May 14, 1963 J. H. MacNEILL ETAL 3,089,413

MEDIUM-SPEED SERIAL PRINTER

Filed June 12, 1961 3 Sheets-Sheet 1

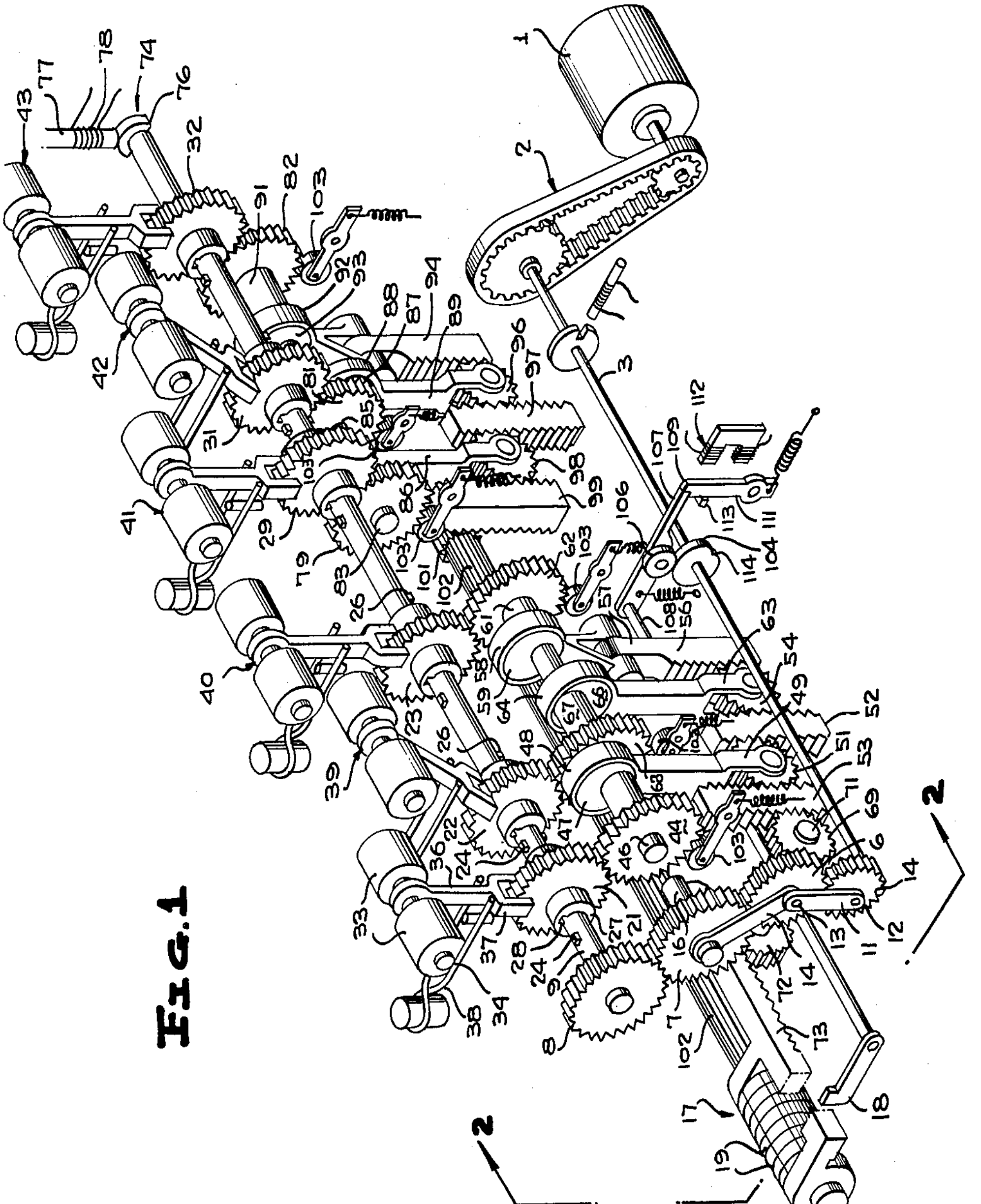

FIG. 1

INVENTORS
JOHN H. MACNEILL
JAMES E. BELLINGER, JR.
& THOMAS G. HOLMES

BY Hurvitz & Rose

ATTORNEYS

MEDIUM-SPEED SERIAL PRINTER

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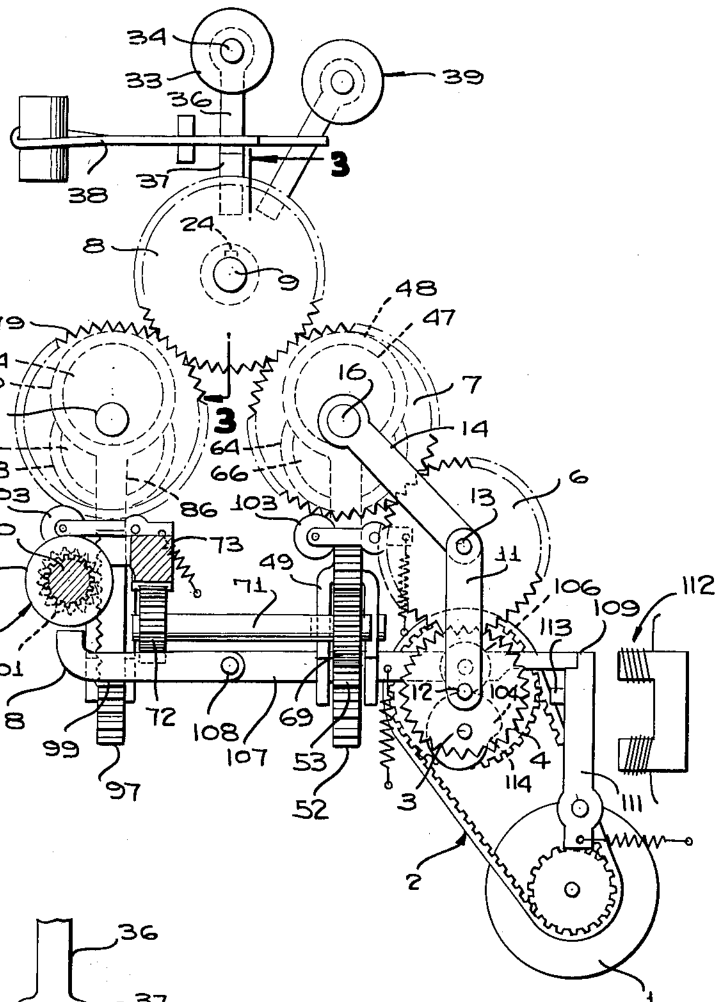
FIG. 2



