April 6, 1965 W. Y. BENSON ET AL 3,176,610

TYPE-SETTING MECHANISM FOR HIGH SPEED PRINTERS

Filed Oct. 25, 1963 3 Sheets-Sheet 1

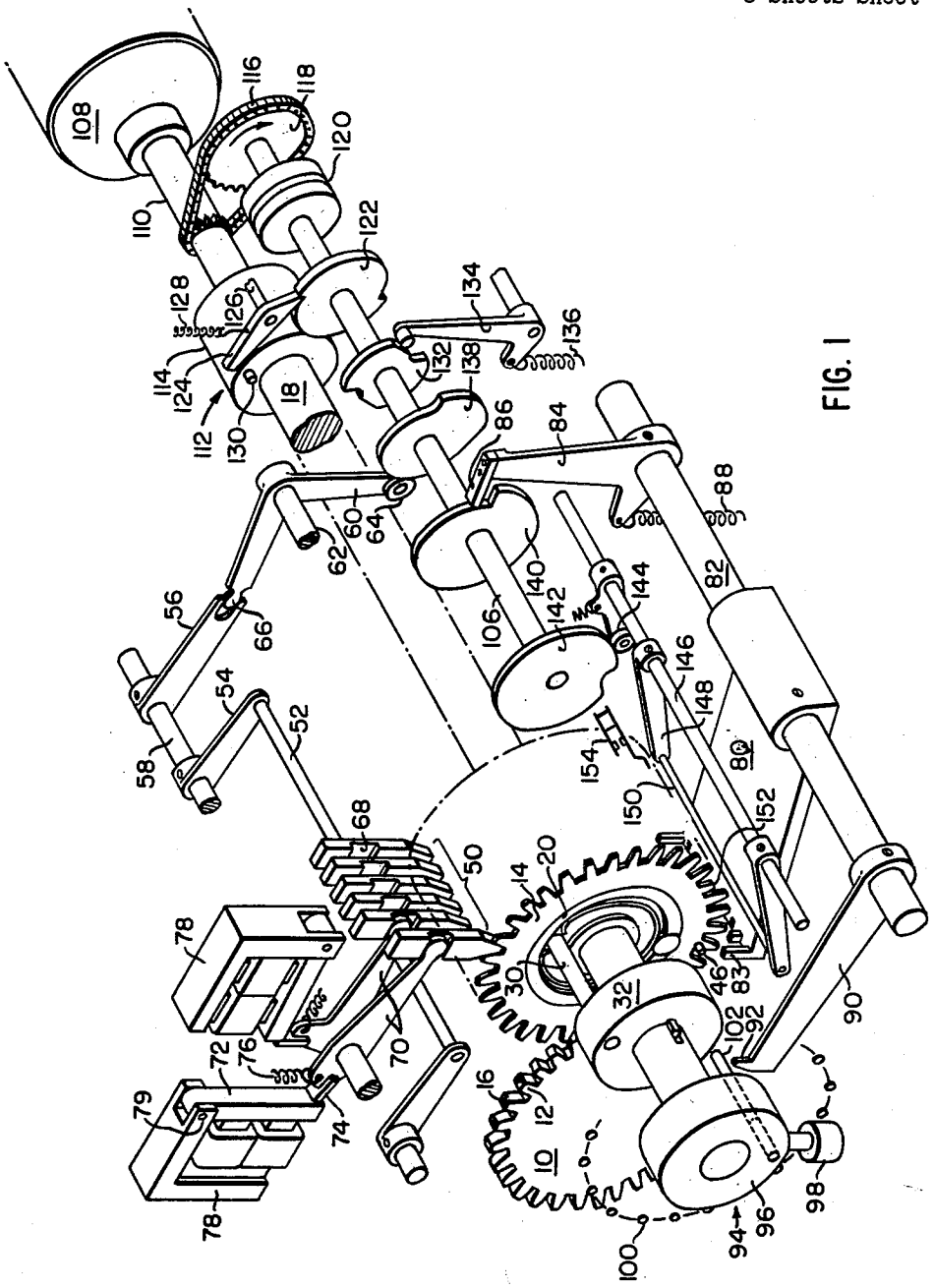


FIG. 1

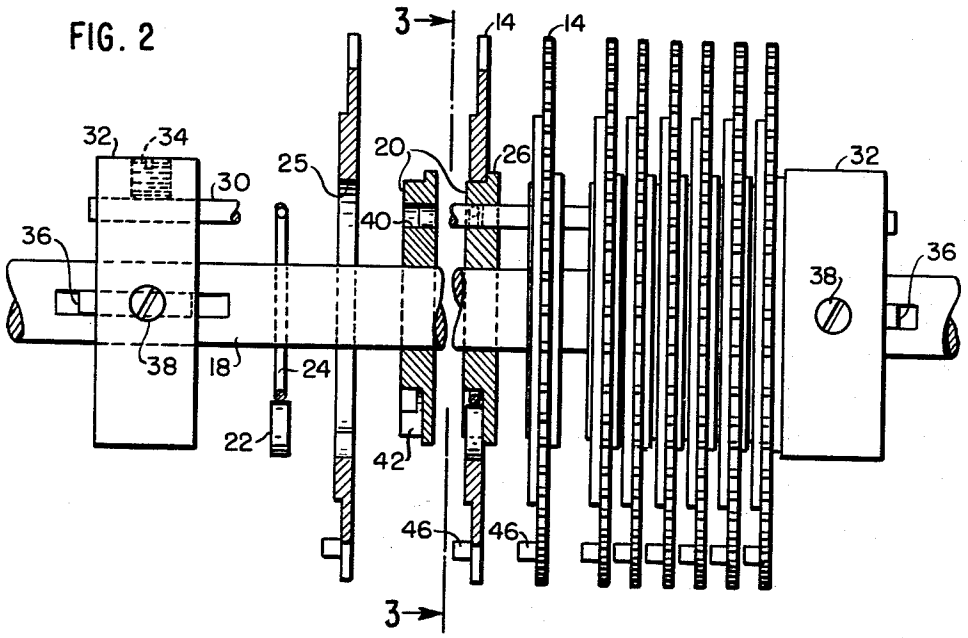
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FIG. 2



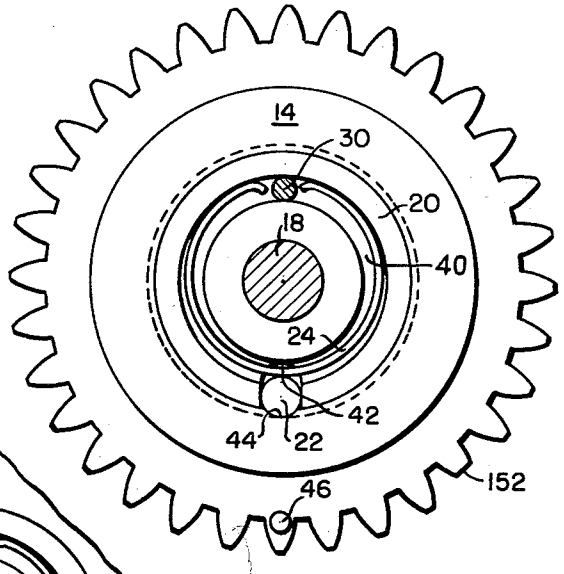


FIG. 3

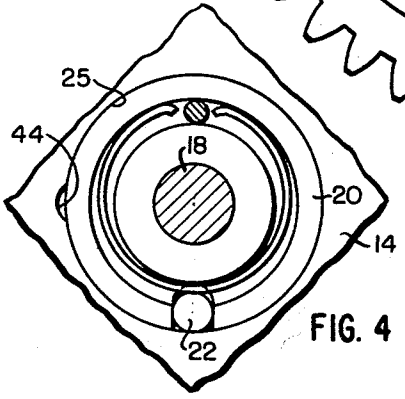


FIG. 4

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FIG. 5

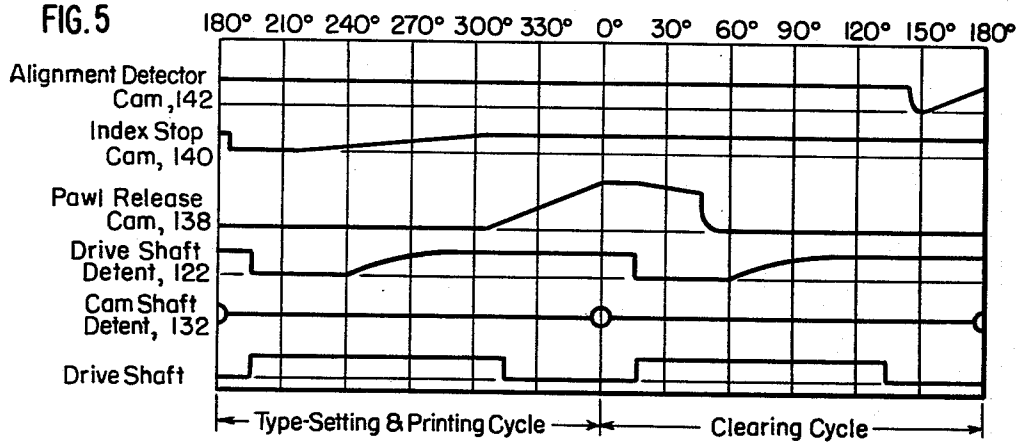
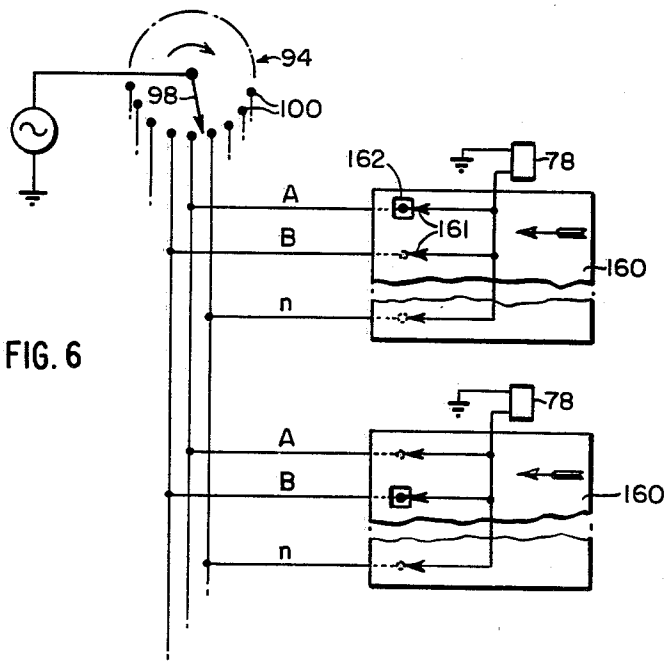


FIG. 6



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TYPE-SETTING MECHANISM FOR HIGH SPEED PRINTERS

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5 Claims. (Cl. 101—93)

This invention relates to an improved type-setting mechanism for high speed printers of the type having a plurality of print wheels spaced along a common axis, and each having a peripheral font of characters. In a printer according to the invention, the print wheels are individually and simultaneously positioned by the type-setting mechanism to form a line of type, which is then printed by a single hammer impresson; the typesetting mechanism then clears the print wheels and re-sets them for printing a subsequent line. For purposes of high speed printing, such as is carried out concomitant to computer operations, it is essential that the cycle of clearing and resetting the print wheels be carried out with a minimum delay.

It is a primary object of this invention to provide an improved type-setting mechanism for simultaneously setting a series of print wheels to position a predetermined sequence of their type faces at a printing station. It is a further object to provide an improved automatic type-setting mechanism which is cyclically operable to clear and reset a series of print wheels for sequentially printing a pre-selected series of lines. It is a further object to provide improved means for rapidly converting stored information into a series of lines each printed as a unit. Further objects and advantages of the invention will become apparent as the following description proceeds.

According to the invention, the print wheels are first set to a common index or cleared position and then, rotating in phase, individually halted at pre-selected angular positions in which the desired sequence of type is aligned at a printing station. This cycle is repeated for each new line; unlike other printing mechanisms in which the angular position of each print wheel must be individually sensed, the re-indexing or clearing step makes it feasible to utilize a single position sensor for determining the angular displacement of the entire group of print wheels from the index position, and thus signal the arrival of each character at the printing station.

The improved mechanism generally comprises driving means including a plurality of gears for individually driving each of a series of print wheels and torque-limiting over-running clutches for driving the gears in unison; positioning means for comparing the common angular displacement of the gears from an index position with stored positioning data, and for halting the individual gears upon arrival at pre-selected positions; and indexing means for returning all of the gears to the index position following each type-setting and printing operation. All of the print wheels in the group are set within a single revolution, the printing of the entire line is carried out in a single impression, and the print wheels are re-indexed within another revolution.

In the preferred embodiment, the drive gears are meshed with gear teeth formed in the print wheels, and are connected with a drive shaft by means of torque-limiting over-running clutches. The clutches are preferably of an improved disc form which permits the drive gears to be spaced sufficiently closely on the shaft to provide for the necessarily close print wheel spacing. An angular position sensor, which in the preferred form comprises a rotary switch having multiple contacts corresponding to the various type faces of the print wheel fonts, is also driven by the drive shaft through a friction clutch.

During a type-setting and printing cycle, the drive shaft is revolved, with all of the gears and the position sensor switch rotating in phase from an indexed position. The latter supplies a series of signals, indicating the sequential positions attained by the print wheels, to a control circuit which compares the transmitted signals with stored pre-selected positioning data, and produces a stop signal for each print wheel when its actual position is in agreement with the pre-selected position. The gears and associated print wheels are individually stopped in the pre-selected positions by means of interposing pawls, which are initially held in inoperative positions by solenoid-actuated latch means, and relased by the stop signals to interfere with the teeth of the gears and thus halt the print wheels in the desired positions.

In a subsequent clearing or indexing cycle, the interposing pawls are withdrawn from the gears, and a stop comb is positioned to interfere with a series of indexing pins mounted on each gear and the position sensor switch, upon their arrival at a common index position. Subsequent withdrawal of the stop comb permits the mechanism to enter a new type-setting and printing cycle by rotating the gears and switch in uniformly-phased relation. The functions performed during the clearing cycle are under the control of a programming cam mechanism, which also regulates the transmission of power to the drive shaft for intermittently revolving the drive shaft to carry the gears cyclically through the type-setting and clearing cycles.

While the specification concludes with claims distinctly pointing out the subject matter which we regard as our invention, it is believed that a clearer understanding may be gained from the following detailed description of a preferred embodiment thereof, referring to the accompanying drawings, in which:

FIG. 1 is a fragmentary view in perspective of the improved type-setting mechanism, showing the operative relationship of the mechanical elements thereof;

FIG. 2 is a view in elevation and partially in section, showing gear drive means of the mechanism in partially disassembled relation;

FIG. 3 is a sectional view taken on line 3—3 on FIG. 2 looking in the direction of the arrows, showing an individual gear and clutch assembly in engaged relation;

FIG. 4 is a fragmentary view of the gear and clutch assembly, showing the clutch disengaged and the gear rotationally advanced;

FIG. 5 is a graphic representation of the sequence of functions of programming cam mechanism of FIG. 1; and

FIG. 6 is a diagram of a comparison circuit for positioning the gears and print wheels in a type-setting cycle.

Referring to FIGS. 1–4, the improved type-setting mechanism serves to position a series of print wheels arranged in closely-spaced relationship along a suitable shaft (not shown) and a representative one of such wheels

is illustrated at 10. Each print wheel has a font of characters arranged peripherally, so that any desired character may be positioned at a printing station for impression by a suitable hammer (not shown) against a web of paper. It will be apparent that any desired number of print wheels may be used, corresponding to the number of columns of type to be printed. The printing mechanism may be of a conventional type, and inasmuch as it forms no part of the present invention, no further detailed description thereof is believed necessary. Conveniently, each print wheel 10 is formed with gear teeth 12 for driving engagement with a corresponding ring gear 14, and the type faces are formed on lands 16 of the teeth.

A set of the ring gears 14 is supported on a drive shaft 18, and is drivingly connected therewith, by means of a series of torque-limiting over-running clutches, each comprising a flat drive disc 20, a detent button 22, and an engaging spring 24. Each ring gear is rotatably mounted upon the periphery of a drive disc 20, received within a concentric bore 25 in the gear, and is positioned against a circumferential flange 26 of the disc. The various drive discs are assembled in stacked relation upon the shaft 18 and drivingly connected therewith by means of a drive rod 30 extending longitudinally through the stack, and secured at its opposite ends in collars 32 by set screws 34. The collars are keyed on the drive shaft at 26, and fastened by set screws 38. It will be understood that the drive discs may be drivingly connected with the drive shaft by splines or other equivalent means, other than the drive rod 30.

Each drive disc is formed with a circular recess 40 inset into one face thereof, and receiving a spring 24, which is in the form of a split ring. The drive rod 30 passes through the recess 40 intermediate the ends of the split spring. A slot 42, milled radially into the periphery of the drive disc, slidably accommodates a detent button 22, which is urged radially outwardly by the spring 24. A mating notch 44 is inset in the bore 25 of each gear, and is drivingly engageable by the detent button 22 to connect the shaft 18 in driving relation with that gear. This relationship is shown in FIG. 3. The axial compactness of the clutch design is advantageous in that the gears may be closely stacked for cooperation of each gear with a corresponding member of a closely spaced set of print wheels.

An index pin 46 is affixed adjacent the periphery of each gear 14 to establish an angular index for that gear, conveniently in the same angular position as the notch 44. It will be seen that interference with the pins 46 at an arbitrary angular index position will cause all of the gears of the set to be held against rotation in the index position, resulting in disengagement of the detent button 22 from the gear if the drive shaft continues to rotate, as suggested in FIG. 4. If the drive shaft is then halted at the index position, all of the clutches will re-engage. These relative movements are utilized in a clearing cycle to reindex the gears and the associated print wheels.

Now if the pins 46 are released with the detent buttons engaged in the notches 44, and rotation of the drive shaft is recommenced, the entire set of gears will be rotated in commonly-phased relation, and any individual gear may be halted individually at any given angular position by interference with its teeth, without interrupting the continued rotation of the remaining gears in phased relation. This relationship is utilized in a type-setting cycle alternating with the clearing cycle.

Referring again to FIG. 1, each gear 14 is arranged to cooperate with an interposing pawl 50, which is shaped to mate with the tooth spaces of the gear and is slidably supported in a machine frame (not shown) for reciprocation to and from an interfering position, one of the pawls being shown in interference with the illustrated gear 14. The pawls serve to position the gears individually in the type-setting cycle. All of the pawls are raised as a group to a disengaged position, preparatory to the clearing cycle, by means of a bail 52, mounted on cranks 54, which are carried by a crank shaft 58, and actuable by a lever 56 about the axis of the crank shaft. The lever 56 is drivingly connected with a bell-crank lever 60 by means of a sliding ball-and-socket connection 66. The lever 60 is rotatably mounted on an axle 62, and bears a cam follower 64 at its free end for actuation by cam means to be described. Displacement of the cam follower clockwise as viewed in FIG. 1, produces an upward motion of the bail for clearing the pawls 50 from engagement with the gear teeth.

The pawls 50 are slotted at 68 to receive actuating arms 70, which are freely rotatably supported on the crank shaft 58. The bail 52 engages these arms to raise the pawls to the disengaged position, in which the pawls are individually latched by means of a series of pivoted latch bars 72. Each latch bar is normally suspended in a position to latchingly engage a keeper 74 affixed to the end of an associated arm 70. The arms 70 are biased in directions to engage the pawls with the gears by means of tension springs 76, and the latch bars 72 are releasable individually by energization of associated solenoids 78. The latch bars 72 are of ferromagnetic material forming portions of the flux paths of the solenoids, and are pivoted to the core structures of the solenoids by pivot pins 79. Energization of the individual solenoids draws their latch bars 72 out of latching engagement with the keepers 74, and thus releases the arms 70 to engage the pawls with the related gears. To permit the solenoids to be fitted into the relatively narrow spacing between adjacent pawls, they are offset as shown in FIG. 1, and alternate ones of the arms 70 are cranked at right angles.

All of the gears, together with the print wheels, may be halted in an index position by means of a stop comb 80, having a series of teeth 83 for radial interposition between adjacent gears to interfere with the index pins 46. The stop comb is rotatably mounted by means of a jack-shaft 82 affixed thereto and supported in suitable bearings (not shown). A bell-crank lever 84, one of whose arms carries a cam follower 86 for selectively engaging the comb with the gears, and the other of whose arms is connected to a tension spring 88 for biasing the comb to the disengaged position shown, is also mounted on the jack-shaft. An additional stop arm 90 borne by the jack-shaft is formed with a finger 92 which serves to index a rotary switch 94.

The switch 94 serves to signal the angular displacement from the index position of the shaft, and consequently of the commonly-phased gears, when the gears and switch are indexed and then permitted to rotate with the shaft. The switch includes a rotor 96 which is driven by the drive shaft 18 through a slip clutch (not shown), which may be similar to those provided for the gears 14, or may be of a conventional friction or torque-limiting over-running type. The rotor bears a contact roller 98 in wiping contact with a circumferential row of spaced contacts 100, which are spaced apart at the same angle as the tooth spacing common to the gears and print wheels. In the form shown, the pitch diameter of the gears and print wheels is identical, so that each contact engagement with the roller 98 momentarily closes an associated circuit to indicate the arrival of a corresponding type character at a printing station. The switch rotor is indexed by means of an indexing pin 102 carried by the switch rotor for engagement with the finger 92 of the stop comb device.

The functions of the apparatus are regulated in part by programming cam means carried by a shaft 106, which is driven in common with the drive shaft 18 by means of a motor 108. The motor shaft 110 drives the rotor (not shown) of an over-running clutch 112, which may be of a conventional friction or slip type, and in which the driven housing 114 is attached to the drive shaft 18. A chain drive 116 couples the motor shaft with a sprocket 118, and is drivingly engaged with the

cam shaft through a half-revolution electrically-energized clutch 120 of a commercially-available type. This coupling may be alternatively formed by a conventional friction clutch or by a direct drive, but in order to avoid damage and facilitate corrective action in case of malfunction, as will further appear hereinafter, it is preferred that it be of a type requiring a positive energization signal to continue its operation after each half revolution.

The programming cam mechanism shown is arranged for a speed ratio of the drive shaft 18 to the cam shaft 106 of 3:1, although it will be apparent that the particular speed ratio chosen is merely a function of the cam design. A series of cams are secured on the cam shaft 106 for regulating the operations of the mechanism, and the first of these is a double-lobed drive shaft detent 122, which cooperates with a locking pawl 124 pivoted at 126 and biased into engagement with the cam surface by a tension spring 128. In the position shown in FIG. 1, which is that which prevails just after the commencement of a type-setting cycle, the locking pawl 124 has just fallen from a lobe of the cam, and has disengaged a stop pin 130 affixed to the driven member of the clutch 114. The drive shaft is thus freed for rotation to carry out the type-setting function. The rotation of the detent 122 during the ensuing half-revolution of the cam shaft brings the pawl 124 back into position to interfere with the stop pin 130 once more, and thus halt the drive shaft upon the completion of a single revolution. Another single revolution of the drive shaft is effected by the opposite lobe of the detent during the ensuing clearing cycle. Thus, each type-setting or clearing cycle is accompanied by a half-revolution of the camshaft, and one full revolution of the drive shaft; the speed ratio being 1:3, the latter occurs in a relatively brief interval corresponding to 120° of rotation of the former.

A cam shaft detent 132, also having two lobes, cooperates with a crank follower 134 biased by a tension spring 136, to halt the cam shaft at precisely the completion of each half-revolution, in the event that the half-revolution clutch 120 is not re-energized at the completion of any cycle, through any malfunction of the type-setting or printing mechanisms. If desired, the motion of the crank follower 134 may also be used, with appropriate control circuitry (not shown), to signal the completion of each half-revolution.

For actuating the cam follower 64 to raise the bail 52 and free the pawls 50 preparatory to clearing and re-indexing the print wheels, a pawl release cam 138 is provided with a single lobe operative at the commencement of each clearing cycle.

Actuation of the stop comb 80 and stop arm 90 into indexing position is accomplished during the clearing cycle by means of a stop cam 140, having a single lobe operative during this cycle.

In the preferred embodiment shown, an additional cam 142 is provided for the purpose of detecting any misalignment of the gears from the index position upon the completion of the clearing cycle. This cam cooperates through a spring-biased follower arm 144, a rotatable shaft 146, and crank arms 148, with a detector bail 150. The bail 150 is arranged to be raised by the spring-biased follower arm 144 into a recess created by the alignment, in the index position, of one shortened tooth 152 formed in each gear 14 (best seen in FIG. 3). As the bail 150 rises into this recess, the crank arm 148 momentarily closes a switch 154, and thereby transmits a signal which may be utilized in a control circuit by means which are not shown and form no part of this invention, to permit the initiation of a subsequent type-setting cycle. Failure of any gear to arrive at the index position for any reason will prevent the bail from rising into the recess, through its interference with gear teeth of normal height, and thus will prevent closure of the momentary contact switch 154; this action can thus be utilized to halt the operation of the mechanism until the difficulty is corrected.

Referring now to FIG. 5, the cyclical operation of the type-setter under the control of the programming cam mechanism is graphically illustrated, the abcissa being plotted in terms of angular displacement of the cam shaft. It will be understood that the cam shaft rotates continuously except in the event of interruption of its drive through the clutch 120 by suitable control circuitry; the cam shaft detent 132 engages intermittently at the 0° and 180° intervals as previously described, but does not normally interfere with continuous rotation.

Assuming that the mechanism is in the indexed 180° position and prepared for the type-setting cycle, the index stop cam 140 first releases the stop comb 80 for withdrawal from the gears by its spring 88. Shortly thereafter, in the position shown in FIG. 1, the drive shaft detent 122 releases the clutch 112, and rotation of the drive shaft commences. Prior to the completion of the ensuing single revolution of the drive shaft, the detent 122 lowers the locking pawl 124 into interfering position, to limit the drive shaft to a single revolution. The ratio of the speed of the drive shaft to that of the cam shaft is 3:1, so that this single revolution occurs through about 120° of the cam shaft rotation. During this interval, the pawls 50 are selectively released individually by their solenoids 78, to interfere with and halt the various gears 14 and print wheels 10 at selected positions, to align the desired type characters at a common angular position or printing station. Printing of the line is carried out by a single hammer impression performed by a suitable printing mechanism, which may be of a conventional type, and is not shown in the drawings. Printing actuation occurs subsequent to the completion of the drive shaft motion, e.g., at roughly 330° of cam shaft rotation. Shortly thereafter, at about the 0° position, the pawl release cam 138 actuates the bail 52 to raise all of the pawls 50 from engagement with the gears, and the mechanism is free for the clearing cycle.

The index stop cam 122 is elevated at this stage and in position to subsequently halt the gears and the switch rotor 96 at the index position, having been raised by the index stop cam 140 prior to the completion of the type-setting cycle. This action does not interefere with the rotation of the gears, which is required for type-setting, for all those gears which are to be set at an intermediate position are halted after completing less than a single revolution.

To clear the mechanism, the drive shaft detent 122 once more raises the pawl 124, releasing the clutch 112 to rotate the drive shaft through a single clearing revolution. Within this revolution, the index pin 46 of each gear strikes one of the teeth 83 of the stop comb 80, and the index pin 102 of the switch rotor strikes the tooth 92 of the stop arm 90, so that all of the gears and the switch are halted in the common index position. The drive shaft is then stopped by the pawl 124, with the detent buttons 22 engaged in the recesses 44 of the gears, so that the clutches are engaged and prepared for a new type-setting cycle. Subsequently, the alignment detector cam 142 causes the detector bail 150 to be raised into proximity with the short teeth 152, and thus close the switch 154 to initiate a subsequent type-setting cycle. It will be understood that this alignment-detecting arrangement may be omitted if desired.

In FIG. 6, circuit means are shown for setting the individual print wheels during the type-setting cycle. This circuit may be of any type which is effective during this cycle to compare the common angular displacements of the gears from the index position with stored position data, and to energize the individual solenoids 78 to cause the pawls 50 to halt the rotation of the individual gears upon their arrival at the desired positions.

In the preferred embodiment shown, the solenoids 78 are energized by the completion of a series circuit through

a contact of the rotary position-sensor switch 94 and any of a series of wiping contact switches 161 in a punch card data-storage system of a conventional type, i.e., upon agreement of the actual angular position, corresponding to the arrival of a given character on each print wheel at the printing station, with a punch chosen to select that particular character. A separate card 160 is provided for each print wheel, that is for each column of print, and each column in the card contains a punch indicating the letter selected for that space in the given line. As the switch rotor 98 engages each contact A, B . . . N, representing the current angular position of the commonly-phased gears with respect to the printing station, it completes a series circuit through any corresponding character which is punched in any card, and energizes that solenoid which is connected with the associated set of switches 161, to release the corresponding pawl and thus halt the corresponding gear in a position aligning the selected type character with the printing station. In the example shown, character "A" is about to be set by the upper punch card for one column, and character "B" by the lower punch card for the next column. After the printing of each line and the completion of the clearing cycle, a conventional punch card reading mechanism advances all of the cards to read the next column of punches for setting a subsequent line of type. It will be understood that other means may be utilized for comparing the angular position of the gears and print wheels with stored type-selection data; for example, the rotary sensor switch may be replaced by a code disc and electric eyes to signal an analogue of the attained position, and this signal may be compared electronically with magnetically-registered type-selection data, to produce solenoid-energization signals upon agreement.

While we have illustrated and described a preferred embodiment of our invention by way of illustration, it will be understood by those skilled in the art that various changes and modifications may be made therein without departing from the true spirit and scope of the invention, which we therefore intend to define in the appended claims without limitation to the details of the foregoing embodiment.

