

Aug. 18, 1964

N. B. WALES, JR

3,144,820

SELECTIVE ROTARY PRINT MEMBER

Filed Feb. 8, 1961

4 Sheets-Sheet 1

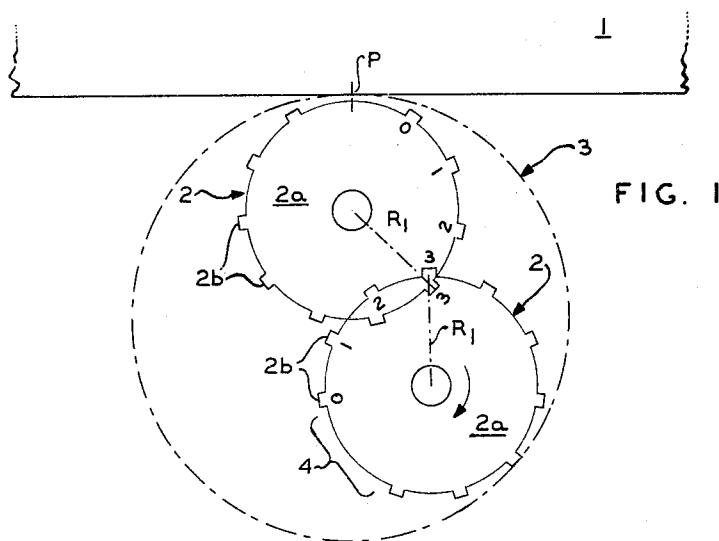


FIG. 1

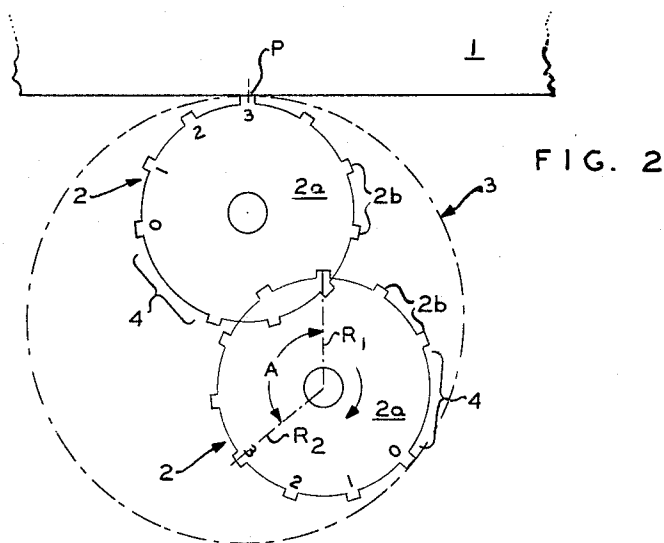


FIG. 2

INVENTOR.
NATHANIEL B. WALES, JR.

