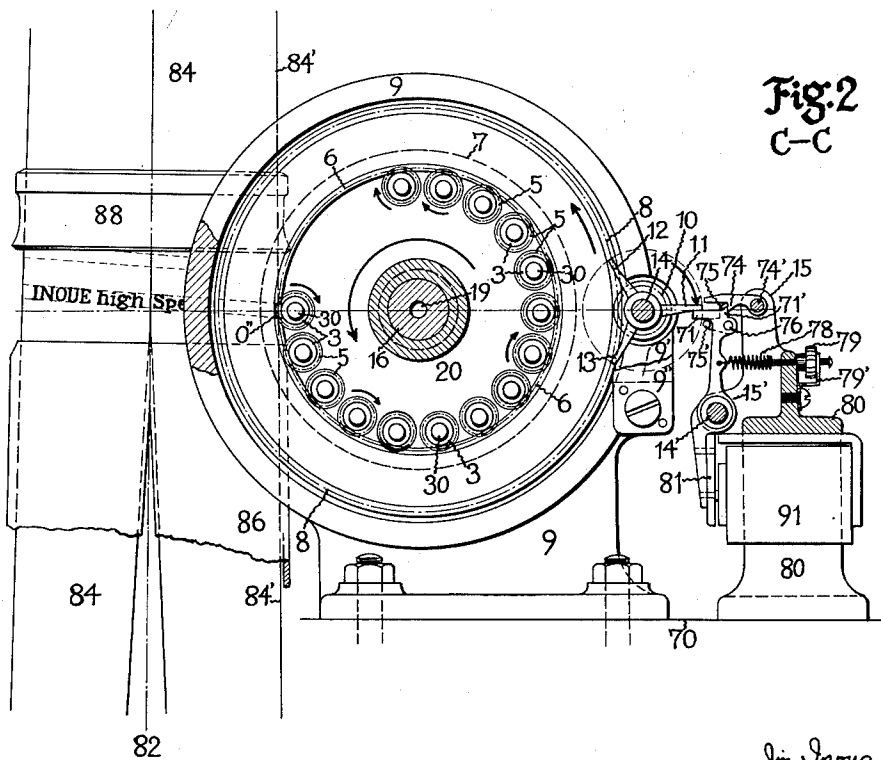


Fig.2
C-C



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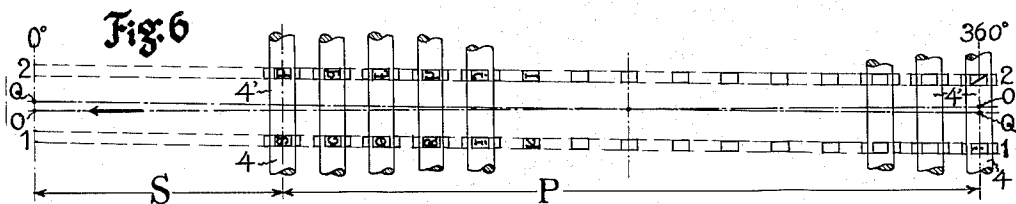
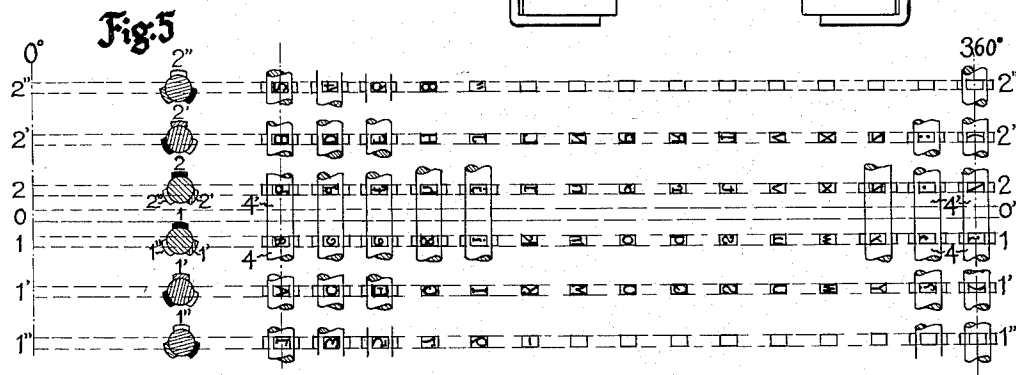
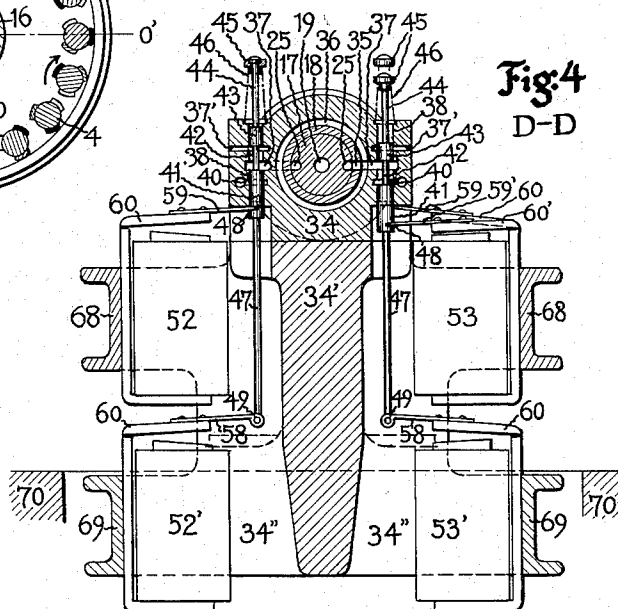
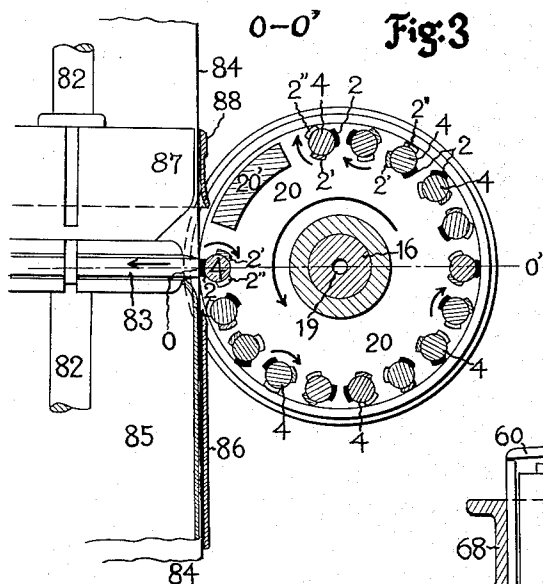
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Jim Inoue

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HIGH SPEED TELE-PRINTER

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9 Claims. (Cl. 178—28)

This invention relates to a high speed printer which is especially adapted for use in the art of printing telegraphy as well as for calculating machines, automatic typewriters and recorders for measuring instruments.

The invention described herein concerns a printing telegraph or tele-printer, the principles of which are equally applicable to the other above named systems. Conventional printing telegraphs operate at present at about 450 to 500 letters per minute. This rate is considered too slow for present day communications and with this invention greater speeds of, for instance, over one thousand letters per minute may be expected. In order to reach such speeds intermittent and reciprocating motions of massive parts having large movements should be avoided. The type characters should approach the printing point on the paper, press or print and withdraw therefrom at a constant speed while traveling in one direction. As there are some repetitions of the same characters in the telegraphic messages, it is necessary that the type be quickly circulated for the next printing operation.

As distinguished from the conventional rotary wheel printer in which the type characters on the periphery thereof do not stop even for an instant, since the wheel is kept under constant rotation, I have provided a rotary form of printer having the characters to be printed about the periphery thereof and in which the character to be printed is static at the printing point. Any chosen character is selected to touch the paper at the printing point to make an impression and immediately return to its original position during rotation of the printer. During page printing, the relative feeds for space and line take place without shock.