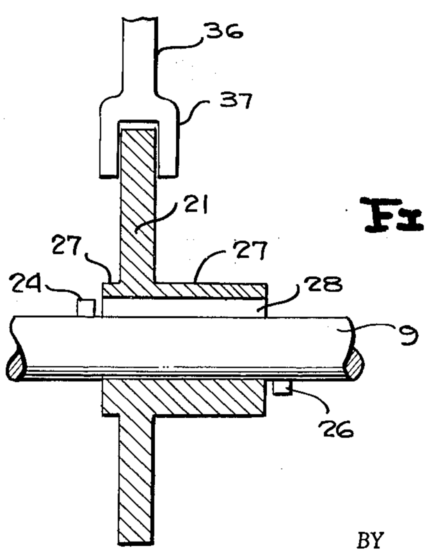


FIG. 3

INVENTORS
JOHN H. MACNEILL
JAMES E. BELLINGER, JR.
& THOMAS G. HOLMES

BY Hurvitz & Rose
ATTORNEYS

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Filed June 12, 1961 3 Sheets-Sheet 3

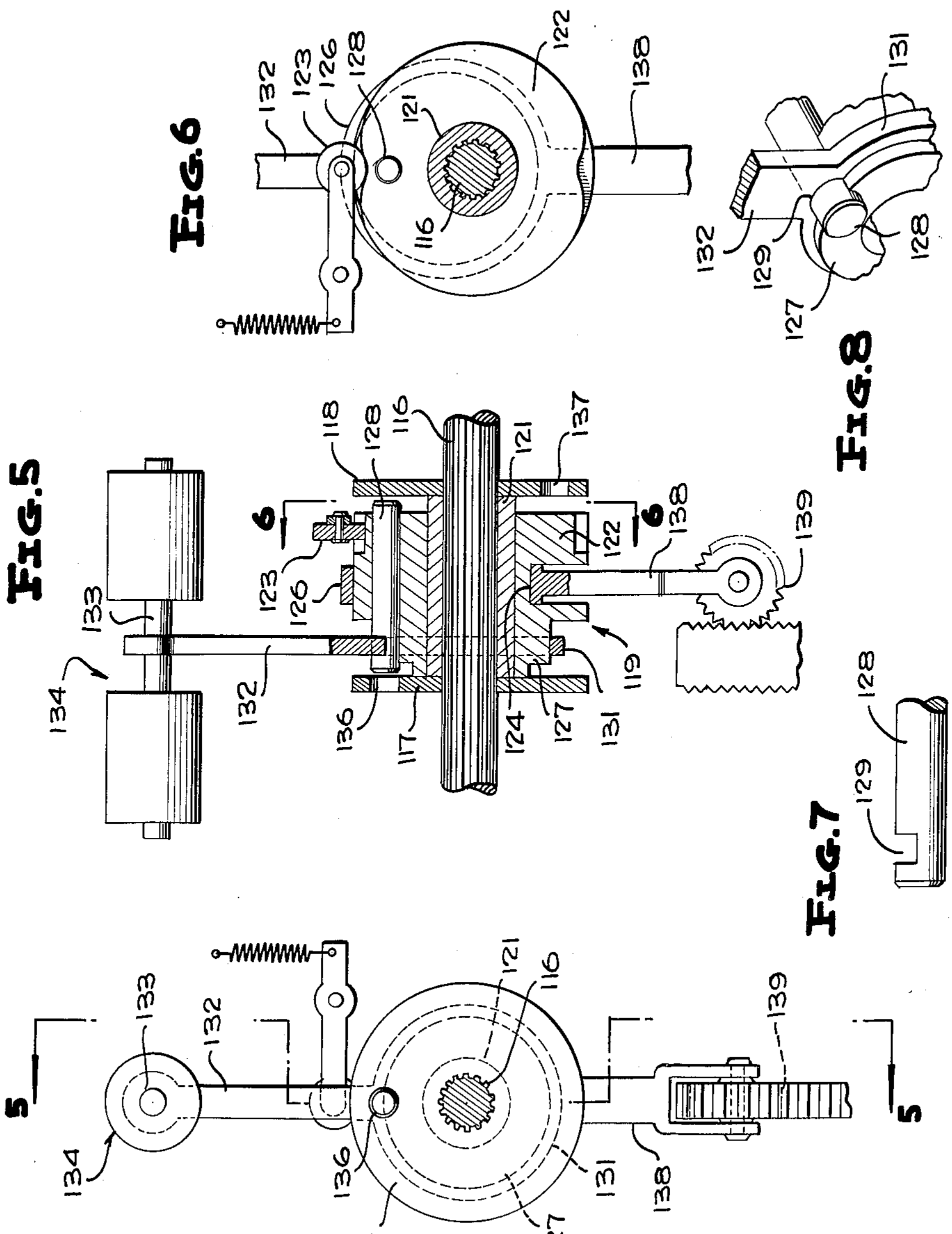

FIG. 4

INVENTORS
JOHN H. MACNEILL
JAMES E. BELLINGER, JR.
& THOMAS G. HOLMES

BY Hurvitz & Rose

ATTORNEYS

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3,089,413

MEDIUM-SPEED SERIAL PRINTER

John H. MacNeill, Indiatlantic, James E. Bellinger, Jr., Eau Gallie, and Thomas G. Holmes, Melbourne, Fla., assignors to Soroban Engineering, Inc., Melbourne, Fla., a corporation of Florida

Filed June 12, 1961, Ser. No. 116,524
24 Claims. (Cl. 101—93)

The present invention relates to printing mechanisms and more specifically to a character selection mechanism for a high speed printing device.

