July 21, 1959 F. M. DEMER ET AL 2,895,411

HIGH SPEED PRINTER

Filed Dec. 27, 1956 3 Sheets-Sheet 1

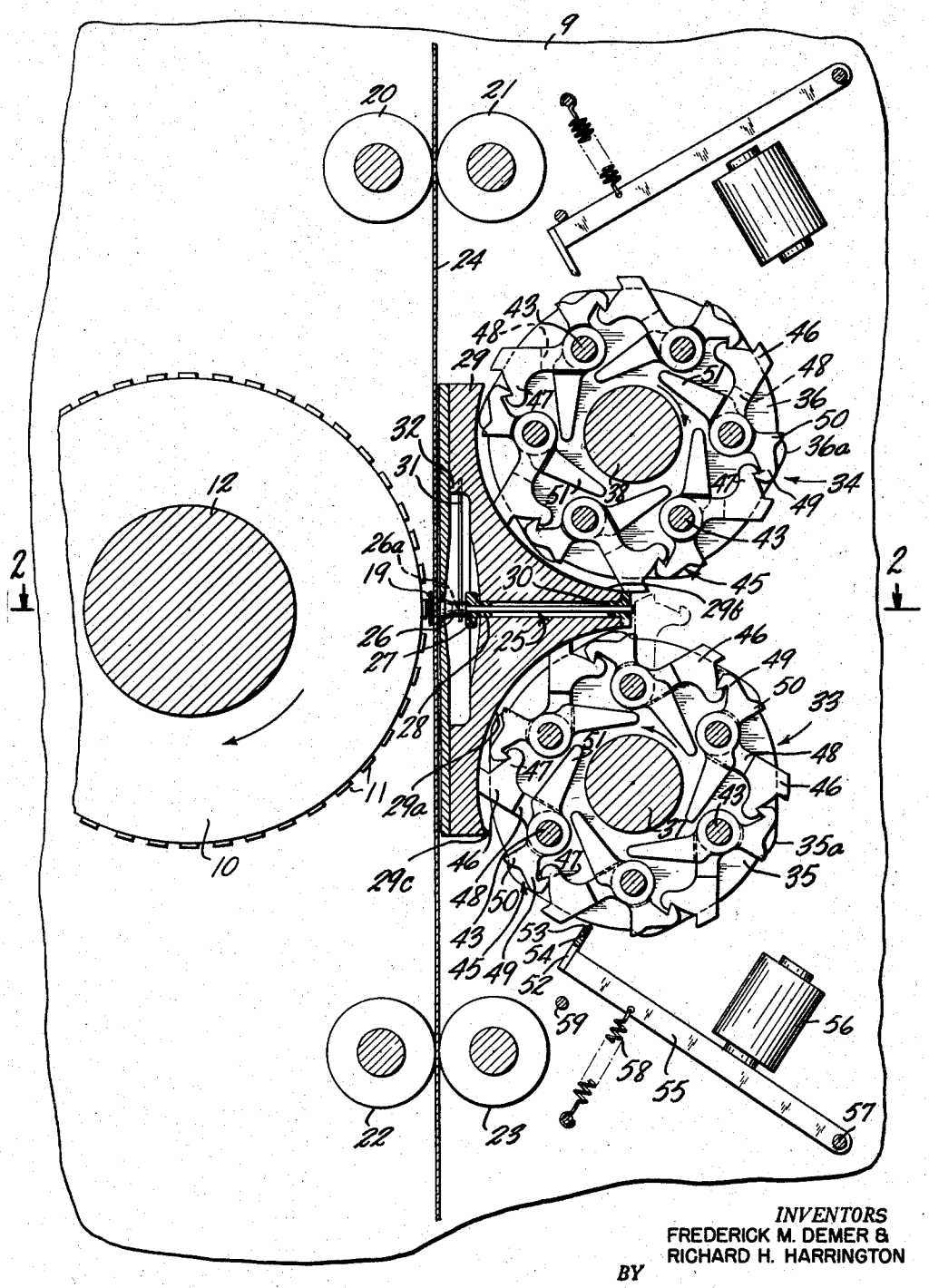


FIG. 1.