BY
Norman Friedman

ATTORNEY

Aug. 18, 1964

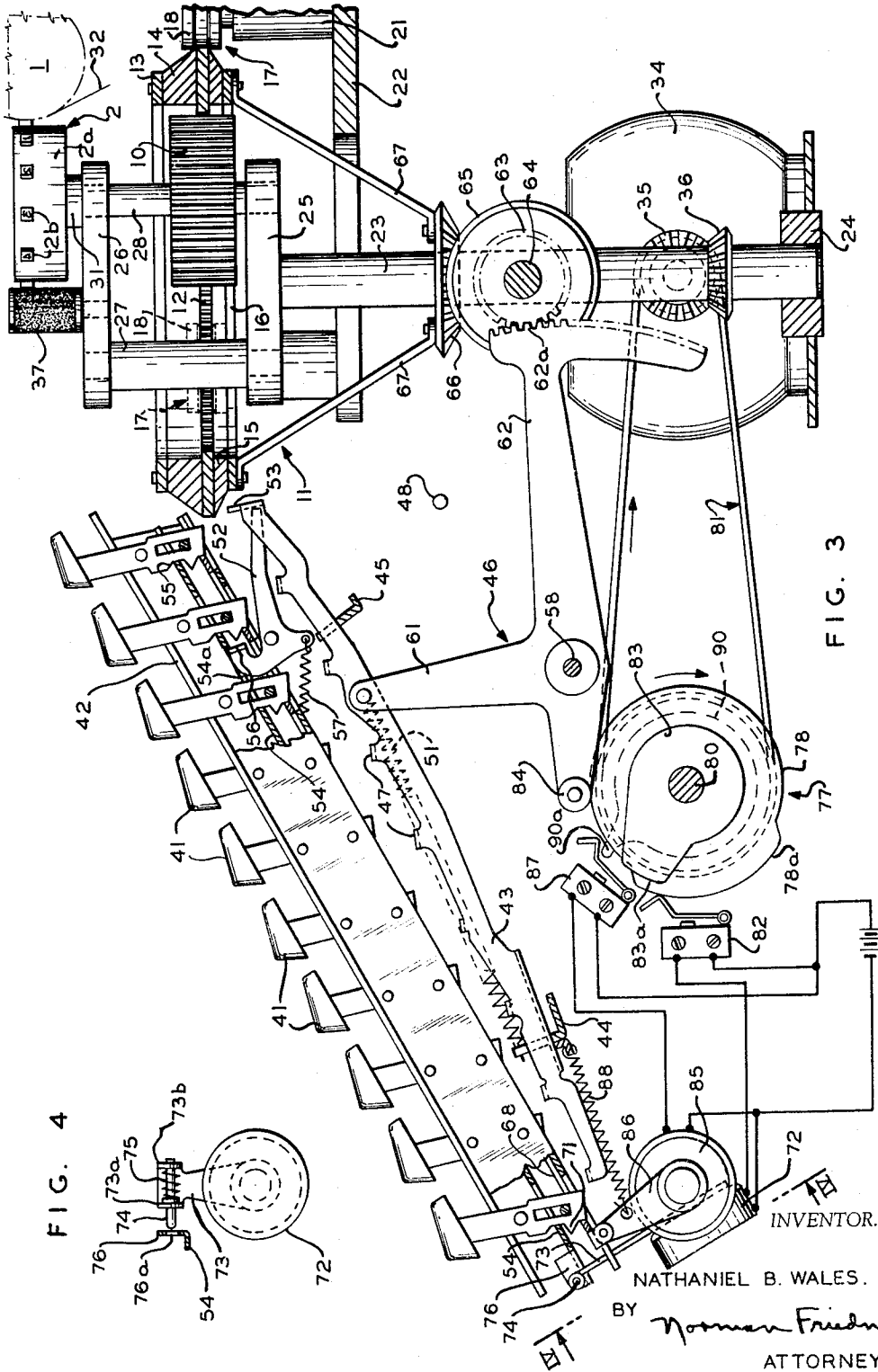
N. B. WALES, JR

3,144,820

SELECTIVE ROTARY PRINT MEMBER

Filed Feb. 8, 1961

4 Sheets-Sheet 2



Aug. 18, 1964

N. B. WALES, JR

3,144,820

SELECTIVE ROTARY PRINT MEMBER

Filed Feb. 8, 1961

4 Sheets-Sheet 3

FIG. 5

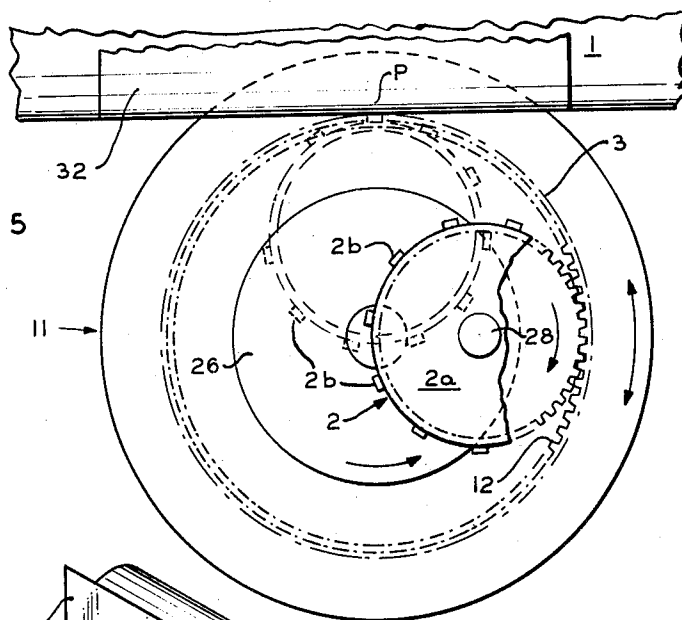
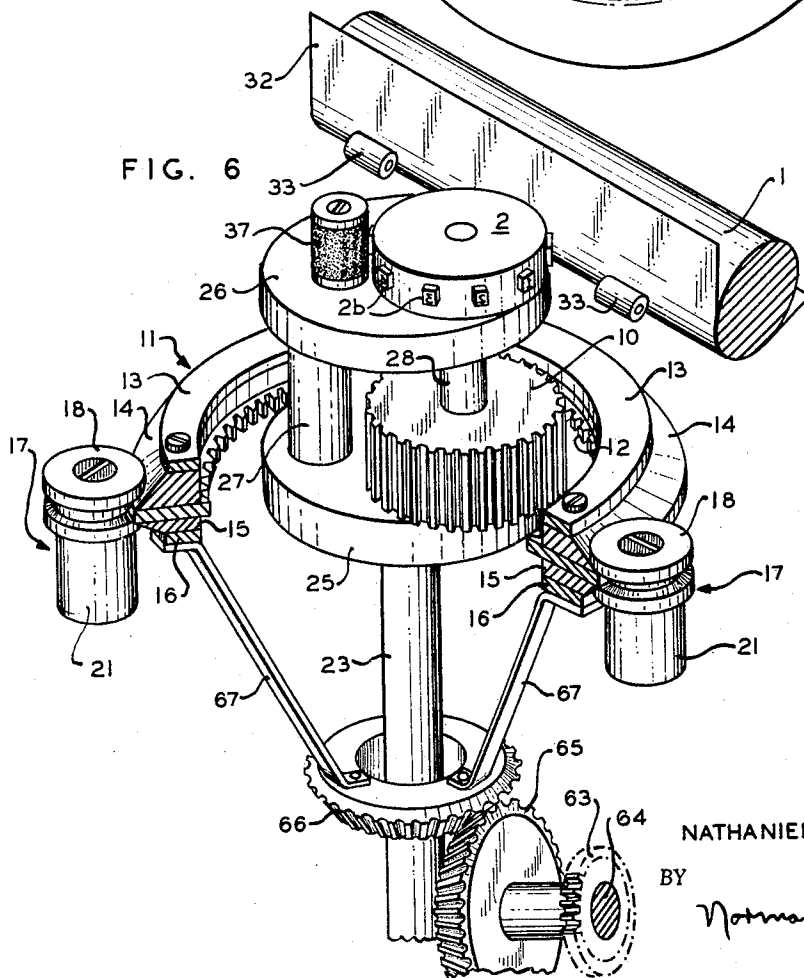


FIG. 6



INVENTOR.
NATHANIEL B. WALES, JR.