For a more complete understanding of my invention, reference is had to the description which follows and to the drawing, of which,

FIG. 1a is a view partly in section along the line 1—1 of FIG. 2,

FIG. 1b is a view in elevation of a continuation of the lower part of the mechanism of FIG. 1a,

FIG. 2 is a sectional view of the tele-typewriter along lines C—C of FIG. 1a,

FIG. 3 is a sectional view along line O—O' of FIG. 1a,

FIG. 4 is a sectional view along line D—D of FIG. 3,

FIG. 5 is a developed plan view of the type rollers on the periphery of the type wheel, and

FIG. 6 is a developed plan view of the type rollers showing the relation between the positions of the type characters and the orders of the rollers in a case where the paper is feeding under constant speed.

The type wheel of this invention comprises two discs 20, 21 fixed on a main shaft 16, 17. Type rollers of cylindrical form are each mounted by means of spindles 3, 3' passing through aligned bearings 23 in the discs 20, 21 and which are equally arcuately spaced and at the same distance from the axis of the shaft 16, 17. The type rollers terminate at their opposite ends in plung-

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ers 30, 31 of smaller diameter. The type rollers are capable of both rotation and axial sliding movement within the bearings 23 in the discs. Each type roller carries two rings of type characters 1, 1', 1'' and 2, 2', 2'' axially spaced from each other by a portion of the roller and a pinion gear 5 adjacent one end spaced from the lower ring of type 1, 1', 1'' by a portion 4'. As shown, each ring of type comprises three type characters equally spaced about the axis of the roller and upon rotation lie on the periphery of a cylinder having a diameter equal to the diameter of the pitch circle of the pinions 5, and all being equal.

The main shaft 16, 17 is supported at opposite ends in two bearings 34, 34 which are fixed on a bed plate 70. On the same bed plate and intermediate the two bearings, is fixed another bearing 9 which supports an internal gear 7 concentric with the main shaft 16, 17. The gear 7 encircles the plurality of pinions 5 and meshes with all of the pinions at the portions of their peripheries furthest from the shaft 16, 17 to provide a planetary gear arrangement.

If the internal gear 7 is fixed and has a pitch circle 6 of a diameter which is n times that of a pinion 5, where n is an integral number, then every pinion returns to its original phase position after n revolutions during one revolution of the main shaft 16, 17. It is obvious that each pinion 5 will remain in pure rolling contact with the internal gear 7, with its own pitch circle within the pitch circle of the internal gear. A predetermined point on the pitch circle of any pinion 5 coincides with a fixed point O'' on the pitch circle 6 of the internal gear when the pinion rolls over the fixed point O'' at every revolution of the main shaft. See FIG. 2.

If now a type character such as 2 is provided at a certain point on the periphery of each roller coinciding with point O'' but somewhat radially inward of the pitch circle 6 as at fixed point O in FIG. 3, then this character will always coincide with the fixed point at every revolution of the main shaft 16, 17. If a paper surface 84 is provided at the fixed point O supported at its rear by a platen of elastic material 83, then the type at the certain point on each roller will make an impression on the paper as it rolls thereover at each revolution of the main shaft. The type characters may be inked in any convenient manner as is conventionally done in typewriters or tele-printers as by an inking ribbon, pad, belt or roller, etc. provided adjacent the paper surface at the fixed point O.

As can be seen from FIG. 3, when the type carrier or main shaft 16, 17 is rotated in a counterclockwise direction, the rollers carrying the type-characters are translationally moved in the same direction. However, due to meshing of the pinions 5 with the internal fixed gear 7, the type rollers are individually rotated about their individual axes in a clockwise direction. As a type-character such as 2 approaches the printing positions O it is relatively static, since its linear velocity in one direction (upwardly in FIG. 3) due to rotation about its own axis, is equal to its linear velocity in the other direction (downwardly in the figure) by reason of its translational movement about the axis of shaft 16, 17. Thus, the problem of high speed printing is met by having the type-characters approach the printing point O on the paper in one direction, press the letter or figure onto the paper while

momentarily relatively stationary and withdraw from the printing point, while still travelling at constant speed in the same direction.

