March 5, 1968 K. J. STALLER 3,371,766

PRINTING APPARATUS

Filed July 18, 1966 3 Sheets-Sheet 1

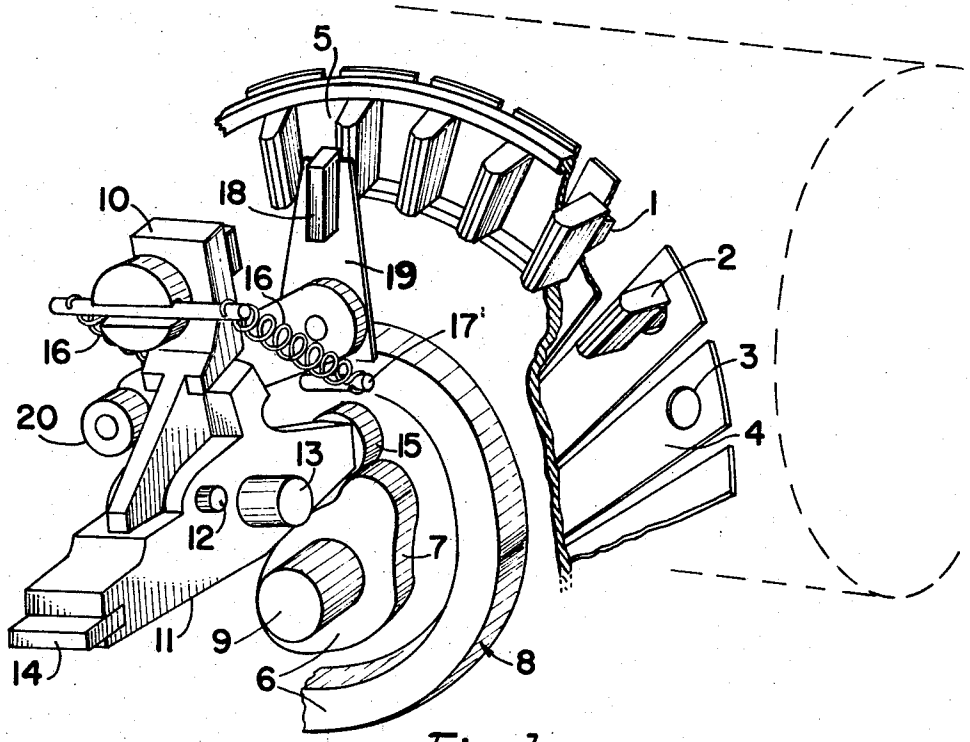

Fig. 1.

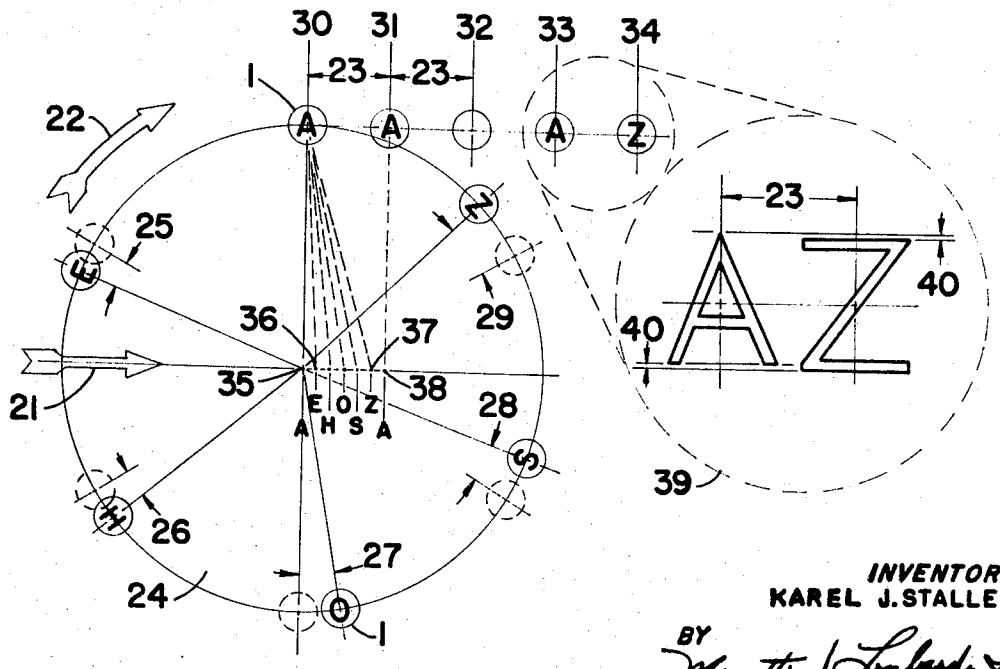

Fig. 2.

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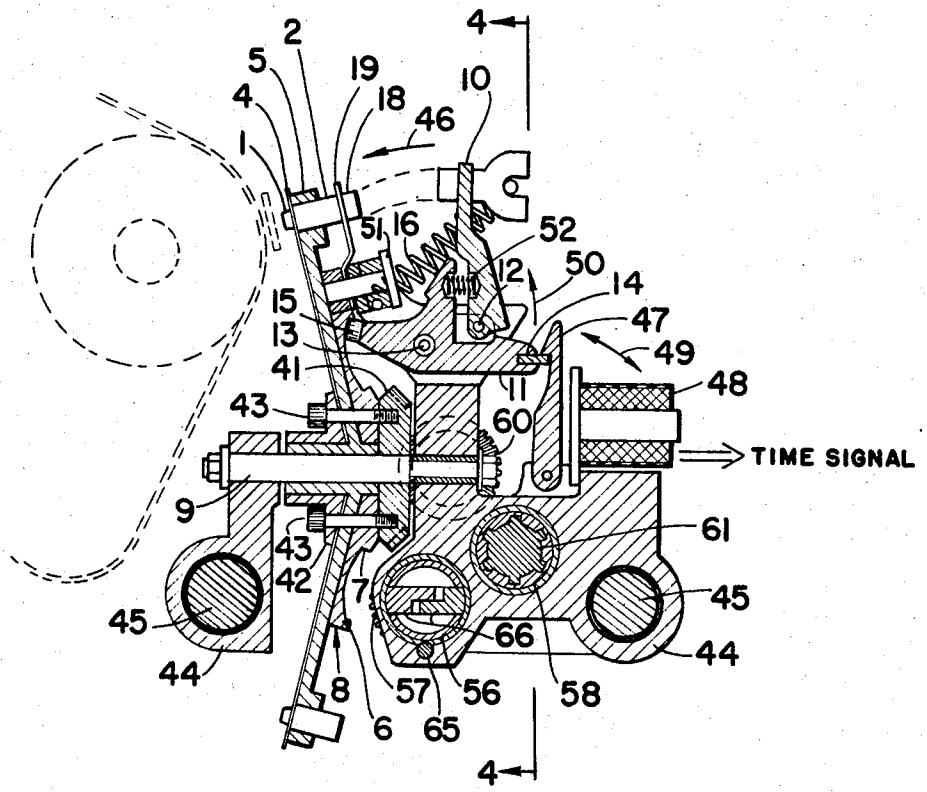

Fig. 3.

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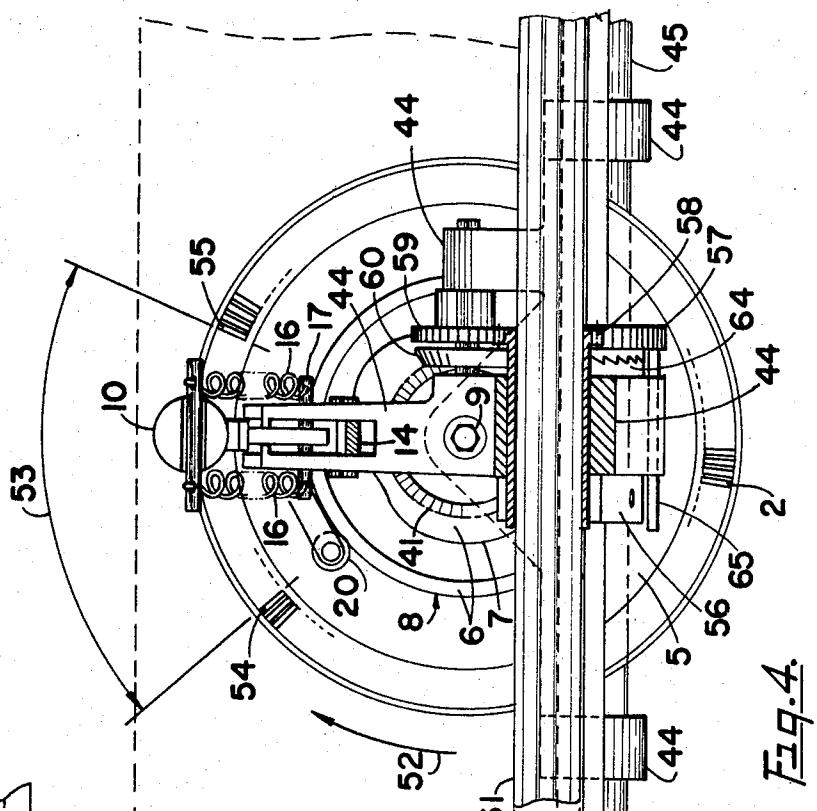

Fig. 4.