BY
Norman Friedman
ATTORNEY

Aug. 18, 1964

N. B. WALES, JR
SELECTIVE ROTARY PRINT MEMBER

3,144,820

Filed Feb. 8, 1961

4 Sheets-Sheet 4

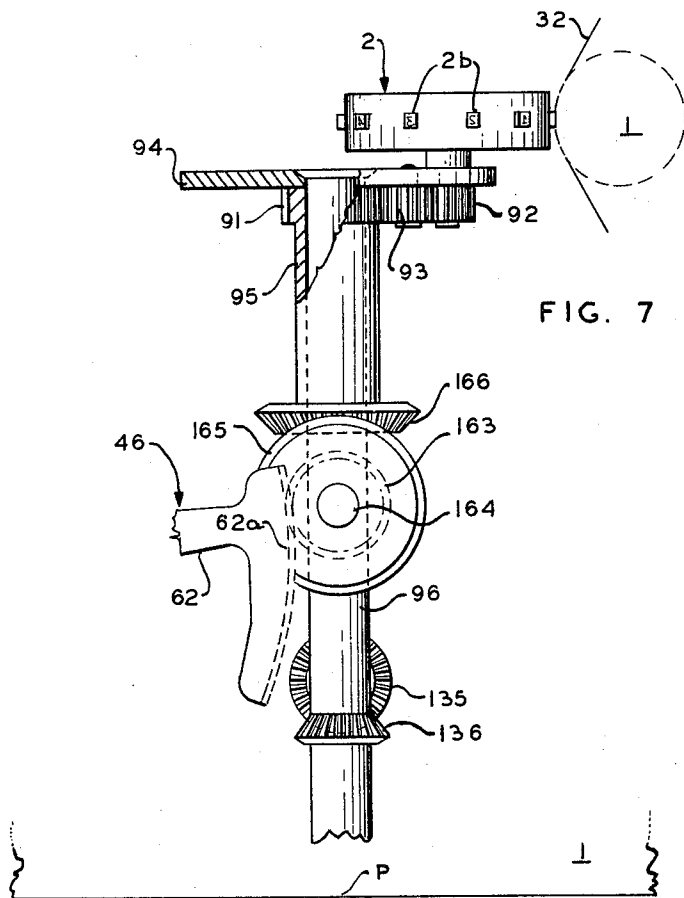


FIG. 7

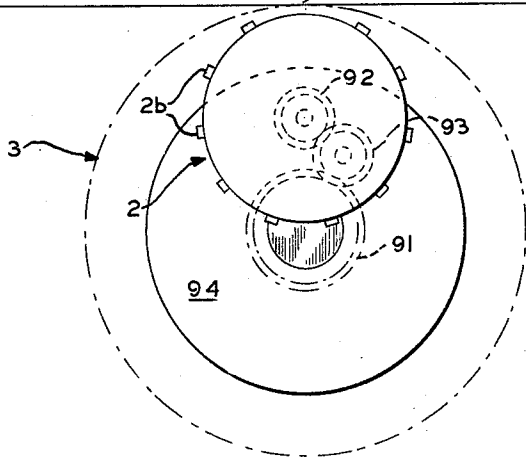


FIG. 8

INVENTOR.
NATHANIEL B. WALES, JR.

BY
Norman Friedman
ATTORNEY

1

3,144,820

SELECTIVE ROTARY PRINT MEMBER

Nathaniel B. Wales, Jr., Sharon, Conn., assignor to Monroe Calculating Machine Company, Orange, N.J., a corporation of Delaware

Filed Feb. 8, 1961, Ser. No. 87,959

20 Claims. (Cl. 101—91)

This invention pertains to printing mechanism. More particularly, it has to do with printing mechanism of the type used in business machines and data processing machines, e.g., typewriters, adding machines, accounting machines, readout devices, and the like.

One class of such printing mechanisms includes a type member (usually a type wheel) which contains a plurality of type faces corresponding to digits and/or alphabetic characters and symbols which it is desired to print. In performing a printing operation with such prior art devices, the type member is adjusted to bring a selected one of its type faces to enabled printing position; and the type member is then struck with a substantial degree of impact against the record sheet upon which printing is being effected. It will be appreciated that such impacting devices produce a considerable amount of noise. Further, because of high impact stresses there will be a considerable amount of wear imposed upon the mechanism. Additionally, since such devices move the type wheel along a reciprocatory path toward and away from the record sheet, they do not lend themselves to high speed operation. U.S. Patents 2,046,464 issued July 7, 1936 to K. A. Knutsen and 2,199,561 issued May 7, 1940 to F. L. Fuller et al. are exemplary of such prior art devices.

The printing mechanism of the present invention avoids the above enumerated disadvantages in that it provides for any selected one of the type faces carried by a printing member to print by rolling on the record member.

It is therefore a major object of the present invention to provide a printing mechanism of the class described which rolls upon rather than impacts the cooperating record member.

It is further object to provide a printing mechanism which greatly minimizes the stresses incident to the printing operation.

It is a further object to provide a printing mechanism which is quieter in operation than prior art devices.

It is a further object to provide a printing mechanism which inherently lends itself to high speed operation.

As will be described in detail hereinafter, the above and other objects and advantages of the invention are achieved, in the preferred embodiments disclosed herein, by a printing mechanism which includes a printing wheel constrained to roll along a path, preferably a closed loop, which is substantially tangent to the record sheet at the printing point. In order to select any one of the types carried by the wheel for printing, the wheel is differentially rocked about its own central axis an amount sufficient to cause the selected type face to roll on the record sheet at the printing point. After printing has been effected, the printing wheel is rocked back to a normal position, simultaneous with its rolling away from the platen along the aforesaid tangent rolling path. Preferably, the wheel is caused to roll continuously in a given direction around the closed loop path thereby eliminating the accelerations and decelerations inherent in prior art devices.

In the drawings:

FIG. 1 is a schematic top plan view illustrating the basic principles of the invention.

FIG. 2 is a view similar to FIG. 1 showing the printing or type wheel adjusted to print a selected character.

FIG. 3 is a right side elevational view, partially in section, showing a machine embodying a first form of the printing mechanism of the invention wherein the printing

2

wheel is guided and controlled by an internal epicyclic gear train.

FIG. 4 is a detail view taken on line IV—IV of FIG. 3.

FIG. 5 is a fragmentary top plan view of FIG. 3 showing the printing wheel and the associated gear train.

FIG. 6 is a perspective view of portions of the first form of the invention.

FIG. 7 is a right side elevational view, partially in section, of a second form of the invention wherein the printing wheel is guided and controlled by an external epicyclic gear train.

FIG. 8 is a top plan view of FIG. 7.