As shown in FIG. 1a, the rings of type 1, 1', 1'' and 2, 2', 2'' on each type roller are normally spaced on either side of a printing plane transverse to the axes of the rollers and passing through the printing point O. When a type-character is to be printed in response to a signal from a telegraphic communication system for each revolution of the type wheel, a selected type roller is raised or lowered to bring a line of type into the printing plane. The mechanism for thus selecting the line of type will now be described. To the outer surfaces of the discs 20 and 21 are secured a plurality of cylinders concentric with and into which the ends of the type rollers extend. Each cylinder comprises two portions in tandem, one portion 27 being of a diameter to rotatably and slidably receive the portions 3, 3' of the type rollers and the other cylinder portion 28 being of a diameter to slidably receive the smaller projecting plunger portions 30, 30' of the type rollers with an air tight fit.

In the normal or neutral position of the type rollers, the lines of type 4 and 4' are maintained on respective opposite sides of the plane O—O' passing through the printing point by compressed air supplied by a pipe 29 to the bottoms of the lower cylinder bores 28', to slightly raise the type rollers from their lowermost positions. The pipes 29 are connected to radial slots 22 in the discs 20 and 21 which communicate with a bore 19 extending longitudinally through the main shaft 16, 17. An annular groove 36'' in the bearing 34 supplies compressed air to the longitudinal bore 19 through a transverse opening 19'.

At the shoulder provided between the reduced diameter cylinder bore 27 and cylinder 28 is an opening with which a pressure pipe 26 communicates at one end. The pressure pipe 26 communicates at its other end with a receiving hole 35 through a pressure hole 25 in the main shaft 17 as seen in FIG. 4. The receiving hole opens into an annular groove 36 in the bearing 34 and the groove 36 has a communication port 37 that opens at the midpoint of a valve cylinder 38 as can be seen in FIGS. 1a and 4. The valve cylinder 38 has an exhaust port 37' at one end and a pressure port 40 at its other end and receives a piston valve 41, 42, 43, the parts designated 41 and 43 being pistons and the part 42 a waist portion connecting the pistons and having an annular space thereabout between it and the inner wall of the cylinder 38 for flow of compressed air. The above described arrangement is provided for each of the type rollers.

Each piston is provided with a neck portion 44 and a head portion 45, there being a coil spring 46 between the head 45 and the adjacent surface of the bearing 34 to bias the valve body to a position in which the port 37 communicates with the exhaust port 37'. One half of the plurality of piston valves each have a tail portion 47 pivoted at its end to a tongue 58 of a respective armature 60 of an electromagnet 52', 53' in a lower tier as shown in FIG. 4. The other half of the plurality of piston valves each have a hook portion 48 at its end inserted in an opening at the end of tongue 59 of a respective armature 60 of an electromagnet in the upper tier as at 52, 53. The hooked and tailed piston valves are alternately positioned in the valve cylinders 38 which are bored through the bearing body 34, 34 along both sides of the main shaft 16, 17 and in which the valves fit with an air-tight slidable engagement.

Both bearings 34 are fixed indirectly on the bed plate 70 through supports 34' mounted on pedestal blocks 34''. The pedestal blocks are provided with upper and lower horizontal beams 68 and 69, respectively. The upper tier of electromagnets 51 . . . 57 and 61 . . . 67 is carried by the horizontal beams 68 and the lower tier 51' . . . 57' and 61' . . . 67' is carried by the lower beams 69. One group of magnets 51-58' is supported

by the beams on one side of the line O—O' and a second group 61-68' on the other side of the line. As shown in FIGS. 1a and 1b there are fifteen type rollers, fifteen electromagnets on each side of the line O—O' and thirty type rings. Each electromagnet is individually controlled by a circuit and corresponds to a type ring on a respective type roller.