It is an object of the present invention to provide a character selection mechanism for high speed printing devices in which precise positioning of a selected character relative to an impact or hammer mechanism may be readily obtained.

It is another object of the present invention to provide a character selection mechanism for high speed printing devices in which all elements directly connected with character selection are stationary during the selection interval which immediately precedes actual positioning of the character bearing device.

It is still another object of the present invention to provide a character selection mechanism for a high speed printing apparatus in which movement of a character bearing element and its selection and positioning mechanisms are subject to controlled acceleration and deceleration thereby to provide long life and accuracy of the apparatus.

It is yet another object of the present invention to provide a character selection mechanism for a high speed printing apparatus in which direct drive between various elements is employed thereby eliminating slipping clutches which tend to permit misalignment of the character bearing device relative to the impact mechanism and which tend to shorten the life of the apparatus.

It is still another object of the present invention to provide a character selection mechanism for a high speed printing apparatus employing internal logic so as to eliminate the necessity of providing external circuits to remember the particular character selected during a previous printing interval.

It is another object of the present invention to provide a character selection mechanism for use with high speed printing devices in which the selection mechanism does not employ springs but employs direct drive and controlled acceleration and deceleration of elements to permit precise positioning of the character.

It is another object of the present invention to provide a character selection mechanism for a high speed printing device which operates at a sufficiently rapid rate to accept character designating information on a character-by-character basis so that large external storage circuits need not be employed.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of one specific embodiment thereof, especially when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a first embodiment of the apparatus of the present invention;

FIGURE 2 is a sectional view taken along section line 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary view taken along section line 3—3 of FIGURE 2, of a first embodiment of the coupling mechanism which may be employed with the apparatus of the invention;

FIGURE 4 is an elevational view in section of a second embodiment of a coupling means of the present invention;

FIGURE 5 is a sectional view taken along section line 5—5 of FIGURE 4;

FIGURE 6 is a sectional view taken along line 6—6 of FIGURE 5;

FIGURE 7 is a side view of the translatable pin employed in the embodiment of FIGURE 4; and

FIGURE 8 is a perspective view of the device of FIG. 4.

Referring now specifically to FIGURES 1 through 3 of the accompanying drawings, there is illustrated a first embodiment of a character selection mechanism conforming to the principles of the present invention. A constant speed electric motor **1** is connected via a notched gear and toothed belt arrangement **2** to a shaft **3** which is constantly rotated by the motor **1** at a predetermined speed. The shaft **3** carries at one end a pinion **4** eccentrically mounted on the shaft **3**. The pinion is in constant engagement with an idler pinion **6** which is, in turn, in constant engagement with a driven pinion **7**. The pinion **7** engages a further pinion **8** secured to a shaft **9** and adapted to impart rotation to the shaft **9** upon rotation of the pinion **8**. The pinion **6** is maintained in engagement with the pinion **4** by a link **11** connected to the pinions by pins or axles **12** and **13** which pass through the centers of the gears **4** and **6**, respectively, and about which the pinions are rotatable. The gears **6** and **7** are maintained in contact by means of a link **14** having one end coupled to the pinion **6** via the pin **13** and the other end secured to and rotatable about a shaft **16** about which the gear **7** is also rotatable. The particular mechanism constituted by the pinions **4**, **6**, **7** and links **11** and **14** constitutes a mechanism for intermittently rotating the shaft **9** at a predetermined rate relative to the shaft **3** and, for purposes of illustration and discussion of the present invention, the shaft **9** is rotated at one-half the rate of the shaft **3**. More particularly, the shaft **9** is rotated through 180° upon rotation of the shaft **3** through 360°. Further, the operation of the coupling, comprising pinions **4**, **6** and **7**, is such that the shaft **9** is held stationary during approximately one-eighth of each cycle of rotation where a cycle of rotation refers to rotation of the shaft **9** through 180°. Thus, if the shaft **3** is rotating at 6000 r.p.m., the shaft **9** rotates at 50 r.p.s., making one complete revolution in a fiftieth of a second and therefore one cycle of operation occurs in one-one hundredth of a second. Since the shaft **9** is held stationary for one-eighth of each cycle, it is therefore held stationary for one-eighth hundredth of a second, which interval is employed to perform the actual selection of the character. The operation of the drive mechanism comprising pinions **4**, **6** and **7** is known in the art and is described in the article "The Three-Gear Drive," S. Rappaport, Product Engineering, January, 1950, pages 120–123. It is not intended to limit the apparatus of the present invention to the specific mechanism illustrated for providing coupling between shafts **3** and **9** and, in fact, this mechanism may be replaced with a constant diameter triangular cam of the general type disclosed in U.S. Patent No. 2,859,816, issued to John H. MacNeill and assigned to the assignee of the present invention. In any event, it is the intention of the invention to provide a coupling between the shafts **3** and **9** which produces intermittent rotation of the shaft **9** and provides a period during each cycle of operation during which the shaft **9** is stationary so that the selection mechanisms for controlling the position of the character bearing member relative to the impact device may be operated during a period in which all rotary motion is discontinued so as to reduce impact loads. Further, the mechanisms employed must provide for relatively slow initial acceleration and deceleration so as to further reduce impact loading. The mechanism illustrated and the triangular cam will provide the low acceleration and deceleration for the reasons as set forth in the references cited above.

The selection mechanism is intended, as indicated several times above, to position a specific character on a character bearing member relative to an impact printing or hammer mechanism. The character bearing member is generally designated by the reference numeral 17 while the impact member or hammer is designated by the reference numeral 18. The character bearing member comprises a cylindrical print drum 19 in which the individual characters are arranged in eight rows and eight columns, thus providing sixty-four distinct locations about the periphery and along the length of the drum 19. One part of the control mechanism causes the drum 19 to rotate about its axis and select or position one of the horizontally extending rows along a line to be intercepted by the hammer 18. At the same time, the drum 19 may be shifted along its longitudinal axis to place one of the circumferential columns in alignment with the hammer 18. Thus, by concurrent rotation and translation of the drum 19, one of sixty-four characters may be positioned in alignment with the hammer 18.

