June 14, 1960 L. CETRAN ET AL 2,940,386

WHEEL PRINTERS

Filed Jan. 22, 1958 3 Sheets-Sheet 1

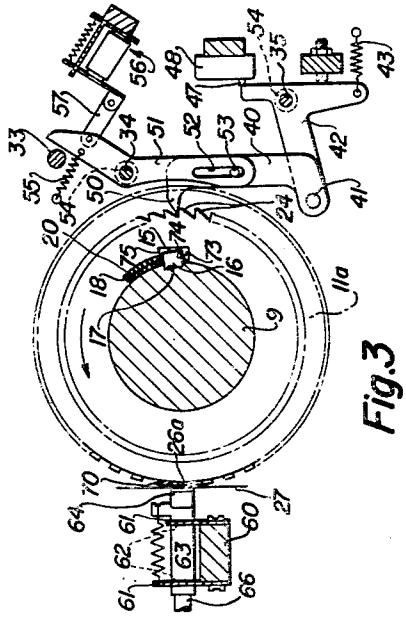


Fig.3

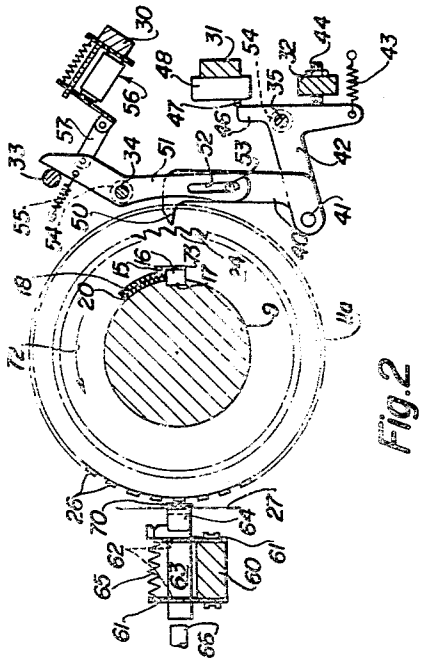


Fig.2

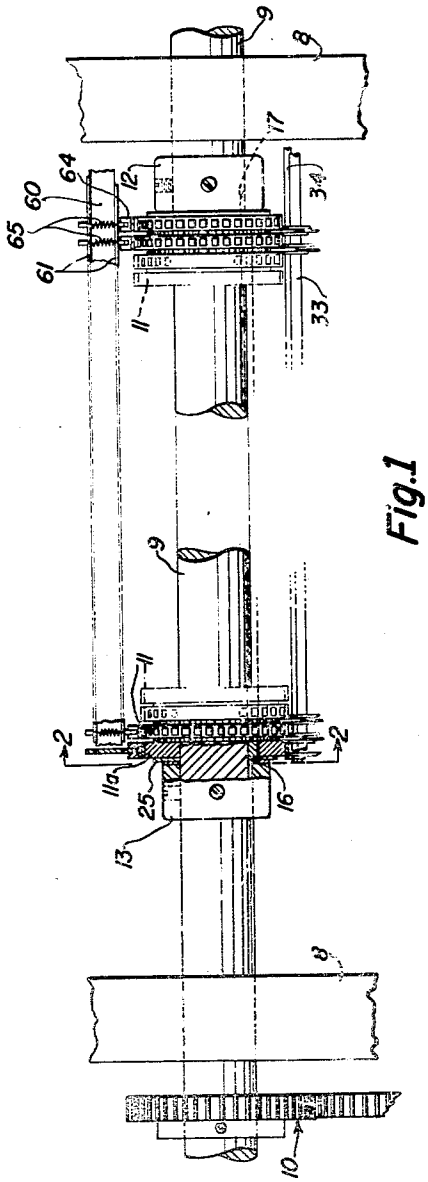


Fig.1

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WHEEL PRINTERS

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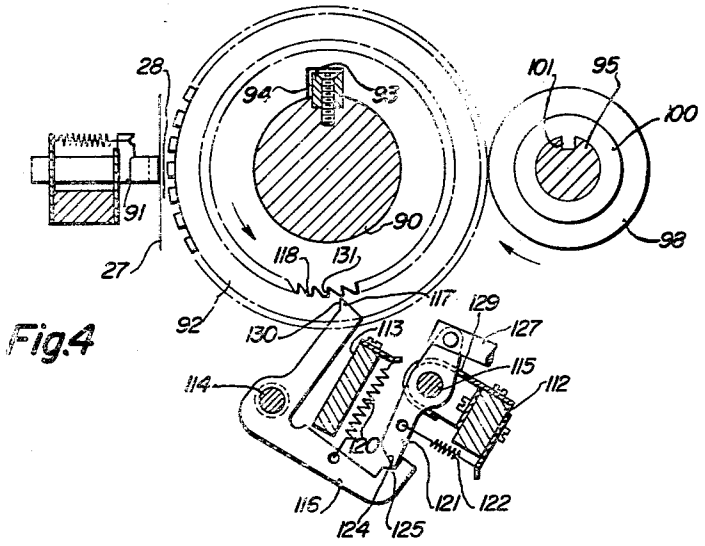


Fig.4

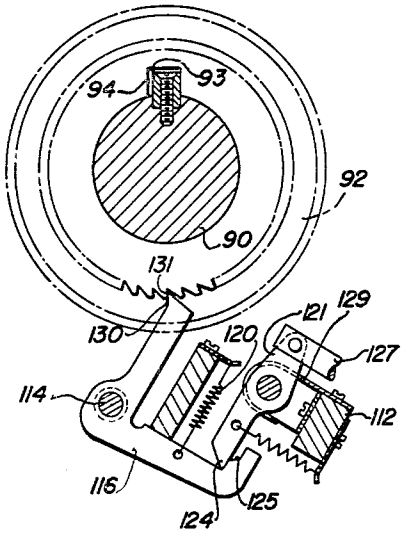


Fig.5