INVENTORS
FREDERICK M. DEMER &
RICHARD H. HARRINGTON

BY Campbell, Brumbaugh, Free & Graves

their ATTORNEYS

July 21, 1959 F. M. DEMER ET AL 2,895,411

HIGH SPEED PRINTER

Filed Dec. 27, 1956 3 Sheets-Sheet 2

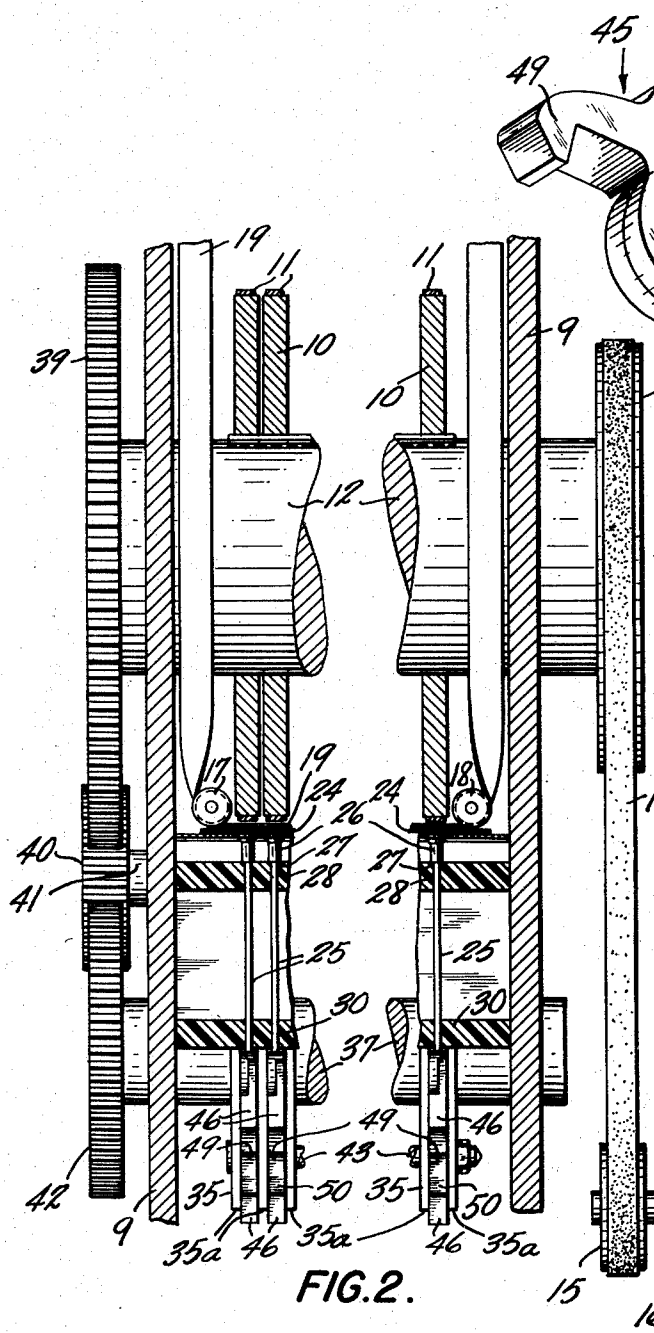


FIG.2.

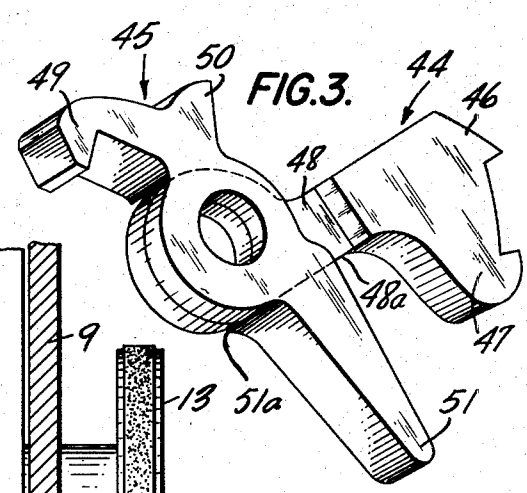


FIG.3.