The mechanism for positioning the drum 19 along a position parallel to its longitudinal axis includes three pinions 21, 22 and 23, each of which is shiftable with respect to the axis 9 and is normally freely rotatable thereupon so that under normal circumstances the pinions 21 through 23 do not rotate with the shaft 9. The shaft 9 is provided with two diametrically opposed studs or small outward projections 24 and 26, respectively, for each pinion. Referring specifically to FIGURE 3, the pinion 21 has a hub 27 extending outwardly from opposite sides of the pinion. A slot 28 extends completely through the hub 27 parallel to the shaft 9 and is of such a size to snugly receive one or the other of the studs 24 or 26. This arrangement is such that, and reference is still made to FIGURE 3, if the pinion 21 is shifted toward the left, the stud 24 becomes seated in the slot 28 and upon subsequent rotation of the shaft 9, the pinion 21 is rotated. However, if the pinion 21 is shifted to the right, a vertical face of the hub contacts the stud 26 limiting further movement of the hub and pinion and no engagement is achieved between the shaft 9 and the pinion 21 so that the pinion does not rotate with the shaft. This description applies to each of the pinions 21, 22 and 23 and further applies to pinions 29, 31 and 32 which are employed in the section controlling rotation of the drum 19 relative to the hammer 18 during the selection interval. The arrangement of the pinions 29, 31 and 32 relative to the shaft 9 and studs 24 and 26 provided on the shaft is identical with the arrangement described relative to the pinions 21, 22 and 23 and their associated parts.

A separate mechanism is provided for selectively shifting each of the pinions 21—23, 29, 31 and 32. Referring to the mechanism associated with the pinion 21, there is provided a push-pull magnetic structure 33 having a common translatable armature 34. The armature 34 carries a shifting fork 36 having fingers 37 disposed on opposite sides of the pinion 21. If the left-hand magnet of the magnetic pair 33 is energized, the armature 34 is shifted to the left, as viewed in FIGURE 1, and carries the shifting fork 36 and therefore the pinion 21 to the left. If the pinion is in the position illustrated, relative to the shaft 9, and more specifically to the stud 24, the stud becomes seated in the slot 28 and upon the next interval of rotation of the shaft 9, the pinion rotates therewith. However, if the right-hand magnet of the magnetic pair 33 is energized moving the armature 34 to the right then the pinion 21 is shifted to the right. However, since the stud 26 is not aligned with the slot 28, the right-hand movement of the pinion is limited and there is no engagement between the stud and the slot and the pinion does not rotate the shaft 9 upon its next interval of rotation. A biasing spring 38 may be employed to normally maintain the shifting fork 36 and thus armature 34 and pinion 21 in a central position in which position disengagement between the pinion 21 and shaft 9 is effected. The spring is not essential to the mechanism but may be employed for convenience in certain situations. Specifically, magnetic return to center may be employed or the system may not require return-to-center but may maintain coupling between the pinions and the shaft 9 from cycle-to-cycle with a movement of the pinions relative to shaft 9 occurring only when it is desired to decouple the pinion from the shaft. The magnetic pairs 33, etc. may be replaced with a polarized magnet in which the direction of movement of the armature is determined by the polarity of the current applied to the magnet. This arrangement illustrated and that described immediately above may be employed alternatively without greatly changing the characteristics of the apparatus.

The arrangements of magnetic pairs relative to each of the other pinions 22, 23, 29, 31 and 32 is identical with the arrangement described relative to pinion 21 and specifically these structures are designated by reference numerals 39, 40, 41, 42 and 43 associated with pinions 21, 22, 23, 29, 31 and 32, respectively.

Referring again specifically to the mechanism for producing longitudinal movement of the drum 19, a pinion 44 supported by a shaft 46 is in engagement with the pinion 21 and when rotated thereby produces rotation of an eccentric 47 about which is disposed a ring or collar 48 rotatable relative to the eccentric 47. Upon rotation of the pinion 44, the eccentric 47 is rotated and produces vertical reciprocation of the ring 48 and a vertically depending arm 49 which is secured to the ring. The arrangement is such that during the dwells the ring 48 and its associated arm 49 are either in their maximum upward position or their maximum downward position; that is, the eccentric 47 either has a maximum of its area above the center of the shaft 46 or a maximum of its area below the center of the shaft 46 so as to provide the maximum vertical displacement of the arm 49 during each cycle of rotation of the shaft 9, assuming of course, that the pinion 21 is coupled to the shaft during the cycle. he arm 49 carries at its lower end a pinion 51 which engages substantially diametrically opposed points on racks 52 and 53 both of which are mounted for vertical movement, the latter under the influence of rotation of the pinion 51. The rack 52 is reciprocated vertically by means of a pinion 54 contacting a toothed surface of the rack 52 opposite to the toothed surface of the rack engaged by the pinion 51. It should be apparent that these two surfaces could be at right angles relative to one another if it were desirable, it having been illustrated in the particular form it is in FIGURE 1 for purposes of clarity. The pinion 54 engages a rack 56 at a point diametrically opposed to its point of engagement with the rack 52 such that movement of the rack 56 may produce rotation of the pinion 54 in the same manner that movement of the rack 52 may produce rotation of the pinion 51. The rack 56 is carried on an arm 57 which is coupled to a ring 58 associated with an eccentric 59 in the same manner that the eccentric and rings 47 and 48 are associated. The eccentric 59 is secured to a tube 61 to which is secured a pinion 62 in meshing engagement with the pinion 23. The pinion 54 is connected via a vertical arm 63 to a ring 64 associated with an eccentric 66 in the same manner that the ring 48 and eccentric 47 are associated. The eccentric 66 is secured to a tube 67 to which is also secured a pinion 68 in engagement with the pinion 22. The shaft 46 supports tubes 61 and 67 which are independently rotatable.