General Principles

The general principles of operation and control as applied to the preferred embodiments of the invention will now be discussed in connection with FIGS. 1 and 2 of the drawing. The reference numeral 1 designates any suitable backing member, for example a conventional platen, against which the record sheet upon which printing is to be effected is held in any conventional manner. The mechanism of the invention includes a printing or type wheel 2 which comprises a main cylindrical body portion 2a carrying a series of equiangularly spaced radially extending printing types 2b. Each type 2b carries a different type face at its outer end; for example, any one of the digits "0" through "9" inclusive. The type wheel is caused to roll along a circular closed path 3 which is substantially tangent to the platen 1 or, in other words, to the record sheet held against the platen, at the printing point P. By adjusting the angular or rotated position of the printing wheel, it is possible to select any desired one of the types 2b to roll on the record sheet at the printing point. In the preferred forms of the invention, a blank zone 4 of the printing wheel normally rolls on the printing point whereby the printing wheel is normally ineffective to print as it rolls about path 3. FIG. 1 illustrates this normal nonprinting condition of the rolling printing wheel 2. This Figure shows the wheel in two of its positions as it rolls around path 3. In the lower of the two positions shown, the wheel is approaching the printing point. In its second shown position, the wheel is at its point of closest approach to the platen and record sheet at the printing point, but is ineffective to print on the record sheet since the blank zone is presented to the record sheet.

FIG. 2 shows, for exemplary purposes, the nature of the adjustment to cause the type wheel to print with any selected one of types 2b, for example the digit character "3." This adjustment involves rocking the type wheel about its own central axis, before it has rolled to the printing point, through an angle such that the selected type—rather than the blank zone 4—will roll on the record sheet at the printing point. This angular adjustment of the type wheel is superimposed on the rotational movement of the type wheel about its own central axis which results from the type wheel rolling about path 3. It should be noted that FIGS. 1 and 2 show the wheel in the same positions along its rolling path. For purposes of explanation, the radius of the wheel to the exemplary type 2b for the digit "3" has been shown in both FIGURES. In the lower position of the wheel shown in FIG. 2, it will be seen that the angular adjustment of the wheel has caused the radius to move from its normal position R1 of FIG. 1 through an angle A to the position R2 of FIG. 2. In other words, the entire wheel has been rocked about its center through angle A of such magnitude that the selected type will be in position to roll on the record sheet at the printing point P. In like fashion, selection of any of the other types 2b for printing involves a corresponding rotational adjustment of the wheel to cause the desired type to roll on the record sheet at the printing point.

Two preferred embodiments of the invention will now

be described, both of which involve the use of an epicyclic gear train for causing the type wheel to roll about a circular closed loop path as described above. In the first described form, the type wheel is rigid and concentric with a pinion gear which is caused to roll about the inner periphery of an internally toothed ring gear, the rotational setting adjustment of the type wheel for selecting any given type face being effected by rotating the ring gear about its central axis. In the second form, the gear train comprises a central sun gear and an idler and planet gear both of which are mounted together as a single unit for rotation about the sun gear. The type wheel is mounted rigidly and concentrically with the planet gear. Rotation of the wheel for printing selection is effected in this case by rocking the sun gear about its central axis.

FIGS. 3, 4, and 5 show in detail the construction of the first form of the invention. Here, the type wheel is caused to roll along, i.e., relative to, the circular path 3 which is tangent to the platen or record sheet at the printing point P, under control of an internal epicyclic gear train. This train comprises a pinion gear 10 rolling about the inner periphery of a ring gear assembly 11. As best seen in FIGS. 3 and 6, the ring gear assembly is a laminar structure comprising an internally toothed ring gear per se 12 rigidly sandwiched between annular plates 13, 14, 15, 16. This laminar construction provides good structural rigidity and at the same time facilitates fabrication and assembly of the parts. The ring gear assembly 11 is supported for angular setting movement about its own central longitudinal axis by a plurality of equiangularly spaced support members 17 positioned about its outer periphery. Each of support members 17 comprises an annularly grooved collar 18 into whose groove the outermost rim portion of the ring gear assembly extends and is supported thereby. Each grooved collar 18 is loosely journaled for rotation in an upstanding fixed sleeve 21 rigidly secured to a suitable framing plate 22 of the machine. As will be described subsequently, before the printing wheel 2 has rolled to the printing point, the ring gear assembly 11 is rotated to differentially adjust the printing wheel an amount corresponding to the selected type 2b which is to print. The antifriction support provided by collars 18 journaled on sleeves 21 facilitates this rotational adjustment of the ring gear assembly.

A vertical main supporting shaft 23 coaxial with the ring gear assembly is journaled at its lower end for rotation in a bearing block 24. Carried at the upper end of shaft 23 are two vertically spaced circular plates 25 and 26. The lower plate 25 is rigidly mounted on shaft 23. The upper plate 26 is rigidly supported on the lower plate by a short shaft 27.

Journaled for rotation in plates 25, 26 is a shaft member 28 which extends parallel to the main supporting shaft 23 but which is eccentric relative thereto. Pinion 10, which meshes with and rolls about the ring gear 12, is rigidly secured to shaft 28 between plates 25 and 26. The printing wheel 2 is concentric with pinion 10 and is rigidly secured to a portion of said shaft 28 which extends above the upper plate 26. A spacer collar 31 serves to maintain the printing wheel at the proper elevation above plate 26.

It will be seen therefore that if shaft 23 is caused to rotate, pinion 10 will roll around ring gear 12. Printing wheel 2, being mounted concentric and rigid with the pinion on the common axis of rotation defined by shaft 28, will therefore partake of similar rolling movement. This rolling movement of the printing wheel will take place relative to the internal circular path 3 which was discussed earlier in connection with FIGS. 1 and 2. This path represents the locus of the successive outermost points of the printing wheel which are at a maximum distance from the main axis of rotation defined by shaft 23 as the

latter rotates and thereby causes the wheel 2 to roll about this locus.