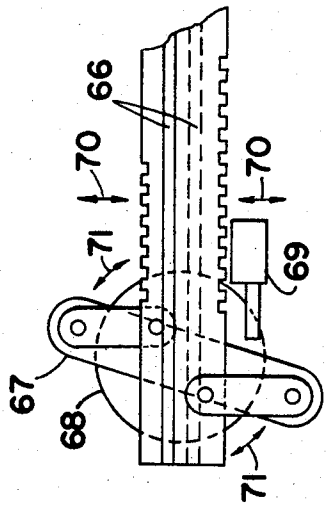

Fig. 5.

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United States Patent Office 3,371,766
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3,371,766

PRINTING APPARATUS

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10 Claims. (Cl. 197—53)

ABSTRACT OF THE DISCLOSURE

A serial printer having a continuous motion carriage and letter carrier, the letter carrier being in the form of a spinning disc which permits the printing of any character on its circumference. The character is struck by a hammer which is released by an electromagnet.

This invention relates generally to printing apparatus, and more particularly to apparatus for a serial printer having a continuous motion letter carrier.

At this time, there exists a great need for high speed serial printers which are comparable to present day printers in lifetime and cost. The speed of most of the existing serial printers is in the order of 10 to 15 characters per second, and it is desirable that in the next generation of printers this speed be increased by factors up to ten. Realizing that the stress on the various parts of a printer varies more than as the square of the speed, this increase would according to the present practice, drastically affect the life and cost of the printer.

Therefore, an object of this invention to design a high speed serial printer to meet these needs.

Another object of this invention is to design a printer in which the characters are mounted on well balanced rotating disc to assure noiseless operation.

A further object of this invention is to design a printer with uninterrupted motion of the carriage carrying the rotating disc.

Yet another object of this invention is to eliminate fully the jerky motion of the carriage with all its well known detrimental consequences.

Still another object of this invention is to do away with a certain degree of the typical clatter of conventional printers.

A feature of this invention is the use of a spinning disc carrying the characters in an arrangement which permits the printing of any character located on its circumference. The desired character is struck by a hammer which is released by an electromagnet holding the hammer in a cocked position, such that when a time signal is transmitted to the electromagnet, the hammer is released and associated springs accelerate the hammer to strike the wanted character at a precise moment. An alternate, arrangement could utilize the short time signal for direct action of the hammer, without auxiliary springs.

The above-mentioned and other features and objects of this invention will become more apparent by the reference to the folowing description taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a partial perspective view of the apparatus according to the invention;

FIGURE 2 is a diagram useful in explaining the principle of printing according to the invention;

FIGURE 3 is a sectional view of the apparatus according to the invention;

FIGURE 4 is a view of the apparatus taken along line 4—4 of FIGURE 3; and

FIGURE 5 is a partial view taken along line 5—5 of FIGURE 4.

Referring now to FIGURE 1, the characters **1** are mounted on oblong guidance blocks **2** and pressed

through holes **3** of a slotted flat beryllium copper spring member **4**. Spring members **4** are held against a rotating disc **5** so that an impact directed against guidance block **2** will cause the associate spring member to deflect and character **1** to impact the printing media shown in phantom lines. Attached to rotating disc **5** is a grooved cam **6** having an inner camming surface **7**, and an outer camming surface **8**. The rotating disc **5**, spring members **4**, and cam **6** rotate about axle **9**. Hammer head **10** is pivotally mounted in hammer body **11** by pivot pin **12**. Hammer body **11** is pivotally mounted in the carriage body (not shown) by pivot pin **13**, and contains a hard metal insert **14** and a cam follower **15** which rides on camming surface **7**. In order that hammer head **10**, biased by springs **16** attached to pin **17**, will centrally hit block **2**, an interconnecting block **18** is angularly positioned by the flat beryllium spring **19**. Attached to spring **19** is cam follower **20** which rides on camming surface **8**, this arrangement permits interconnecting block **18** to centrally strike guidance blocks **2**, because cam follower **20** controls the position of interconnecting block **18** by means of camming surface **8**. The cocking of hammer head **10** is controlled through hammer body **11** by means of camming surface **7**. Thus the relative motion of interconnecting block **18** and hammer head **10** is maintained by coordinating the eccentricities of camming surfaces **7** and **8**.