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WHEEL PRINTERS

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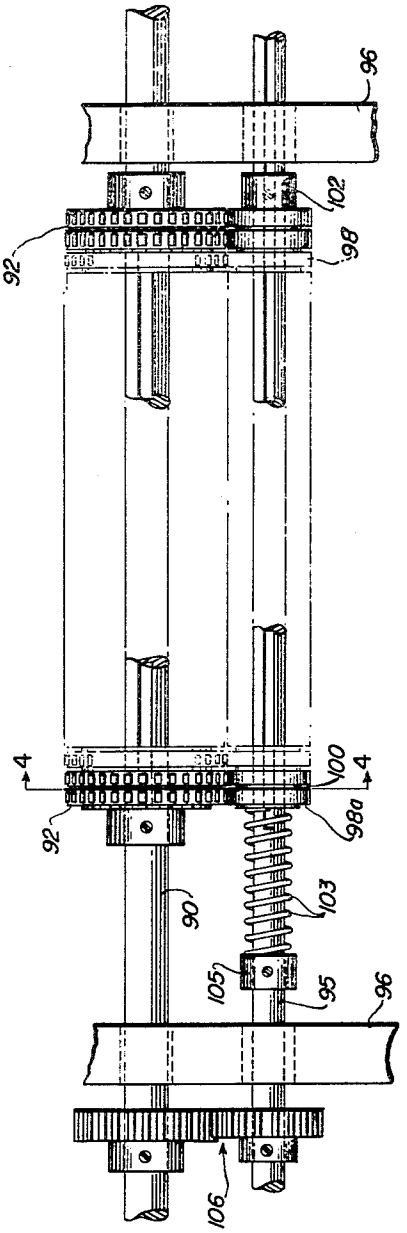


Fig.6

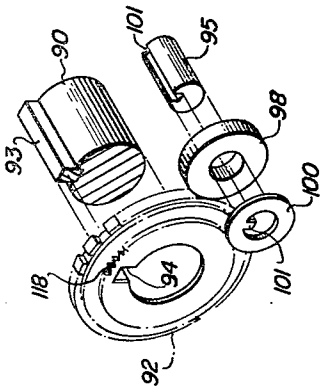


Fig.7

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WHEEL PRINTERS

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9 Claims. (Cl. 101—93)

This invention relates to a novel printing apparatus and more particularly relates to an improved wheel printing device.

Conventional types of wheel printers operate in one of two characteristic fashions. In one case the printing wheel is constantly rotated and printing is done "on the fly." In the other case the wheel is rotatably indexed for character selection and printing is done while the wheel and its supporting means remain rotatably fixed. Each of these two operations has its particular advantages and disadvantages. In the former case the printing speed is relatively high but the quality of print is poor. In the latter case the printing speed is relatively low but the quality of print is relatively high.

The present invention contemplates the provision of a printing apparatus which possesses the combined advantages of both of the above noted types of wheel printers.

The primary object of the instant invention is to provide an improved wheel printing device whereby the rotational movement of each of a plurality of printing wheels may be momentarily interrupted so as to permit each of said wheels to effect a printing operation.

Another object of the instant invention is to provide a novel interconnection between a printing wheel and its supporting shaft whereby a predetermined amount of relative rotational movement is possible between said shaft and wheel.

Another object of the invention is to provide an improved printing device having a printing wheel whose rotational movement may be momentarily interrupted and then automatically restored.

Other objects of the invention will become apparent as the disclosure progresses.

In the drawings:

Fig. 1 is a plan view of the instant apparatus taken in partial section.

Fig. 2 is an enlarged sectional view taken along section line 2—2 of Fig. 1 and shows the drive means associated with each printing wheel of the instant apparatus.

Fig. 3 is an active view of the parts shown in Fig. 2.

Fig. 4 is a sectional view corresponding to that of Fig. 2 and shows an alternate construction for the instant wheel printing apparatus, and,

Fig. 5 is an active view of the parts shown in Fig. 4.

Figure 6 is a plan view of the said alternate embodiment of the apparatus illustrated in Figure 4.

Figure 7 is an exploded perspective view showing the frictional drive connections for each printing wheel of the apparatus shown in Figures 4 and 6.

Referring to the plan view of Fig. 1, there is shown a pair of side frames 8 which, by means of any suitable type of bearings, rotatably supports a main shaft 9 that is adapted to be rotatably driven by gearing 10. A plurality of printing wheels 11 are mounted on the shaft 9 in coaxial juxtaposition. The longitudinal position of wheels 11 relative to shaft 9 is determined by collars 12 and 13 which are fixedly secured to said shaft.

The respective walls forming the central aperture in each printing wheel are provided with a notch 15, Fig. 2, which is adapted to cooperate with a key 16 fixedly secured in the longitudinal groove 17 of shaft 9. The circumferential length of notch 15 is made greater than the width of the key 16 so that a predetermined amount of relative rotational movement is possible between the said shaft 9 and each of the respective printing wheels 11. Operatively disposed between said shaft key and each of said wheels is a spring 18 which tends to rotate the respective printing wheels in a counterclockwise direction relative to shaft 9. The greater part of each spring 18 is disposed in the circumferential extension 20 of the said notch 15. A plurality of equally spaced teeth 24 are formed about the periphery of an axial shoulder 25 which is provided on the left side, Fig. 1 of each wheel 11. Fixedly secured to the outer periphery of each wheel 11 is a plurality of type 26 which are adapted to print characters on the record sheet 27 in a manner to be described.

Secured between the side frames 8 are three parallel cross beams 30, 31 and 32 and three parallel cross shafts 33, 34 and 35. On these cross members are mounted a plurality of individually operable linkages which respectively control the alternate stopping and starting of the rotational movement of the various printing wheels 11. In that all of said linkages are similar, a detailed description of one thereof will suffice here.

Referring to Fig. 2, the lower end of the arresting arm 40 is articulately secured as at 41 to the left hand end of bell crank 42 which is pivotally mounted on the cross shaft 35. A spring 43 biases the bell crank 42 in a counterclockwise direction into engagement with the adjustable stop screw 44 mounted in the cross beam 32. In the normal position shown in Fig. 2 the upward extension 46 on said bell crank overlies the plunger 47 of the switch 48 which is secured to the cross beam 31. The upper end of the arresting arm 40 is provided with a finger 50 which is adapted to be moved into and out of operative engagement with the said teeth 24 formed on the printing wheel 11*a*. The means for swinging the arresting arm 40 towards and away from the said printing wheel comprises a lever 51 which is pivotally mounted on the cross shaft 34 and which is provided at its lower end with an elongated slot 52. The stud 53 secured to the arresting arm 40 is operatively disposed in said slot so that any pivotal motion of lever 51 may be transferred to said arresting arm 40. The spring 55 biases the lever 51 in a counterclockwise direction so that the upper end of said lever normally engages the cross shaft 33. In this normal position of lever 51 the finger 50 of the arresting arm 40 is held out of operative engagement with the teeth 24 of the printing wheel 11*a*. The lever 51 may be pivotally actuated in a clockwise direction by means of a solenoid 56 which is mounted on the cross beam 30 and which is operatively connected to the upper end of said lever 51 through the link 57. The clockwise movement of lever 51, produced by operation of solenoid 56, moves the finger 50 of arm 40 into operative engagement with said teeth 24 of the printing wheel. In order to maintain levers 51 and bell cranks 42 in predetermined planar relation with respect to the printing wheels 11, spacer bushings 54 are provided between the respectively adjacent levers and the respectively adjacent bell cranks.

The means for bringing the record sheet 27 into printing contact with the said type 26 comprises a cross beam 60 which is fixedly secured between said side frames 8 and which is disposed immediately adjacent one side of said printing wheels as shown in Figs. 1 and 2. A pair of vertically disposed plates 61 are respectively secured

to the sides of the cross beam **60** and are provided with a plurality of cooperating pairs of aligned apertures **62** which respectively slidably support a plurality of axially movable printing hammers **63**. Said hammers are disposed in the same planes as their respectively associated printing wheels **11** and each are provided with a head **64** which operatively supports and displaces that portion of the record sheet **27** which is to be printed on by said type **26**. Hammers **63** are each normally axially biased away from the printing wheels **11** by means of a spring **65**. The means for respectively advancing the hammer **63** towards the said printing wheels comprise a plurality of solenoids **66** which are operatively connected to the respective hammers **63** by any suitable means.

The number of printing wheels mounted on the main shaft **9** will be determined by the number of letter spaces desired in each line which is to be printed. The number and position of the teeth **24** formed on each printing wheel **11** is such that when the hooked finger **50** is in operative engagement with any one of said teeth, one of said type **26** will be operably aligned with the head **64** of the associated printing hammer **63**. Any suitable inked ribbon **70** may be operatively disposed between the record sheet **27** and the printing wheels **11**.

In the operation of the apparatus of Figs. 1–3, the main shaft **9** is continually driven at a constant rotative speed by means of the gearing **10**. As the shaft is thus driven in a counterclockwise direction **72**, Fig. 2, the key **16** will act through the spring **18** so as to cause the printing wheel to rotate in said counterclockwise direction **72**, the action of spring **18** urging the side shoulder **73** of the wheel notch **15** into engagement with the adjacent side shoulder or flank **74**, Fig. 3, of the said key **16**. Under these conditions all the printing wheels will normally rotate with the shaft **9**, and will have a predetermined rotative position with respect to said shaft. When it is desired to print a given letter, e.g. that represented by the type **26***a* of printing wheel **11***a*, the solenoid **56** is actuated to thereby throw the finger **50** into operative engagement with the said teeth **24** of printing wheel **11***a* as shown in Fig. 3. The timing of this engagement is such that the rotational movement of the printing wheel will be arrested when the selected type **26***a* is operatively aligned with the associated printing hammer **63**. Immediately after the operation of solenoid **56**, solenoid **66** is actuated so that the hammer **63** will force the record sheet **27** and the inked ribbon **70** into operative printing engagement with the said type **26***a* at the moment that the latter is stopped. During the short period of time in which this printing action occurs, the shaft **9** will continue to rotate in direction **72** and in doing so will move relative to the printing wheel **11***a* thereby compressing the spring **18**. When the printing action is completed the power supply to both said solenoids **56** and **66** is cut off so that the hammer **63** moves to the left under the action of spring **65** and the finger **50** moves out of engagement with said teeth **24** under the action of spring **55**. The release of wheel **11***a* by said finger **50** occurs before the upper edge or flank of the key **16** reaches the upper shoulder **75**, Fig. 3, of the wheel notch **15**. After said release, the key **16** will engage said shoulder **75** and cause the wheel **11***a* to again rotate with the shaft **9**. Immediately thereafter, the now compressed spring **18** will cause said wheel **11***a* to rotate an additional amount in said direction **72** relative to shaft **9** to thereby bring said wheel into its normal rotative position relative to shaft **9**: such normal relative position having been shown and described in connection with Fig. 2. Thereafter said wheel **11***a* and shaft **9** will continue to rotate together preparatory for a second printing cycle.

The printing wheels **11** may be individually and serially operated, or successive groups of said wheels may be sequentially operated to complete the printing of a given line of figures and/or letters on the record sheet **27**. In that each printing wheel is always arrested at one of a series of predetermined rotative positions the printing characters will be mutually aligned and each line of print will be horizontally straight. This line printing operation may be successively repeated as the record sheet **27** is successively line spaced upwardly.

A safety device is provided for the instant apparatus whereby the entire device is turned off in the event that finger **50**, for any reason, fails to disengage from the teeth **24** of a printing wheel **11** before said upper shoulder of the key **16** engages the said upper shoulder **75** of the wheel notch **15**. If and when such a failure occurs the arm **40** will be lifted upwardly against the normal detenting action of spring **43**, stud **53** moving vertically in the lever slot **52**, thereby rotating the bell crank **42** in a clockwise direction about the cross shaft **35**. The upward extension **46** of said bell crank will then depress said plunger **47** of the switch **48** which in turn may disconnect the power supply to the entire printing apparatus.

Figs. 4–7 illustrate a second embodiment of the instant invention. Here the main shaft **90** and the printing hammers **91**, Fig. 4, are supported and driven in a manner similar to that described above in connection with Figs. 1–3. In that the construction and operation for each of the printing wheels **92** are similar a description of one such wheel and its driving and controlling linkages will suffice here. The wheel **92** of Fig. 4 is supported in a manner similar to wheel **11***a* of Fig. 2 except that there is no spring provided between the shaft key **93** and the wheel notch **94**. Here different means are provided for normally urging the right hand shoulder, Fig. 4, of the wheel notch **94** into engagement with the right side of the key **93**. An additional shaft **95** is suitably journalled in the side frames **96** of the machine, said shaft being disposed parallel to the said main shaft **90**. Rotatably mounted on shaft **95** is a plurality of driving disks or drive rolls **98** each of which may have a hard rubber coating secured to the peripheral surfaces thereof. Between successive driving disks there is mounted a friction disk **100** which is rotatably secured to shaft **95** by means of the key and slot arrangement **101** shown in Fig. 7. The disks **98** and **100** are axially biased towards the abutment collar **102** by means of a compression spring **103** which is operatively disposed between the abutment collar **105** and the leftmost driving disk **98***a*, Fig. 6. Both of said collars **102** and **105** are fixedly secured to shaft **95**. The various disks **98** are positioned so as to be coplanar with the respective printing wheels **92** and so that the outer surfaces of the said rubber coating on each of said disks **98** frictionally engages the respective peripheral surfaces of said printing wheels. Any suitable gearing such as **106** from shaft **90** may be used to rotatably drive the shaft **95**. It will be apparent that the frictional contact between the radial surfaces of the disks **98** and **100**, created by the action of spring **103**, will cause the disks **98** to be yieldably rotated when the shaft **95** is driven by said gearing **106**. The speed ratio between shafts **90** and **95** is such that the peripheral speed of the outer surfaces of the driving disks **98** is slightly greater than that for the printing wheels **92**. Under these conditions each wheel **92** will normally be yieldably urged to and retained in a predetermined counterclockwise position relative to the main shaft **90** as shown in Fig. 4.

The means for momentarily arresting the rotational movement of printing wheels **92** comprises a pair of parallel cross beams **112** and **113**, Fig. 4 and 5, and a pair of parallel cross shafts **114** and **115** which are respectively fixedly secured between the said side frames **96** of the machine. Pivotally mounted on the cross shaft **114** is a bell crank **116** that is provided with a tooth **117**. The tooth **117** is adapted to engage the teeth **118** integrally formed on the side of the printing wheel **92**; said teeth **118** being formed and disposed in a manner similar to that described for teeth **24** of Fig. 2. A spring

120 operatively connected between the bell crank 116 and the cross beam 113 serves to rotatably bias bell crank 116 in a counterclockwise direction. Pivotally mounted on the cross shaft 115 is a detent lever 121 which is rotatably biased in a counterclockwise direction by means of a spring 122 that is operatively secured between said lever 121 and the cross beam 112. The nose 124 of the lever 121 normally engages the walls forming the notch 125 in the lower right hand end of bell crank 116 thereby determining the normal rotative position for bell crank 116. Under these conditions the tooth 117 will be normally held out of operative engagement with the said wheel teeth 118.