In accordance with the invention, the aforesaid parts of the mechanism are so proportioned and arranged that locus 3 is substantially tangent to the record sheet which is being printed on, and the movement of the printing wheel relative to this locus is essentially a pure rolling movement.

The record sheet 32 can be held in position to receive printing impressions from printing wheel 2 by any suitable mechanism. For example, any conventional platen construction mounted in a shiftable carriage of the type usually found in typewriters and the like can be used. For this purpose there is provided the aforementioned platen 1 which may be provided with the customary resilient outer surface, the sheet 32 being held in intimate contact therewith by pressure rollers 33. As is also conventional in business machine printing mechanisms, any suitable means may be provided to effect a relative shift between the sheet-holding structure and the printing mechanism after each printing impression has been made upon the sheet. Such record sheet holding structures and mechanisms for effecting the aforesaid relative shifting movement are well known in the prior art and their details form no part of the present invention.

It will be understood to be desirable that the gear train ratio of the ring gear 12 to the pinion 10 be an integral value so that with any given angular setting of the ring gear assembly 11, the same portion of the printing wheel 2 will always roll on a given point, for example the printing point P, of its rolling path 3. Otherwise, the wheel would assume different angular positions as it made successive rolling passes across any given point of the rolling path. This would make it difficult to control the selection of any desired type 2b for printing.

In the embodiment of FIGS. 3-6 the gear train ratio which has been employed is the minimum value which can be used, i.e., two for economy of space. If desired, larger integral ratios, e.g., three, four, etc. can be used.

The power for operating the instant mechanism is provided by an electric motor 34 adapted to be energized in response to operation of a suitable switch (not shown). A bevel gear 35 mounted on the output shaft of motor 34 drives a cooperating bevel gear 36 secured to the vertical main shaft 23 which supports the printing unit. Accordingly, shaft 23 will be continuously rotated about its central longitudinal axis, causing pinion 10 to be continuously rolled around ring gear 12. The printing wheel 2, which is rigid and coaxial with the pinion will consequently be constrained to roll along and relative to the circular path 3.

As shown in FIG. 5 the diameter of type wheel 2 (including the radial thickness of the types 2b) is substantially equal to the diameter of pinion 10. Hence, the diameter of path 3 relative to which the wheel rolls will be substantially equal to the pitch diameter of the ring gear 12. However, if desired wheel 2 may be of a different diameter than the pinion 10 whereby the wheel's rolling path locus will likewise differ in diameter from the pitch diameter of ring gear 12.

In any event, the geometry of the system is such that: (a) the aforesaid rolling path locus 3 of printing wheel 2 is substantially tangent to the platen 1 (i.e., to the record sheet 32 held in intimate contact with the platen); and (b) the movement of the wheel along said rolling path locus is substantially pure rolling movement. The selected type face will therefore roll on the record sheet at the point of tangency (i.e., the printing point P) to apply a rolling imprinting pressure to the sheet. It will be appreciated that the amount of imprinting pressure which must be applied will depend upon the means utilized to transfer the printing medium such as ink to the record sheet. For example, if an inked ribbon is interposed between the printing wheel and the record sheet for this

5

purpose, a greater degree of imprinting pressure will be needed to transfer ink to the sheet than would be the case if the type faces of the printing wheel are preinked and roll directly on the record sheet to transfer the printed ink impression thereto.

The latter type of ink supply is shown in the drawing. It comprises an absorbent inked roller 37 loosely journaled for rotation about its vertical longitudinal axis on upper plate 26. As the printing wheel rotates, the faces of its types 2b will wipe the outer surface of roller 37 and will thereby be inked. This wiping action will also cause the roller to rotate whereby successive areas thereof will be presented to the types for applying ink to the latter.

It will be apparent that regardless of the type of inking employed, the rolling path locus 3 of the wheel should intersect or overlap the plane of the record sheet 32 at the printing point by a slight amount so that some rolling pressure will be imparted to the sheet. Further, the greater the pressure needed to transfer the printing ink to, or otherwise cause a printing impression on, the record sheet, the larger should be the degree of overlap. Accordingly, in this specification and the appended claims it is intended that any reference to the printing wheel rolling path being "substantially tangent" to the record sheet 32 or platen 1 cover arrangements which make use of the basic concept of the invention, i.e., printing by essentially a pure rolling action, even though the locus along which the wheel is rolling slightly overlaps the plane of the record sheet at the printing point.

Selection

As discussed earlier, selection of a particular one of types 2b for printing is effected by differentially rotating the ring gear assembly 11. The pinion 10 will therefore be rocked about its axis defined by shaft 28 rigid therewith. This will control which portion of the circumference of printing wheel 2 will be rolling along the path 3 at the printing point P.

It will be recalled from the previous description that the printing wheel 2 includes a blank zone 4 which is unprovided with a printing type 2b. The normal angular setting of the ring gear assembly 11 is such that this blank zone will be presented to the record sheet at the printing point. Hence, the rolling type wheel will normally be ineffective to print. In response to operation of selection mechanism, the ring gear assembly 11 will be differentially rocked to adjust the angular position of the wheel (through pinion 10) to cause the selected type 2b, rather than the blank zone 4, to roll into imprinting pressure relation with the record sheet. It will be appreciated that any suitable arrangement can be employed to control the angular setting of the ring gear assembly. The particular selection mechanism shown in the drawing and now to be described is presented merely as one example of such a selection mechanism.

Referring to FIG. 3, the selection mechanism includes a keyboard comprising a column of keys 41 each of which corresponds to a different one of the printing types 2b. The keyboard is in certain respects similar to that shown in U.S. Patent 1,932,013 granted October 24, 1933 to L. P. Crosman. The stems of the keys are mounted for vertical sliding movement in an upper keyboard plate 42. Springs (not shown) normally bias the keys to their raised position shown in FIG. 3. Underlying the column of keys 41 is an elongated index blade 43 supported for fore and aft movement in slotted brackets 44 and 45.