When an electromagnet, as for example 53 in FIG. 4, is selectively excited by a signal current, its armature 60' is moved to pull down a piston valve by engagement of tongue 59' with hook 48 to connect pressure port 40 with a communication port 37. The compressed air issuing from port 40 reaches the cylinder 27' (FIG. 1a) pushes the spindle 3' to position the type ring 2, 2' 2'' to coincide with the line O—O' through the printing point. The selected type-character will therefore roll over the printing point O on the paper 84 to impress or print such character. When the selected type ring coincides with the printing plane, the force of the spindle thrust is decreased due to the shoulder portion on the spindle 3' reaching the slit 31 to release the compressed air in the cylinders 27', 28'. The maintenance of the compressed air up to that point is to prevent the frictional resistance induced by thrust from acting between the opposite shoulder on spindle 3 and bottom of cylinder 28 and between the end of plunger 31 and the bottom of cylinder 27.

When the excitation of the magnet 53 is discontinued, the pulled armature 60' is released to permit the piston valve to return to its original position by spring 44 acting on the head 45. This closes the pressure port 40 and connects the communication port 37 with the exhaust port 37'. The type ring which had been in the printing plane then returns to its original position to one side thereof. In the same manner as hereinabove described, any one of the type rollers may be moved to position the selected type ring in the printing plane in accordance with a selecting signal from the telegraphic communication circuit.

The selected electromagnet must receive the signal early enough in each revolution of the main shaft 16, 17 to allow the desired type roller to move by the compressed air to bring its type ring into the proper position for printing. The time that is needed to adjust a piston valve is constant, but the air passages to each cylinder are of various lengths and it is estimated that about 0.01 second is needed to bring a type ring to the printing plane after its piston valve is opened. As shown in FIG. 6, the longest time allowed for the first type roller in the array to bring the type ring into the printing position, after initiation of an electrical signal, is S and the other type rollers are allowed longer times due to their positional order in the space P. Therefore, the length of the path 37, 35, 25, 26, 27 for the compressed air must be shortest for the first type roller and successively longer for the following rollers. Each character type that is selected must be steady at the printing point in order to make a clear impression, so that all of the above described motions should be completed before the roller that supports the selected character reaches the printing point in every revolution of the main shaft. The time needed for moving each piston valve may be overlapped with the preceding revolution of the main shaft 16, 17 which is constant and uniform about all the valves.

The shifting action to change letters or figures from the lower case to the upper case as in conventional typewriters or teletype systems is included by this invention. However, the reciprocating motions for this operation together with the resulting shock and noise, especially at high speeds, are avoided by the adoption of a circular shift as hereinafter described. For this purpose, each type ring is comprised of three or more characters, three being shown in the drawings, and designated 1, 1', 1'', on one ring and 2, 2', 2'' arcuately spaced about the axis of the type roller by 120°. As described in the earlier part of the application, the pitch circle 6 of the internal gear 7

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is n times the diameter of the pinions 5 so that when the internal gear 7 turns $1/n$ revolution, the first type characters 1, 2 the second type 1', 2' and third type 1'', 2'' return to their original positions after one rotation of the pinion 5 and its associated type roller. In other words, they remain in their original phase. If the internal gear 7 turns $1/n$ revolution from a predetermined point, the pinion 5 will be rotated $1/n$ revolution so that the second type 1', 2' appears at the point where the first type appeared previously. This shifting action is analogous to the case shift of a conventional typewriter. Similarly, the next $1/n$ revolution of the gear 7 turns the pinions another $1/n$ revolution and the third type 1'' and 2'' appear at the original position of the first type.

In order to carry out the shifting operation of the various type as above described, the outer periphery gear 7 is provided with gear teeth to form an external gear 8 about its periphery and which meshes with a pinion 10 having a diameter which is $1/n$ that of the external gear 8 and has $1/n$ teeth as compared to that of the gear 8. The pinion 10 is supported in bearings 9' and 9'' by a shaft 14 on which are secured three radially extending pins 11, 12 and 13. The pins are arcuately spaced about the axis of the shaft by 120° and are axially spaced. A shifter frame 80 is fixed to the bed plate 70 and is provided with a pair of parallel arms 15' which supports a horizontal shaft 14'. Pivotaly mounted about the shaft are three setting hooks 71, 72, 73 in the form of levers, the lower arms of which each support an armature 81 of a respective electromagnet. The top surface of each of the setting hooks is flattened in a horizontal plane and each lever is biased by a tension spring 78 to maintain the flattened surface clear of the path of the phase pins 11, 12 and 13. The tension springs 78 are adjustable by nuts 79 which are frictionally held against turning by members 79'.

Shifter magnets 91, 92 and 93 are fixed on the shifter frame 80, one for each setting hook, and face a respective armature 81. Each setting hook has a notch or shoulder 71' toward the rear portion of its upper end, as shown in FIG. 2, and a movable projection 75 pivoted at 76 to the body of the setting hook and capable of turning forwardly but stopped from turning rearwardly by a stop pin 75'. A common check pawl 74 pivoted at 74' on the top 15 of the shifter frame 80 is pulled down toward the notches in the setting hooks by light springs, not shown. When a shifter magnet, for example 91, is energized it pulls its armature 81 to project the setting hook 71 into the path of a phase pin 11, the hook being prevented from moving rearwardly by engagement of the pawl 74 within the notch 71'. The rotation of shaft 14 and pinion 10 is thus stopped by engagement of pin 11 with setting hook 71. If the external gear 8 and pinion 10 are so engaged that the first type 1, 2 are in such phase that they may be positioned at the printing point when the type roller is moved to the proper position, they will remain in that phase as long as phase pin 11 is caught by setting hook 71. This condition is provided as described above, by the excitation of shifter magnet 91 and this condition continues until any other shifter magnet is excited.

When another shifter magnet is excited, 92 for example, it attracts its armature to project the setting hook 72 into the path of the phase pin 12. The projection 75 of the setting hook 72 raises the check pawl 74 as it moves forwardly, to move it away from the notch or shoulder 71' to release the previously moved setting hook 71 to allow it to move rearwardly. The phase pin 11 is freed for revolution with the shaft 14, but the latter is stopped as soon as the phase pin 12 is caught on the setting hook 72. The shaft 14 will have turned sufficiently to allow the internal gear 7 to turn $1/n$ revolution before it is stopped by the phase pin 12 catching on the setting hook 72. The pinions 5 of the type rollers are translated about the axis of shaft 16, 17 at this time together with internal gear 7,

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but are not relatively rotated about their axes. By the time the gear 7 is stopped against rotation, the angular phase position of the pinions and type rollers relative to the internal gear 7 has changed by 120° so that the second type 1', 2' can be positioned at the printing point.

When the third shifter magnet 93 is energized by a shifting signal, the setting hook 73 is projected into the path of phase pin 13 and raises the common check pawl 74 to release the previously projected setting hook for return movement by its spring. In the same manner as described above, the third type 1'', 2'' will be positioned at the printing point O. It now becomes possible to bring any letter or figure selected by a signal up to the printing point regardless of which phase of the type rings the letter or figure belongs to. The number and spacing of the phase pins together with the number of setting hooks and magnets are of course dependent on the number of type characters in a type ring.

The machine of this invention can be provided for printing on tape or in page style. In order to print page style at high speed, however, the motion of the carriage return with its consequential disadvantages of high resistance and shock due to movements of a large mass at great speed, should be avoided. Spiral printing is therefore provided as a substitute for the conventional spacing and carriage return movements where page printing is desired. For this purpose, both marginal edges 84'', 84''' of the paper which are to remain unprinted and which correspond to the space S, are folded back at right angles and the paper wound about a disk-like platen 83 with the folded margins inserted into a radial slot as shown in FIG. 1a. The platen 83 is mounted on a center shaft 82 which rotates about an axis transverse to that of shaft 16, 17. At one side of the platen 83, an inner cylindrical guide 85 is fixed on the shaft 82 concentric therewith. An outer guide 86 formed of an elongated metal sheet somewhat wider than the paper sheet 84 has both edges folded back through 180° to form a narrow groove at each side to guide the edges of the paper 84. The outer guide 86 surrounds the inner guide 85 and is fixed to the shaft 82 and platen 83. At some distance from its lower end, the margins of the outer guide equal in width to the folded margins of the paper, are folded along lines parallel to the grooves and with an increasing angle of fold up to 90° as it approaches the platen. The flat portion of the sheet between the folds is rolled into conical form to complete a circular cross-section to surround the inner guide adjacent the platen, but the lower end is left flat.

