Fig. 1

Fig. 2

Fig. 3
2,910,935

HIGH SPEED PRINTER

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This invention relates to a high speed printer of the kind generally using a set of type wheels arranged side-by-side and each carrying a plurality of types, said printer being particularly useful as an output unit for high speed data processing equipments, electronic computers and similar devices.

The high speed printers known heretofore of the type referred to usually require extremely costly and intricate control devices.

It is the object of the invention to eliminate this and other disadvantages and to provide a high speed printer which is of simple manufacture and fast and reliable operation.

In accordance with the invention I provide in a high speed printer a set of type wheels frictionally driven through consecutive cycles by a continuously rotating member associated with a clock signal generator. I further provide a common zeroizing mechanism operable for arresting all the type wheels of said set in a predetermined mutual position, control means settable to operate said zeroizing mechanism and timing means having a period at least as long as one cycle of said type wheels. Means jointly controlled by said generator and said timing means are provided for unsetting said control means to enable the type wheels to resume their rotation from said position in synchronism with the clock signals generated by said generator.

It will thus be apparent that in the printer according to the present invention the type wheels normally rotate at random and only upon starting an operating cycle they are first mutually aligned and thereupon they resume rotation in a timed relation with the clock signal generator, whereby the sequential steps of the type wheels will be in perfect synchronism with the clock signals.

This and other features of the invention will become apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings in which:

Fig. 1 is a longitudinal sectional view showing a printer embodying the invention;

Fig. 2 is a block diagram showing the electronic circuit for controlling the printer shown in Fig. 1; and

Fig. 3 is a partial top plan view of the printer.

Referring now to Figs. 1 and 3, the reference numeral 1 indicates a shaft supported by the printer frame and continuously driven by a motor not shown in the drawings.

Mounted on the shaft 1 is a set of type wheels 2 arranged side-by-side and frictionally driven by the shaft 1 in the manner described, as for example, in applicant's Italian Patent No. 510,783.

Each type wheel 2 is provided with eleven teeth 3, ten of which carry printing types 4 numbered 0 to 9, whereas the eleventh tooth does not carry a type and corresponds to a "non print" position of the wheel. Secured to each wheel 2 is also a zeroizing tooth 5.

Rockably mounted on a pivot 45 is a zeroizing comb ball 6 having a lug 6' for each zeroizing tooth 5. The ball 6 is normally disengaged from the teeth 5 by the urge of a spring 7 and is operable by a solenoid 8 to engage all the teeth 5, whereby all the wheels 2 may be arrested in a predetermined mutual position which in the present embodiment will be their "non print" position.

Rockably mounted on a further pivot 45 is a set of detent levers 9, each detent lever being operable by a solenoid 11 against the urge of a spring 12 to engage a selected one of the teeth 3 of the corresponding type wheel 2, whereby a selected type 4 may be set in a printing position.

Slidable movably in a slot 13 of the printer frame schematically shown at 46 is the axle of a platen 12 whose movement toward and away from said type wheels is controlled by a crank shaft 16 through a disc shaped crank 17, a crank pin 15 and a connecting rod 14. The shaft 16 is adapted to be frictionally driven by the motor through a slip-coupling not shown in the drawings and is normally prevented from rotating by a detent lever 17 operable by a solenoid 18. By means of a suitable transmission the speed of the shaft 16 is half the speed of the shaft 1, whereby due to the position of the crank pin 15 on the disc 17 the shaft 1 will turn through a little more than a full revolution before the plate 12 is moved being then thrown leftwards strikes against the type wheels 2.

Further mounted on the shaft 1 is a clock signal generator comprising a toothed magnetic disc 19 whose teeth, which are eleven like those of the type wheels 2, cooperate with a magnetic pick-up head 20. The reluctance variation which occurs as the teeth of the disc pass between the pole pieces of the head 20 induces therein a voltage which is then amplified and shaped at 21 to obtain a suitable clock signal S in a manner well known in the art. By way of example, a suitable amplifying and shaping circuit is shown in the United States Patent 2,609,143, Fig. 4. The frequency of the clock signals S is determined both by the number of revolutions of the shaft 1 and the teeth number of the disc 19. In the present embodiment eleven clock signals S are generated at each revolution of the shaft 1.

Referring now to Fig. 2, an electronic circuit is shown which is timed by the clock signals S to suitably control the energization of the solenoids 8, 11 and 18. This circuit makes use of conventional components, such as and-gates, one-shot multivibrators, flip-flops, switches, delay units and counters, which are well known in the art, as for example, from the book "Electronics Experimental Techniques" by William C. Elmore and Matthew Sands, McGraw-Hill, 1949, and therefore will not be described hereinafter in detail.

As shown in Fig. 2, the circuit comprises a first part A controlling the sequence of the zeroizing, selecting and printing phases which form an operating cycle of the printer, and a second part B controlling the selective arrest of the type wheels 2 according to an item to be printed.

To initiate a printing cycle a start signal is applied in a known way to the input terminal 22. Through a condenser 23 this signal trips over a timing means including a one-shot or univibrator 24 of the type described in the cited book with reference to page 87 and Figs. 2.33. The one-shot 24 in turn through a condenser 25 sets a control means such as a flip-flop 26 to its state II thus triggering a switch 27 adapted to cause energization of the solenoid 8.

Therefore, the solenoid 8 moves the comb ball 6 to place the lugs 6' into the path of the zeroizing teeth 5. Since during the next preceding printing cycle, as will be seen hereinafter, the type wheel 2 had been angularly moved with respect to the shaft 1 according to the individual type selected in said cycle, the zeroizing teeth 5 will now contact the corresponding lugs 6' of the ball...
3

6 in various instants of one revolution of the shaft 1, whereby the type wheels 2 will be arrested in their "non print" position, provided the solenoid is held energized during at least one full revolution of the shaft 1.

To this end the flip-flop 25 will not be reset to its state I until return of the one-shot 24 to its initial state, the period of the one-shot 24 being a little longer than the duration of a full revolution of the shaft 1.

More particularly, the one-shot 24 upon returning to its initial state sends a signal through a condenser 28 to a flip-flop 29 which will thus be set to its state II. An and-gate 36, having an input supplied by the clock signals S, is thus opened and the first clock signal outgoing therefrom trips over a further one-shot 31 similar to the one-shot 24 and included in said timing means, the period of said one-shot 31 being a little longer as well than one revolution of the shaft 1.

Upon trip-over the one-shot 31 opens an and-gate 32 which also has an input supplied by the clock signals S. The first signal outgoing from said and-gate 32 resets both the flip-flop 26 and, through a delay unit 33, the flip-flop 29.

The flip-flop 26 on being reset to the state I turns off the switch 27 thus discontinuing the energization of the solenoid 8. The comb bail 6 is therefore restored by its springs and the wheels 2 are now released to resume rotation bodily with the shaft 1 from said "non print" position. It will thus be apparent that, since the release of the wheels 2 was timed with a certain one of the clock signals S, a timed relation has been established between the generator and the rotation of the wheels 2, whereby the sequential steps thereof will be in perfect synchronism with the clock signals.

Upon being reset to the state I the flip-flop 26 further triggers through a condenser 34 a switch 35 controlling energization of the solenoid 18. The switch 35 may be, by way of example, of the thyatron type shown in the United States Patent 2,692,551, Fig. 5. On being energized the solenoid 18 releases the disk 17 thus allowing the shaft 16 to start rotation. At the end of one revolution the shaft 16 is adapted by known means to operate a switch 36, 36', . . . 36n (Fig. 2) inserted in the supply circuits of the solenoids 18 and the solenoids 11, . . . 11n, to the end of transistorly opening said circuits.

During the time elapsing from the release of the disc 17 to the striking of the platen 12 against the wheels 2 the part B of the electronic circuit performs the selection of the characters to be printed. This part comprises as many identical circuit arms as are the type wheels 2 which are arranged in a denominational orders. Corresponding to each denominational order is a counter 37, . . . 37n wherein first the corresponding digit of an item to be printed is set up and then a sequence of impulses is entered until the counter is filled up, such a counter being usually referred to as predetermined counter. This item comes from a store 38 which for instance may be of the well known type of main or auxiliary store used in computer electronic computers. Each counter 37 is of the type formed, as for example, of a chain of flip-flops and shown in the cited book, pages 209 to 212 and Fig. 4.3.