The forward excursion of the index blade determines the rotation of a three-armed lever 46 pivotally coupled thereto, said lever being coupled to the ring gear assembly 11 through a suitable power train. The lower portion of the stem of each key is adapted, when the key is depressed, to act as a stop for a related one of a plurality of cooperable laterally extending stop lugs 47 of index blade 43. The distance between each key stem, when

6

depressed, and its related stop lug 47 is proportioned to the amount of angular setting movement of the ring gear assembly 11 to be controlled by the given key. It should be noted that in accordance with conventional keyboard construction, the rearmost key stem does not act as a stop for the index blade. Instead, a fixed stop pin 48 cooperable with a rearwardly extending arm of lever 46 is provided for this purpose.

In response to depression of any one of keys 41, index blade 43 will be urged forwardly by a relatively heavy spring 51 to control the setting of ring gear assembly 11. The index blade, however, is normally held blocked in the rearward position shown in FIG. 3 against the urge of spring 51 by a pivoted dog 52 cooperable with a lateral tongue 53 at the rearmost end of the blade.

Mounted beneath the keyboard plate 42 is a longitudinally extending slide 54 having apertures 54a through which the key stems extend. When any one of keys 41 is depressed, a cam edge 55 thereof, through engagement with the forward edge of the related aperture 54a, will be effective to shift the slide 54 forwardly against the urging of a suitable spring means (not shown). At its upper end, the blocking dog 52 includes a lateral lug 56 urged clockwise by a spring 57 into engagement with the rearward end wall of one of apertures 54a. Accordingly, when slide 54 is shifted forwardly in response to depression of any one of the keys, dog 52 will be rocked counterclockwise out of blocking engagement with index blade 43. Spring 51 will thereupon move the blade forwardly an extent determined by the depressed key.

This forward differential movement of index blade 43 causes a proportional rocking movement of the ring gear assembly 11 as follows. The aforescribed three-armed lever 46 is supported for rotation on a fixed shaft 58 and includes an upstanding arm 61 pivotally coupled to the index blade, and a rearwardly extending arm 62 which terminates in an arcuate toothed rack segment 62a meshed with a pinion 63 secured to a shaft 64. Also secured to shaft 64 is one gear 65 of a bevel gear pair, the other gear 66 of which is rigidly coupled to the ring gear assembly by bracket arms 67. It will therefore be seen that forward movement of index blade 43 will be effective, through lever 46, rack 62a thereof, pinion 63, and bevel gears 65, 66, to cause a proportional rotary setting movement of the ring gear assembly in a counter-clockwise direction as viewed from above (FIGS. 5, 6).

Any operated key 41 is held latched in depressed position by a conventional latching slide 68. This slide is cammed forwardly by a tooth 71 of any depressed key and is then spring-retained rearwardly to snap over said tooth whereby the key is held down.

Selection Control Mechanism

It is desirable that operation of the selection mechanism be prevented when the printing wheel 2 is closely approaching the printing point P, if a key 41 has not yet been depressed. Otherwise, it might coincidentally happen that rotary setting movement of the ring gear assembly 11 could occur at the precise moment when the wheel is at the printing point, thereby causing a smearing wiping movement of the type face relative to the record sheet 32. Accordingly, means are provided to block the selection mechanism from operating after the wheel has passed a point a short distance before the printing point. It will, of course, be appreciated that the latest point at which this blocking action should become effective in any given embodiment of the invention will depend upon various design factors such as the speed at which the wheel is moving along path 3, etc. After the wheel has rolled past the printing point, the keyboard is cleared (if any key has been previously operated), the index blade is restored rearwardly, and the blocking means is normalized.

The mechanism whereby the above functions are performed will now be described. The blocking of the selection mechanism is effected by the aforementioned slide 54 provided with the apertures 54a through which the key stems extend. Slide 54 is normally spring-biased to the rearward position shown in FIG. 3 and will be shifted forwardly against its spring bias by cam edge 55 of any key upon depression thereof. However, if no key has been depressed, at a predetermined point in the approach movement of the printing wheel to the platen, a blocking means will be engaged with slide 54 to rigidly hold the latter in its rearward home position and thereby prevent depression of any key. For this purpose, there is provided a rotary solenoid 72 (i.e., an actuating device which provides a rotary output movement in response to energization of an electromagnet contained in the device) having mounted on its rotary output shaft a crank arm 73. Note FIGS. 3 and 4. Laterally bent integral ears 73a, 73b of crank arm 73 support and guide a pin 74 for movement along its length in a direction transverse to the crank arm. A compression spring 75 normally biases the pin to the leftmost position shown in FIG. 4 as limited by a collar fast with the pin. The path of movement of crank arm 73 is in a plane perpendicular to the longitudinal direction of movement of slide 54. The latter element is provided at its forward end with an upstanding lug 76 having an aperture 76a of a size adapted to closely receive pin 74. Aperture 76a is so located on slide 54 that it will be in alignment with the path of movement of pin 74, when the slide is in its rearward unoperated position, i.e., if no key is depressed. If solenoid 72 is now operated with the parts in this relative position, crank arm 73 will swing to the left carrying pin 74 into aperture 76a. Pin 74 will therefore prevent forward movement of slide 54; and the latter in turn will prevent any of the keys 41 from being depressed by virtue of the unyielding abutting relation between the forward ends of the slide apertures 54a and the cam surfaces 55 of the key stems.

However, if any of keys 41 has already been depressed to make a selection before solenoid 72 is operated, slide 54 will have been moved to the forward operated position whereby aperture 76a is no longer aligned with pin 74 but lies forwardly thereof. In this position, the slide now presents an unapertured portion of lug 76 to the pin. Therefore, in response to operation of solenoid 72, pin 74 will merely press against the right side face of lug 76, spring 75 allowing the pin to yield.

The timing of the operation and release of solenoid 72 is controlled by one cam 78 of a rotary cam cluster unit 77 journaled on a shaft 80. Cam unit 77 is driven from the output shaft of motor 34 by a belt and pulley drive 81 at a one-to-one ratio with shaft 23. Shortly before the printing wheel 2 reaches the printing point P, a high portion 78a of cam 78 will close a switch 82 in the control circuit for solenoid 72 to operate the latter, and will continue to hold it operated until the printing wheel has rolled a short distance past the printing point.