What we claim is:

1. A type-setting mechanism for a high-speed printer of the type which includes a plurality of rotatably mounted print wheels each bearing a peripheral font of characters, said type-setting mechanism comprising:

driving means including a drive shaft, a plurality of gears mounted on said drive shaft in relatively rotatable relation, each for driving engagement with one of said print wheels, and a plurality of torque-limiting over-running clutch means each drivingly connecting one of said gears with said drive shaft;

selectively-operable indexing means constructed and arranged for interference with said gears to halt the rotation of all of said gears at a common index position, and for subsequently releasing said gears for rotation with said shaft by said clutch means in commonly-phased relation;

means for positioning said gears individually at selected angular positions, said positioning means including a pluralty of interposing pawls, pawl-displacing means including a plurality of solenoids each selectively operable to produce interference of one of said pawls with a corresponding one of said gears, circuit means for comparing the angular positions of said gears with stored positioning data for each print wheel corresponding to a pre-selected angular displacement thereof, and a rotary selector switch having stationary and rotatable contact elements, one of said contact elements having a plurality of angularly-spaced contacts each individually connected with said circuit means for delivering a different position signal thereto upon contact with the other of said elements;

torque-limiting over-running clutch means drivingly connecting said rotatable contact element with said drive shaft, said rotatable contact element having an index stop, said indexing means further including a stop arm selectively movable for interference with said index stop to halt the rotation of said rotatable element at an index position corresponding to said common index position of said gears;

said circuit means being operatively connected with each of said solenoids to produce interference of one of said pawls upon the arrival of the corresponding gear at its preselected position.

2. A type-setting mechanism as recited in claim 1, in which said indexing means comprises a stop comb having a plurality of fingers and mounted for movement to and from a position in which one of said fingers interferes with each of said gears and said index stop to halt the rotation thereof at a common index position.

3. A type-setting mechanism for a high speed printer of the type which includes a plurality of rotatably mounted print wheels each bearing a peripheral font of characters, said type-setting mechanism comprising:

driving means including a drive shaft, a plurality of gears mounted on said drive shaft in relatively rotatable relation thereto, each for driving engagement with one of said print wheels, each of said gears having an index stop means, a plurality of torque-limiting over-running clutch means each drivingly connecting one of said gears with said drive shaft, each of said gears being formed with a foreshortened tooth in a common angular location with respect to said index stop means, and means for detecting proper alignment of said gears in said common index position comprising a bail movable to and from a recess defined by the foreshortened teeth of said gears in the indexed position;

indexing means operable upon an indexing rotation of said drive shaft, and comprising a stop comb having a plurality of fingers and mounted for movement to and from a position in which one of said fingers interferes with said index stop means of each of said gears to halt all of said gears at a common index position;

means for positioning said gears individually, operable upon a type-setting rotation of said drive shaft, and comprising a plurality of interposing pawls each movable individually to and from a position interfering with rotation of one of said gears;

programming cam means drivingly connected with said driving means, and including first cam means operable to move said stop comb to a position interfering with each of said gears, second cam means operable to withdraw said interposing pawls from positions interfering with said gears, and means for biasing said bail toward said recess subsequent to completion of said indexing rotation, whereby misalignment of any gear from the indexed position interferes with movement of said bail into said recess;

said first and second cam means being constructed and arranged for initial operation of said first cam means by said driving means to cause interference of said stop comb with said gears during said indexing rotation, and subsequent operation of said second cam means by said driving means to withdraw said interposing pawls for commencement of said indexing rotation.

4. A type-setting mechanism as recited in claim 3, in which said programming cam means includes a detent cyclically operable by said driving means to interrupt rotation of said drive shaft intermittently, said detent being constructed and arranged to initiate said indexing rotaton subsequent to operation of said first and second cam means, and to initiate said type-setting rotation subsequent to discontinuance of operation of said first and second cam means.

5. A type-setting mechanism as recited in claim 4, in which said clutch means are constructed and arranged to re-engage, when said gears are restrained against rotation by said stop comb in the index position, at intervals of one revolution of said drive shaft; said detent being operable to terminate said indexing rotation of said drive shaft at the completion of one revolution thereof with said clutch means re-engaged, whereby said clutch means are in engaged relation upon commencement of said type-setting rotation.

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