A link 127 is articulately secured to the upper end of lever 121 and may be actuated by any suitable means, such as a solenoid, so as to rotate the lever 121 in a clockwise direction. The slotted comb member 129 secured to cross beam 112 provides a means for retaining the various levers 121 in proper laterally spaced relation and in predetermined planar relation with respect to the various printing wheels 92.

In operation the main shaft 90 and the shaft 95 are respectively driven at predetermined constant speeds. When it is desired to effect a printing operation the lever 121 is displaced in a clockwise direction, as seen in Fig. 4, by means of link 127 so as to release bell crank 116 for a counterclockwise movement under the action of spring 120 whereby the tooth 117 may be brought into operative engagement with a predetermined one of said teeth 118 as shown in Fig. 5. The detenting action of bell crank 116, as effected by the biasing action of spring 120, is sufficient to arrest the rotational movement of the printing wheel 92 so that the desired printing type may be aligned with the associated printing hammer 91. As long as the tooth 117 remains in operative engagement with the teeth 118 of the arrested printing wheel 92, the radial surfaces of the driving disk 98 associated with said arrested wheel will frictionally slide over the contiguous surfaces of the two adjacent friction disks 100. The said hammer 91 is operatively displaced to the right in a manner similar to that shown and described above in connection with Figs. 1–3 so as to bring the record sheet 27 into printing engagement with the selected type of said arrested wheel. During this short printing time the shaft 90 continues to rotate relative to the now stationary wheel 92 whereby key 93 moves away from the right side shoulder of the notch 94. Shortly after the completion of said printing action the left side of key 93 will engage the left side shoulder of the notch 94. This will force the printing wheel to resume its counterclockwise rotation and the latter will serve to automatically disengage the tooth 117 from the teeth 118 in the manner described below.

The left side edge 130, Fig. 5, of tooth 117 constitutes that portion of the bell crank which actually engages the respective leading edges 131 of the teeth 118. Although said edges 130 and 131 when in the engaged position are substantially radially disposed with respect to printing wheel 92, the bell crank supporting shaft 114 is offset from said radial position so that when a relatively large horizontally directed force is exerted on said tooth edge 130 by the rotating wheel 92 the said detenting action maintained on wheel 92 by the tooth 117 and the spring 120, Fig. 5, will be overcome and the counterclockwise moving printing wheel tooth edge 131 will produce a clockwise displacement of bell crank 116. This displacement of bell crank 116 will move the tooth 117 out of operative engagement with the teeth of printing wheel 92 and will permit the nose 124 of lever 121 to be spring driven to its normal position in the said notch 125. In this manner the printing wheel arresting means is automatically restored to its normal condition, Fig. 4, after any printing operation.

Immediately after the disengagement of the wheel arresting means the now rotating printing wheel 92 will be free to be restored to its said normal counterclockwise rotative position relative to the shaft 90. Here the frictional drive connection between said printing wheel and the shaft 95 will cause the wheel 92 to rotate in a counterclockwise direction relative to shaft 90 so that the right side shoulder of notch 94 again engages the right side of key 93 as shown and described in connection with Fig. 4. Thus the printing wheel is restored to its normal relative position preparatory for a second printing cycle.

It will be apparent that each of the various printing wheels of the instant apparatus will be stopped or arrested for only a very short period of time during which time the printing action occurs. The arresting means for each printing wheel is very light and hence may be efficiently operated at very high speeds. This will permit a rapid alternate starting and stopping of each printing wheel thereby allowing high speed printing. At the same time a good quality of print is obtained from each of the momentarily arrested printing wheels.

While two embodiments of the invention have been shown and described, it will be apparent to those skilled in the art that numerous variations and modifications may be made in the particular construction without departing from the underlying principles of the invention. It is therefore, desired by the following claims, to include within the scope of the invention all such variations and modifications whereby substantially the results of the invention may be obtained by the use of substantially the same or equivalent means.