The index blade 43 and the keys 41 are normalized immediately after the printing wheel has moved past the printing point, as follows. A second cam portion 83 of cam unit 77 includes a high segment 83a. If, in response to depression of a key 41, index blade 43 and three-armed lever 46 have been allowed to operate—the latter by moving counterclockwise as viewed in FIG. 3—a roller follower 84 at the forward end of lever 46 will have moved downwardly into the path of rotary movement of said high segment 83a. The latter will therefore engage the roller 84 and restore lever 46 clockwise to home position. This will cause the index blade coupled to arm 61 of said lever to be restored rearwardly. Furthermore, the normalizing movement of lever 46 will rock the ring gear assembly 11 back to normal position, causing pinion 10 and the printing wheel 2 to return to their normal nonprinting condition of adjustment where-

in the blank zone 4 of the rolling wheel will be presented to the record sheet at the printing point as the wheel rolls relative to its path 3. The keyboard is cleared by moving the latching slide 68 forwardly a distance sufficient to release any depressed key, the slide then being returned to its normal rearward position for subsequent key latching operation. For this purpose a second rotary solenoid 85 (FIG. 3) has an actuator arm 86 pivotally coupled to a depending lug at the forward end of said latching slide. Solenoid 85, when operated in response to operation of a control switch 87, will rock arm 86 counterclockwise whereby the latching slide 68 is shifted forwardly to release any depressed key. Upon deenergization of the solenoid, a spring 88 will restore it and slide 68 rearwardly. Switch 87 is pulsed at the appropriate time by a narrow lobe 90a of a third cam portion 90 of cam cluster 77.

Modified Form of the Invention

FIGS. 7 and 8 show a second form of the invention. Here, as in the first form of the invention, the printing wheel 2 is caused to roll relative to a locus or path 3 which is substantially tangent to the platen 1 and record sheet 32 at the printing point P. In the form of FIGS. 7 and 8, however, such rolling movement is caused to occur under control of an external epicyclic gear system rather than an internal gear system of the type described previously.

This external gear system comprises a central sun gear 91, a planet gear 92, and an idler gear 93 interposed between the two. The planet and idler gears are mounted on centers which are fixed relative to one another but which are constrained for rotation about the sun gear 91. In the specific embodiment shown in the drawing the planet and idler gears, 92 and 93 respectively, are both journaled for rotation on a plate 94. The sun gear 91 is provided at the upper end of a tubular shaft 95 which underlies said plate 94. The latter is rigidly secured to and supported by an elongated shaft 96 which extends through the hollow tubular shaft 95, and which is suitably journaled for rotation about its central longitudinal axis. Shaft 96, which corresponds to shaft 23 of the first form of the invention, is adapted to be rotatably driven by a bevel gear train 135, 136 (corresponding to gears 35 and 36 of FIGS. 3-6). Gear 135 is driven from the output shaft of an electric motor (not shown). The printing wheel 2, disposed above plate 94, is mounted coaxially and rigidly with the planet gear 92. Therefore, rotational movement of shaft 96 will rotate plate 94 which in turn will cause the idler gear 93 to continuously roll around the sun gear 91. This will cause the planet gear 92 and the type wheel 2 rigid therewith to rotate about the central axis of said planet gear and will also cause said axis to rotate about the central axis of the sun gear. In the course of this movement, the successive outermost points of the periphery of the printing wheel will define the circular locus or path 3. As in the first form of the invention, the parameters of the system are so chosen that locus 3 is substantially tangent to the platen 1 and the record sheet 32 at the printing point P; and that the movement of the printing wheel relative to said locus 3 is substantially a pure rolling movement. The printing wheel 2 includes, as in the first form of the invention, a blank zone which will be presented to the record sheet at the printing point in the normal nonprinting condition of angular adjustment of the rolling printing wheel.

The principles involved in selection of any one of the types 2b of printing wheel 2 for printing are the same for the form of FIGS. 7 and 8 as in FIGS. 3-6. Selection between the printing wheel and its rolling path is effected by varying the angular relation between the printing wheel and its rolling path locus 3 so that any selected type 2b will roll on the record sheet at the printing point. This is done by differentially

rocking the sun gear 91 about its central axis through an angle of such magnitude as to cause a selected type to roll on the record sheet at the printing point. The selection mechanism employed to control the differential rocking of the sun gear may be of any suitable type, e.g., that previously described in conjunction with FIGS. 3-6. FIG. 7 shows a portion of the selection mechanism including the rearward end of arm 62 of the aforescribed lever 46 including the toothed rack portion 62a meshed with a pinion 163 rigidly mounted on a shaft 164 on which is also rigidly mounted a bevel gear 165 meshed with a cooperable bevel gear 166 secured to the lower end of tubular shaft 95. It will be recalled that the sun gear 91 also is rigid with shaft 95. The remainder of the selection mechanism not shown in FIG. 7 is substantially identical with the mechanism previously shown and described in connection with FIGS. 3-6.

Operation of the selection mechanism will differentially rock the sun gear. The latter, acting through idler gear 93 and planet gear 92, will in turn rock the printing wheel 2 relative to locus 3 thereby effecting the necessary angular adjustment of the wheel relative to said locus 3 to cause the selected type 2b to be in position to roll on the record sheet 32 at the printing point P.

The form of FIGS. 7-8 may be provided with any suitable inking means such as an inked roller or ribbon as described earlier in connection with FIGS. 3-6.