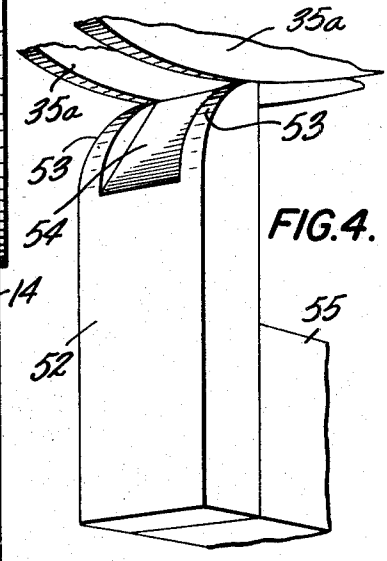


FIG.4.

INVENTORS
FREDERICK M. DEMER &
RICHARD H. HARRINGTON

BY

Campbell, Brumbaugh, Freet, Graves

their ATTORNEYS

July 21, 1959 F. M. DEMER ET AL 2,895,411

HIGH SPEED PRINTER

Filed Dec. 27, 1956 3 Sheets-Sheet 3

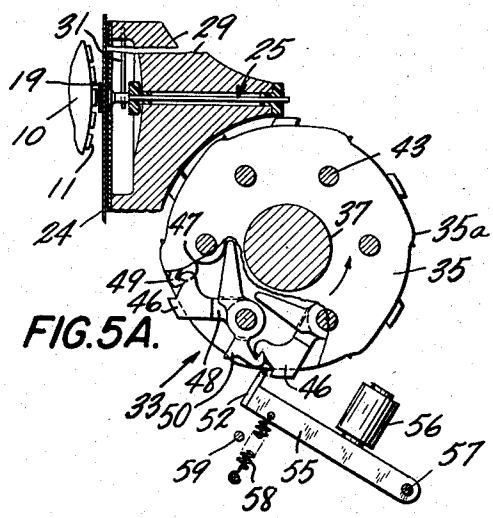


FIG.5A.

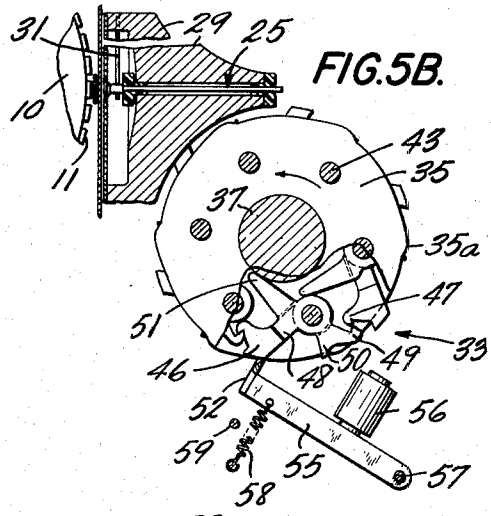


FIG.5B.

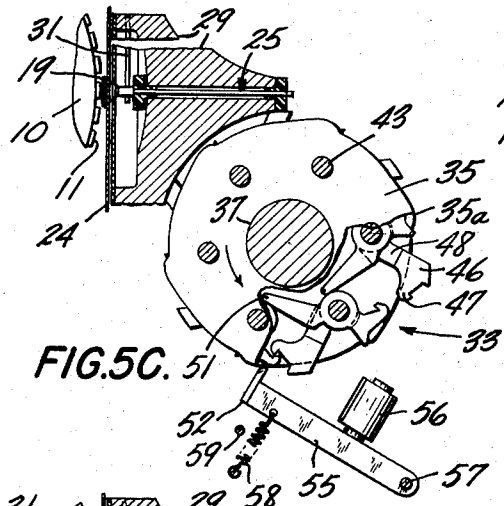


FIG.5C.

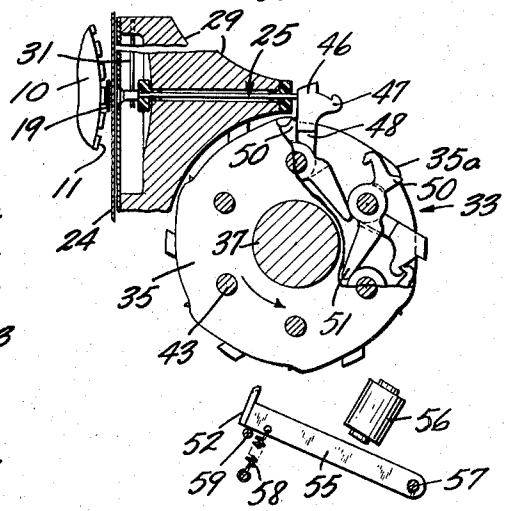


FIG.5D.

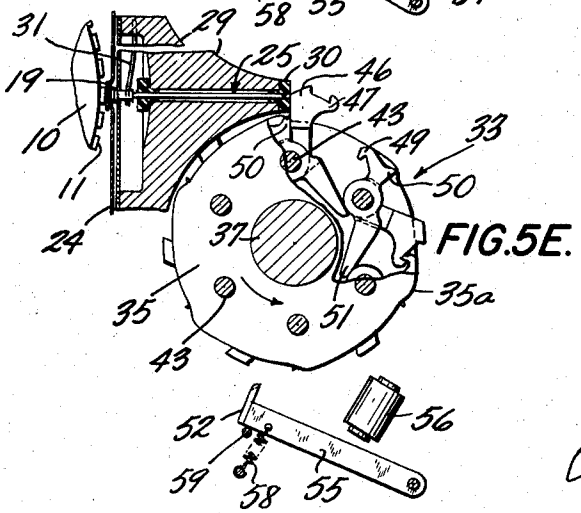


FIG.5E.

INVENTORS
FREDERICK M. DEMER &
RICHARD H. HARRINGTON

BY Campbell, Brumbaugh, Freet & Graves

their ATTORNEYS

United States Patent Office 2,895,411 Patented July 21, 1959

2,895,411

HIGH SPEED PRINTER

Frederick M. Demer, Johnson City, and Richard H. Harrington, Vestal, N.Y., assignors to International Business Machines Corporation, New York, N.Y., a corporation of New York

Application December 27, 1956, Serial No. 630,817

6 Claims. (Cl. 101—93)

This invention relates to a high speed printer and, more particularly, to such printers in which a number of the printing elements are in continuous motion.

The translation of computed information from electrical signals to printed characters has been one factor limiting computer speeds. Among the proposed high speed printers, those having continuously moving printing elements, often termed "on-the-fly" printers, have many advantages. For example, continuously rotating type wheels or drums may cooperate with selectively actuated hammers to provide rapid printing, a number of these hammers ordinarily being laterally disposed to print lines of characters. It is apparent that the several printing hammers, one for each column, must be closely synchronized in their actuation to preclude faulty alignment of the printed characters.

Previous printing arrangements have included solenoid hammer actuators. However, electrical timing variations due to changes in supply voltages and other factors have resulted in objectionable misalignment of the printed lines.

Accordingly, it is an object of the present invention to provide a high speed printer in which the printed characters are accurately aligned.

It is another object of the invention to provide a printer of the above character in which continuously moving character carrying members are synchronized with actuating hammers to provide accurately printed lines.

It is a further object of the invention to provide a printer having the above characteristics in which moving hammers synchronized with the type carrying member are selectively unlatched to enable the selected hammer to actuate printing mechanism.

These and further objects of the invention are accomplished by disposing a firing pin adjacent to a continuously moving type wheel. A plurality of hammers rotated in synchronism with the type wheel are normally held out of engagement with the pin. Upon reception of a printing impulse, one of the continuously rotating hammers drives the firing pin against a selected character on the type wheel.

In one embodiment of the invention, a series of hammers and associated latches are carried by a rotor synchronized with the type wheel, a hammer being selectively unlatched in response to a printing impulse. Preferably two rotors are provided so that the speed of rotation of the hammers may be halved.

These and further objects and advantages of the present invention will be more readily understood when the following description is read in connection with the accompanying drawings, in which:

Figure 1 is an elevation, partially broken away, of one printing station of a high speed printer embodying the principles of the present invention;

Figure 2 is a plan view of a plurality of the printing stations illustrated in Figure 1 showing the synchronized drive means between various elements in the system;

Figure 3 is a view in perspective, greatly enlarged, illustrating a hammer and latch of Figure 1 in detail;

Figure 4 is a view in perspective, greatly enlarged, of an interposer element used in the printer; and

Figures 5A to 5E are fragmentary views of the printer showing the relative position of essential elements at five progressive times in an individual printing operation according to the invention.

Referring to a typical embodiment of the invention in greater detail with particular reference to Figures 1 and 2, suitable supporting structure for a high speed printer includes outer frame members **9** between which are disposed type wheels **10**, each carrying a complete array of forty-eight characters **11**, rotated by a shaft **12** journaled in the members **9**. A pulley **13** on one end of the shaft **12** is driven by a belt **14** looped around a drive pulley **15** on a driving motor **16**.

Pulleys **17** and **18** guide inked ribbon **19** and cooperating pairs of drive rolls **20—21** and **22—23** control the movement of a continuous paper sheet **24** in front of the type wheels **10**. Any conventional ribbon and paper drive may be substituted for this arrangement.

A firing pin **25** at each of the printing stations includes an enlarged head portion **26** forming a shoulder **27** normally engaging a bushing or guide **28** formed of nylon, for example, in a support **29** formed with camming surfaces **29***a* and **29***b*. A further bushing **30**, also formed of nylon, is positioned at the other end of the support **29** to guide the pin **25** toward the type wheel **10**. A spring wire **31** anchored in a flange **32** on the member **30** extends through an opening **26***a* in the firing pin head **26** to urge it rearwardly toward the bushing **28**.

A pair of rotors **33** and **34** are formed by parallel mounted discs **35** and **36** respectively carried by shafts **37** and **38**. The periphery of the discs **35** and **36** include knock off cams **35***a* and **36***a*. A gear **39** (Figure 2) affixed to the shaft **12** drives through an idler gear **40** on a shaft **41** a lower rotor gear **42** mounted on the shaft **37**. Another gear on the shaft **38** (not shown) meshes with the rotor gear **42** to drive the rotor **34** in a direction opposite to the rotor **33**. In the particular embodiment of the invention being described, a four to one speed ratio is established between the rotors **33** and **34** and the type wheels **10**.

Six equally spaced pivot pins **43** extend through the discs **35** on the rotor **33**, each pin carrying a hammer **44** and a latch **45**, best shown in Figure 3. Each of the hammers **44** is formed by a thick striking portion **46** from which extends a hook **47**. A thinner portion **48** one half the thickness of the outer striking portion includes an opening permitting the hammer **44** to swing freely on the pin **43**.

The latch **45** is formed by an arm **49** from which extends a stop **50** and a tail section **51**, the outer latch sections having the same thickness as the outer portion of the hammer **44**. The inner section of the latch includes an opening fitting the pins **43** and is one half the outer thickness to permit its cooperation with the hammer **44** in a manner to be explained in detail hereinafter.

In order to unlatch each hammer **44** from its retracted position, an interposer **52** (Figure 4) at each printing station consists of a bar specially formed at one end with outer rounded edges **53** and an inner flattened and recessed section **54**. An armature **55** (Figure 1) carrying the interposer **52** is selectively actuated by a magnet **56** about a pivot **57**, a spring **58** biasing the assembly against a stop **59**. The interposers **52** at adjacent printing stations are preferably displaced circumferentially from each other to provide the width of two columns for each magnet and armature.

