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HIGH SPEED PRINTING APPARATUS

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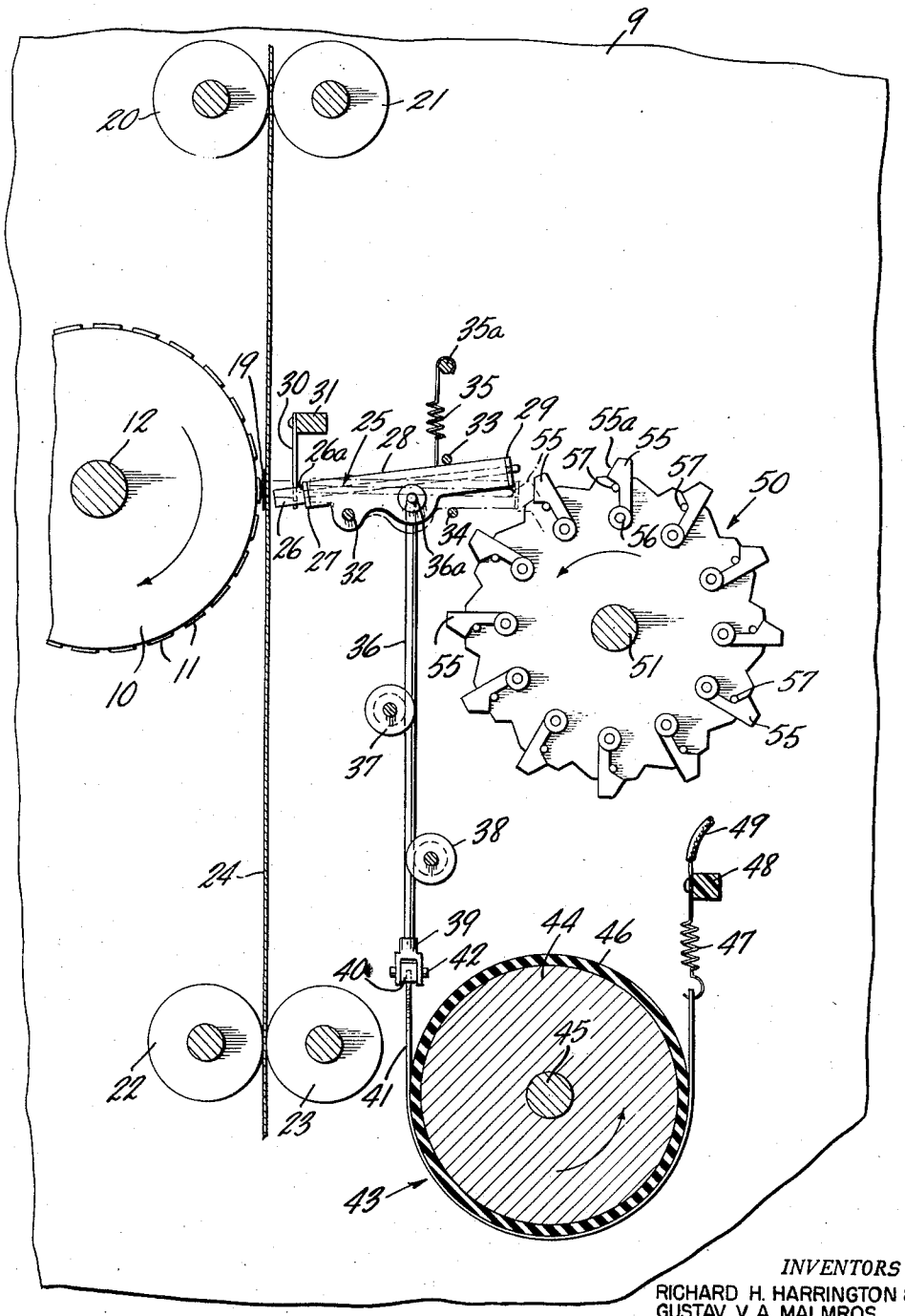

FIG. 1.