Conclusion

From the foregoing description, it will be seen that there has been provided a novel type of printing mechanism for use in business machines and the like. The novel mechanism of the invention provides means whereby any selected one of a plurality of type faces carried by a printing member is adapted to be selected for a printing operation in which the selected type rolls on, rather than impacts, the record member. In the preferred embodiments of the invention disclosed herein this result is achieved by a mechanism which includes a rotary type wheel to which are rigidly affixed the various printing types, and which is caused to partake of substantially pure rolling movement relative to a closed loop path which is substantially tangent to the record sheet at the desired printing point; and wherein the printing wheel is caused to partake of such movement under control of an epicyclic gear train which may be an internal gear train as in FIGS. 3-6 or an external gear train as in FIGS. 7-8. Adjustment of the type wheel to cause any selected type to roll on the record sheet at the point of tangency is effected by differentially rocking the type wheel whereby the selected type will be positioned to roll on the record sheet at the tangent printing point.

It will be understood that in practice numerous modifications and refinements can be employed without departing from the basic principles of the invention. The individual printing types, rather than being rigidly secured to a carrier member therefor, could be mounted movably thereon and the particular type selected for printing caused to roll on the record sheet. The path relative to which the type wheel rolls need not necessarily be a circular path but could be of some other shape, for example, elliptical. Instead of having the type wheel continuously roll around a closed loop path, the path itself could be open, e.g., a segment of an arc which is tangent to the record sheet intermediate the opposite ends of said arc. Further, regardless of whether an open or closed path is employed, the movement of the type wheel relative to such path could be either continuous as disclosed herein, in which case the differential rocking of the type wheel for selection purposes is made on the fly; or the type wheel could normally be at rest and be made to commence rolling along the path only at those times when printing is to be effected, following which the printing wheel could once again be brought to rest. The printing mechanism could be oriented 90° from the horizontal plane used in

the two preferred embodiments, whereby the printing wheel would roll relative to a path which lies in a vertical plane.

In order to provide a greater capacity of different type faces, the type wheel can include several bands of types rather than merely one as disclosed herein. In such a case, a selection operation would also include a vertical adjustment of the entire type wheel to bring the appropriate type band into printing position.

Further, although the hereindisclosed embodiments involve an angular selection adjustment in one direction only, the mechanism can be arranged so that the printing wheel is angularly rocked in either direction from a neutral position whereby to reduce the amount of angular selection movement. Suitable interlocks may be provided to prevent misoperation of any portion of the mechanism of the invention. Numerous other variants which nevertheless embody the principles of the invention will be apparent to those skilled in the art.

It is therefore intended that the foregoing disclosure of specific embodiments of the invention be illustrative only and not limitative of the following claims.

I claim:

1. In a printing mechanism: a printing wheel including an arcuate print sector comprising a group of printing types disposed circumferentially relative to the longitudinal axis of said wheel, any one of said types being adapted to be selected for printing on a record member at a printing point; movement control means for constraining said printing wheel to roll along an invariable path such that the path along which said group of printing types rolls is substantially tangent to said record member at said printing point, said movement control means including means for causing said wheel to roll bodily along said path including said printing point while rotating about its longitudinal axis, so that said wheel as a whole, including its longitudinal axis, moves in the course of such rolling movement; and selection means for causing any selected one of said printing types to roll on said record member at said printing point; said path being unchanged irrespective of the control exercised by said selection means.

2. The combination according to claim 1; including adjusting means controlled by said selection means for varying the rotated position of said printing wheel relative to said path.

3. The combination according to claim 2; wherein said path is arcuate.

4. The combination according to claim 3; wherein said printing wheel rolls along the inside of said path.

5. The combination according to claim 4; wherein said path is a closed loop.

6. The combination according to claim 5; wherein said path is circular.

7. The combination according to claim 5; including drive means for causing said wheel to roll continuously along said path.

8. The combination according to claim 2; wherein said movement control means comprises an epicyclic gear train.

9. The combination according to claim 8; wherein said printing wheel is actuated for rolling movement along said path by one of the gears of said epicyclic gear train.

10. The combination according to claim 9; wherein said printing wheel and said one gear are rigidly secured together.

11. The combination according to claim 8; wherein said epicyclic gear train includes a ring gear, and a pinion gear mounted to roll about the ring gear; said printing wheel being actuated for rolling movement along said path by said pinion gear.

12. The combination according to claim 11; wherein said printing wheel and said pinion gear are rigidly secured together.

13. The combination according to claim 8; wherein

11

said adjusting means is effective to control the rotated position of said printing wheel by differentially rotating one of the gears of said epicyclic gear train.

14. The combination according to claim 11; wherein said adjusting means is effective to control the rotated position of said printing wheel by differentially rotating said ring gear.

15. The combination according to claim 8; wherein said epicyclic gear train includes a sun gear and a planet gear unit mounted for rotation about said sun gear; said printing wheel being actuated for rolling movement along said path by said planet gear unit.

16. The combination according to claim 15; wherein said planet gear unit comprises a planet gear and an idler gear interposed between said planet gear and said sun gear.

17. The combination according to claim 16; wherein said printing wheel and said planet gear are rigidly secured together.

18. The combination according to claim 16; wherein

12

said adjusting means is effective to control the rotated position of said printing wheel by differentially rotating said sun gear.

19. The combination according to claim 1; wherein there is sufficient space between two adjacent ones of said printing types to allow said wheel to roll across said printing point without causing printing thereat.

20. The combination according to claim 19; wherein said selection means includes said movement control means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,520,354	Keller et al. -----	Dec. 23, 1924
1,750,399	Friedrichs -----	Mar. 11, 1930
2,285,018	Colombo -----	June 2, 1942
2,311,737	Columbo -----	Feb. 23, 1943
2,399,788	Columbo -----	May 7, 1946
2,476,841	Columbo -----	July 19, 1949
2,825,279	Gottscho -----	Mar. 4, 1958

**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,144,820

August 18, 1964

Nathaniel B. Wales, Jr.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 41, after "is" insert -- a --; column 2, line 45, for "black" read -- blank --; column 4, line 38, after "two" insert a comma; line 46, for "continuuosly" read -- continuously --; line 75, for "recrod" read -- record --; column 8, line 71, strike out "tion between the printing wheel and its rolling path"; column 10, line 70, for "whel" read -- wheel --.

Signed and sealed this 12th day of January 1965.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents