United States Patent

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[54] **SELECTOR STRUCTURE FOR PRINTING MACHINE**
19 Claims, 14 Drawing Figs.

[52] **U.S. Cl.** **197/55,** 178/34, 197/18
[51] **Int. Cl.** **B41j 1/26**
[50] **Field of Search** 178/34; 197/49, 48, 50, 51, 52, 53, 54, 55, 18

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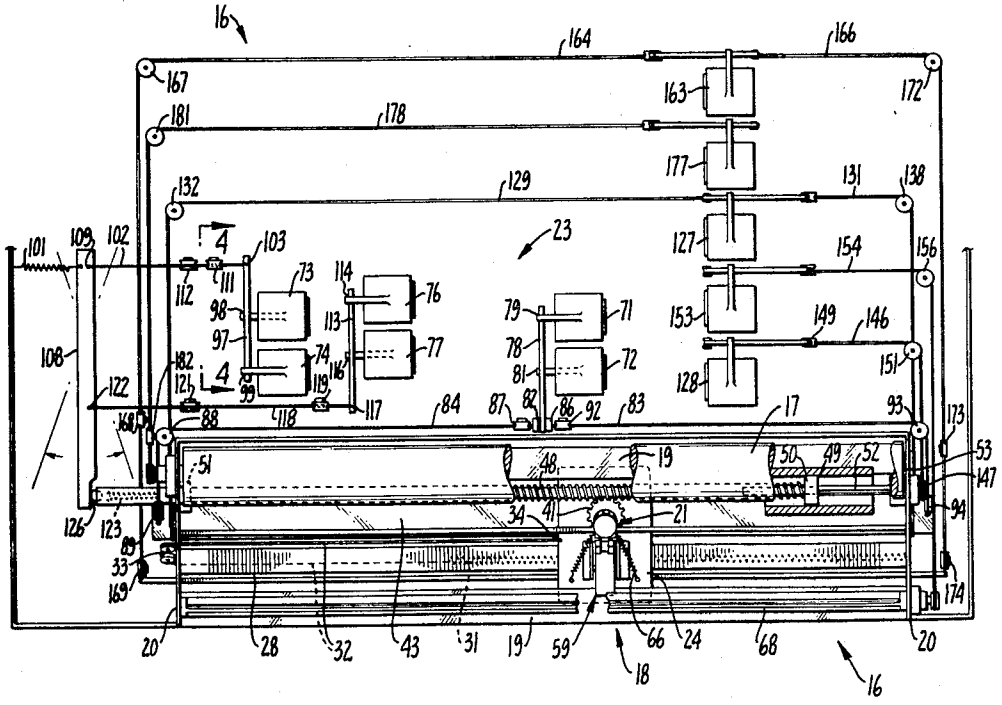
ABSTRACT: A teleprinter for printing characters on a receiving medium in response to a telegraphic code, including a platen, a carriage movable along the platen, a cylindrical type element mounted on the carriage and bearing the print characters embossed thereon in circumferential rows, a worm gear mounted for both rotation and axial motion and a lockable pinion gear meshed with the worm gear so that the combination of the two acts both as a rack and pinion and as a lead screw and follower for rotatably and transversely positioning the type element to select a print character, and a selector mechanism for operating the type positioning means in response to the signals for a decoding and conversion circuit which processes the incoming telegraphic code signal. The type element is mounted on a shaft which is splined through the center of the pinion gear to rotate with the slide axially through the pinion gear. The end of the shaft opposite the type element slides laterally along a vertically movable track. The selector mechanism uses solenoids coupled in combinations to levers which gang the actions of the solenoids to create the motions of the worm gear and the transversely movable track. The type element is struck to print the character by a trigger mechanism cocked and released by an elongated spline, the spline being rotated by a ratchet driven by a solenoid. The decoding and conversion circuit includes a clock for generating time codes which in turn gate a serial to parallel converter. A first set of memory units stores the parallel signal until it is examined to detect nonprinting function characters, and the signal is then gated to a second set of memory units for retention of those portions of the signal which are unchanged from one character to the next, to minimize motion of the type element. A logic circuit recognizes the carriage return instruction, examines the position of the carriage and spaces forward if necessary before returning the carriage, to preserve synchronism. Other logic circuits recognize the spacing, line feed, figures shift and the letters shift instructions and operate solenoids appropriate to lock the pinion gear, shift the worm gear laterally, rotate the worm gear or advance the platen ratchet as necessary. Detection of a function instruction inhibits the gating of the signal into the second set of memory units and inhibits the printing action.



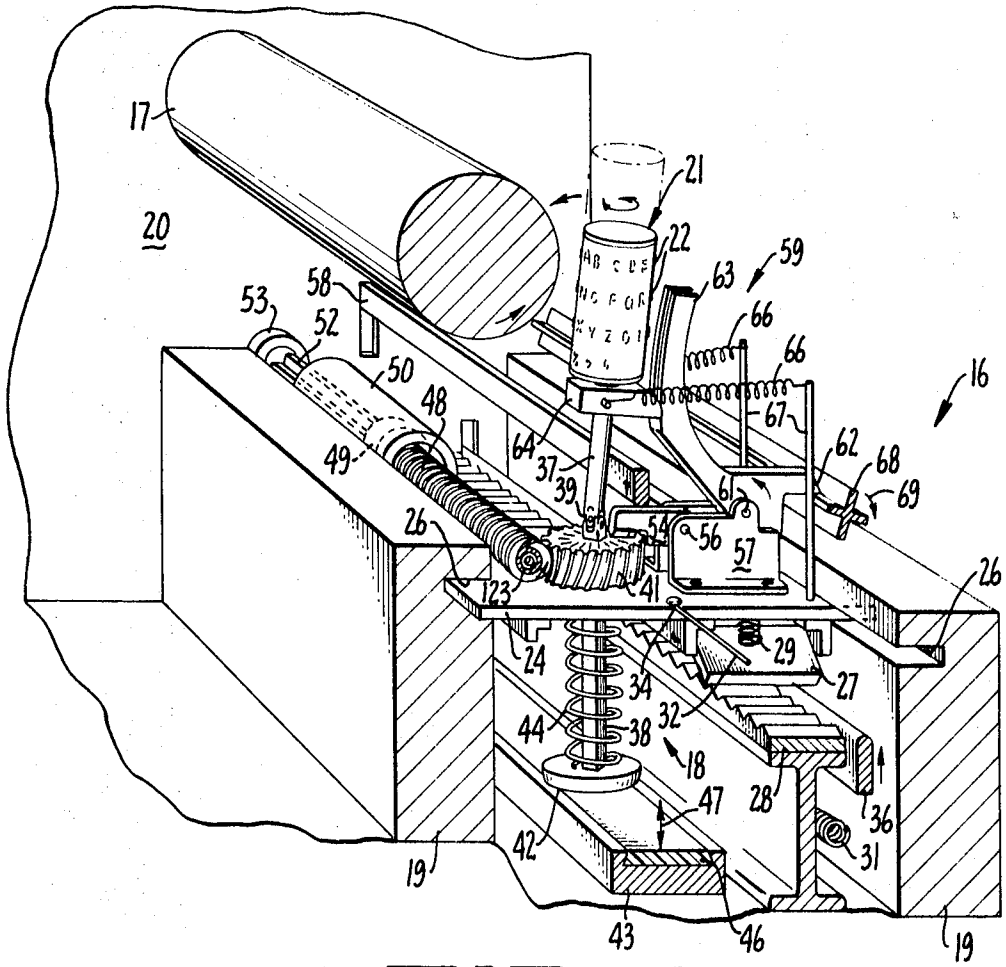


FIG. 1.

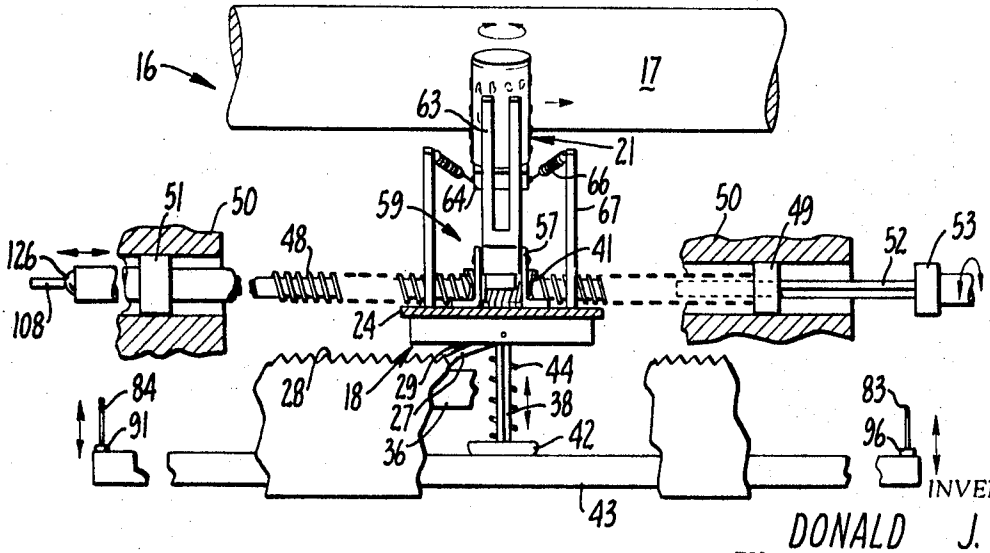


FIG. 2.

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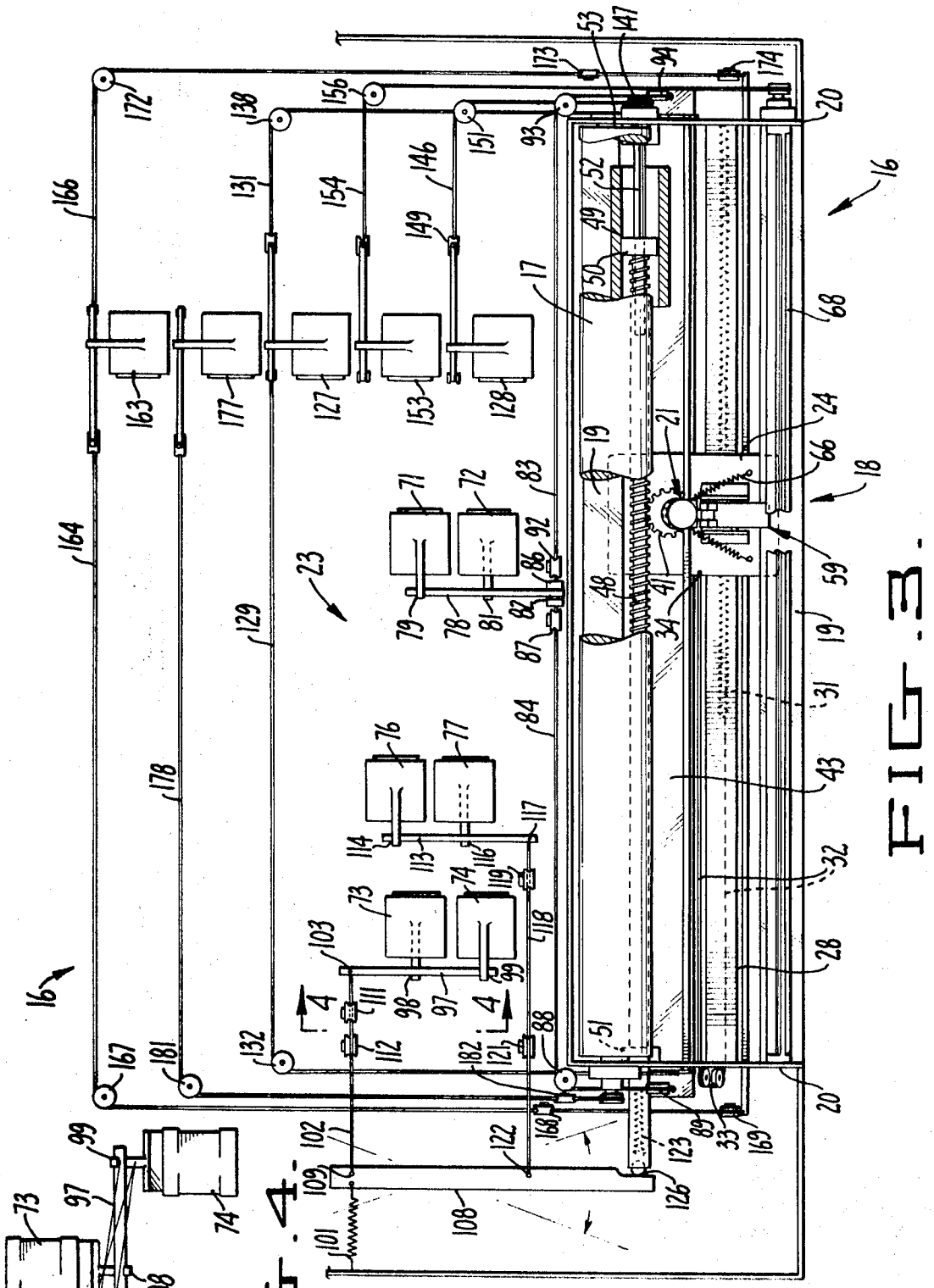

FIG. 3.

FIG. 4.

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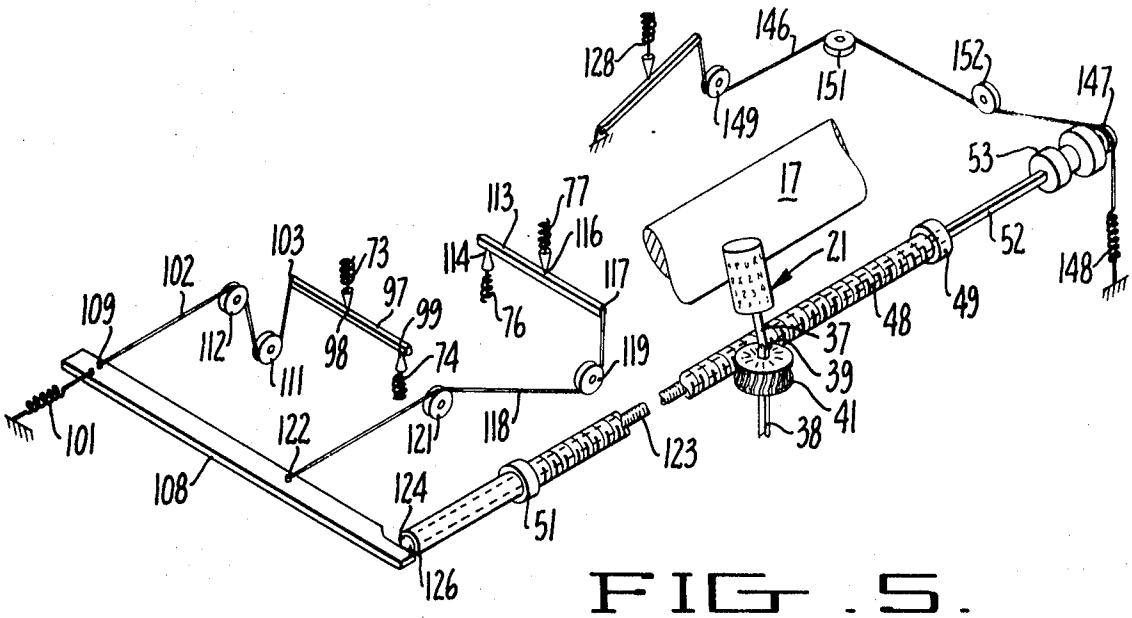

FIG. 5.

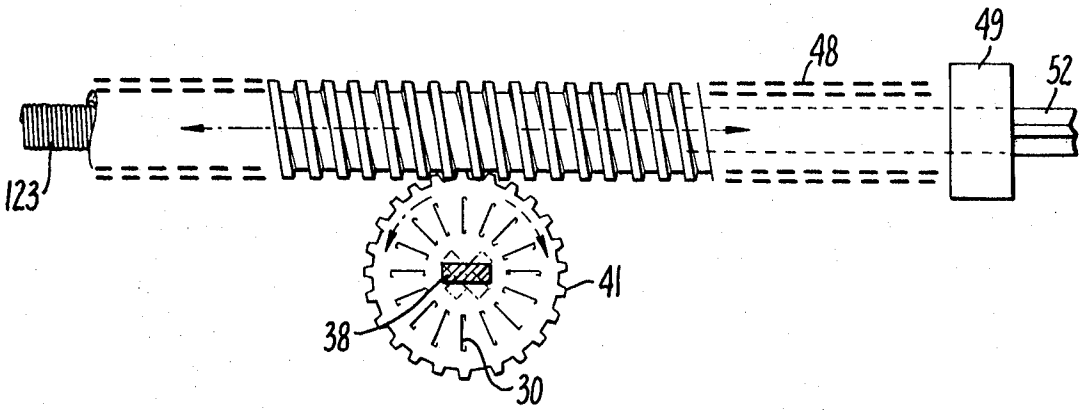

FIG. 6.

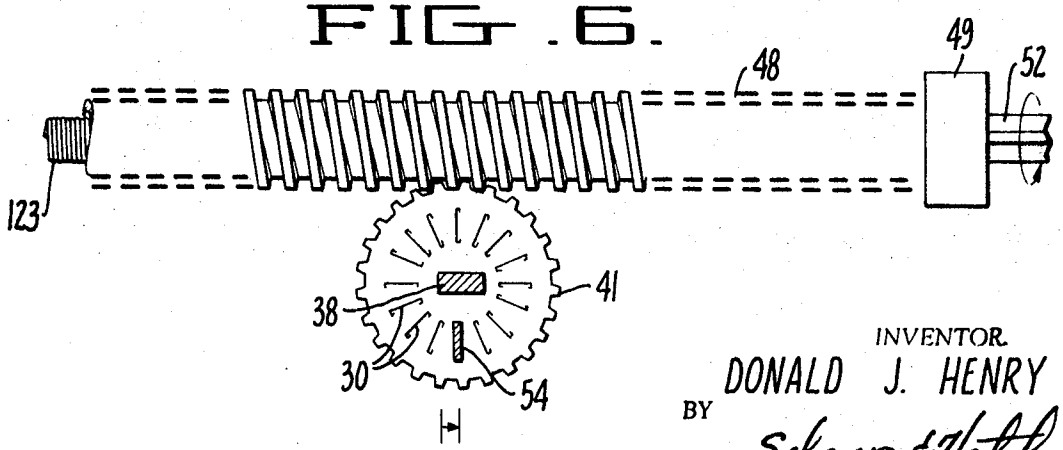

FIG. 7.

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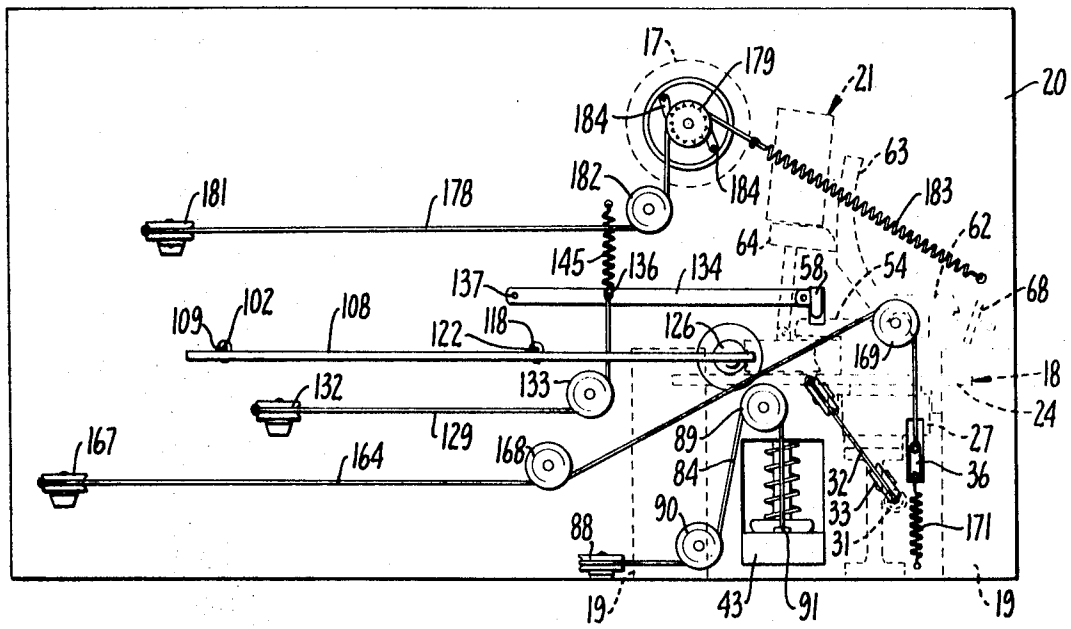

FIG. 8.

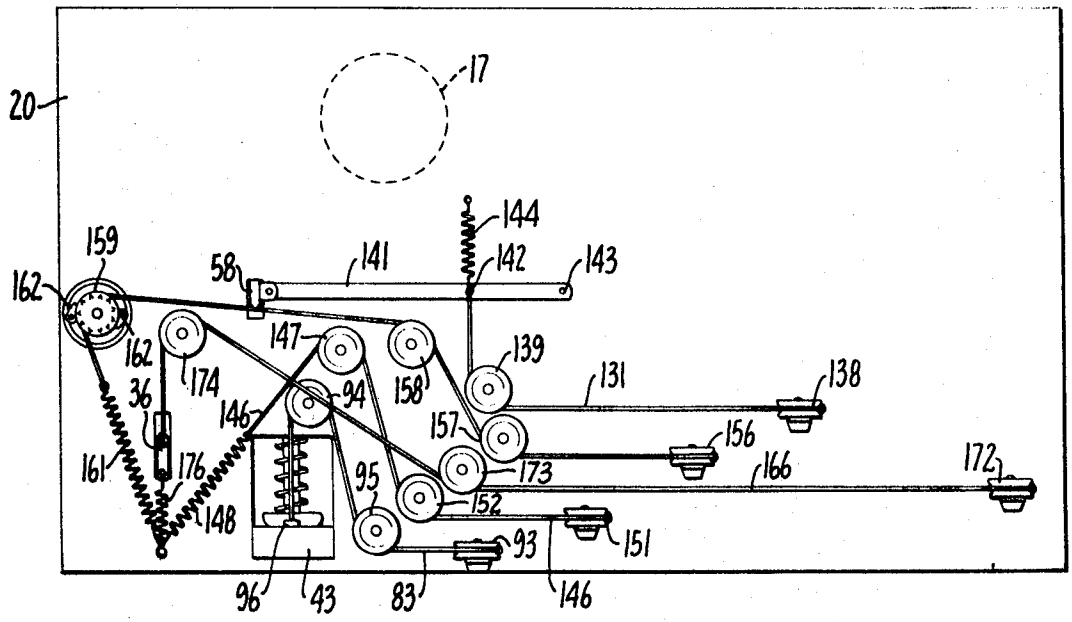

FIG. 9.