FIGURE 2 illustrates the printing principle according to this invention, in which arrow **21** represents the linear direction of movement of a carriage carrying a hammer and a rotating disc of characters, and arrow **22** shows the rotary direction of the characters on the disc. In one embodiment the linear spacing **23** of characters **1** on a horizontal line is 0.100 inch. To accomplish this, disc **24** is made 3½ inches in diameter and the spacing of the characters on the disc is made such that each character is placed in a position shifted angularly against the direction of rotation. This angular shift is indicated by numerals **25**, **26**, **27**, **28**, **29** and increases from the first to the last character as indicated by the difference between the dotted circle position and the actual character **1** positions. FIGURE 2 illustrates only a few of the characters in order to present the principle of printing in a simplified manner, however, the disc in one embodiment will actually contain 96 characters and 32 idle positions, the idle positions providing the time required for cocking the hammer.

Since it is desired to progressively print in a line at positions **30**, **31**, **32**, **33**, **34** with equal spacing **23** between each printing position, it can be seen that when the center of disc **24** is at point **35**, then letter A will be printed in position **30**. However, if letter E is desired to be printed at position **30**, the center of the disc will be at a point **36** due to the continuous motion of the carriage. This motion has been compensated for by the angular shift **25** of letter E, this angular shift will cause the letter E to be printed in position **30**. In a similar manner, when printing the last letter Z at position **30**, the angular shift **29** will compensate for the movement of the center of the disc to point **37**. In this way the printing of any of the 96 characters on the circumference of the rotating disc may be performed in the same spot, i.e. position **30**, **31**, **32**, **33**, **34**, notwithstanding the continuous motion of the carriage. When the last letter Z passes printing position **30**, this novel distribution of characters causes the letter A to be printed in the next position **31**, at which time the center of the disc is at point **38**, a distance of 0.100 inch. This cycle repeates itself over and over again.

The spacing of 96 characters and 32 idle positions on 3½ inch diameter disc will result in a difference **40** shown in enlarged view **39**. This difference is 0.003 inch and will exist between the first and the last character which in prac-

tice can be considered negligible. It is also well known, that to eliminate this difference each character may be placed at an increasing radius from the center of the disc, rather than on the circumference of a circle. It is felt however, that since this difference is easily tolerated in practice, the savings in manufacturing the disc justify placing the characters on the circumference of a circle.

In FIGURE 3, the platen, paper, and ink ribbon are shown in phantom lines. Rotating disc **5** which mounts guidance block **2** and spring member **4** is assembled to rotate about axle **9**. And in the same manner, cam **6** and driving bevel gear **41** rotate about axle **9**. The disc **5**, spring member **4**, cam **6**, bevel gear **41**, and ring **42** are held together by several equally spaced screws **43**. Axle **9** is located in the body of the carriage **44** which is slidably mounted on two parallel bars **45** connecting both side walls of the structure of the carriage **44**.

The printing of character **1** is accomplished by hammer head **10** moving in the direction indicated by arrow **46** and striking interconnecting block **18**, causing interconnecting block **18** to strike guidance block **2** imparting a deflection to spring member **4**, and thereby causing impact of character **1** on the ribbon and paper. Hammer head **10** is pivotally mounted in hammer body **11** which is held in a cocked position by catch **47** through the hard metal insert **14**. When a time signal is transmitted to electromagnet **48**, catch **47**, which can move in the direction indicated by arrow **49**, will release hammer body **11**, this will cause movement of hammer body **11** and hammer head **10** in the direction indicated by arrow **50**. Hammer body **11** pivots on pivot pin **13** and hammer head **10** pivots on pivot pin **12**, upon release of part **14** by catch **47**, the acceleration imparted by springs **16** cause hammer body to first impact solid surface **51**, and then hammer head **10** by its inertia continues its motion against the pressure of spring **52** to transmit to parts **18**, **2** and **1** only such amount of energy as required for legible printing. The purpose of this unique arrangement is to return the hammer head **10** as fast as possible to such a position that the fast moving edge of the next guidance block **2** cannot interfere with interconnecting part **18**. The mass of hammer **10** must be kept minimal in order to be rapidly repelled after hitting part **18**.