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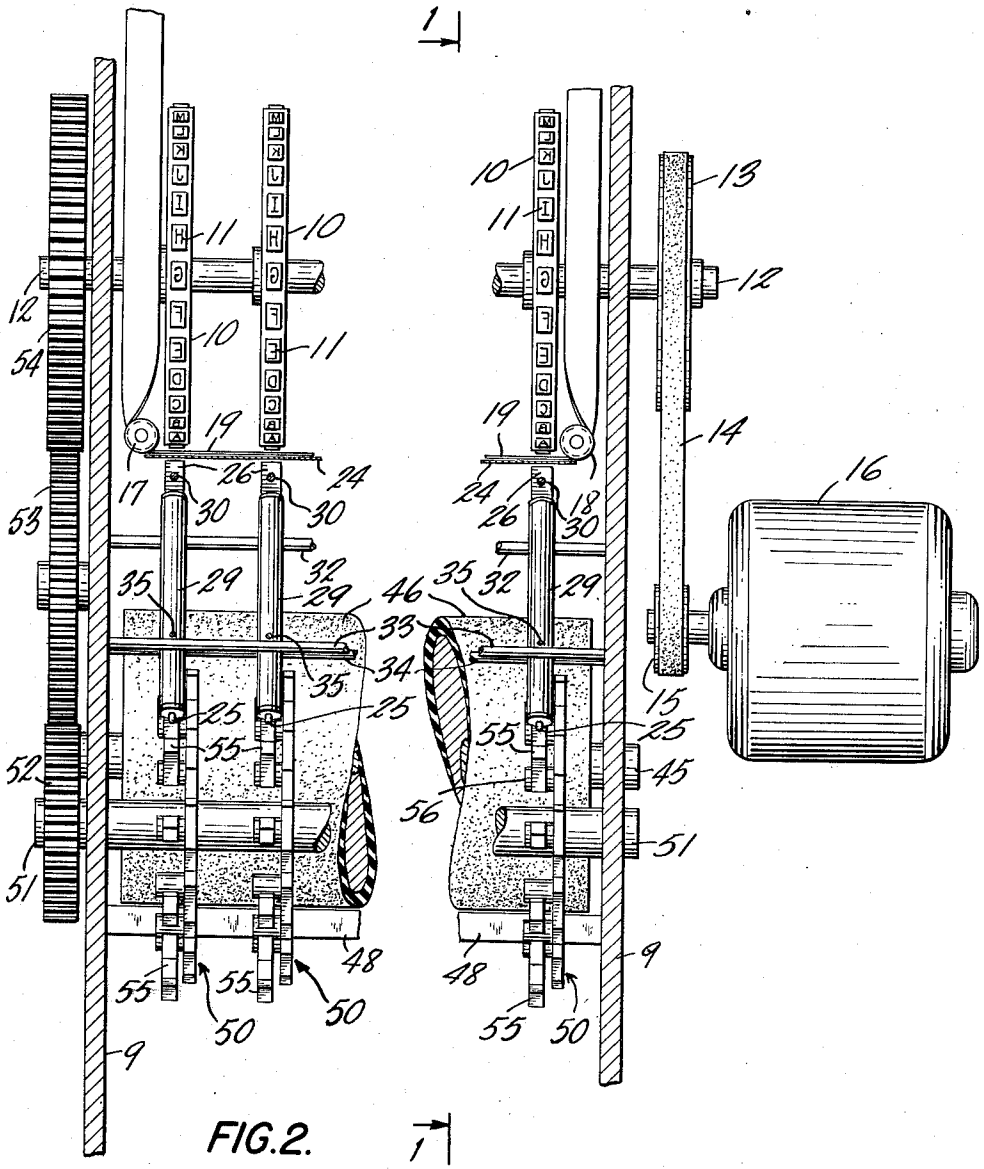

FIG.2.