The stroke of the eccentrics 59 and 66 are identical whereas the stroke of the eccentric 47 is twice that of the eccentrics 59 and 66. This, in conjunction with the rack and pinion arrangement previously described, permits a selection of the eight circumferential columns on the drum 19 and may be effected in accordance with a binary code. Specifically, if the rack 56 only is caused to move, let us say, upwardly through a predetermined distance, this movement is coupled through the pinion 54, rack 52, pinion 51 and rack 53 to a further pinion 69, causing the pinion 69 to rotate through, for purposes of explanation, one unit of rotation. This unit of rotation may be any desired angle depending upon the gearing ratios in the system. The pinion 69 is secured to a shaft 71 which carries a pinion 72 in engagement with the teeth of a rack 73 secured to the drum 19. Thus, upon one unit of rotation of the pinion 69, the rack 73 moves a distance sufficient to move the drum 19 one circumferential column relative to the hammer 18. If the pinion 68 is rotated, thereby rotating eccentric 66, the arm 63 moves through the same stroke as the rack 56 but due to the inherent properties of the rack and pinion and, in fact, all differential gearing arrangements, twice the vertical movement is imparted to the rack 52 as would be imparted thereto by equal vertical movement of the rack 56 only. Thus, if nothing else in the system is rotated, the print drum 19 is translated through a displacement equal to two longitudinal units. If now the pinion 44 is rotated, the vertical displacement of the arm 49, and therefore the pinion 51, is twice that of the displacement of the members 56 and 63 due to rotation of their respective or associated pinions and eccentrics. However, since again the pinion axis is being driven the displacement of the rack 53 under these conditions as compared with displacement of the rack 53, when only the rack 56 is displaced, is four times displacement as in the former case. Therefore, the print drum 19 is displaced four columns relative to its initial position.

Now, by combining displacements of the rack 56 and pinion 54 in opposite directions, the combination of these two displacements produces a displacement of three columns of the print drum 19 relative to the hammer 18. Displacement of the pinion 51 and rack 56 in the same direction produces displacement of five columns on the print drum 19 relative to the hammer and movement of the pinions 51 and 54 in opposite directions produces a displacement of six columns on the print drum 19 relative to the hammer 18. Displacement of all of the members of the group; that is, the members 51, 54 and 56, in proper directions produces a movement of seven columns of the print drum 19 relative to the hammer 18. The selection of the eighth column of the print drum is effected by simply not moving any of the members 51, 54 and 56 thereby leaving the print drum 19 in its prior position, this situation arising when a character in the same circumferential column it to be imprinted. It is apparent from the above description that the mechanism including pinions 51 and 54 and rack gears 52, 53 and 56 constitute a mechanical summing device, the total output motion of which is applied to pinion 69 via rack gear 53.

It can be seen then that by employing a three-bit binary code any one of the eight circumferential columns of the print drum 19 may be aligned with the hammer 18, the bits of the code being employed to energize the control magnetic structures 33, 39 and 40 selectively in accordance with the position of the bits in the code. It was previously mentioned that the apparatus was provided with an internal logic arrangement which eliminated the necessity for providing external circuits to remember the previous character selected. This is accomplished by means of the studs 24, 26 and slot 28 and a variable reluctance pick-up generally designated by the reference numeral 74. This mechanism comprises a semi-circular disc 76, secured to the end of the shaft 9 and having a substantially common axis therewith and a magnetic, for example, a variable reluctance, pick-up 77. When the shaft is in a position illustrated the reluctance of the path, as sensed by a coil 78, is of one value and if the shaft 9 is rotated to 180°, the reluctance of this path, as sensed by the coil 78 increases. Thus, there are generated signals in the coil 78 of different polarities indicative of the position of the shaft 9 at any selection interval. The signal developed by the coil 78 is employed to determine which of the electromagnets of a magnetic pair are to be energized in response to ones and which are to be energized in response to zeroes. Referring again to FIGURE 2, it is assumed that the vertical arm 49, associated with the mechanism of pinion 21, is in its lowermost position, this being indicative of a binary one for that position. If now a voltage pulse comes in which indicates a binary one for this same position, then obviously, the pinion 51 and its driving mechanism should maintain the same position as during the prior interval. Therefore, the right-hand magnet of the electromagnetic group 33 should be energized, since under these circumstances, coupling between the hub and the shaft is prevented. The coil 78, since it provides signals of different polarities depending upon the initial position of the shaft 9 is employed to control the external circuit such that during this interval the appropriate magnets of each magnetic pair is energized to respond to a binary one for its specific position in the code. If, on the other hand, the pinion 51 is to be moved to its retracted position, corresponding to a binary zero in this position in the code, then the signal is routed to the left-hand magnet of the pair 33 and the hub 27 is moved to the left so that it rotates with the shaft and the pinion 51 is raised. After the next cycle of rotation of shaft 9, the situation is reversed; that is, the stud 26 is now opposite the slot 28 and if the eccentric and arm are in the one position and are to remain there, the left-hand magnet of the pair must be energized to indicate a binary one for that position. The signal produced by the magnetic coil 78 causes a reversal in the application of signals to the magnets of the magnetic pairs for each subsequent cycle of operation, and all signals indicating binary ones are supplied to the appropriate magnet of the pairs during one cycle of operation and in the subsequent cycle the signals indicating binary ones in the various positions are fed to the opposite members of the magnetic pairs. In this manner, the problem of keeping track by means of external circuits of the particular character positioned under the hammer is eliminated.