In the typical embodiment of the invention described herein, the type wheels **10** carry forty-eight characters **11** and the rotors **33** and **34** rotate at four times the speed of

the wheel **10**. Therefore, in order to print a series of lines at a 600 line per minute rate, for example, each of the forty-eight possible printing times during one cycle point may be allocated a period of 1.75 milliseconds, the time for printing one line being 84 milliseconds. Adding an additional 16 milliseconds for line spacing provides a total time of 100 milliseconds per line. Acceptable alignment of characters on the paper is plus or minus .005 inch. Therefore, the action of the firing pin **25** must be within 40 microseconds of the theoretically proper time.

In operation, it will be apparent that the twelve actuating hammers **44**, six on each rotor, are carried past the firing pin 25 forty-eight times during each revolution of the type wheel **10**, once for each possible character. The rotors **33** and **34** are displaced from one another by 30 degrees so that the hammers on the rotor **33** alternate with those on the rotor **34** in passing the firing pin **25**. Therefore, in order to print a particular character at one or more of the printing stations, selected magnets **56** receive a printing impulse which results in the interposer **52** being displaced into the position illustrated in Figure 5A. An instant later, the inner flattened section **54** of the interposer **52** engages the outer thick hammer portion **46**, as shown in Figure 5B, causing clockwise rotation of the hammer **44**.

To reduce wear on the latching surfaces, the camming surface **29***a* is formed by an arc about a center slightly removed from the rotor center. The outer portions **46** of latched hammers **44** engage the surface **29***a* smoothly at the guide **30** and subsequently are cammed slightly clockwise to remove the load from the latching surfaces of all hammers. Consequently, the interposer **52** may function without wearing the latching surfaces. The surface **29***a* merges with a true arc about the rotor center at a point **29***c*.

As will be evident from Figure 3, a leading edge **48***a* on the hammer inner section **48** engages an edge **51***a* of the latch tail section **51** resulting in clockwise rotation of this member. Accordingly, the latch arm **49** releases the hook **47** on the next hammer **44** (Figure 5B) and under the influence of centrifugal force generated by rotation of the rotor **33**, this hammer swings outwardly as illustrated in Figure 5C.

It should be noted that while the interposer **52** causes clockwise rotation of one of the hammers **44** and its associated latch **45**, the latch tail section **51** engages the shaft **37** (Figure 5B) to limit such clockwise rotation. Subsequently centrifugal force urges the latch **45** to rotate in a counterclockwise direction due to the heavy tail section **51**, such rotation being limited by engagement of this section with the following hammer and latch, as shown in Figure 5D.

Positive removal of the interposer **52** from the path of any succeeding hammers **44** is provided by a camming action between the immediately succeeding knock off cams **35***a* and the outer rounded edges **53** on the end of the interposer **52** (Figure 4).

The hammer **44** released by the interposer **52** swings outwardly under the influence of centrifugal force until the striking section **46** engages the latch stop **50** (Figure 5D). The hammer **44** is held against the stop **50** by centrifugal force so that it may strike the firing pin **25** from a stable precisely reproducible position.

As shown in Figure 5D, upon reaching the top of its arc the hammer **44** strikes the end of the firing pin **25**, the mass of the pin closely approximating the effective mass of the hammer. Accordingly, the kinetic energy of the hammer **44** is transferred by impact to the pin **25** which moves forward at a high velocity carrying with it the paper **24** and ribbon **19** against a selected one of the characters **11** on the type wheel **10** (Figure 5E). The firing pin **25** then rebounds from the wheel **10** but is effectively restrained from further action by the spring **31**.

The striking section **46** of the hammer **44** loses all forward velocity at the instant of impact. Thereafter, the hammer rotates smoothly back toward its latched position as the pivot pin **43** pulls it into contact with the edge of the guide **30**, the hammer **44** finally resuming its normal and stable latched position under the influence of centrifugal force.