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HIGH SPEED PRINTING APPARATUS

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Application December 28, 1956, Serial No. 631,168

7 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.

Translating computed data from electrical signals to printed characters has been one important 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 printers of this type have included solenoid hammer actuators. However, electrical timing variations due to changes in supply voltages and other factors resulted in objectionable misalignment of the printed lines.

An "on-the-fly" printer providing rapid and accurate printing has been disclosed and claimed in copending application Serial No. 630,817, filed December 27, 1956, for "High Speed Printer," and it is an object of the present invention to provide an improved "on-the-fly" high speed printer.

It is another object of the present invention to provide an improved high speed printer in which the printed characters are accurately aligned.

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

It is still another object of the invention to provide a printer having the above characteristics in which a firing pin cooperating with a rotating type wheel is selectively displaced into the path of actuating hammers to print characters with a minimum of deviation from a theoretically correct timing arrangement.

These and further objects of the invention are accomplished by disposing a firing pin adjacent to a continuously rotating type wheel. A plurality of hammers rotating synchronously with the type wheel normally pass the end of the firing pin. Upon reception of an actuating impulse, the firing pin is moved momentarily into the path of the hammers and thereby driven against a selected character on the type wheel to print it on suitably positioned data receiving means.

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; and

Figure 2 is a plan view of a plurality of the printing stations illustrated in Figure 1 showing synchronized driving elements in the system.

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 26*a* normally engaging a bushing 27 formed of nylon, for example, in a carrier 28. A further bushing 29, also formed of nylon, is positioned at the other end of the carrier 28 to guide the pin toward the type wheel 10. A wire spring 30 secured to an anchor 31 urges the pin 25 into the carrier 28 and holds the shoulder 26*a* against the bushing 27. The carrier 28 pivots on a pin 32 between stops 33 and 34, as shown in phantom outline in Figure 1, a spring 35 anchored by a pin 35*a* normally biasing the carrier against the stop 33.

A pull rod 36, formed with an angled end received in an opening 36*a* in the carrier 28, is guided by a pair of offset pulleys 37 and 38. An insulated U-shaped connector 39 on the end of the rod 36 receives a terminal block 40 carried by the end of a tempered steel band 41, a pin 42 holding the connector and block together.

An electrostatic clutch 43 includes a continuously rotating drum 44 driven by a shaft 45, a clutch facing layer 46 formed, for example, of a hard rubber and carbon composition, and the clutch band 41. The right end of the clutch band 41 is urged upwardly by a spring 47 secured to an anchor 48, a conductor 49 supplying electrical impulses to energize the clutch.

The fast acting properties of electrostatic clutches are well known in the art making it unnecessary to discuss the theory of such clutches in detail herein. In the present apparatus, the drum 44 and the surface layer 46 extend the length of the printing apparatus past the several printing stations, a separate clutch band 41 at each printing station operating the rods 36 and the firing pin carriers 28.

The clutch layer 46 is grounded through its hub 44 and shaft 45 and the clutch bands 41 are insulated by the connectors 39 and anchor 48. Accordingly, when a voltage pulse is applied to the band 41 through the conductor 49 and spring 47, the clutch band will be attracted to the surface 46 of the continuously rotating clutch drum 44 and pulled in a counterclockwise direction, thereby operating the carrier 29. It will be evident that other fast acting clutches or similar mechanical arrangements may be substituted for the electrostatic clutch 43.

A rotor 50 at each printing station is driven by a shaft 51 journaled in the members 9. A gear 52 on the shaft 51 meshes with an idler gear 53 driven by a gear 54 on the shaft 12, the gear ratio being chosen to drive the rotor 50 at a speed several times that of the shaft 12, in this particular example a ratio of four to one.