Referring again specifically to FIGURE 1, the mechanism for producing rotation of the print drum 19 about its longitudinal axis, in addition to the pinions 29, 31 and 32 and magnetic pairs 41, 42 and 43, comprises pinions 79, 81 and 82 meshing respectively with the pinions 29, 31 and 32. The pinion 79 is supported on a shaft 83 and drives an eccentric 84, a ring 90 and an arm 86 which correspond in every detail with the arrangement including pinion 44, shaft 46, eccentric 47, ring 48 and arm 49. The pinion 81 has associated therewith a tube 85 and eccentric 87, a ring 88, an arm 89 corresponding with the elements 68, 67, 66, 64 and 63. The pinion 82 has associated therewith a tube 91, ring 92, and eccentric 93 and a rack 94 corresponding in every detail to the elements 58, 59, 61, 62 and 56. The rack 94 is in engagement with the pinion 96 carried on the end of the arm 89, the pinion also being in contact with a rack 97. The arm 86 carries in its lower end a pinion 98 in engagement with the rack 97 and a further rack 99. The rack 99 engages a gear 101 carried on a splined longitudinally extending shaft 102 which has splined thereon the print drum 19. Thus, the print drum 19 rotates with the shaft 102 but may slide longitudinally therealong as demanded by the rack 73. The gearing ratio between rack 99 and gear 101 is such that when the arm 94 is moved by its eccentric from one extreme position to the other, the print drum 19 is rotated relative to its initial position through one horizontal row. Movement of the arm 98 rotates the head through two horizontal rows while movement of the arm 86 moves the head through four horizontal rows. Combinations of movements of the elements 84, 89 and 94 can produce any combination of rotation of the print drum **19** from one to seven rows and the eighth row is selected by maintaining the mechanism in its position from the prior printing cycle so that the print drum is not rotated. The mechanism thus constitutes a mechanical motion summing device, the output of which is developed on rack gear **99**. Thus, these two mechanisms which for purposes of brevity are associated on the one hand with the magnetic pairs **33, 39** and **40** and on the other hand with the magnetic pairs **41, 42** and **43**, may effectively present any one of sixty-four distinct characters carried on the drum **19** to the hammer **18** by selecting the area of intersection between one of eight longitudinally extending rows and one of eight circumferentially extending columns. Positive positioning of the various elements in the selection mechanism is assured by the direct drive arrangements in conjunction with detents which are generally designated by the reference numeral **103** each of which is in engagement with a different one of the driven opinions **44, 68** and **62**, and **79, 81** and **82**. As is well known, the detents will engage the teeth of the pinions so that any tendency of the mechanism to assume an intermediate position is overcome, the gear being always driven to a position in which the roller of the detent is seated between and engaging adjacent surfaces of two adjacent teeth of the gear. This specific arrangement illustrated is for purposes of simplicity of illustration and it is preferable to employ the detenting arrangement illustrated in FIGURES 4, 5 and 6 which also discloses the second embodiment of the invention. Specifically, a double heart-shaped cam is employed so as to minimize chatter which would obviously be large in the arrangement illustrated in FIGURE 1 and to provide for a more positive positioning of the mechanism. In order to maintain the detenting forces at reasonable values, the stationary positions of all eccentrics are such that the axis of the shaft **67** is aligned in the case of the pinion with the center of the pinion and the longiutdinal axis of its connecting arm and in the case of the rack with the longitudinal axis of the rack. Because of this arrangement torques are not developed in the system tending to rotate the eccentrics and their associated elements.

It is apparent that in order to provide for good design of the mechanism, the pinions such as pinion **21** must be sufficiently wide relative to their associated pinions, for instance the pinion **44**, such that complete engagement with the teeth of the pinion **44** is maintained regardless of which of its three positions the pinion has assumed during a driving interval.

Referring now to the hammer mechanism, the hammer **18** may be selectively driven and when driven must be driven in synchronism with the remainder of the mechanism. In order to effect these results, the shaft **3** carries a cam **104** engaged by a roller **106** carried on an arm **107** secured to a shaft **108**. The axis of the shaft **108** serves as the pivot point for the arm **107** and the shaft rotates with the arm upon movement thereof. The arm **107** extends forwardly of the shaft **103** and the roller **106**, as illustrated in FIGURE 1, and is adapted to seat in a groove **109** of an armature **111** of an electromagnetic structure **112**. A stop **113** is provided below the arm **107** to limit its downward movement. If the electromagnetic **112** is energized the arm **109** rotates clockwise and the roller **106** may follow the contours of the cam **104**. The cam **104** is perfectly round, or concentric with the shaft **103**, except at one location **114** in which location the diameter of the cam **104** is materially reduced. Thus, during each cycle of rotation of the shaft **3**, the arm **107** is maintained in the position illustrated in FIGURE 1 except during a short interval at which time the forward end of the arm **107** rotates downwardly. This produces rotation of the shaft **108** and results in clockwise rotation of hammer **18** such that the hammer strikes the drum **19**. In actual operation, of course,

a printing medium and print receiving medium are disposed between the hammer **18** and drum **19** so that an impression may be made upon the print receiving medium. Obviously, these two elements may be an inked ribbon and a piece of paper or other corresponding materials depending upon the system in which the apparatus is to be utilized. If it is desired not to produce actuation of the hammer **18**, this occurring during shift and spacing functions, etc. and the magnetic structure **112** is not energized and the forward end of the arm **107** remains seated in the groove **109** of armature **111** so that the roller **106** cannot follow the contours of the cam **104**. In this case the shaft **108** is not rotated and hammer **18** is not actuated. The cam **104** is positioned on the shaft **3** such that actuation of the hammer **18** occurs only after a complete selection interval of the particular character to be printed and at a time when the shaft **9** is stationary; this being important to the provision of clear printing since if the hammer is actuated during rapid movement of the drum some blurring is bound to occur.

This stationary interval of the drum occurs during the one-eighth of each cycle of rotation of the shaft **9** when the shaft is stationary. Further, during this hammer actuation interval the magnetic pairs are energized so as to produce selection of the next character to be printed and immediately after the interval of actuation of the hammer, the gearing arrangement including the gears **4, 6**, and **7** may impart rotation of the shaft **9** to produce movement of the drum **19** as required by the input information designating the next character to be printed. If, a character is not to be printed during the next cycle of operation the magnet **112** is not energized and the hammer is not actuated. Alternative to this arrangement is one in which the hammer is always actuated and spacing is effected by moving the drum **19** so as to present a recessed area to the hammer so as to prevent imprinting of the print receiving medium.