It will be apparent that the cooperation of the upper rotor **34** with its associated interposer is exactly the same as that discussed in connection with the rotor **33**.

The precision with which printing may be accomplished with the above described embodiment of the present invention will be evident when it is understood that the 60 degree interval between hammers on one of the rotors represents 3.5 milliseconds of time, assuming rotation at a speed of 2800 revolutions per minute. One degree variation, therefore, produces less than 60 microseconds' variation in hammer blow timing. Moreover, mechanical synchronization of the two rotors **33** and **34** with the type wheel **10** may be very closely controlled with commercially available precision gears to achieve these results.

It will be understood that the above described embodiment of the invention is illustrative only and modifications thereof will occur to those skilled in the art. Therefore, the invention is not to be limited to the particular apparatus described herein but is to be defined by the appended claims.

We claim:

1. In a high speed printer, means carrying a plurality of characters past a printing position, a firing pin adjacent to the printing position adapted to urge data receiving means against the characters, a rotating element synchronized with the character carrying means, a plurality of hammers pivoted on the rotating element, the effective mass of each hammer approximating the mass of the firing pin, and means selectively enabling one of said hammers to strike the firing pin and print a selected character on the data receiving means.

2. In a high speed printer, means carrying a plurality of characters past a printing position, a firing pin adjacent to the printing position adapted to urge data receiving means against the characters, a rotating element synchronized with the character carrying means, a plurality of hammers pivoted on the rotating element, the effective mass of each hammer approximating the mass of the firing pin, and means to condition a selected one of the hammers to strike the firing pin and print a selected character on the data receiving means.

3. In a high speed printer, a member rotating a plurality of characters along an annular path, a firing pin adjacent to the annular path and adapted to urge data receiving means against the characters, a rotating element synchronized with the member, a plurality of hammers pivoted on the rotating element, the effective mass of each hammer approximating the mass of the firing pin, latch means normally holding said hammers in a retracted position against centrifugal force acting thereon, and means to disengage a selected hammer from the latch means to enable it to be pivoted outwardly by centrifugal force to strike the firing pin and print a selected character on the data receiving means.

4. In a high speed printer, a rotating wheel having a plurality of characters spaced along its periphery, a firing pin positioned adjacent to the wheel and adapted to urge data receiving means against the characters, a rotating element synchronized with the wheel, a plurality of hammers pivoted on the rotating element, the effective mass of each hammer approximating the mass of the firing pin, a like plurality of latches associated with the hammers to hold them in retracted position against centrifugal force acting thereon, means to unlatch a selected hammer to enable it to be pivoted outwardly by centrifugal force to strike the firing pin and print a selected character on the data receiving means.

5. In a high speed printer, a rotating wheel having a plurality of characters spaced along its periphery, a

firing pin positioned radially of the wheel and adapted to urge data receiving means against the characters, a rotating element synchronized with the wheel, a plurality of hammers pivoted on the rotating element and urged outwardly by centrifugal force, a like plurality of latches pivoted concentrically with the hammers to hold them in retracted position against centrifugal force, an interposer positioned adjacent to the rotating element, and means to urge the interposer into engagement with one of the hammer and latch combinations to unlatch a selected hammer and enable it to be pivoted outwardly by centrifugal force to strike the firing pin and print a selected character on the data receiving means.

6. Apparatus as defined in claim 5 in which a camming surface is provided adjacent to the rotating element to engage the hammer and latch combinations and relieve the load on latching surfaces.

References Cited in the file of this patent

UNITED STATES PATENTS

1,896,538	Bryce	Feb. 7, 1933
1,981,990	Carroll	Nov. 27, 1934
2,013,533	Buhler	Sept. 3, 1935
2,053,063	Bryce	Sept. 1, 1936
2,627,807	Buhler	Feb. 10, 1953
2,766,686	Fomenko	Oct. 16, 1956
2,787,210	Shepard	Apr. 2, 1957