The rotor 50 carries twelve spaced hammers 55 pivoted on pins 56 and normally resting against forward stop pins 57. In order to transfer maximum energy between the hammer 55 and the firing pin 25, a striking face 55*a* on each of the hammers 55 slants rearwardly to afford a substantially perpendicular relationship between these elements. It will be apparent that with the provision of twelve hammers on the rotor 50, forty-eight characters

on the type wheel 10, and a four to one speed ratio, during each rotation of the type wheel 10 one of the hammers 55 will be in a position to strike the firing pin 25 and print a selected character, as discussed hereinafter.

In a typical operation of the above described apparatus in accordance with a cycle conventional to many "on-the-fly" printers, such cycle may be considered as beginning with a 16 millisecond period devoted to paper spacing and the loading into storage of data for printing. Following this period, there are forty-eight cycle points each one of which is devoted to the possible printing of one of the characters on the type wheel 10. For example, in order to print a series of lines at a 750 lines per minute rate, each cycle point is allocated a period of 1.4 milliseconds so that the total cycle consists of 67.2 milliseconds for printing and an additional 16 milliseconds for line spacing, the total being 83.2 milliseconds per line.

A voltage pulse applied to the conductor 49 at a selected time shifts the carrier 28 from its initial attitude against the stop 33 to an operative attitude against the pin 34 momentarily to shift the end of the firing pin protruding from the carrier into the path of one of the hammers 55 very rapidly, for example in 800 microseconds. The voltage pulse may be so timed that it terminates at the instant one of the hammers 55 strikes the end of the firing pin 25.

The effective mass of the hammers 55 preferably closely approximates the mass of the firing pin 25. Under these circumstances the kinetic energy of the hammer 55 is transferred by impact to the firing pin 25 which moves forward with a high velocity carrying with it the paper 24 and the ribbon 19 against the selected character 11 on the type wheel 10. The firing pin 25 then rebounds from the wheel 10 but is effectively restrained from further action by the spring 30. After impact, the hammer moves in a clockwise direction around its pivot pin 56 and after a short interval again assumes a position against the forward stop 57 under the influence of centrifugal force. The carrier 28 is returned to its initial position by the spring 35 when the voltage pulse on the conductor 49 subsides.

When utilizing the above described high speed printer, it will be understood that timing of the firing pin is primarily a function of the mechanical connection between the type wheel 10 and the rotor 50 and, therefore, alignment of printed data on the paper 24 is dependent only upon the degree to which this mechanical synchronization is achieved. With precision gears, it will be obvious that such synchronization may be within close tolerances.

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, a rotating type wheel having a plurality of characters spaced along its periphery, a rotating element synchronized with the type wheel, a plurality of hammers pivoted on the rotating element and carried along a circular path, a firing pin assembly including a firing pin slidably mounted in a movable carrier resiliently biased to a position in which one end of the pin is adjacent to the type wheel and its other end is adjacent to the circular path, the firing pin being adapted to urge data receiving means against the characters, and means to shift the carrier and place the other end of the firing pin in the circular path at a selected time to receive a hammer blow and print a selected character on the data receiving means.

2. In a high speed printer, a rotating type wheel having a plurality of characters spaced along its periphery, a rotating element synchronized with the type wheel, a plurality of hammers pivoted on the rotating element and carried along a circular path, a firing pin assembly including a firing pin slidably mounted in a pivoted carrier resiliently biased to a position in which one end of the pin is adjacent to the type wheel and its other end is adjacent to the circular path, the firing pin being adapted to urge data receiving means against the characters, means resiliently urging the firing pin away from the type wheel into the carrier, and means to shift the carrier and place the other end of the firing pin in the circular path at a selected time to receive a hammer blow and print a selected character on the data receiving means.

3. In a high speed printer, a rotating type wheel having a plurality of characters spaced along its periphery, a rotating element synchronized with the type wheel, a plurality of hammers pivoted on the rotating element and carried along a circular path, a firing pin assembly including a firing pin slidably mounted in a pivoted carrier resiliently biased to a position in which one end of the pin is adjacent to the type wheel and its other end is adjacent to the circular path, the firing pin being adapted to urge data receiving means against the characters, and electrostatic clutch means to shift the carrier and place the other end of the firing pin in the circular path at a selected time to receive a hammer blow and print a selected character on the data receiving means.