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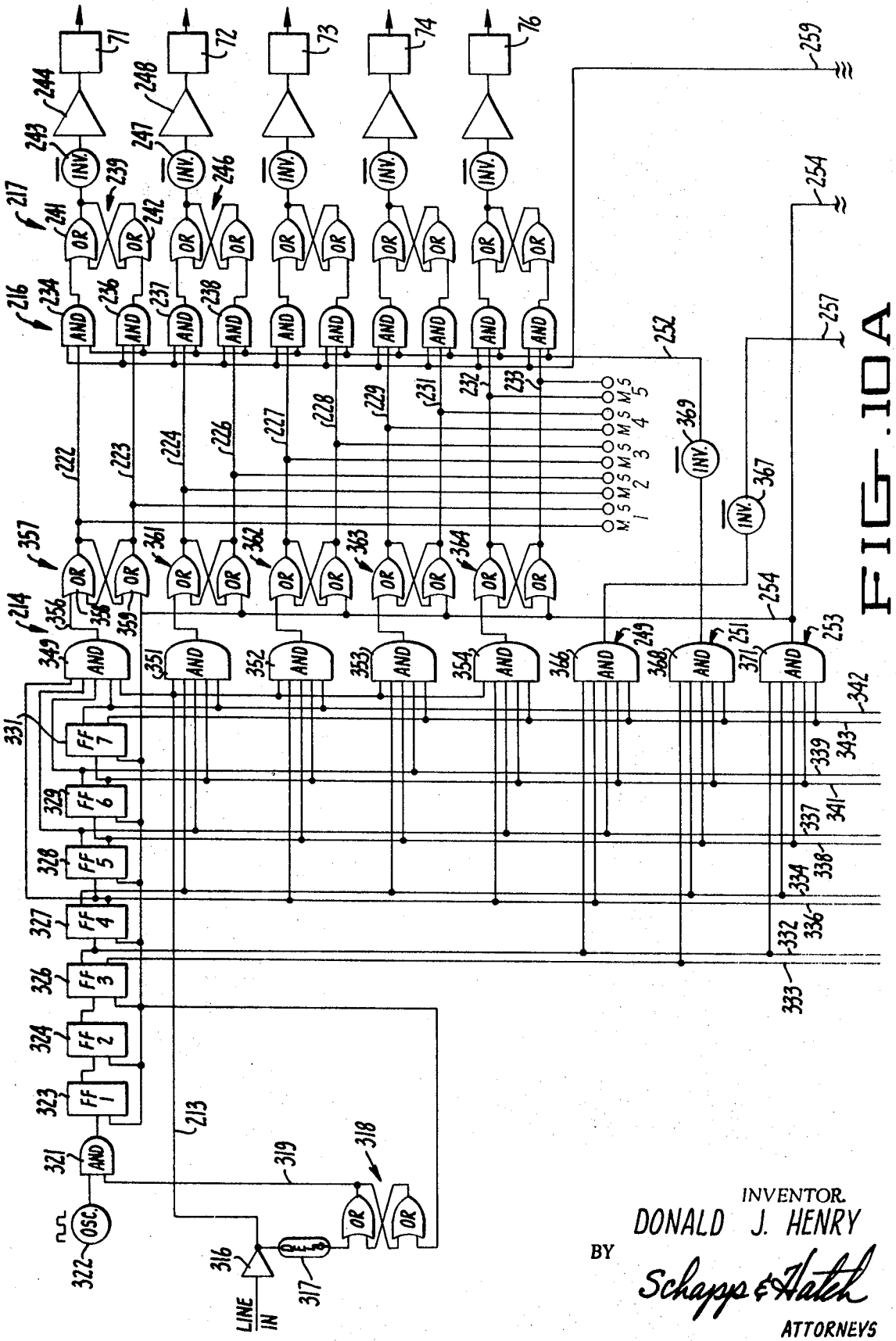

FIG. 10A

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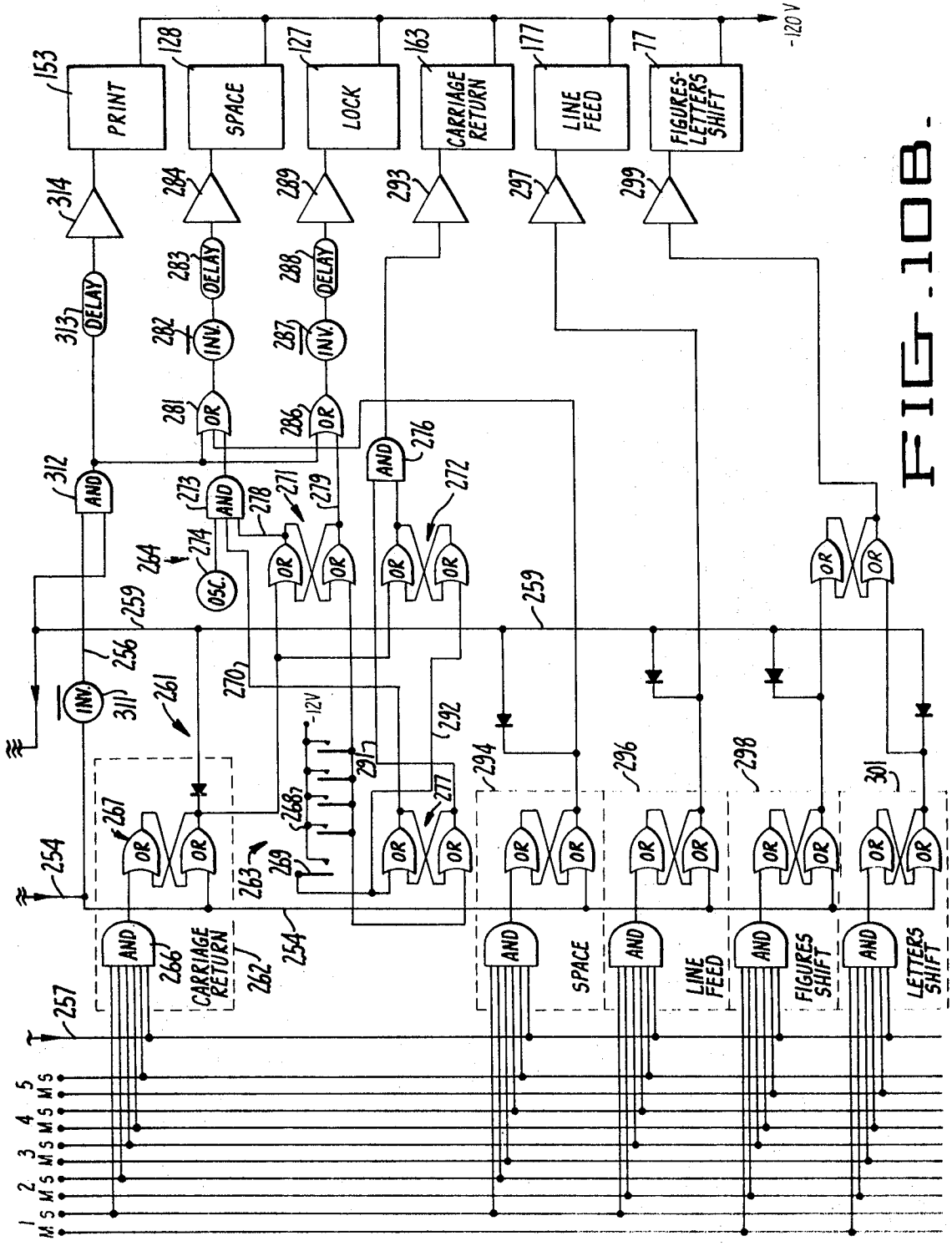

FIG. 10B.

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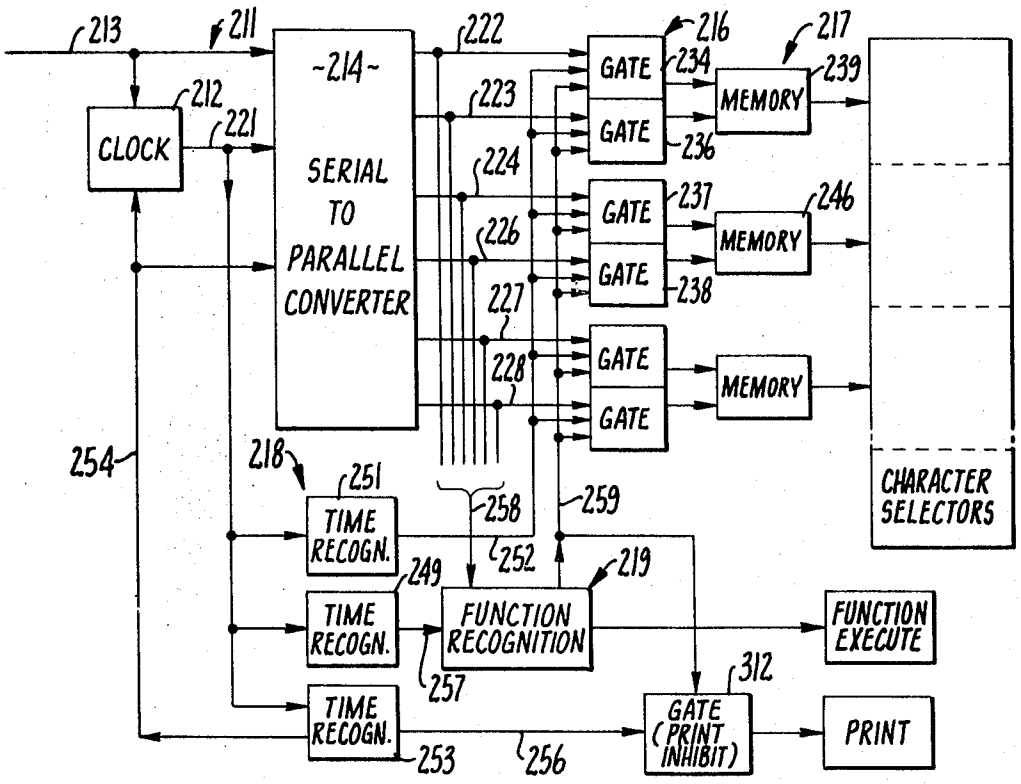

FIG. 11.

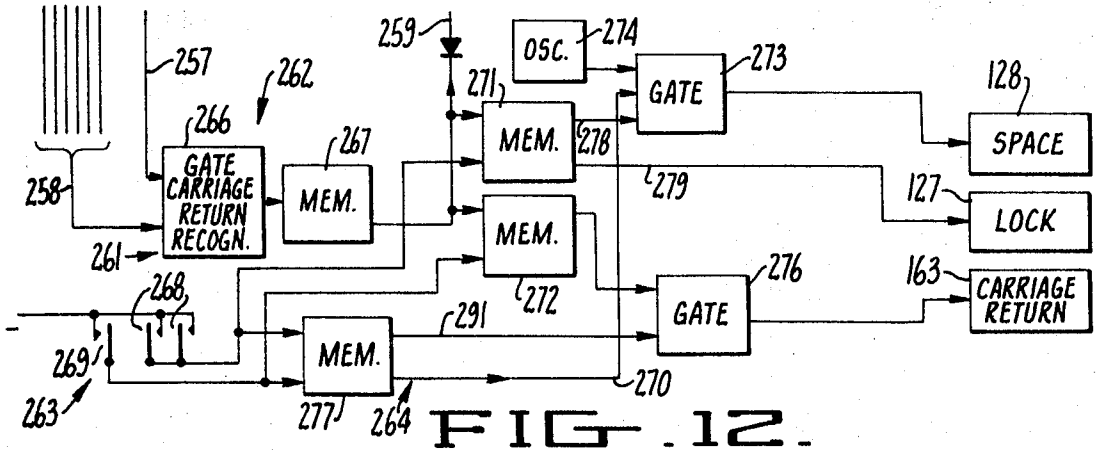

FIG. 12.

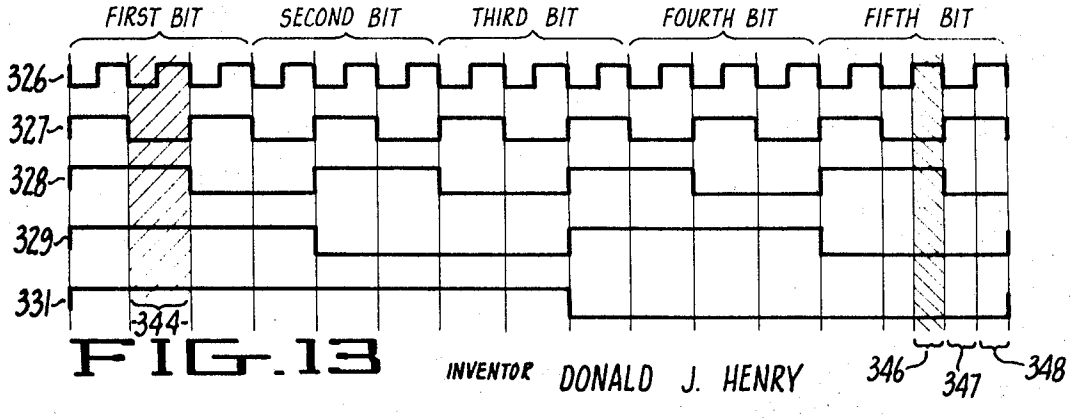

FIG. 13

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SELECTOR STRUCTURE FOR PRINTING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to a PRINTING MACHINE operable by coded electrical signals, and more particularly to such a printing machine capable of typing characters on a sheet of paper in response to said code by mechanisms designed for rapid and efficient operation.

Teleprinters are well known, and serve the function of providing a written record of information at a distance. Early teleprinters or teletype machines operated in a similar fashion to an ordinary typewriter, but had circuitry associated therewith so that the operation of the keyboard provided coded signals, and conversely, coded signals however provided caused operation of the typewriter to print pages. The teletypewriters or page printers served quite well, and are still extensively used, although they only have a speed of, say, up to about 100 words a minute.

Accordingly, it is quite desirable to provide a machine that transforms telegraphic signals into written form, which will not be unduly complicated and expensive, but which will operate at a much greater rate of speed.

Efforts have been made recently in this direction, and this development is leading to improvements in the mechanical moving parts which is the "bottle neck" of the procedure. However, most of these designs still follow the criterion of the standard typewriter, wherein certain mechanical steps must occur in sequence with other steps, and a single motive power source drives all operations.

From the foregoing, it is seen that a new and reliable printing mechanism should be developed, which more nearly fits the task at hand. In other words, a new mechanism is desired, which is more closely integrated with the incoming code signals and designed for minimized mechanical operation time.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide a printing machine for printing characters, received in coded form, on a page, in which the mechanical motion required for printing is provided from a plurality of motive power sources integrated together through an electric circuit.

In other words, a multiple number of motive power sources are provided for separate and independent operation, and in the preferred form of the invention, a separate motive power source such as a solenoid is provided for each operational function requiring movement. For example, considering the nonprint functions, there is preferably a solenoid operative through the circuit to cause the print trigger to operate when it is desired to print the character positioned for printing, and another motive power source, such as a solenoid, to provide the mechanical energy for spacing, and similarly one for line feed and one for carriage return. Each of these nonprint functions are directed by a certain signal and typically the system will operate to perform the function with at least one power source or solenoid for each function, even though more than one mechanical movement is involved.

The most complicated operation, and the one which is generally most time consuming, is the selection of the print character determined by the incoming code signal. Typically, these codes are binary and represent a signal level at one position or another, such as negative and ground, with the particular condition going together with a group of same to provide an overall code. A number of standard coding systems have been provided, but discussion of any one will be applicable to the others, because by simple addition or subtraction of parts, whatever the case may be, a conversion may be effected to design the machine for any code in accordance with this invention. In this description, the application of the invention for use with the standard five level, 7.42 unit, Baudot code system will be fully explained, but it will be appreciated that the new USASCII eight level, 11 unit, code system or others could be used by simple additions which will be indicated herein.

The print character selection operation is the most complicated and time consuming of the operations, and since it occurs quite frequently, it is very important to minimize the time required for selecting characters. In accordance with this invention, the print character selection is speeded up considerably by providing a novel print character selector mechanism operative from a plurality of motive power sources which are binary in character, such as typical solenoids, and move between two fixed positions. Preferably, a number of solenoids or the like will be provided that will correspond with the number of codes utilized for character selection so as to integrate the code signals directly with mechanical movement. By providing such a plurality, all of the motive power sources may be operated simultaneously and the print character positioned in an accurate and rapid fashion.

For example, with the five-level Baudot code, five solenoids will be operative and they will be able to produce 32 different character selection positions. Typically, with this code, figures-letters shift signals are also provided which will operate a sixth solenoid in a separate operation and double the number of characters printable, from 32 to 64. However, since the figures-shift comes in on a separate signal having the same time duration allotted for one letter signal, ample time is provided to effect this conversion. Similarly, the return shift from figures to letters comes in on a separate signal.

As indicated above, the electrical signals may be brought into the machines as fast as desired, and electrical circuit operations are extremely rapid so that the mechanical components substantially determine the speed of operation. Therefore, it is preferred to provide a novel decoding and conversion circuit which will take the five-code signals serially from the line, convert them to a parallel position, and deliver them to the five corresponding power units used for character selection simultaneously for rapid and efficient operation. In addition, it is preferred that the character selector be constructed so that no home position is required, and repetition of the same character would simply leave the motive power devices in their prior position. This operation is achieved by the use of memory units in the circuit. Thus the changed character would only require a change of so many of the powered units as is necessary to move to the newly selected character.

Another feature of the circuit is a provision of a storage system and a plurality of gates for the incoming serial signals and the parallel conversion thereof, so that newly arriving signals can begin to go through the circuit before the last signal has been printed. Other devices in the circuitry such as automatic operating holds and locks will operate to assure proper sequential operation, i.e. printing and spacing, and retaining proper coordination between the type element and the selector mechanism on carriage return. These devices will be more fully apparent in the complete description of a typical circuit incorporated hereinafter.

Therefore it is another object of the present invention to provide an electric circuit which will receive coded signal, store same, and deliver the required function signals to a plurality of motive powered units in a substantially simultaneous manner, yet which provides for and positively assures the mechanical sequence where mechanical steps must be performed sequentially.

Another object of the invention is the provision of a specially constructed selector mechanism operative to receive mechanical motion from a plurality of motive power sources such as solenoids, and transfer the permuted positioning of the powered units into accurately determined spaced linear positions for transfer to a type element having characters spaced to correspond with the preset spacing.

Yet another object of the invention is to provide the printing machine having a selector mechanism of the character described, which is capable of positioning a cylindric type element both rotatably and axially for character selection thereon.

The selector mechanism of this invention comprises one or more levers, each having three-functional positions thereon. One of these positions will generally be at one end of the lever and provide an accurate stepwise lateral movement at the end thereof for operative connection to the type element. The other two positions are located at the other end and intermediate of the lever as pivot positions with respect to the lever, each being connected to and receiving translational motion from at least one solenoid. Thus where four distinct lateral lever positions are desired, such as in the case of axially positioning of the preferred type element of this invention, two solenoids will provide four positions at the end of the lever by adjusting each of the two pivot positions between two conditions.

In situations where more than four positions are required, such as the lateral positions which will provide rotary motion to the preferred type element described herein, the levers are ganged to provide the desired multiples. For example, a lever providing four positions from two solenoids is used to adjust a pivot position on a main lever, and a second lever similar to the one described above and operating from two solenoids to provide four positions is used to adjust the pivot second position of a main lever. In this way, each pivot of the main lever will be provided with four distinct positions so as to provide 16 positions at the operative end thereof. If additional numbers of positions are desired, further ganging of levers may be utilized, if desired.

In its broad aspect, the selector mechanism of this invention may be utilized with cables and any of the known structure for translating motion accurately adjusted in fixed increments to a type element such as a rotary type element. However, another feature of the invention is to provide a special mechanical means for transferring movement to adjust a rotary type element formed for providing character selection on rotation and axial movement thereof. It will be appreciated that this mechanical means or connecting structure could also transfer movement from other systems than the selector mechanism of this invention, but it is preferred to utilize both of these devices together.

Specifically, the connecting structure of the selector mechanism comprises a first gear means on the type element for rotation therewith, and a second gear means mounted for rotation and axial movement and formed for engagement with the first gear means, said second gear means being constructed for driving the first gear means in a rotational motion on an axial movement thereof. Preferably, the second gear means will be a worm gear so that other operations may be accommodated as well as the conversion of translational to rotational movement required between the connecting structure associated with the positioning means and the rotatable type element. However, it will be appreciated that a simple rack gear would serve to provide the positioning function alone. However, the use of the worm gear allows for spacing of the carriage by operating a latch to hold the type element against rotation on the carriage, and rotation of the worm gear which in turn causes translation of the type element. Since the type element is latched, the rotational movement thereof forces the whole carriage to advance against a spring and holding latch to move the carriage forward one space.

Thus it is seen that another object of the invention is to provide sturdy and reliable mechanical structures operating through minimum of moving parts, independently operated from independently powered sources, which in turn are controlled by the circuit of this invention.

Yet still another object of the invention is to provide a printing machine of the character described which contains all of the mechanisms necessary to carry out the coded functions, and rapidly print out any indicia indicated by the code.

Further objects and advantages of the invention will be apparent as the specification proceeds and the new and useful features of the printing machine will be more fully defined in the claims attached hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred form of the invention is illustrated in the accompanying drawings, forming a part of this description, in which:

FIG. **1** is a fragmentary perspective view partly in section illustrating certain of the mechanical parts incorporated in the preferred form of this invention;

FIG. **2**, a fragmentary elevational view of certain of the parts of the machine illustrated in FIG. **1**;

FIG. **3**, a plan view, partially diagrammatic of the machine shown in FIGS. **1** and **2**;

FIG. **4**, a view illustrating the solenoids and levers thereof as seen in the line of **4—4** of FIG. **3**;

FIG. **5**, a diagrammatic view of the selector mechanism utilized in the machine of FIGS. **1** through **4**;

FIG. **6**, an enlarged plan view of the gears utilized in the selector mechanism of this invention indicating the selection operation thereof;

FIG. **7**, a plan view of the gear shown in FIG. **6** indicating the operation thereof when the gears are utilized to effect spacing;

FIG. **8**, an end elevational view

FIG. **8**, an end elevational view illustrating the various independently powered units as seen from the left-hand side of the machine of FIG. **3**;

FIG. **9**, an end elevational view of certain of the independently powered units as seen from the right-hand hand side of the machine of FIG. **3**;

FIGS. **10***a* and **10***b*, a circuit diagram illustrating the decoding and conversion circuit utilized in the machine of FIGS. **1** through **9**;

FIG. **11**, a block diagram of the circuit illustrated in FIGS. **10***a* and **10***b*;

FIG. **12**, a block diagram of the function portion of the circuit; and

FIG. **13**, a timing chart indicating how the clock circuit synchronizes operations of the machine with the incoming code.

While only the preferred form of the invention is shown and described in detail, it should be understood that various changes or modifications may be made within the scope of the claims attached hereto without departing from the spirit of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in greater detail and more particularly to FIGS. **1** and **3**, there is shown a printing machine **16** comprising a platen **17**, a carriage **18** mounted in suitable frame members **19** for transverse movement along the platen, a type element **21** mounted on the carriage and has a plurality of print characters **22** embossed thereon, and positioning means or selector mechanism **23** operatively engaged with the type element **21** for orienting the type element and placing a selected character **22** in print position as desired.

As here shown, platen **17** is a roller similar to the roller on an ordinary typewriter, rotatably mounted on the main frame through sideplates **20** and formed for feeding spaced lines of paper through the machine in position to receive printed characters.

The carriage is constructed with a main support or platform **24** slideably mounted in grooves **26** of frame members **19**. In this way, the platform is free to slide back and forth and move the carriage back and forth with respect to the platen, and the sliding surfaces are formed with suitable bearing materials such as Teflon so as to allow easy sliding action. The purpose of the carriage is to advance the type element and its associated print trigger one space at a time so that it may type characters sequentially in the usual fashion. For this purpose, a spacing catch **27** is carried in depending fashion from the lower surface of the support platform **24**, with the spacing catch **27** urged into spacing rack **28** by spring **29**. Thus, when

the carriage 18 is moved forward one space, the spacing catch 27 slips over a tooth of the spacing rack and engages in the next tooth. The carriage is constantly urged toward its line start position by a spring 31 fastened to a cable 32 which is trained around a pulley 33 and fastened to the carriage at 34 (see FIG. 3). In order to return the carriage, spacing catch 27 is moved upwardly and disengaged from the spacing rack 28 by means of bail 36 moving as shown by the arrow in FIG. 1.

The type element 21 is mounted on the carriage 19 for both rotary and axial movement thereof. As here shown, the type cylinder 21 is carried on a shaft 37 which is connected to a square shaft 38 through a universal joint 39. A gear 41 is carried on the support platform 24 of the carriage 18 through suitable bearings (not shown) so that the gear may rotate with respect to the platform. Gear 41 also has a conforming square hole centrally located therethrough for receiving the square shaft 38 so that the gear, shaft and type element 21 all rotate as a unit. However, square shaft 38 is slidable through gear 41 so that the type cylinder may be raised upward and downward with respect to the gear 41 and carriage 18. A foot member 42 is provided at the lower end of the square shaft 38, and the foot member bears against positioning slide or table 43. In order to assist in this positioning, a spring 44 is provided around the square shaft 38 and compressed between the foot member 42 and the platform 24.

The positioning slide 43 is formed with a bearing 46 made of Teflon or the like on the upper surface thereof in order to allow foot member 42 to move slidably and rotationally with respect to the positioning slide 43. This slide 43 is operated by the selector mechanism 23 which causes it to move between any two or four vertical positions through up and down movement as indicated by arrow 47. These four vertical positions correspond in spacing to spacing of the four rows of print characters 22 on type element 21. In this way, the type element is oriented and positioned as to rows.

In order to position the type element according to rotational movement, the element is rotated through the gear 41 by the selector mechanism 23 acting through a worm gear 48. This gear is mounted on collars 49 and 51, and journaled through sleeve bearings 50 carried on frame 19, with the journal being formed to allow both axial and rotational motion of the gear and collars through the sleeve bearing.

As shown in FIGS. 1, 2 and 5 through 7, an elongated spline 52 is telescoped into worm gear 48, with the spline being journaled for rotation within a collar 53, which in turn is mounted on one of the sideplates 20. In this way, worm gear 48 is free to move axially through sleeve bearings 50 in telescopic relation to spline 52, and on such lateral movement will turn gear 41 and present different characters in print position. Rotational motion is imparted to the worm gear when it is desired to space the carriage, and this movement is achieved by locking the gear 41 against rotation with respect to the carriage. With this locking effected, rotation of worm gear 48 causes gear 41 to move laterally along the worm gear far enough for spacing catch to move over a tooth on the spacing rack 28 and home into the next position.

The locking of gear 41 is achieved by locking lever 54 pivotally mounted in pin 56, which is carried on support flanges 57 extending upwardly from the carriage support 24. This locking lever is normally held out of locking position by a suitable spring (not shown), and it is forced into locking position by locking bail 58.

As best seen in FIG. 1, a print trigger 59 is also mounted on the carriage, with the mounting being through a pivot pin 61 located on support flanges 57. The print trigger is an elongated curved bar having a cocking spur 62 at one end and a bifurcated camlike member 63 at the other end. A bearing 64 is provided on the shaft 37 of the type element 21 for holding the type element in position above the universal joint and oriented for printing. This bearing is formed for allowing axial and rotational movement of the shaft 37 therethrough, and for holding the vertical orientation of the type element. In order to hold the bearing in place, it is urged against the print trigger 59 by a pair of springs 66, which in turn are anchored to posts 67 mounted on the carriage. The surface of bearing 64 is formed to fit against the bifurcated camlike member 63, in a manner tending to hold the bearing in place.

In order to actuate print trigger, a splined shaft 68 having a cross-shaped cross section is mounted behind the cocking spur 62 of the print trigger with the shaft being elongated so that it will engage the cocking spur in the same manner regardless of the carriage position. In order to provide the print function, the shaft 68 is rotated a quarter turn as indicated by arrow 69, and this causes the print trigger to pivot forward against bearing 64 and throw the type element 21 against the platen 17. The print trigger and operative structures are formed so that the trigger itself does not cause the type element to bear directly on the platen, but instead leaves a slight clearance. The type element is accelerated by the trigger movement so that its inertia carries it forward to provide the actual printing operation desired. As soon as the character is struck, springs 66 bring the type cylinder back into position against the print trigger and urge the trigger into position for the next operation.

typewriter. order to print the character on paper in ink form, a suitable ribbon will generally be provided, but the ribbon system may be conventional in construction, as now in general use in an ordinary typewriter. Alternatively, of course, special paper can be utilized that will print simply by the impression of the print cylinder without use of ribbon, if desired.

Referring more particularly to FIG. 3, it is seen that the selector mechanism 23 also comprises solenoid 71, solenoid 72, solenoid 73, solenoid 74, solenoid 76 and solenoid 77 operating through suitable connector means to impart movement to the type element 21. Thus solenoids 71 and 72 position a lever 78 by adjusting the pivot positions 79 and 81. The end 82 of lever 78 is connected to cables 83 and 84 through a suitable connector 86 so that cables 83 and 84 will be drawn up tighter or released. Cable 84 is trained over pulley 87, pulley 88, pulley 89 and pulley 90 to an attachment at 91 on positioning slide 43 (see FIGS. 3, 8 and 9). Similarly, cable 83 is trained over pulley 92, 93, 94 and 95 and then connected to bar 43 at 86.

The solenoids 71 and 72 are formed to move in one direction on energization thereof, and return on deenergization thereof. The return is assisted by the spring 44 urging foot member 42 downward against positioning slide 43. Accordingly, each of the solenoids 71 and 72 provide two separate positions of the pivot points 79 and 81 so as to make four separate positions at connector 82. The motion is essentially the same as the motion of solenoids 73 and 74 depicted in FIG. 4. The four positions at connector 82 translate through the cables 83 and 84 to provide movement of the type cylinder 21 as shown in phantom in FIG. 1 for realignment of the four rows of characters. Thus, solenoids 71 and 72 are tow of the character selection solenoids operating from a decoding and conversion circuit 211 as will be explained more fully hereinafter.

Solenoids 73, 74, 76 and 77 are also a part of the character selector and are utilized to determine the position of rotation of the type element 21. Solenoids 73 and 74 are connected to a lever 97, with solenoid 73 being attached at pivot point 98 and solenoid 74 being attached at pivot 99. Thus the solenoid pair 73 and 74 are operative to adjust the end of lever 97 to four positions in the same manner that solenoid 71 and 72 adjusted the end of lever 78. However, in order to illustrate how the solenoid pairs operate on their associated lever, FIG. 4 is provided to illustrate the situation in greater detail. As there shown, solenoids 73 and 74 are both in the relaxed position and the lever is pulled by a spring 101 acting through a cable 102, which is attached to lever 97 at 103. If solenoid 74 is actuated while solenoid 73 retains its position, the lever will shift one position as indicated by the first arrow 104 in FIG. 4. However, if solenoid 74 is retained in its deenergized position and solenoid 73 is actuated, the lever 97 is moved so as to lie

on the line at the arrow head of arrow **106**. If both solenoids are actuated then the lever **97** assumes the position at the head of arrow **107**. Thus FIG. **4** illustrates the four positions obtained by each pair of solenoid whether the pair be pair **71** and **72**, **72** and **73**, or **76** and **77**.

Referring back to solenoid pair **73** and **74**, it is seen that their cable **102** is attached to a lever **108** at a pivot **109** so as to provide four different lateral positions of pivot **109**. As here shown, the cable **102** is passed over pulleys **111** and **112** in order to provide normal relationships between the cables and the lever.

Solenoid pair **76** and **77** is attached to a lever **113** at pivot points **114** and **116** respectively. These provide four lateral positions to the end of the lever **113** at **117** where cable **118** is connected. Cable **118** is passed over pulleys **119** and **121** and attached to lever **108** at a pivot **122**. Spring loading for the solenoid pair **76** and **77** is provided by a spring **123** carried within the worm gear **48**. In other words, the worm gear **48** is hollow and the spring is carried in compressed relation so as to bear against the spline section **52** telescoped within the worm gear at one end the the worm gear at the other end thereof. The joint between lever **108** and worm gear **48** is preferably formed by providing a socket **124** on the worm gear and a ball **126** on the lever or any other suitable ball and socket joint so as to provide a low-friction contact as relative pivoting takes place.

From the foregoing description, it is seen that six solenoids are ganged together to provide character selection by adjustment of the type element to one of **64** positions. It is also seen that some or even all of these solenoids may be operated simultaneously so that the entire selection may take place extremely rapidly. It should also be noted that in a typical operation of the device, the solenoids which are energized remain energized until turned off. Therefore there is no homing or return motion required in the operation of the machine.

As indicated above, when using the Baudot code, five of the solenoids are used with the five-bit code to provide the character selection for each code group. The sixth solenoid operates in response to a separate code group to change the type element from letters to figures and punctuation in the operation referred to as figures-letters shift. As here shown, the solenoid moving the type cylinder the most is utilized for figures-letters shift, for the greatest economy of motion. This is solenoid **77**, which provides the greatest movement on lever **113** which in turn provides the greatest movement on lever **108**. However, it should be appreciated that any of the six solenoids **71**, **72**, **73**, **74**, **76** or **77** control half the field of characters, and could be utilized to make the figures-letters shift.

The spacing function is provided by solenoid **27** and solenoid **128** operating in unison. Solenoid **127** operates first to actuate the locking lever **54** and hold gear **41** against rotation. Then solenoid **128** operates to rotate worm gear **48** and cause the carriage to advance so spacing catch **27** moves forward one space. The solenoids are then deenergized, the locking lever released, and the spacing catch finds its new position.

Referring again to the locking solenoid **127**, it is seen that it is constructed to draw in cable **129** and cable **131** on energization thereof. Cable **129** is trained around pulley **132** and pulley **133** and attached to locking lever **134** at **136**. Locking lever **134** is pivotally mounted at one end through pivot **137** and carries locking bail at the other end. Cable **131** is trained around pulley **138** and pulley **139** and attached to lever **141** at **142**. The lever **141** is pivotally mounted at **143** and carries locking bail **58** at an end thereof as shown in FIG. **9**. Locking lever **134** and locking lever **142** are also equipped with springs **145** and **144** respectively to lift the locking bail when the solenoid **127** is deenergized.

Solenoid **128** operates to pull cable **146**, which is wound around pulley **147** and spring tensioned with spring **148** at an anchor point. Other pulleys **149**, **151** and **152** are provided to adjust the direction of the cable. Pulley **147** is attached to the spline **52**, and equipped with a one way ratchet or similar device so that a pull on cable **146** will cause it to rotate in a forward direction and cause the carriage to advance along the platen, yet the release of the cable allows the cable to slip back on return by spring **148** without moving the spline **52**.

After the print character has been selected and prior to or at the first portion of the spacing operation, the character is printed by print trigger **59** by rotation of splined shaft **68** over a distance of one quarter turn. The desired turning is effected by solenoid **153** formed to pull on cable **154**, which is trained over pulley **156**, pulley **157** and pulley **158**, and thence over the pulley gear **159** with its end being anchored and spring loaded through spring **161** (see FIG. **9**). The pulley and gear **159**, is attached to the spline shaft **68** and equipped with ratchets **162** which allow the desired forward rotation, but hold the spline against reverse rotation as spring **161** reacts the cable for a new bite.

Carriage return is effected by lifting bail **36** to release spacing catch **27** as indicated above. This lifting motion is provided by operation of solenoid **163** which is operative on energization to retract cables **164** and **166** which in turn are attached to each end of the bail **36**. Thus cable **164** extends around pulley **167**, pulley **168** and pulley **169** to its point of attachment at the end of locking bail **36**, with the bail being spring loaded on the side opposite the pulley **169**, by a spring **171**. Similarly cable **166** is directed around pulleys **172**, **173** and **174** and attached to bail **36** at the other end, with the bail being urged downwardly by a spring **176**.

In order to provide a line feed to the platen **17**, a solenoid **177** is provided with operates a cable **178** over pulley and gear **179** to effect rotation of the platen. As best seen in FIGS. **3** and **8**, the cable is trained over pulleys **181** and **182** and anchored beyond gear and pulley **179** by spring **183**. The pulley and gear **179** is also equipped with ratchets **184** to hold the platen as spring **183** returns the cable upon deenergization of the solenoid. In this way, the platen is rotated rapidly and quickly each time solenoid **163** is energized.

In operation, the mechanical elements operate rapidly and quickly, with as many as the axial taking place simultaneously as practical. Thus when the machine is to be used to print a page, the page is positioned in the platen and the machine turned on. For sake of illustration, assume that when the code starts coming in, the first character is to be a figure. The first signal will then be a figures shift character, which will actuate solenoid **77** for the figures-letters shift. This will throw lever **108** from one position to another, the displacement being its maximum movement and the lever will cause corresponding axial movement in worm gear **48**. The worm gear **48** then drives the type cylinder a distance which will typically be about a half a revolution thereof.

With the figures-letters shift operated to provide a figure the next code will provide the settings for solenoids **71**, **72**, **73**, **74** and **76** for completing the character selection. If the solenoids were already set in the proper position, no mechanical movement takes place. On the other hand, if a new character is chosen, whatever solenoids must move will be moved simultaneously so as to quickly reposition lever **108** and positioning slide **43** and thereby position type cylinder **21** ro the selected character. With the character selected, a print signal will cause solenoid **153** to be actuated which will rotate splined shaft **68** causing print trigger **59** to throw the type cylinder against the platen **17** and print the character..

While this printing is taking place, the spacing function may begin by operation of solenoid **127**. As explained above, solenoid **127** causes locking bail **36** to close the locking lever **54**. The locking lever **54** will find a corresponding recess **30** in the gear **41** to latch into, there being 16 recesses **30** on gear **41** corresponding to the **16** vertical lines of characters on the type cylinder. As soon as this lever **54** has been depressed and locked in place, and preferably after the print trigger is fired solenoid **128** is energized to rotate spline **52** and thereby rotate the worm gear **48**.

The mechanical operation is illustrated in FIGS. **6** and **7**, where FIG. **6** illustrates the rotational movement imparted to

gear 41 on axial movement of worm gear 48 as indicated by the arrow on the gear. It will be appreciated that in this position, the spacing catch 27 and the spring 31 have sufficient force to retain the carriage in position so that gear 41 will rotate. However, when the locking lever 54 is in place as shown in FIG. 7, the gear 41 cannot rotate. In this situation, rotation of worm gear 48 as indicated by the arrow in FIG. 7 will cause the gear 41 to move transversely along the worm gear 48. As soon as this spacing is completed, solenoids 127 and 128 are deenergized to allow the locking lever 54 to disengage and to allow the carriage 18 to find its natural position at the next space.

For illustration, assume that the next character is to be a letter. It would be preceded by a nonprinting letters shift character, which would operate the figures-letters shift through solenoid 77 back into the letters condition. Then the character to be printed will be selected in letters by the five solenoids 71, 72, 73, 74 and 76 operating in binary fashion from the five bits of the letter—specifying incoming signal. Should the next character be the same as the preceding one, no change in the type cylinder is necessary because the solenoids hold their prior position till changed.

Printing is continued in this manner with printing and spacing until the end of a word is reached. At this time, a nonprinting function signal will be received through the code indicating a space without printing, and the machine will simply block off the print function and space in the same manner indicated above.

When the end of the line is reached, a nonprinting carriage return signal is received which will operate solenoid 163. Since the carriage return functions simply by lifting the spacing catch 27, and allowing the carriage to be spring returned, it is appreciated that gear 41 will rotate during the return of the carriage. Accordingly, it is important to provide that this carriage return only occurs at certain fixed positions so that the type cylinder will make a complete revolution and remain in proper figures synchronization. Therefore carriage return circuitry is set up to provide a carriage return at position 17, 33, 49 and so forth. Should the carriage return signal be received before one of these positions is reached, the circuitry is provided to operate the spacing function until a position for carriage return is reached, and then carriage return solenoid 163 is energized and the carriage is returned.

At this time, a line feed signal should also have been received and this will actuate solenoid 177 and cause the platen to advance a line. Printing will then continue along the next line as before. While the carriage return and line feed functions have been described here as positively triggered by incoming nonprinting code signals, it should be appreciated that they may also be triggered otherwise, as by a microswitch located to be tripped at the line end by arrival of the carriage 18.

It will be appreciated that with independent power sources, certain of the operations can be taking place at the same time. For example, if the carriage return function is lengthy, the next signal for line feed may operate and the line feed may take place at the same time the carriage is being returned. Similarly, the signal for the next printed indicia can be received by the circuit as the carriage is returned, in the event that it gets this far behind. These simultaneous operations speedup the machine and will in no way effect the accuracy of the printing so long as the proper print character is present each time the print trigger is fired and the nonprint functions are completed in the proper sequence.

The decoding and conversion circuit 211 of the teleprinter 16 is illustrated in FIGS. 10*a* and 10*b*. This circuit is operative to process the incoming signal for use by the selector mechanism 23, and includes a clock circuit 212 activated by the incoming signal on the incoming signal bus 213 to generate time codes, a serial to parallel converter 214, a plurality of gates 216 coupled to the outputs of the converter 21, a plurality of memory units 217 coupled to the outputs of the gates 216, time recognition circuits generally indicated as 218 coupled to the clock circuit 212 to generate signals at particular times, and function recognition circuits generally indicated at 219 for detection of nonprinting characters. The clock circuit 212 directs the time codes which it generates along the time bus 221 to the converter 214 and the time recognition circuits 218. The converter 214 is gated by the time codes for receiving the incoming signal on the incoming signal bus 213 and converting the signal to a parallel form.

Within the serial to parallel converter 214 there are a plurality of channels corresponding to the number of information bits in the incoming signal. For instance, with a five-level teleprinter code signal such as the five-level 7.42 unit Baudot code, the converter 214 has five channels for assembling these five information bits in parallel form. In the block diagram of FIG. 11, only three of the five channels have been shown, for clarity. Each of the channels has a pair of outputs with one member of each pair of outputs being energized when the corresponding bit of the incoming signal is in the condition commonly referred to as marking, and the other member of each pair of outputs is energized when the corresponding bit of the incoming signal is in the condition commonly referred to as spacing. Thus lines 222 and 223 represent the outputs of one of the channels of the converter 214, for convenience sake here designated as the first channel, corresponding to the first information bit of the incoming signal. Line 222 represents the marking output of the first channel, and line 223 represents the spacing output. Similarly line 224 represents second channel marking, line 228 represents third channel spacing, line 229 represents fourth channel marking, line 231 represent fourth channel spacing, line 232 represents fifth channel marking, and line 233 represents fifth channel spacing.

The plurality of gates 216 includes a separate AND gate coupled to each one of the output lines 222 through 233 to gate the signal on those output lines into the memory units 217. The gates 216 operate in pairs, with a pair being associated with each channel of the serial to parallel converter 214. Thus AND-gate 234, associated with the first channel marking output line 222, and AND-gate 236, associated with the first channel spacing output line 223, form one such pair. The output of the AND-gate 234, present when the first pulse is marking, and the output of AND-gate 236, present when the first pulse is spacing, are fed to a memory unit 239 comprising a pair of OR-gates 241 and 242. The OR-gates 241 and 242 are coupled to form a flip-flop circuit by having their outputs fed back to each other.

The form of the flip-flop used in the memory unit 239 is bistable, in that it remains in either its set or reset state, whichever has been triggered, until the opposite state is triggered. It should be appreciated that a wide variety of typed of flip-flops could be used for the memory unit 239. As here shown, the cross-coupled OR-gates 241 and 242 are triggered to the set state by the delivery of a negative pulse form the AND-gate 234 to the OR-gate 241. The negative pulse produces a ground output from the OR-gate 241 which is fed to one input of OR-gate 242. This ground input to OR-gate 242 then produces a negative output from OR-gate 242 which is in turn fed back to one input of OR-gate 241 to lock the OR-gate 241 into the "set" condition. The memory unit 239 will remain in this "set" condition until a negative pulse is received by the OR-gate 242 from the AND-gate 236. Such a negative pulse coming into OR-gate 242 will produce a ground output from OR-gate 242 which is then fed to an input of OR-gate 241. This ground input to OR-gate 241 will produce a negative output from OR-gate 241 which is then fed back to an input of OR-gate 242 to lock OR-gate 242 in, placing the memory unit 239 in the "reset" condition.

The output of the memory unit 239 is taken from the output of the OR-gate 241, and for purposes of convenience is inverted in polarity by an inverter 243 before it is fed to a power amplifier 244. The output of the power amplifier 244 is then coupled to one of the actuator solenoids 71 through 76 to move the type element 21. It may be seen, then, that when the incoming first signal bit is "marking," i.e. negative, line 222 is

at ground and this ground signal is communicated to the AND-gate **234**. When all of the inputs of the AND-gate **234** are energized by ground signals, the AND-gate **234** creates a negative output to the OR-gate **241** to trigger the memory unit **239** into its "set" position producing a ground output from the OR-gate **241**. This ground output from the OR-gate **241** is inverted to a negative output by inverter **243** and amplified and inverted again to a ground output in power amplifier **244** to energize the one of the solenoids **71–76**.

Should the first incoming signal bit be "spacing" (i.e. at ground) rather than "marking," the output line **223** will be at ground and line **222** will be negative, so that AND-gate **234** will not be activated despite inputs on its other input lines, and AND-gates **236** will be activated upon the simultaneous presence of the ground output signal on line **223** and ground signals on its other two inputs. Then AND-gate **236** will then produce a negative output to the OR-gate **242**, triggering the memory unit **239** into the reset state as described above, resulting in a negative output from OR-gate **241**. The negative output of the OR-gate **241** will then be inverted by inverter **243** to a ground output and inverted again by the power amplifier **244** to a negative output. The negative output of the power amplifier **244** to one of the actuator solenoids **71–76** will result in no actuation of the solenoids. If the particular solenoid has been actuated for previous character, it would then drop back to its unactivated state.

It should be noted that if the state of the first information bit of the incoming signal is the same, either marking or spacing, for one character as for the preceding character received, the memory unit **239** will be triggered the same as for the preceding character and thus will remain steadily in the same state. Since the state of the memory unit **239** remains fixed until an incoming signal bit is different from the same bit in the preceding character received, the particular actuator solenoid in the selection means remains in the state to which it was previously actuated, either energized or deenergized, until an incoming information bit of the opposite sense is received.

For the second channel of the converter **214** a pair of AND-gates **237** and **238** are provided, connected respectively to the second pulse marking and spacing output lines **224** and **226**. The outputs of AND-gates **237** and **238** are fed to a memory unit **246** identical to the memory unit **239** associated with the first channel. The arrangement for the third, fourth and fifth channels is the same as the arrangement for the first and second channels. The output of the memory unit **246** associated with the second channel is inverted by an inverter **247**, amplified and inverted again by a power amplifier **248**, and fed to another one of the actuator solenoids **71–76**.

A first time recognition circuit **249** is coupled to the clock circuit **212** through the time bus **221** to generate a function read signal at a particular time relative to the incoming signal on the incoming signal bus **213**. The function read signal is used to trigger the function recognition circuits **219** as described below. A second time recognition circuit **251** also receives time codes on the time bus **221** to generate a gating signal at a second particular time relative to the incoming signal on the incoming signal bus **213**. The gating signal from the second time recognition circuit **251** is communicated by a gating bus **252** to one input of each of the AND-gates **216**.

A third time recognition circuit **253** is also coupled to the clock circuit **212** through the time bus **221** to generate a reset and print signal at a third particular time relative to the incoming signal. The reset and print signal is communicated on a reset bus **254** to the clock circuit **212** and the serial to parallel converter **214** to reset them for reception of a new incoming pulse train specifying a new character, and is also coupled to a print signal bus **256** to the print actuator solenoid **153** for actuation of that solenoid to print the desired character onto the receiving medium.

The function read signal from the first time recognition circuit **249** is communicated to the function recognition circuits **219** by the function read bus **257**. The output lines **222** through **233** from the converter **214** are also coupled to the function recognition circuits **219** as schematically indicated by the line **258**. Upon being gated by the function read signal from line **257**, the function recognition circuits **219** query the outputs of the converter **216** to detect the pattern of outputs of the converter **216** specifying functions such as spacing, carriage return, line feeding or figures-letters shifting to be executed in the teleprinter rather than type characters to be impressed on the receiving medium. When such a functional character is detected, the function recognition circuits **219** produce signals to the appropriate actuators in the teleprinter to accomplish the desired function, and also produce a negative signal on an inhibit bus **259** to block the operation of the gages **216** and prevent operation of the character-selecting actuator solenoids **71–76**. The inhibit signal **259** also blocks operation of the print actuator **153** despite any presence of a signal on the print signal bus **256**.

The function recognition circuits **219** include a carriage return circuit **261** which is operative to actuate the carriage **18** to return when the carriage **18** is in certain selected positions along its path of travel and to prevent the carriage **18** from returning from positions intermediate those selected positions. Referring now to the block diagram in FIG. **12**, the carriage return circuit **261** comprises a recognition circuit **262** responsive to the outputs of the converter **214** to produce a first signal in response to the detection of the character in said outputs which signifies the carriage return function and to continue the first signal until reset, a position sensor **263** which is operative to produce a first position signal at the selected positions and a second position signal at the line start position, and memory and gate circuits generally indicated as **264**. The memory and gate circuits **264** are responsive to the first signal and the first and second position signals to actuate the spacing operation until the carriage **18** reaches one of the selected positions. Once the selected position is reached, the memory and gate circuits **264** stop the spacing operation, actuate the return operation until the carriage **18** reaches the line start position, and then stop the return operation at that position.

The recognition circuit **262** includes a first gate **266** connected to the outputs **258** of the converter **214** for recognizing the carriage return character and producing a signal when that character is recognized and a first memory unit **267** receiving that signal and producing the first output signal in response thereto until reset. As here shown the position sensor **263** includes a group of switches **268** connected electrically in parallel and located at the positions of permissible carriage return along the path of the carriage **18** so that they are closed by the location of the carriage **18** at those positions, and a switch **269** located at the line start position to be closed by the location of the carriage **18** at the line start position.

Among the units which make up the memory and gate circuits **264** are second and third memory units **271** and **272** respectively which receive the first output signal and produce second and third output signals respectively in response thereto until reset. A second AND-gate **273** having two inputs receives the second output signal as one of those inputs and the output of an oscillator **274** on the other of its inputs. The output of the second gate **273** actuates the spacing solenoid **128**.

A third AND-gate **276** having two inputs receives the third output signal as one of those inputs and the output of a fourth memory unit **277** as the other of its inputs. The output of the third gate **276** actuates the return solenoid **163**. The fourth memory unit **277** receives the first position signal from the position sensor **263** via closure of one of the switches **268**, and is reset by the second position signal supplied by closure of switch **269** in a position sensor **263**. The second memory unit **271** is reset by the first position signal to terminate the actuation of the spacing operation (solenoids **127** and **128**) and the third and fourth memory units **272** and **277** are reset by the second position signal to terminate the actuation of the return solenoid **163**. The first memory unit **267** is reset by the reset and print signals from the third time recognition circuit **253**. The output of the second memory unit **271** may also be used

to actuate the lock solenoid **127** in the teleprinter for preventing rotation of the type element **21** during printing and spacing operations.

The first gate **266** is a six input AND gate with five of its inputs connected respectively to the first pulse spacing, second pulse spacing, third pulse spacing, fourth pulse marking, and fifth pulse spacing output lines of the converter **214**. The remaining input of the AND-gate **266** is connected to the function read bus **257**. Upon concurrence of all of these inputs, the AND-gate **266** produces an output to the first memory unit **267**.

The first memory unit **267** comprises a pair of OR gates connected in the same flip-flop configuration as the memory units **239** and **246**, with the exception that the output of the memory unit **267** is taken from the second OR gate, so that the negative input from the AND-gate **266** produces a negative output from the memory unit **267** when the memory unit **267** is in the set condition. This negative input is communicated to the inhibit bus **259** to block the gates **216**, and to the memory units **271** and **272**. Thus the memory unit **267** sets upon recognition of a carriage return character by the AND-gate **266** and remains set until reset by the reset pulse on the reset pulse bus **254**.

When the memory unit **271** is set by the negative pulse from the memory unit **267**, a ground output is produced on the output line **279** of the memory unit **271** and at the same time a negative output is produced on the output line **279** of the memory unit **271**. The negative signal on line **279** is passed through an OR-gate **286**, an inverter **287**, a delay unit **288**, and a power amplifier **289** to activate the lock solenoid **127**, causing the printing element **21** to be locked against rotation during the spacing motion. The ground output on line **278** is communicated to one input of the second gate **273**, which is three-input AND gate having another of its inputs connected to an oscillator **274** and the third of its inputs connected by line **270** to the switches **268**. When the ground output from line **278** is delivered to the gate **273** and no negative signal is received on line **270**, the gate **273** passes the output of the oscillator **274** through an OR-gate **281**, an inverter **282**, a delay unit **283**, and a power amplifier **284** to repeatedly actuate the spacing solenoid **128** until one of the permissible points along the path for carriage return is reached, at which point one of the switches **268** will be closed by the carriage **18**.

The closure of one of the switches **268** applies a negative pulse to the input of the fourth memory unit **277** to cause that memory unit to assume the set condition, producing a ground input on line **291** to one input of the third gate **276**. The other input of the AND-gate **276** is connected to the output of the third memory unit **272**. When the third gate **276** receives simultaneous ground outputs from the third memory unit **272** (the third output signal) and the fourth memory unit **277**, the gate **276** produces an output to a power amplifier **293** which drives the carriage return actuator solenoid **163**. When the fourth memory unit **277** is triggered to "set" state by closure of one of the switches **268**, it transmits a negative signal on line **270** to the second AND-gate **273**, to inhibit the further spacing of the carriage by blocking the gate **273**.

The carriage return actuator **163** remains in operation until the carriage is returned to the line start position. At line start position, the carriage **18** closes the switch **269** to produce an negative signal (the second position signal) on line **292** to the third memory unit **272** and the fourth memory unit **277**, resetting both of those units. Upon the resetting of the third and fourth memory units the actuation actuation the carriage return actuator **163** is terminated through removal of both inputs form the AND-gate **276**.

Should the carriage **18** already be at one of the locations for carriage return when that character is received, one of the switches **268** fairly be closed, causing memory until **277** to immediately "the carriage return character recognition circuit **262**, including a six-input thereby inhibiting any spacing, via line **270**.

The remaining functions of the teleprinter, such as the spacing function, the line feed function and the figures-letters shift function are all accomplished in a fairly straight-forward manner. Each has a recognition circuit similar to the input AND gate activated by the reception of the proper combination of outputs on the lines **258** from the converter **214** and the function read pulse on the function read pulse bus **257**. Each of these AND gates is connected to a flip-flop type memory unit similar to the first memory until **267** so that a negative input to the memory unit produces a negative output which is communicated to the inhibit bus **259**.

In the case of the space function, the negative output of the memory unit is also communicated to the OR-gate **281** which passes it through the inverter **282**, the delay unit **283**, and the power amplifier **284** to activate the spacing solenoid **128** on a one-shot basis. The line feed function is detected by a recognition circuit **296** similar to the recognition circuits **294** and **262**, and the negative output of its memory unit is communicated to the inhibit bus **259** and through a power amplifier **297** to the line feed actuator solenoid **177**.

The figures-shift function character is detected by a recognition circuit **298**, similar to the preceding recognition circuits, whose negative output is communicated to the inhibit bus **259** and to a memory unit **302**, whose negative output is in turn communicated to a power amplifier **299** for driving the figures-shift solenoid actuator **77**.

The letters shift recognition circuit **301** is constituted similarly to the preceding recognition circuits. Its negative output is communicated to the inhibit bus **259** and to the reset input of the memory unit **302**, causing the memory unit to terminate the energization of the figures-letters shift solenoid **77**. Since the memory unit **302** is not reset after each character by the reset pulse on line **254**, but only by the signal from the letters shift recognition circuit **301**, a shift lock function similar to that found on conventional typewriters is provided. A substantial saving in operation time results, as a figures shift character need not be sent before each figure of a group.

As mentioned above, the printing function is accomplished by the print signal on the print signal bus **256**. This signal is derived from the reset signal on the reset bus **254** through an inverter **311**, which produces a ground output on receipt of the negative reset pulse at its input. The ground output of the inverter **311** is transmitted to a two-input AND-gate **312**, which has its other input connected to the inhibit bus **259**, to allow the print signal to be blocked by the inhibit signal. The output of the AND-gate **312** is communicated through a delay unit **313** and a power amplifier **314** to the print actuator solenoid **153**. The output of the AND-gate **312** is also communicated to the OR-gates **281** and **286** to operate the lock actuator solenoid **127** before the printing takes place and to operate the space actuator solenoid **128** once for each printing actuation of the print actuator solenoid **153**.

Turning now to the logic diagram of FIG. **10***a*, the incoming signal is fed to a power amplifier **316** and from thence onto the signal bus **213**. The incoming signal is also fed to the clock circuit **212**, which includes a delay unit **317** for adjusting the synchronism of the incoming signal with the clock circuit **212**. From the delay unit **317** the incoming signal passes to a memory unit **318**, comprising a pair of OR gates arranged in the same fashion as the OR gates of memory unit **239**. Upon receipt of the first positive-going pulse of the incoming pulse train, the power amplifier **316** supplies a negative-going output through the delay unit **317** to the input of the memory unit **318**. The memory unit **318** then locks into the "set" condition to produce the steady ground output along line **319** until the memory unit **318** is reset. In the conventional Baudot teleprinter code system the first positive going pulse of the pulse train will be the start pulse, and hence the memory unit **318** will lock in upon receipt of a start pulse and remain locked until a reset pulse is received on the reset bus **254**.

The line **319** communicates the ground output of the memory unit **318** to one input of a two-input AND-gate **321**. The other input of the gate **321** is connected to an oscillator

322 which produces a square wave having a frequency of 24 cycles per bit of the incoming pulse train. When the AND-gate 321 is activated by the ground signal on line 319, the output of the oscillator 322 is counted down by a cascaded chain of self-steering flip-flop 323 through 331 to form the time codes.

Each of the flip-flops 323 through 331 has a pair of output lines, one of the lines being energized (i.e. ground output) when the flip-flop is in its set state and the other of the lines being energized when the flip-flop is in its reset state. The set output of flip-flop 323 is coupled to the input of flip-flop 324 and the set output of flip-flop 324 is coupled to the input of flip-flop 326. Flip-flop 323 and 324 are not used directly in the generation of the time codes but are included in the cascade to produce closer synchronism between the starting of the clock 212 and the incoming signal.

The set output of flip-flop 326 is connected to the input of flip-flop 327 and to a signal line 332. The reset output of the flip-flop 326 is connected to a signal line 333. The set output of flip-flop 327 is connected to a signal line 334 and the reset output is connected to a signal line 336 as well as to the input of flip-flop 328.

The set output of flip-flop 328 is connected to a signal line 337, and the reset output is connected to a signal line 338 and to the input of flip-flop 329. The set output of flip-flop 329 is connected to a signal line 339, and the reset output is connected to a signal line 341 as well as to the input of flip-flop 331. The set and reset outputs of flip-flop 331 are connected to signal lines 342 and 343 respectively.

Referring to the timing diagram of FIG. 13, the set state of each flip-flop is indicated by the raised portion of the line and the reset state of each flip-flop is indicated by the lowered portion of the line. The phase inversion created by the change in input triggering between flip-flops 327 and 328 may be seen from this diagram, as the flip-flop 326 begins the timing cycle in a reset state and flip-flops 327, 328, 329 and 331 begin a timing cycle in a set state. As may be seen from the timing chart, the middle one-third of each bit of the incoming information pulse train is uniquely specified by a combination of the set and reset states of flip-flops 327, 328, 329 and 331. Likewise, the last half of the fifth bit of the incoming pulse train is divided into three uniquely specified parts by the output of the last five flip-flops in the chain, including flip-flop 326.

For instance, the middle one-third of the first information bit, occupying the length of time indicated by the shaded portion 344 on the time chart, may be seen to be specified by flip-flop 327 being in the reset state while flip-flops 328, 329 and 331 are in the set state, so that outputs for this period of time are produced on signal lines 336, 337, 339, and 342. Similar unique combinations of the state of the last four flip-flops in the chain specify the middle third of each of the bits of the incoming signal.

The period of time recognized by the first time recognition circuit 249 is indicated by the shaded portion 346 on the timing chart. In this case the particular combination of flip-flop states is flip-flop 326 set, 327 reset, 328 set, 329 reset, and 331 reset.

Within the serial to parallel converter 214 there are provided five AND-gates 349 through 354, each having five inputs connected to combinations of the signal lines 332 through 343. For example, the AND-gate 349 has its inputs connected to signal lines 336, 337, 339, and 342. It will be noted from the time chart of FIG. 13 that the condition of these four signal lines being energized uniquely specifies the middle one-third of the first bit of the incoming information pulse. The incoming information bits are all provided to the fifth input of the AND-gate 349. However, only during the middle one-third of the duration of the first bit are the remaining four inputs of the AND-gate 349 energized by the signal lines to which they are connected. Thus only during the middle one-third of the first bit is the AND gate able to respond to the presence of a marking signal (ground output) on the signal bus 213.

When all of the remaining inputs of the AND-gate 349 are energized and a marking bit is received on the signal bus 213, the AND-gate 349 produces an output negative pulse on its output line 356 to a memory unit 357. The memory unit 357 consists of a pair of OR-gates 358, and 359, connected in a flip-flop configuration essentially similar to the configuration of the memory unit 239. The negative input to the OR-gate 358 produces a ground output from that gate on output line 222, signifying that the first bit of the incoming signal is "-marking."

The ground output of the OR-gate 358 is fed back to an input of the OR-gate 359 to lock in the flip-flop and to cause the OR-gate 359 to produce a negative output on output line 223 signifying that the first bit of the incoming signal is not "-spacing."The memory unit 357 remains locked in until reset by the reset pulse on the reset bus 254. The AND-gate 349 and the memory unit 357 together form the first channel of the serial to parallel converter 214.

The second channel of the serial to parallel converter 214 is formed by the AND-gate 351 and a memory unit 361. The memory unit 361 is essentially identical to the memory unit 357. One of the inputs of the AND-gate 351 receives the incoming signal pulse train, and the other four inputs are connected to signal lines 334, 337, 341 and 342 to recognize the middle one-third of the second bit of the incoming pulse train (see FIG. 13).

Upon concurrence of the five inputs of the AND-gate 351, a negative output is produced to the memory unit 361, triggering the memory unit 361 into its "set" state. The memory unit 361 then produces a ground output on output line 224, signifying that the second bit of the incoming signal pulse train is "-marking." In a similar fashion inputs of AND-gate 352 are connected to signal lines 336, 338, 341 and 342 to recognize the middle one-third of the third bit, the inputs of the AND-gate 353 are connected to signal lines 334, 338, 339 and 343, to recognize the middle third of the fourth bit, and the inputs of AND-gate 355 are connected to the signal lines 336, 337, 341 and 343, to recognize the middle one-third of the fifth bit. Memory units 362, 363 and 364 are associated with AND-gates 352, 353 and 354 respectively and function in the same fashion as memory units 357 and 361.

It alltted to be noted that each of the AND-gates 349 through 354 is sensitive to the presence of a marking condition in the incoming pulse train only during the middle one-third of the time allotted to the bit of the pulse train that the AND gate is intended to recognize. The limitation of the response of the AND gates to the middle one-third of each bit of the incoming pulse train allows a considerable degree of distortion in the incoming signal without interfering seriously with its correct detection. It should be appreciated, of course, that other forms of clock circuits 212 and other forms of serial to parallel converter 214 could be used with the present invention, rather that the forms described herein in detail.

With the arrangement of the serial to parallel converter 214 shown here the incoming pulse train is held in the memory units 357 and 361 through 364 in parallel form despite the successive activation and subsequent deactivation of each of the AND-gates 349 through 354. The parallel form of the signal is held in the memory units 357 and 361 through 364 for subsequent gating through AND-gates 216 to the memory units 217 and is held until the memory units 357 and 361 through 364 are reset by the reset pulse on reset bus 254.

The first time recognition circuit 249 comprises a five input AND-gates 366 and an inverter 367. The AND-gate 366 has its five inputs connected to signal lines 332, 336, 337, 341 and 343. As may be seen from the timing diagram of FIG. 13 the energization of these five signal lines occurs only during the last half of the middle one-third of the fifth bit. At this time, the AND-gate 366 is activated, producing a negative output which is in turn inverted by the inverter 367 to produce the function read signal on the function read bus 257.

The second time recognition circuit 251 also comprises a five-input AND-gate 368 and an inverter 369. The inputs of

the AND-gate **368** are connected to the signal lines **333, 334, 338, 341** and **343** to detect the first half of the last one-third of the fifth bit. At the time its inputs are so energized, the AND-gate **368** produces a negative output which is inverted by the inverter **369** to become the gating signal on the gating bus **252**.

The third time recognition circuit **253** comprises a five input AND-gate **371** having its inputs connected to signal lines **332, 334, 338, 341** and **343** for detection of the last half of the last third of the fifth bit. When this AND-gate **371** is energized, its negative output forms the reset pulse on the reset bus **254**, and its inverted output as inverted by the inverter **311** forms the print signal on the print signal bus **256**. As mentioned above, the reset signal on the reset bus resets all of the memory units **357** and **361** through **364** in the serial to parallel converter **214**, all of the flip-flops **323** through **331** in the clock circuit **212**, the memory unit **318** in the clock circuit **212**, and all of the recognition circuits **262, 294, 296, 298** and **301**. The decoding and conversion circuit **211** is thus prepared for the reception of the next pulse train specifying the next character.

From the foregoing description, it is seen that an improved printing machine is provided, in which electrical and mechanical operations are coordinated in a manner that minimizes the mechanical operations and provides rapid printing from coded signals in a reliable manner.

I claim:

1. In a printing machine, a selector mechanism for moving a type element to select a desired position thereof, comprising

a first lever having a first, second and third position located longitudinally along the lever,

a first lateral positioning means for providing a plurality of lateral positions to the first lever at the first position thereof;

said first lateral positioning means comprising

a second lever having a movable first position thereof operatively connected to the first lever at the first position of said first lever,

a first electrically controlled motive means adapted to provide motion between two fixed positions and operatively connected to the second lever at a second position thereon, and

a second electrically controlled motive means adapted to provide motion between two fixed positions and operatively connected to the second lever at a third position thereon,

a second lateral positioning means for providing a plurality of lateral positions to the first lever at the second position thereof;

said second lateral positioning means comprising

a third lever having a movable first position thereof operatively connected to the first lever at the second position of said first lever,

a third electrically controlled motive means adapted to provide motion between two fixed positions and operatively connected to the third lever at a second position thereon,

a fourth electrically controlled motive means adapted to provide motion between two fixed positions and operatively connected to the third lever at a third position thereon, and

means for interconnecting the first lever from its third position to said type element for effecting movement of said type element and positioning thereof in response to the movement and positioning of said first and second lateral positioning means.

2. In a printing machine, a selector mechanism as defined in claim **1**, in which the first electrically controlled motive means is a solenoid operative to move the second lever at its second position between two fixed lateral locations, and the second electrically controlled motive means is a solenoid operative to move the lever at its second position between two fixed lateral locations, whereby four accurately adjusted positions are provided for the first position of the second lever.

3. In a printing machine, a selector mechanism as defined in claim **1**, in which said first lever is used to provide rotational positioning of the type element, and in which the selector mechanism also comprises a fourth lever for adjusting the axial positioning of the type element, and a pair of binary positioning means at a spaced pair of fixed fulcral points on the fourth lever, with each binary positioning means being formed to position the lever at its associated fulcrum in one of two positions whereby four axial adjustments of the type element are provided;

4. In a printing machine, a selector mechanism as defined in claim **1**, in which said first lever is used to provide rotational positioning of the type element in any one of said 16 lateral positions, and in which the selector mechanism also comprises a fourth lever for adjusting the axial positioning of the type element, and a pair of solenoids attached to the fourth lever at spaced fulcral positions therealong.

5. The printing machine defined in claim **4**, in which each of the electrically controlled motive means are solenoids, and in which all of the solenoids are controlled by a decoding and conversion circuit formed to operate a plurality of said solenoids simultaneously.

6. In a printing machine, a selector mechanism for moving a rotatable type element having a plurality of characters located in different positions around the type element,

a first gear means on said type element for rotation therewith,

a worm gear mounted for rotational and axial movement and in engagement with the first gear means,

axial movement of said worm gear causing rotation of said first gear means to select one of said plurality of characters and

character spacing means including means to selectively lock said first gear means against rotation, and

means for rotating said worm gear while said first gear is locked against rotation to drive said first gear means along said worm and thereby effect character spacing movement of said type element.

7. A printing machine as defined in claim **6**, which also comprises a lever having two fulcral positions therealong and a third position connected to said worm gear for coupling the lateral movement of the third position on the lever with axial movement on the worm gear, and in which drive means are provided to drive the lever at each of the two fulcral positions.

8. A printing machine as defined in claim **6**, which also comprises a platen, and a carriage mounted for movement along said platen, said type element being mounted on the carriage in a mounting allowing both rotational movement and axial movement of the type element with respect to the carriage.

9. A printing machine as defined in claim **8**, which also comprises a lock means for selectively holding the type element against rotation, yieldable latch means for holding the carriage at any one of a plurality of spaced increments, and means for rotating the worm gear while the lock means is engaged to move the carriage and advance the yieldable latch means.

10. A printing machine as defined in claim **8**, which also comprises a print trigger mounted on the carriage in position to throw the type element against the platen on actuation thereof, and means for actuating the print trigger including a cocking spur on the pring trigger, and an elongated splined shaft mounted for rotation on the machine in juxtaposed position to the carriage for engagement with the cocking spur at all of the various carriage positions along the platen.

11. A printing machine as defined in claim **8**, in which the drive means comprises a plurality of solenoids.

12. A printing machine as defined in claim **11**, in which the type element is formed with a foot member for transmitting axial movement thereto, and in which elevator means are provided to adjust the axial position of said foot member, said elevator means including a positioning slide formed to abut the foot member while allowing relative lateral movement of and rotational movement of the foot member, an elevator lever carried on two fulcral positions and connected to said slide through a third position for providing various elevational

positions to the slide corresponding to various locations of said third position, and elevator positioning means connected to said lever at said fulcral positions.

13. A printing machine, as defined in claim 12, in which the elevator positioning means comprises a plurality of solenoids.

14. A printing machine, as defined in claim 13, which also comprises a decoding and conversion circuit for receipt of and decoding of coded signal, said circuit being formed to control and operate all of said solenoids.

15. A printing machine, comprising a platen,

a carriage mounted for movement along the platen,

a type element mounted on the carriage and having a plurality of print characters embossed thereon,

type positioning means for rotatably and vertically positioning the type element and orienting the print characters thereon,

lock means mounted on the carriage for holding the type element against rotation as the carriage is moved along the platen in a spacing operation,

means for actuating the lock means between a locked and unlocked position,

yieldable latch means for holding the carriage in any one of a plurality of spaced increments, and

gear means coupled to the type element for normally providing positional rotation to the type element and operative to override the yieldable latch means and advance the carriage while the lock means is engaged.

16. A printing machine as defined in claim 15, which also comprises a print trigger mounted on the carriage in position to throw the type element against the platen on actuation thereof, and means for actuating the print trigger including a cocking spur on the print trigger, and an elongated splined shaft mounted for rotation on the machine in juxtaposed position to the carriage for engagement with the cocking spur at all of the various carriage positions along the platen.

17. A printing machine as defined in claim 15, which also comprises a selector mechanism for moving the type element to select a desired position thereof, said selector mechanism comprising

a first lever having a first, second and third position located longitudinally along the lever,

a first lateral positioning means for providing a plurality of lateral positions to the first lever at the first position thereof;

said first lateral positioning means comprising

a second lever having a movable first position thereof operatively connected to the first lever at the first position of said first lever,

a first electrically controlled motive means adapted to provide motion between tow fixed positions and operatively connected to the second lever at a second position thereon, and

a second electrically controlled motive means adapted to provide motion between two fixed positions and operatively connected to the second lever at a third position thereon,

a second lateral positioning means for providing a plurality of lateral positions to the first lever at the second position thereof;

said second lateral positioning means comprising

a third lever having a movable first position thereof operatively connected to the first lever at the second position of said first lever,

a third electrically controlled motive means adapted to provide motion between two fixed positions and operatively connected to the third lever at a second position thereon,

a fourth electrically controlled motive means adapted to provide motion between two fixed positions and operatively connected to the third lever at a third position thereon, and

means for interconnecting the first lever from its third position to said type element for effecting movement of said type element and positioning thereof in response to the movement and positioning of said first and second lateral positioning means.

18. In a printing machine, a selector mechanism as defined in claim 17, in which each of the electrically controlled motive means are solenoids for providing four lateral positions from each lateral positioning means, whereby 16 lateral positions are provided at the third position and on the type element.

19. In a printing machine, a selector mechanism as defined in claim 18, in which said first lever is used to provide rotational positioning of the type element in any one of said 16 lateral positions, and in which the selector mechanism also comprises a fourth lever for adjusting the axial positioning of the type element, and a pair of solenoids attached to the fourth lever at spaced fulcral positions therealong.