The invention claimed is:

1. In a wheel printer; a frame; a main shaft rotatably mounted in said frame and adapted to be operatively driven in a given rotational direction; a printing wheel mounted on said shaft; means for permitting a limited amount of relative rotational movement between said wheel and shaft; a movable finger adapted to engage a toothed portion of said printing wheel for arresting the rotational movement of said wheel; and means for producing a rotational movement of said wheel, in said direction, relative to said shaft.

2. In a wheel printer; a frame; a main shaft rotatably mounted in said frame; a printing wheel mounted on said shaft; means for permitting a limited amount of relative rotational movement between said wheel and shaft; means for momentarily arresting the rotational movement of said wheel; and means for yieldably rotatably biasing said wheel relative to said shaft; said biasing means comprising a rotating drive roll which engages the periphery of said wheel.

3. In a wheel printer; a frame; a main shaft rotatably mounted in said frame; a plurality of printing wheels mounted on said shaft; means for permitting a limited amount of rotation of each of said wheels relative to said shaft; spring means operatively mounted between each of said wheels and said shaft whereby each printing wheel is rotatably biased with respect to said shaft; and means respectively engageable with toothed portions of said wheels for selectively momentarily arresting the rotational movement of each of said wheels.

4. In a wheel printer; a frame; a main shaft rotatably mounted in said frame and adapted to be operatively driven in a given rotational direction; a printing wheel mounted on said shaft; means for permitting a limited amount of relative rotational movement between said wheel and shaft; means for arresting the rotational movement of said wheel; means for producing a rotational movement of said wheel, in said direction, relative to said shaft; and means operated in response to a predetermined maximum arresting force exerted by said wheel arresting means and adapted to disable said wheel printer.

5. In a wheel printer; a frame; a main shaft rotatably mounted in said frame and adapted to be operatively driven in a given rotational direction; a printing wheel

mounted on said shaft; means for permitting a limited amount of relative rotational movement between said wheel and shaft; means for arresting the rotational movement of said wheel; means engaging the periphery of said wheel for producing a rotational movement of said wheel, in said direction, relative to said shaft; and means for yieldably driving said last mentioned means.

6. In a wheel printer; a frame; a main shaft rotatably mounted in said frame; a printing wheel mounted on said shaft; means for permitting a limited amount of relative rotation between said wheel and shaft; means for arresting the rotational movement of said wheel; means for producing said relative motion; and means responsive to the operation of the last mentioned means and operative when said wheel has been arrested for effecting the release of said arresting means from a printing wheel engaging position.

7. In a wheel printer; a frame; a main shaft rotatably supported in said frame; a printing wheel mounted on said shaft, said wheel having a plurality of teeth formed on the periphery thereof; means for permitting a limited amount of relative rotation between said wheel and shaft, said means also permitting said wheel to be retained in a predetermined rotative position relative to said shaft; a pawl movably supported on said frame and engageable with said teeth for momentarily arresting the rotary motion of said wheel, said pawl being automatically released from engagement with said teeth in response to the completion of said relative rotation; and means for moving said pawl into operative engagement with the teeth of said printing wheel.

8. In a wheel printer; a frame; a main drive shaft rotatably mounted in said frame; a key longitudinally secured to said shaft; a printing wheel mounted on said shaft; said wheel being provided with an internal notch

which is effectively wider than and which cooperates with said key; means for arresting a rotational movement of said wheel; a second shaft rotatably mounted in said frame; a drive roll secured to said shaft and being adapted to peripherally engage said wheel; and means for yieldably driving said drive roll.

9. In a wheel printer of the class described comprising: a frame; a main shaft rotatably supported by said frame and driven at a substantially constant speed in a given rotational direction; a plurality of printing wheels mounted on said shaft; means for allowing a limited amount of relative rotational movement between said wheels and shaft; selectively operable means respectively engageable with said printing wheels for respectively arresting the rotational movement of said wheels; means for producing a rotational movement of the arrested wheels upon their release and in the same direction as said shaft rotation; a plurality of type formed on the periphery of said printing wheels; a printing hammer operatively associated with each printing wheel; and means for respectively actuating said printing hammers when their associated printing wheels have been arrested.

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