4. In a high speed printer, a rotating type wheel having a plurality of characters spaced along its periphery, a rotating element synchronized with the type wheel, a plurality of hammers pivoted on the rotating element and carried along a circular path, a firing pin assembly including a firing pin slidably mounted in a pivoted carrier resiliently biased to a position in which one end of the pin is adjacent to the type wheel and its other end is adjacent to the circular path, means resiliently urging the firing pin away from the type wheel and into the carrier, the firing pin being adapted to urge data receiving means against the characters, and electrostatic clutch means to shift the carrier and place the other end of the firing pin in the circular path at a selected time to receive a hammer blow and print a selected character on the data receiving means.

5. In a high speed printer, a member rotating a plurality of characters along an annular path, a firing pin adjacent to a printing location on the annular path and adapted to urge data receiving means against the characters to print them, a movable carrier slidably mounting the firing pin with its rear end protruding from the carrier and further from the printing location than its front end, a rotating element synchronized with said member, a plurality of hammers pivoted on the rotating element and carried along a circular path, the movable carrier when in a first attitude holding the firing pin away from a position normal to a tangent to the annular path at the printing location, the rear end of the firing pin in the first attitude being displaced from the circular path out of contact with the hammers, and means to shift the carrier momentarily from its first attitude to a second attitude to dispose the firing pin normal to the annular path tangent with the protruding rear end of the firing pin in position to be struck by one of the hammers and driven forward in the carrier to print with its front end a selected character on the data receiving means, the firing pin rebounding after printing the selected character, and means to retain the rebounded firing pin in its initial position with its rear end protruding from the carrier ready to be struck again and driven forward by one of the hammers.

6. In a high speed printer, a member rotating a plurality of characters along an annular path, a firing pin adjacent to a printing location on the annular path and adapted to urge data receiving means against the characters to print them, a movable carrier slidably mounting the firing pin with its rear end protruding from the carrier and further from the printing location than its front end, a rotating element synchronized with said

member, a plurality of hammers pivoted on the rotating element and carried along a circular path, the movable carrier when in a first attitude holding the firing pin away from a position normal to a tangent to the annular path at the printing location, the rear end of the firing pin in the first attitude being displaced from the circular path out of contact with the hammers, and clutch means to shift the carrier momentarily from its first attitude to a second attitude to dispose the firing pin normal to the annular path tangent with the protruding rear end of the firing pin in position to be struck by one of the hammers and driven forward in the carrier to print with its front end a selected character on the data receiving means, the firing pin rebounding after printing the selected character, and means to retain the rebounded firing pin in its initial position with its rear end protruding from the carrier ready to be struck again and driven forward by one of the hammers.

7. In a high speed printer, a member rotating a plurality of characters along an annular path, a firing pin adjacent to a printing location on the annular path and adapted to urge data receiving means against the characters to print them, a movable carrier slidably mounting the firing pin with its rear end protruding from the carrier and further from the printing location than its front end, a rotating element synchronized with said member, a plurality of hammers pivoted on the rotating

element and carried along a circular path, the movable carrier when in a first attitude holding the firing pin away from a position normal to a tangent to the annular path at the printing location, the rear end of the firing pin in the first attitude being displaced from the circular path out of contact with the hammers, and electrostatic clutch means to shift the carrier momentarily from its first attitude to a second attitude to dispose the firing pin normal to the annular path tangent with the protruding rear end of the firing pin in position to be struck by one of the hammers and driven forward in the carrier to print with its front end a selected character on the data receiving means, the firing pin rebounding after printing the selected character, and means to retain the rebounded firing pin in its initial position with its rear end protruding from the carrier ready to be struck again and driven forward by one of the hammers.

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