Referring now specifically to FIGURES 4–8 there is illustrated a second embodiment of the invention relating specifically to the mechanism for selectively transmitting motion from the shaft **9** to the various members of the differential gearing arrangement such as the pinions **51** and **54** and the rack **56**. Specifically, a shaft **116**, which corresponds to the shaft **9** of FIGURE 1, is a splined shaft which receives two discs **117** and **118** disposed on opposite sides of a member **119**. The member **119** is rotatable on a sleeve **121** which is splined to the shaft **116** and extends outwardly from opposite ends of the member **119** and into engagement into the discs **117** and **118**.

The member **119** comprises a first section **122** which is in effect a double heart-shaped cam adapted to be engaged by a roller **123** of a detenting mechanism which maintains the apparatus in a specific position during intervals when the member is not positively driven from the shaft **116**. The section **122** terminates in an eccentric portion **124** having a ring **126** disposed thereabout and rotatable with respect thereto. The eccentric portion **124** terminates in a left-hand portion **127** of the member **119** of lesser diameter than the other sections of the member and concentric to shaft **116**. A pin **128** extends parallel to the shaft **116** through the member **119** and is of a length approximately equal to the length of the hub **121**. The aperture through the member **119** which receives the pin **128** is located such that a semicircular groove is formed in the member **127** that is; the radius of the section **127** is equal to the radius at which the centerline of the aperture for the pin **128** is located. A portion of the pin **128** which is adjacent or axially aligned with the section **127** of the member **119** is provided with a recess or notch **129** equal to the radius of the pin. A ring **131** encircles the portion **127** and is disposed in the notch **129** in the pin **128** and therefore the ring is in contact with the circumferential surface of the section **127** throughout its entire periphery except in the region of the notch 129 of the pin 128 where it engages the notch. The ring 131 is connected via a shifting member 132 to an armature 133 of a magnetic pair generally designated by the reference numeral 134. Thus, upon energization of one or the other of the magnets of the pair 134, the arm 132 and consequently the pin 128 is shifted to the left or to the right relative to the position illustrated depending upon which of the magnets is energized.

The disc 117 carries an aperture 136 which is in alignment with the pin 128 when the member 119 is in the position illustrated and the disc 118 carries an aperture 137 which is in alignment with the pin 128 when the member 119 is rotated through 180° about the shaft 116 relative to the position illustrated. If, for instance, the left-hand magnet of the pair 134 as viewed in FIGURE 4 is energized, the pin 128 is shifted to the left and enters the aperture 136 in the disc 117. Since the disc 117 is splined to the shaft 116, rotation of the shaft 116 produces rotation of the member 119, and the eccentric portion 124 of the member 119, in association with the ring 126, causes a vertically depending arm 138 to be moved downwardly. The arm 138 carries, for instance, a pinion 139 (or rack) which may correspond to any one of the pinions 51, 54, 96 or 98 (or racks 56 or 94) of FIGURE 1. If, on the other hand, in the above example, the right-hand magnet of the pair 134 had been energized, the arm 132 would tend to attempt to shift the pin 128 to the right but upon so doing the pin would contact a solid surface of the disc 118 and the detent roller 123 would maintain the member 119 in the position illustrated upon rotation of the shaft 116. Thereafter, if during the next cycle of operation, the right-hand magnet of the pair 134 were energized, the pin 128 would move to the right and enter the slot 137 so that during this interval the member 119 would be rotated and the arm 138 would be moved downwardly. Thus, by employing the embodiment of the invention illustrated in FIGURES 4 to 8, one may eliminate the type of drive provided by the pairs of pinions, such as pinions 21 and 44, and provide a mechanism of lesser mass thereby rendering the system more readily susceptible to high speed operation. This is of considerable importance when one considers that the mechanism of the present invention is to operate at a printing rate of at least 100 characters per second.

In the assembly of a mechanism employing the device illustrated in FIGURES 4 to 8, there are provided six of these assemblies corresponding to the six selection elements of FIGURE 1. These devices are aligned along the shaft 116 with the discs of adjacent elements in abutting relationship with one another and all elements are clamped on the shaft 116 by means of nuts on opposite ends of the shaft. This can be accomplished as a result of the use of the sleeve 121 which causes the discs 117 and 118 to be maintained out of engagement with the member 119 and therefore permitting relative rotation of the member 119 with respect to the discs and the shaft 116 even though the entire mechanism is compressed by the nuts at the opposite ends of the shaft. The remainder of the structure is essentially the same as that illustrated in FIGURE 1; that is, the coupling between the shaft 116 and shaft corresponding to the shaft 3 of FIGURE 1 may be through the three gear drive or through a constant diameter cam. Also, the coupling between the pinion 139 and the remainder of the selection elements of the particular group may be the same as that illustrated in FIGURE 1, as is the coupling between the selection mechanisms and the character print drum 19. In effect then, the mechanism illustrated in FIGURES 4 to 8 merely replaces the selective coupling and drive arrangement including, for instance, pinions 21, 44, hub 27 and studs 24 and 26 illustrated in this prior figure.

As previously indicated, the particular coupling between the shafts 3 and 9 must be such as to provide for low acceleration and deceleration of the various elements. This feature is further enchanced by appropriate design of the eccentrics. Specifically, the eccentrics effect a slow initial change of position of the downwardly depending arms which is followed by more rapid displacement so as to effect total displacement of the arms in the time alloted. It should be noted that the two selection mechanisms need not be driven from a single shaft, such as shaft 9. The shaft 3 may drive two shafts disposed for instance in parallel, this arrangement being preferable where the printing mechanism cannot accommodate the length of one shaft 9 but can accommodate two parallel shafts; that is, greater width than in the apparatus illustrated.

While we have described and illustrated several embodiments of our invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What we claim is:

1. A character selection mechanism for printing devices comprising a character bearing element, a printing member and means for positioning said character bearing element relative to said printing member, said means comprising an intermittently rotatable member, means for intermittently rotating said rotatable member such as to provide a short stationary interval between each interval of rotation, a drive element for moving said character bearing element relative to the printing member, and a selectively operable coupling means for coupling said drive element to said intermittently rotatable member for movement thereby, said coupling means comprising a mechanical motion summing device including a plurality of elements each, when coupled to said intermittently rotatable member being movable between a first and a second position for applying mechanical motions to said summing device which, respectively, represent a zero and a different selected multiple of a specified unit of motion and means for at will coupling each of said plurality of elements to said intermittently rotatable member during said stationary interval.