Upon trip-over the one-shot 31 opens both the and-gate 32, as described above, and a set of and-gates 39, thus allowing the signals S to enter the selecting circuit and to initiate type selection, one gate 39 being provided for each denominational circuit arm. The output signals of each gate 39 pass a delay unit 40 and a condenser 41 and sequentially enter the corresponding counter 37, wherein they are added to the digit previously set up. Upon being filled up each counter 37 is automatically cleaned off by generating an output pulse which through a condenser 42 triggers a switch 43. The latter switch may be of the above mentioned thyatron type and causes energization of the corresponding solenoid 11. At the same time the counter 37 remains locked by known means until a new item is set up therein.

The present combination of predetermined counters, condensers, thyatron switches and solenoids is similar to the combination illustrated in the United States Patent 2,692,551 with reference to Fig. 1 and will thus not be described in detail.

It will thus be apparent that each type wheel 2 will be arrested upon having advanced a number of steps conditioned by the digit set up in the corresponding counter. More particularly, if a digit x to be printed is set up in a counter 37, the number of signals S required to fill up the counter and therefore the number of steps made by the corresponding type wheel 2 will be equal, in the present embodiment, to the ten complement of x, provided the types 4 are arranged as shown in Fig. 1.

The selecting phase ends when the one-shot 31 returns to its initial state at the end of its period, thereby shutting the and-gates 39. It should be remarked that during the time the one-shot 31 remains tripped over the and-gate 32 remains open, whereby the output signals of the latter gate may prevent the flip-flop 26 from being set to its state II by a start signal eventually applied to the input 22 before completion of the cycle previously initiated.

It has been stated above that upon completion of the selecting phase the platen 12 strikes against the type wheels 2 thus printing the selected item.

Upon completion of one revolution the shaft 16 operates the switch 36 which opens the supply circuits of the solenoids 18 and 11 thus deenergizing same whereby the shaft 16 is arrested and the wheels 2 are released and start again rotation bodily with the shaft 1.

To ensure a reliable and correct operation of the printer, suitable delay units 40 are provided having a delay adjustable at will. In the drawings a plurality of delay units 40 is shown, one delay unit being provided for each denominational circuit arm, but a single delay unit common to all said arms may be provided as well.

Brieley, a printer according to the invention operates as follows. After having set up an item in the counters 37, . . . 37n, a start signal is applied to the input terminal 22. This signal trips over the one-shot 24 which in turn sets the flip-flop 26 to its state II. The solenoid 8 is thus energized and moves the ball 6 into engagement with the zeroizing teeth 5. The type wheels 2 which had been angularly positioned with respect to the shaft 1 according to the types selected in the next preceding cycle are, therefore, aligned in their non print position.

At the end of its period the one-shot 24 sets the flip-flop 29 to its state II, whereby the first signal S thereafter generated will trip over the one-shot 31. The latter allows the same signal S to reset the flip-flop 26 thus both deenergizing the solenoids 8, whereby the type wheels 2 aligned as above start again rotation, and energizing the solenoid 18, whereby the shaft 16 is started.

The one-shot 31 further enables the and-gates 39 to allow the signals S to enter the counters 37. When any counter 37 fills up it generates an output pulse which energizes the corresponding solenoid 11, whereby the associated type wheel 2 will be arrested in the selected position.

Within one revolution of the shaft 1 all the type wheels 2 are arrested according to the item set up in the counters 37, and item being thereupon printed by the platen 12.

Finally, at the end of its period the one-shot 31 shuts the gates 32 and 39, while at the end of one revolution of the shaft 16 the switch 36 causes the shaft 16 to be stopped and the detent levers 9 to release the type wheels 2. The printer is thus restored to normal and is adapted to initiate a new operating cycle.

It will be apparent that the zeroizing and the selecting phases occurring within an operating cycle are timed by the periods of the one-shots 24 and 31, respectively, and that the printing phase is determined by the striking of
the platen 12 against the type wheels 2 after a little more than half a revolution of the shaft 16.

While the invention has been described primarily in terms of controlling a high speed printer having the simplest embodiment of frictionally driven type wheels, it should nevertheless be understood that the type wheels may be actuated by other embodiments of non-positive generally frictional devices, such as hydraulic or pneumatic joints, pawl and star-wheel joints and the like known in the art. The term "frictionally driven" as used in the appended claims should, therefore, be intended as broad enough as to embrace said other drives.

While I have disclosed and described herein a presently preferred embodiment of the invention, it should nevertheless be understood that the same is susceptible of various modifications and changes by those skilled in the art.

I claim:

1. In a high speed printer, a set of type wheels, a continuously rotating member for frictionally driving said wheels through consecutive cycles, a clock signal generator associated with said member, a normally ineffective common zeroizing mechanism operable for arresting all the type wheels of said set in a predetermined mutual position, control means settable irrespective of the instantaneous angular position of said rotating member to operate said zeroizing mechanism, timing means having a period at least as long as one cycle of said type wheels, and means jointly controlled by said generator and said timing means for resetting said control means to enable said type wheels to resume their rotation from said position in synchronism with the clock signals generated by said generator.

2. In a high speed printer, a set of type wheels, a continuously rotating member for frictionally driving said wheels through consecutive cycles, a clock signal generator associated with said member, a normally ineffective common zeroizing mechanism operable for arresting all the type wheels of said set in a predetermined mutual position, normally ineffective individual arresting means operable for selectively arresting said type wheels according to an item to be printed, control means settable irrespective of the instantaneous angular position of said rotating member to operate said zeroizing mechanism, timing means having a period at least as long as one cycle of said type wheels, and means jointly controlled by said generator and said timing means for resetting said control means to enable said type wheels to resume their rotation from said position and for rendering said individual arresting means effective.

3. In a high speed printer, a set of type wheels, a continuously rotating member for frictionally driving said wheels through consecutive cycles, a clock signal generator associated with said member, a common zeroizing mechanism operable for arresting all the type wheels of said set in a predetermined mutual position, a one-shot multivibrator having a period at least as long as one cycle of said type wheels, control means settable by said multivibrator upon trip-over to operate said zeroizing mechanism, and means jointly controlled by said generator and said multivibrator upon return of the latter to its initial state for resetting said control means to enable said type wheels to resume their rotation from said position.

4. In a high speed printer, a set of type wheels, a continuously rotating member for frictionally driving said wheels through consecutive cycles, a clock signal generator associated with said member, a common zeroizing mechanism operable for arresting all the type wheels of said set in a predetermined mutual position, normally ineffective individual arresting means operable for selectively arresting said type wheels according to an item to be printed, a first and a second one-shot multivibrator each having a period at least as long as one cycle of said type wheels, said second multivibrator being controlled by said first multivibrator to be tripped over substantially on the return of said first multivibrator to its initial state, control means settable by said first multivibrator upon trip-over to operate said zeroizing mechanism, and means jointly controlled by said generator and said second multivibrator upon trip-over of the latter for resetting said control means to enable said type wheels to resume their rotation from said position and for rendering said individual arresting means effective.

5. In a high speed printer, a set of type wheels, a continuously rotating member for frictionally driving said wheels through consecutive cycles, a clock signal generator associated with said member, a common zeroizing mechanism operable for arresting all the type wheels of said set in a predetermined mutual position, normally ineffective individual arresting means operable for selectively arresting said type wheels according to an item to be printed, a first and a second one-shot multivibrator each having a period at least as long as one cycle of said type wheels, said second multivibrator being controlled by said first multivibrator to be tripped over substantially on the return of said first multivibrator to its initial state, control means settable by said first multivibrator upon trip-over to operate said zeroizing mechanism, and means jointly controlled by said generator and said second multivibrator upon trip-over of the latter for resetting said control means to enable said type wheels to resume their rotation from said position, and a set of predetermined counters jointly controlled by said generator and said second multivibrator for rendering said individual arresting means effective upon the trip-over of said second multivibrator.

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