There are several pairs of feed rollers at a level beneath the platen so as to face and press against each other from within the inner guide and from without the outer guide. The rollers are rotated respectively with the revolutions of the shaft 16, 17 while revolving about the shaft 82 to feed the paper just the height of one line during one revolution of the platen. On the upper side of the platen are an inner cylinder 87 and an outer cylinder 88 to guide the paper in a cylindrical form that is fed up from the platen 83 and protects the paper from deflection against the type wheel and consequent mutilation due to the high speed of rotation of the wheel. The outer cylinder 88 may terminate in a sharp edge which acts as a cutting knife and is fixedly secured on the bed plate 70. The whole face of the paper that appears about the platen between the upper and lower guides is prepared for printing at all times since it corresponds to the full length of a lettering line.

It is important to provide quick line feed at the end of each line where high-speed printing is desired and this can be done by providing spiral printing with the apparatus of this invention. The spacing or horizontal feed is provided by the revolution of the platen and the line feed or vertical feed of the paper is done during the revolution of the platen uniformly and slowly. The result is that beginning of one line connects with the

end of a preceding line at the folding edges of the paper. To provide a printed spiral line, the paper should be fed with a slight inclination to produce the spiral angle of the lettering line. Thus the inner and outer guides 85 and 86 should be slightly in spiral form to correspond to the angle of the lettering line. Also, the shaft of the platen 82 is inclined with respect to the plane through the printing point at an angle which is equal to and opposite to the angle of the spiral in order to obtain upright letter printing.

If the letter spacing is to be made after the printing of each letter or figure, as in conventional typewriters, this can be provided for by intermittent rotation of the platen 83, so that the paper remains static at each printing stroke. The printing speed, however, with such an arrangement, may be slower than 1000 words per minute. The letters and figures on the type rollers will be distributed as shown in the developed view of FIG. 5.

But where high speed printing of over 1000 letters per minute is desired, the intermittent rotations of the platen 83 is not favorable to the smooth operation or durability of the apparatus. It is more advantageous to rotate the platen and its parts at a uniform speed relatively to the revolutions of main shaft 16, 17. Where the paper moves at uniform speed in a fixed direction throughout the printing of a message, any one character type selected by a signal must roll over the printing point O on the paper in a direction which is along the hypotenuse O—O' of a right angled triangle, as in FIG. 6. Such triangle has a length of one circumference of a circle circumscribed by the type wheel and a length of one letter space as the base. The circumscribed circle referred to is one described by a point at the outermost end of the common diameter of the type wheel and type ring corresponding to the diameter of the pitch circle of gear 6. Thus, the surface of a type character selected by a signal is static relative to the paper at their tangent point when the type ring rolls over the printing point O.

Due to the positional order of the type rollers 4 about the axis of the shafet 16, 17, each type roller lags by a different time increment in reaching the printing position after the last character has made an imprint and may cause a disarrangement of the letter spacing. To compensate for this, the type rings are each offset a different amount from the plane O—O' including the printing point and lie along the line Q, Q' which is inclined from the plane O—O' to provide one space length between the first and last type rollers of the array during one revolution of the type wheel. The distance S in FIG. 6 corresponds to the time required to place the type rollers in the printing position and the remaining distance P corresponds to the time in which all of the rollers are rotated about the axis of shaft 16, 17 and during which time a type character on one of the rollers has made an imprint on the paper 84. The whole distance S plus P is equal to one circumference of the circle transcribed by the rotatable type wheel.

The main shaft 16, 17 is sheathed by a hollow shaft 18 at each side of the type wheel in order to cover the air passages 25 tightly and protect them. Toward each end of the main shaft is mounted a thrust collar 33' to prevent axial movement of the type wheel and a heavy flywheel 89 is fixed adjacent one end of the shaft to equalize the reactions of the shifting and phase selecting motions and to maintain the rotating parts at a constant speed. A flywheel may be secured to the one of the shaft to drive it from a motor.

From the description above, the following characteristics of the apparatus may be recognized: (1) the printing and paper feeding movements are accomplished during constant rotation of the main shaft at high speed; (2) the case shifting of the letters is accomplished during a partial rotation of the type rollers; (3) the selection of the character to be printed is provided by the

axial reciprocating motion of the type roller which is of light construction and has a short movement independently of the rotation of the type wheel; and (4) the capabilities of continuous high speed printing without endangering the durability of the parts. In the practical operation of the teleprinter apparatus herein disclosed it must be combined with a translator which is coupled to a distant transmitter and in operative synchronism therewith.

Having thus described the invention, what is claimed is:

1. A high-speed automatic typewriter comprising, a carrier rotatable about an axis, an array of type-characters equally radially spaced from and concentric with the axis, means mounting each of said characters on the carrier for rotation about individual axes parallel to the axis of the carrier, means for simultaneously rotating the carrier in one direction and the type-characters in an opposite direction such that the linear velocity of the characters due to rotations about the axis of the carrier and their individual axes are equal, and a sheet having a surface supported in a predetermined plane tangent to the periphery of a cylinder described by the rotation of the characters about the axis of the carrier, to receive an imprint thereof.

2. A high-speed automatic typewriter in accordance with claim 1, in which the means for simultaneously rotating the carrier and characters includes a driven gear secured to and rotatable with each type-character and a fixed driving pinion commonly engageable with each of the driven gears, whereby rotation of the carrier causes rotation of the characters.

3. A high-speed automatic typewriter in accordance with claim 2, in which each type-character is supported on the periphery of a shaft over which it extends for a small arcuate distance, the driven gears being of equal diameter and so related to the diameter of the fixed pinion that the characters are successively positioned at the predetermined plane by rotation of the carrier.

4. A high-speed automatic typewriter in accordance with claim 1, in which the type-characters are individually mounted for axial movement from a first axial inoperative position to a second axial printing position and means for selectively moving a character axially to the printing position to provide an imprint on the surface of the sheet in the tangent plane and at said second axial position.

5. A high-speed automatic typewriter in accordance with claim 4, in which each of the type-characters is individually secured to the periphery of a shaft, cylindrical bearings in the carrier for supporting the shafts for axial and rotatable movements, the bearings at least at one end of the shafts being provided with inlet openings, a source of compressed air, and means for operatively connecting the inlet opening of a selected cylinder to the source of compressed air to move the shaft axially for positioning the character at said second axial printing position.

6. A high-speed automatic typewriter in accordance with claim 4, including a circular platen mounted for rotation on an axis transverse to that of the carrier for movably supporting said sheet in the predetermined tangent plane and printing position.

7. A high-speed automatic typewriter in accordance with claim 6, including means operated by the carrier upon each revolution thereof for moving the sheet supported on the platen a distance corresponding to a desired spacing between successive characters to be printed.

8. A high-speed automatic typewriter in accordance with claim 6, including a radial slot in said platen to receive the ends of the sheet wrapped about the platen whereby the sheet forms an endless web, means operated by the carrier during its rotation for continuously moving the platen about its axis at a speed to receive imprints of successive characters, the axial printing positions of successive characters in the arcuate array varying in ac-

cordance with their arcuate distance from a predetermined character in the direction of rotation of the carrier, whereby successive selected characters printed respectively at each rotation of the carrier are equally spaced.

9. A high-speed automatic typewriter in accordance with claim 6, including a radial slot in said platen to receive the ends of the sheet wrapped about the platen whereby the sheet forms an endless web, means operated by the carrier during its rotation for continuously moving the platen about its axis at a speed to receive imprints of successive characters, the axial printing positions of successive characters in the array varying in accordance

with their arcuate distance from a predetermined character in the direction of rotation of the carrier, whereby successive selected characters printed respectively at each rotation of the carrier are equally spaced, and means for simultaneously moving the sheet axially at a predetermined uniform rate to effect continuous spiral lines of printing.

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