Hammer head **10** and body **11** are pushed into the cocked position by cam follower **15** riding on cam surface **7**. In order that the hammer head **10** strikes the center of guidance block **2**, a further cam surface **8** controls the motion of interconnecting block **18** which is angularly positioned by a flat spring **19**. During one revolution of disc **5**, interconnecting block **18** moves from right to left 0.100 inch which is opposite to the direction of rotation in order to compensate for the continuous motion of the hammer from left to right. Thus the problem of centrally hitting the guidance blocks is eliminated.

Referring in addition to FIGURE 4, the paper on a platen is shown in phantom lines.

The carriage body **44** traverses from left to right with uniform motion so that for one revolution of disc **5** in the direction indicated by arrow **52**, the carriage body **44** advances 0.100 inch, the required spacing between individual letters in the horizontal line. The distance **53** between the first of 96 characters **54** and the last of 96 characters **55**, is equivalent to thirty-two positions, this being the number of positions required for cocking of the hammer when the carriage is moving at a particular velocity.

The uniform horizontal motion of carriage **44** is achieved by rotation of hollow cylinder **56** which has an inside thread and is driven by geared wheel **57**. Geared wheel **57** meshes with geared wheel **58** which in turn is engaged with geared wheel **59**. Geared wheel **59** is on the same axis as bevel gear **60** which meshes with the main driving bevel gear **41** mounted on axial **9**. The driving force of the whole system is transmitted by a single splined shaft **61** which is uniformly rotated by electric motor **62** through gearing **63**. Since the uniform motion of the carriage **44** is derived from rotation of gear **57** driving cylinder **56** which has an inside thread, the cylinder can be disengaged in the extreme left position by a clutch **64** shifting gear wheel **57** by pin **65**, the purpose of this short disconnection is to allow the flat, divided and threaded rod **66** to smoothly grip the inside thread of cylinder **56**. The driving shaft and all meshed gears rotate continuously at a uniform rate during the printing cycle as well as during the rapid carriage return cycle. The flat rods **66**, shown in FIG. 5 do not rotate but consist of two symmetrical halves. Both ends of the threaded rods rest on swivel links **67**, the width of the flat rods **66** can be changed from maximum to minimum by motion of swivel links **67**, the swivel links being connected through wheel **68** to a solenoid control **69**. When both halves of rods **66** are squeezed together to the narrowest dimension by motion of links **67**, both threaded sides of the rods are disengaged from the threaded hollow cylinder **56**. The carriage **44** then can freely slide on rod **45** along the splined driving shaft **61**. The solenoid **69** causes motion of rods **66** in the direction indicated by the arrows **70** the motion of swivel links **67** is indicated by arrows **71**.

The force required for carriage return is transmitted by a wire rope attached on both sides of carriage **44** in a known manner. The pulleys of the rope are equipped with a brake to slow down the speed of the carriage before reaching the extreme left position, thus avoiding sharp shocks. The rope and brake are not shown in the drawings, they being well known to one skilled in the art.

The reverse motion of the carriage can start at any time, even when printing only the first letter of the line, by the control of solenoid **69**. When the carriage is moving back, all wheels and also including the hollow cylinder **56** continue to rotate at full speed. Only the small mass of cylinder **56** must be stopped in order to permit the thread of the nonrotating flat rod **66** to be engaged without shock. As soon as clutch **64** is in a definite position, it is interlocked and the slow motion of carriage **44** from left to right begins. The uninterrupted motion of the characters are of great importance, as it eliminates shocks in mechanisms, increases the lifetime of the individual parts, and does away to a certain degree with the typical clatter of conventional teleprinters.

In operation the spinning disc **5**, the spinning members **4**, and the spinning characters **1**, are arranged to permit the printing of any character on the circumference of the disc at a predetermined moment. The character is struck by hammer head **10** which is released by a catch **47** which holds the hammer body **11** in a cocked position through a metal insert **14**. When the time signal is transmitted to the electromagnet **48**, the hammer is released and the springs **16** accelerate the hammer which strikes the interconnecting block **18**. This connecting block is correctly positioned in front of guidance block **2** by means of cam follower **20** riding on eccentric cam surface **8**, the interconnecting block then strikes the guidance block at the precise moment to cause printing of the selected character. This operation eliminates the jerky motion of the carriage with all its well known detrimental consequences. The cocking of the hammer is accomplished during thirty-two idle positions **53** reserved for this purpose on disc **5**.