2. The combination according to claim 1 wherein said intermittently rotatable member comprises a rotatable shaft, and means for reciprocating said plurality of elements through predetermined displacements when coupled to said shaft.

3. The combination according to claim 2 wherein said means for at will coupling each comprises a first plurality of pinions rotatable about and translatable along said shaft, means for selectively connecting each of said pinions to said shaft for rotation therewith, a further plurality of pinions each in engagement with a different one of said first plurality of pinions and means for translating rotation of each of said second plurality of pinions into reciprocation of a different one of said plurality of elements.

4. The combination according to claim 3 wherein said plurality of elements apply motions to said summing device in accordance with the binary notation.

5. The combination according to claim 4 wherein said first plurality of pinions each includes a slot therein, a plurality of pairs of diametrically opposed studs on said shaft, each pair adapted to seat in said slot in a different one of said pinions and being disposed on opposite sides of said pinions, means for selectively translating said pinions in one direction and another relative to a central position in which said pinion is disposed between said studs and out of contact therewth, said means for intermittently rotating said shaft producing 180° of rotation during each interval of rotation, means for establishing an arbitrary angular position relative to the circumference of said shaft, and means for determining the angular position of said shaft relative to said arbitrary angular position.

6. The combination according to claim 5 wherein

said means for selectively translating said pinions comprises a shifting fork having fingers disposed on opposite sides of said pinion and magnetic means for translating said shifting fork.

7. The combination according to claim 1 wherein said charcter bearing element is both rotatable and translatable relative to the printing member, a second drive element for rotating said character bearing element, said first mentioned drive element producing translation of said charcter bearing element, said second drive element comprising a further coupling means including a further mechanical motion summing device having a further plurality of elements each, when coupled to said intermittently rotatable member for applying a mechanical motion to said further summing device which is a different select multiple of said specified unit of motion and further means for at will coupling each of said further plurality of elements to said rotatable member during said stationary interval.

8. The combination according to claim 1 wherein said means for intermittently rotating said rotatable member includes means for imparting relatively low initial acceleration and deceleration to said rotatable member during each cycle of rotation.

9. The combination according to claim 1 further comprising a printing member and means for actuating said printing member during the stationary interval of said rotatable member.

10. The combination according to claim 1 wherein said mechanical motion summing device comprises a differential gear mechanism including a plurality of interconnected racks and pinions.

11. The combination according to claim 10 wherein said means for at will coupling each of said plurality of elements to said rotatable member comprises a pinion, means for selectively connecting said pinion to said rotatable member, said combination further including eccentric means driven by said pinion for converting rotation of said pinion to translation of one of said elements of said plurality of elements.

12. The combination according to claim 1 wherein said means for at will coupling each of said plurality of elements to said intermittently rotatable member comprises a hub rotatable on said rotatable member, a pin secured to said hub for rotation therewith and translation with respect thereto, a pair of members disposed at opposite ends of said hub and rotatable with said rotatable member, said pair of members having diametrically opposed pin receiving apertures and means for selectively translating said pin toward one and the other of said pair of members.

13. The combination according to claim 12 wherein each of said hubs has an eccentric section and means connecting each of said eccentric sections to a different one of said plurality of elements.

14. The combination according to claim 12 wherein said hub includes a cam having diametrically opposed recess formed in its cam surface and detent means for engaging the cam surface of said cam.

15. The combination according to claim 12 wherein said pin is parallel to the axis for rotation of said hub, said hub having a section of a radius approximately equal to the radial position of the center line of said pin, said pin having a notch therein of a depth approximately equal to its radius, a ring encircling said section and disposed in said notch in said pin, said means for selectively translating said pin comprising magnetic means for translating said ring.

16. The combination according to claim 1 wherein said means for at will coupling includes logic means for inhibiting coupling to said rotatable member of those of said elements whose positions represent the units of motion to be applied thereby to said summing device.

17. The combination according to claim 14 wherein said notches are angularly aligned with said pin receiving apertures of said members.

18. A printing device comprising a printing member, a character bearing element containing a discrete number of character bands, each of said character bands including the same number of discrete character positions, drive means for establishing a basic cycle of operation of said device including a first interval during which said character bearing element may be positioned relative to said printing member and a second interval during which printing occurs and said character bearing element is held stationary, positioning means for said character bearing element, said positioning means moving said character bearing element directly from a previously established position wherein a selected discrete character position of a selected character band is presented to said printing member to a newly selected position, coupling means for coupling said positioning means to said drive means during said first interval, said coupling means including, at least in part, means for selecting the position of said character bearing element.

19. The combination according to claim 18 wherein said positioning means includes a rack and pinion digital summing means.

20. The combination according to claim 19 wherein said positioning means comprises means for generating a plurality of individual motions, means for summing said motions, said means for generating comprising selectively positioning eccentrics.

21. The combination according to claim 20 wherein said means for summing comprises a rack and pinion digital differential system.

22. The combination according to claim 20 wherein said drive means includes a shaft rotated through 180° during each said first interval, said means for generating including a driven member having a single coupling means, a pair of coupling means secured to said shaft at diametrically opposed positions relative to said shaft, means for detenting said driven member with its associated coupling means in alignment with any one of said pair of said coupling means, means for selectively shifting said coupling means associated with said driven member toward a selected one of said pair of coupling means to effect coupling of said driven member to said shaft only if said coupling means are aligned and means for effecting rotation of one of said eccentrics if coupling is effected.

23, The combination according to claim 22 wherein said shifting of said driven means occurs during said stationary interval.

24. The combination according to claim 18 wherein said intervals are obtained by a drive means comprising a three gear drive having an input drive gear, a rotatable drive shaft secured to said input gear eccentrically thereof, an idling gear maintained in driving engagement with said input gear and a single output gear maintained in driving engagement with said idler gear.

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