This arrangement may be further simplified by development of the basic idea of transmitting the motion derived from a cam directly to the bearings of a hammer. Such that during each revolution of the printing wheel, the hammer would move horizontally from right to left for 0.100 inch without shocks, and at the end of the idle angle of the disc, the hammer would be in the next printing position to await the proper moment to strike the characters. This of course will eliminate the need for an interconnecting block as described above.

The above description of my invention in connection with a specific embodiment will make obvious several alter-

natives of the basic principle, and it is to be clearly understood that this description is made only by way of example and not as a limitation of the scope of my invention, as set forth in the objects thereof and in any of the accompanying claims.

I claim:

1. Printing apparatus comprising:
a continuous traversing carriage;
a continuously rotating disc, rotatably mounted in said carriage;
a multiplicity of characters mounted for continuously rotating with said disc;
a hammer pivotally mounted in said carriage, and positioned to strike one of said characters;
means for holding and releasing said hammer at a predetermined moment;
a splined driving shaft in splined engagement with said carriage;
a main driving gear attached to said rotating disc and in geared relationship with said shaft;
a hollow cylinder with an inside thread mounted in said carriage; means coupling said cylinder to said shaft;
a pair of complementary threaded rods, inside said hollow cylinder for smoothly engaging and disengaging the inside thread of said cylinder; and
means coupled to said driving shaft for continuously driving said shaft, so that said shaft by means of the engagement of said rods with said cylinder causes lateral motion of said carriage and by means of said driving gear synchronous rotation of said disc.

2. Apparatus according to claim 1, comprising:
a cam having a plurality of camming surfaces,
said cam being attached and driven by said main driving gear; and
means coupling said hammer to one of said camming surfaces for cocking said hammer according to the configuration of said camming surface.

3. Apparatus according to claim 2 in which:
an interconnecting block is positioned between said disc and hammer;
a spring strip retaining said connecting block; and
a cam follower attached to said strip and positioned on the other of said camming surfaces, so that one revolution of said disc will cause one step motion of said interconnecting block, thereby being always in a position to strike by means of the force imparted by said hammer, the center of one of said characters.

4. Apparatus according to claim 1, wherein said disc has a plurality of spring-like finger members, said members being adapted for mounting of said characters, one character on each of said members, so that when one of said characters is struck by a force, the deflection of said member is sufficient to cause printing of said character.

5. Apparatus according to claim 4, wherein the characters are shifted angularly against the direction of the rotation of said disc in order to compensate for the continuous motion of said carriage and disc.

6. Apparatus according to claim 4, wherein the force required for said hammer to strike one of said characters is provided by a spring, said spring being positioned to urge said hammer toward said disc when said hammer is released by said holding and releasing means.

7. Apparatus according to claim 1, wherein said carriage is slideably mounted on a pair of parallel bars attached to the frame of said printer.

8. Apparatus according to claim 1, wherein the means for holding and releasing said hammer is an electromagnet mounted on said carriage, the armature of said electromagnet being pivotally mounted and adapted to hold said hammer, and said armature to release said hammer in response to a signal to said electromagnet, said signal being indicative of a desired character.

9. Printing apparatus comprising:
a continuous transferring carriage;
a continuously rotating disc having a plurality of spring like finger members, said disc and finger members being rotatably mounted about a common axis in said carriage;
a cam having a plurality of camming surfaces, said cam being coupled to said disc for rotating about said common axis;
a plurality of characters, each of said characters being mounted on one of said members and placed in a position about the circumferential face of said disc, which is shifted angularly against the direction of rotation of said disc, such that the angular shift of each character around the circumference of the disc increases in order to compensate for a continuous motion of said carriage and disc;
means for holding and releasing a hammer pivotally mounted on said carriage, such that at a predetermined moment a selected one of said characters is struck;
means coupling said hammer to one of said camming surfaces for cocking said hammer according to the configuration of said one camming surface; and
means for driving and synchronizing the continuous lateral motion of said carriage and the continuous rotary motion of said disc.

10. Apparatus according to claim 9, comprising:
an interconnecting block centrally positioned between said disc and hammer;
a spring strip for retaining said block; and
a cam follower attached to said strip and positioned on the other of said camming surfaces, such that one revolution of said disc will cause one step motion of said block to maintain it in a central position.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,371,766 March 5, 1968

Karel J. Staller

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 2, "transferring" should read -- traversin

Signed and sealed this 9th day of September 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents