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[54] **CHARACTER GENERATION MARKING DEVICE**
10 Claims, 6 Drawing Figs.

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 346/75, 101/114, 197/1, 101/366, 118/315,
 117/37
 [51] Int. Cl..... **B41f 3/02,**
 G01d 15/18
 [50] Field of Search..... 101/1, 426,
 93RC, 114, 109, 350, 365, 366; 197/1:
 346/75, 74, 76; 118/315, 313, 314; 117/37, 38

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 Attorney—Carothers and Carothers

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ABSTRACT: A method of and apparatus for character generation marking wherein a plurality of liquid spray nozzles, each adapted to spray a line segment on the object to be marked, are cooperatively arranged with respect to one another to spray a segmented character on the object when they are selectively actuated. An electrical character selection circuit is provided to selectively actuate the desired combination of nozzles to generate the corresponding segmented character.

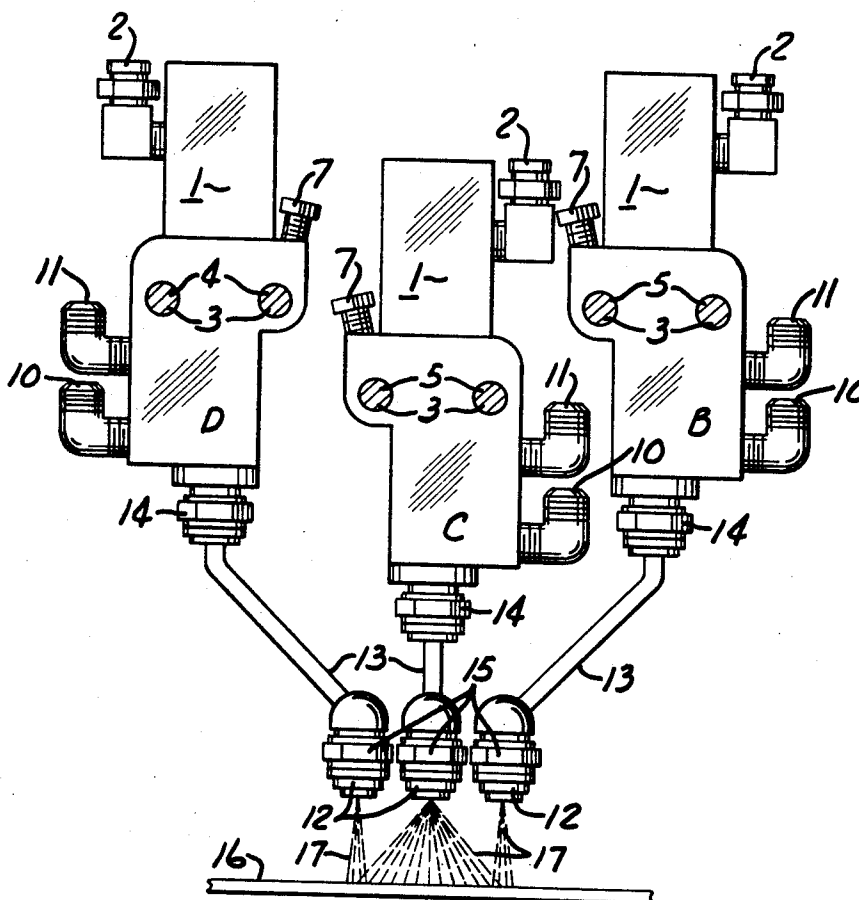


Fig. 1

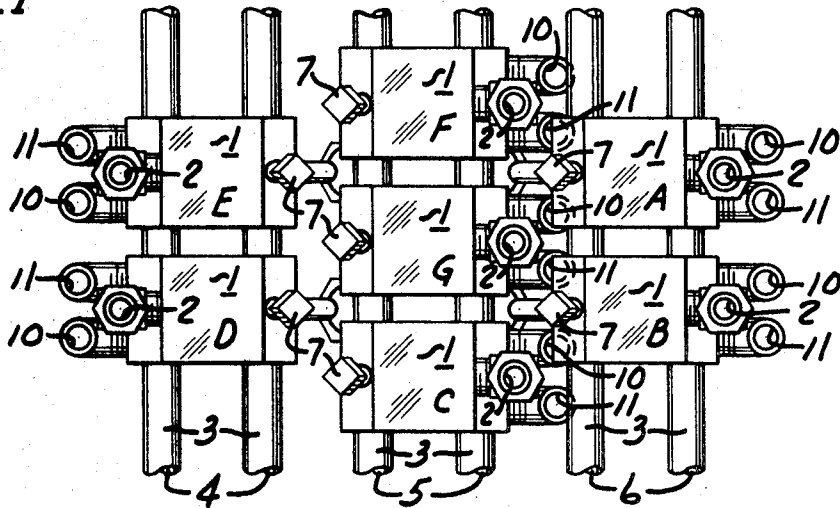


Fig. 2

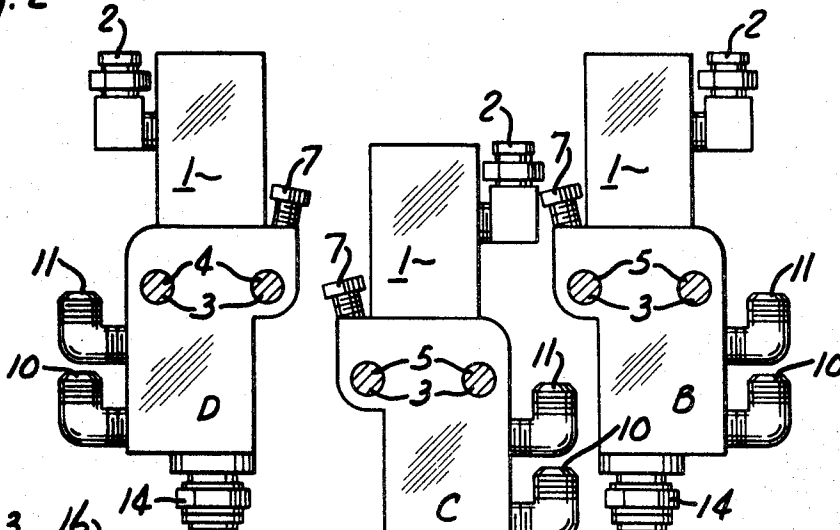
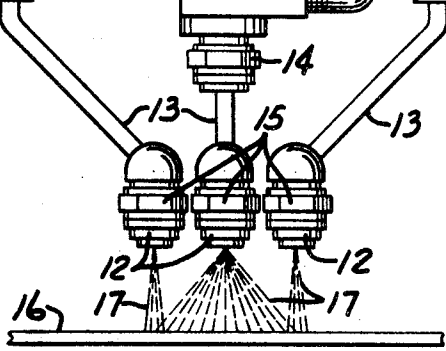
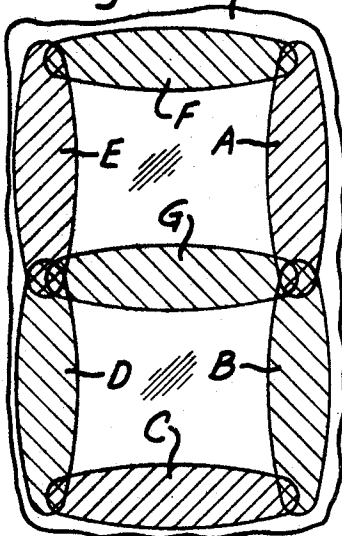


Fig. 3



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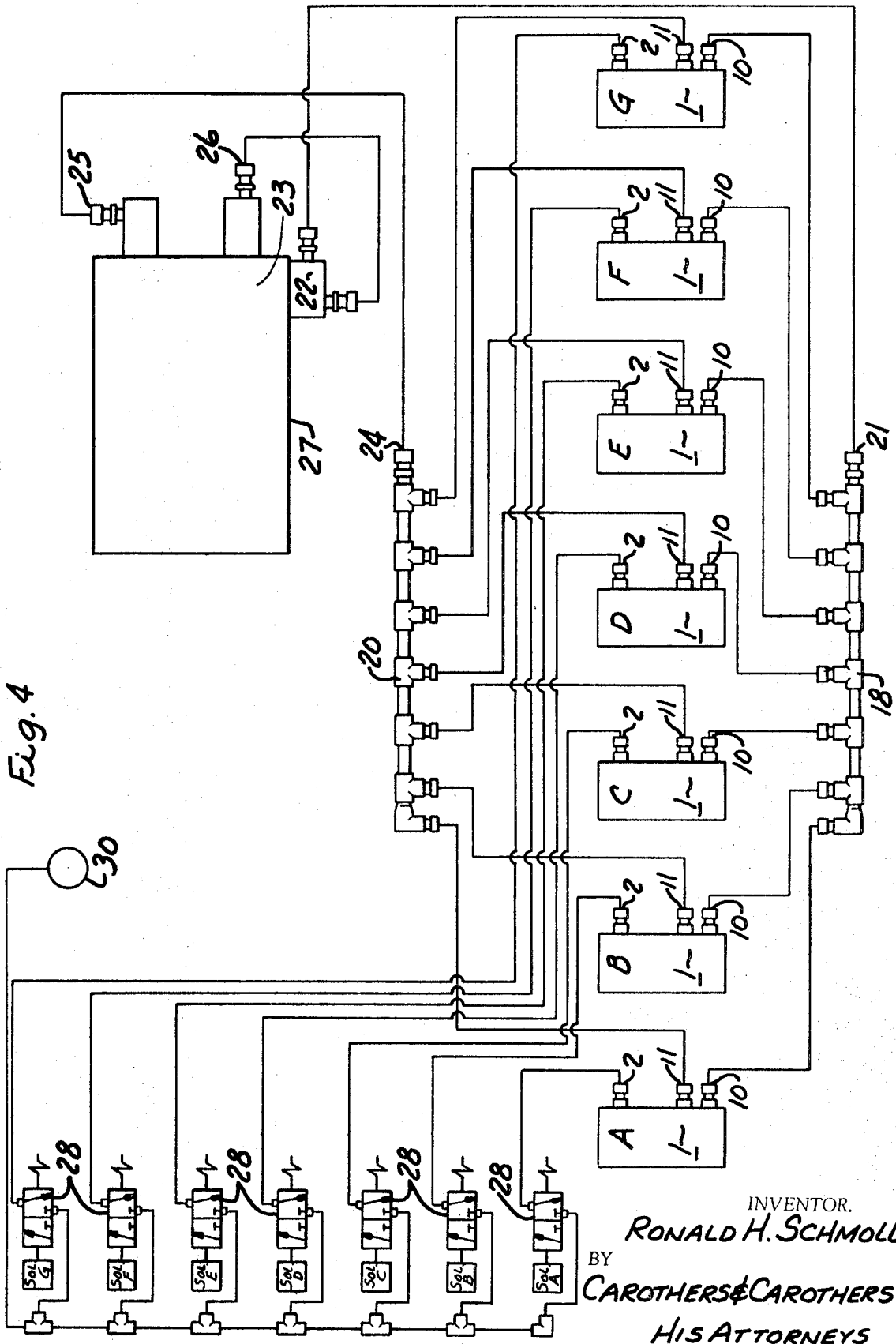


Fig. 4

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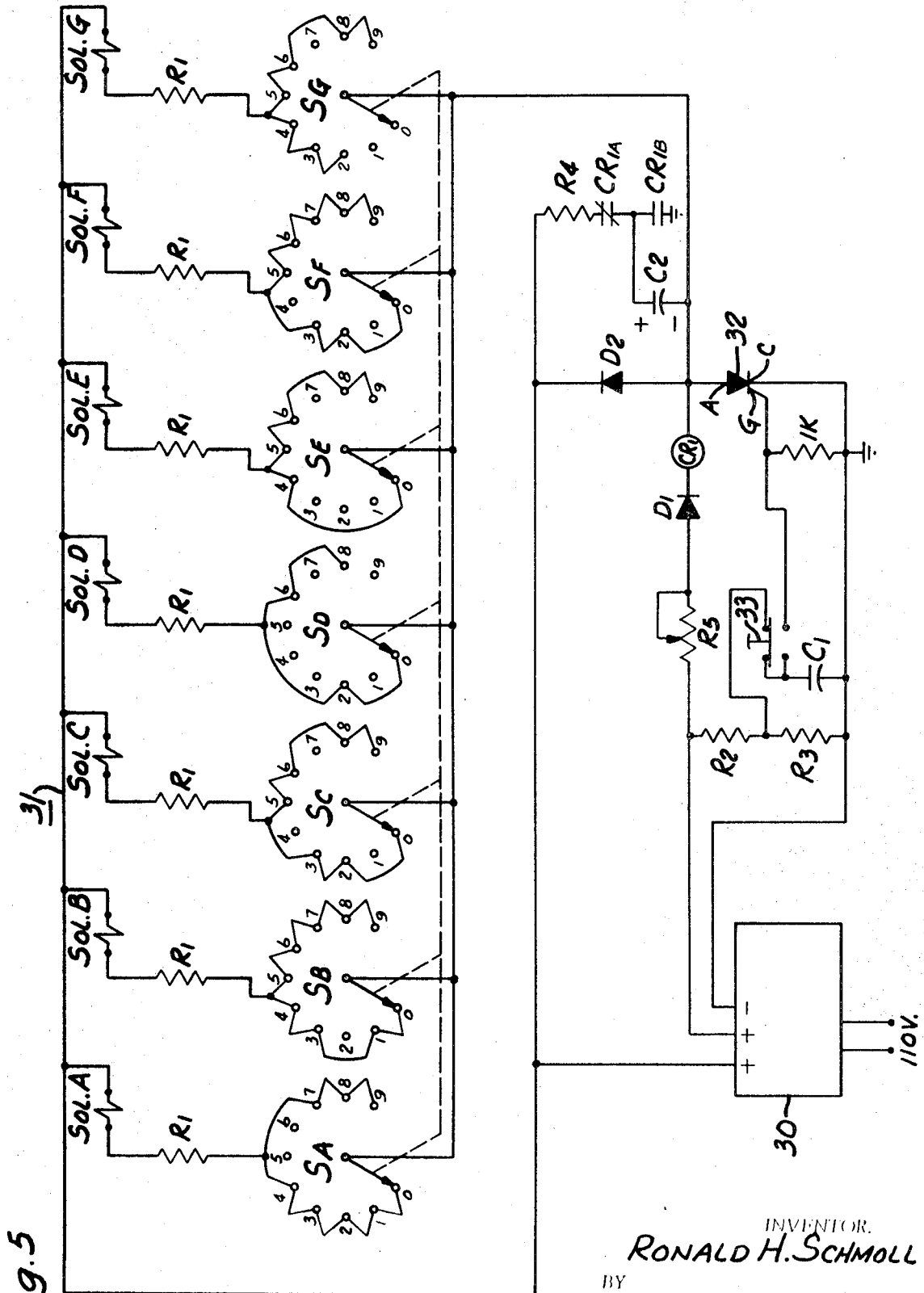


Fig. 5

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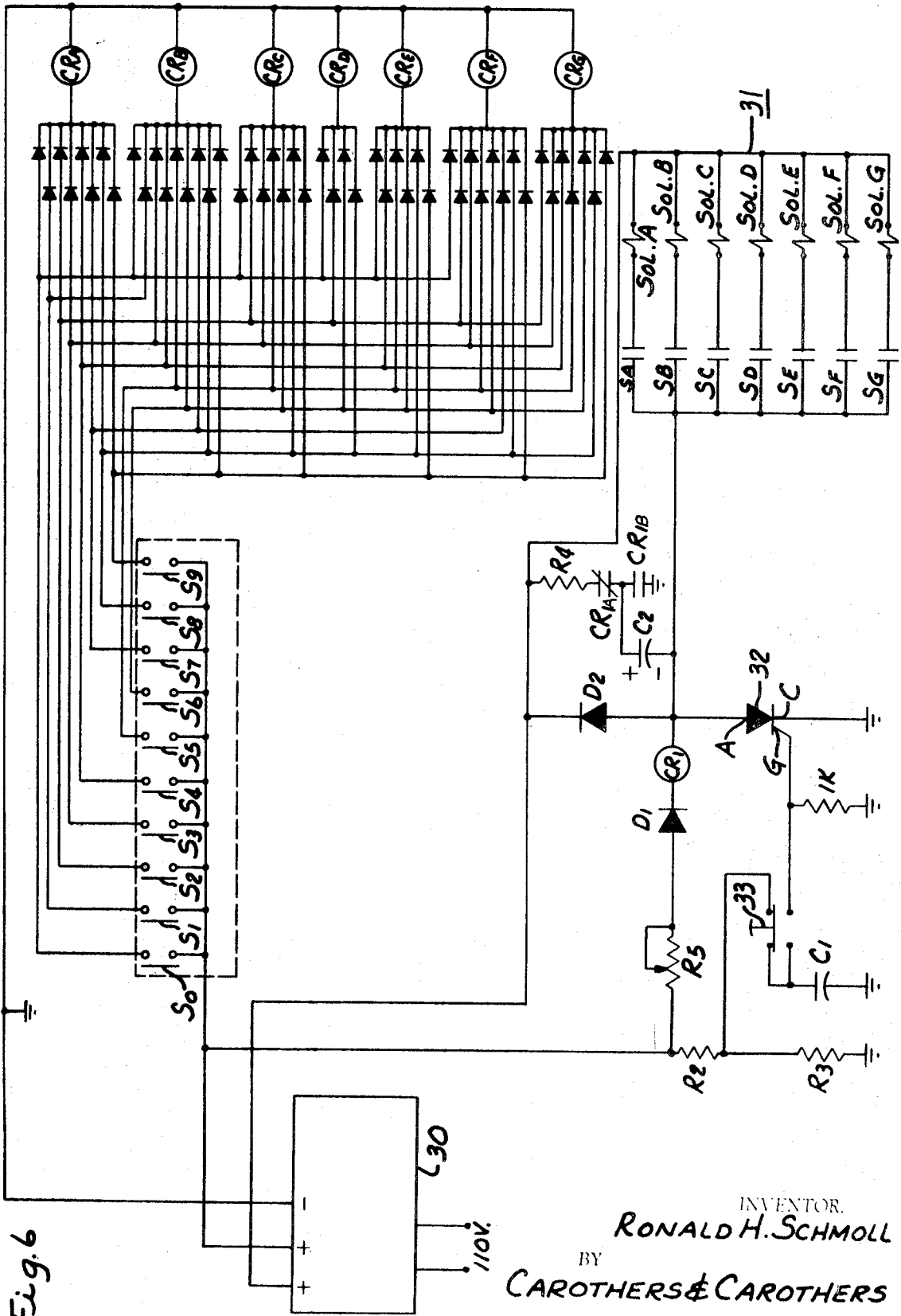


Fig. 6

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CHARACTER GENERATION MARKING DEVICE

BACKGROUND OF THE INVENTION

This invention relates generally to the art of marking and more specifically to character generation for the marking of objects such as steel plate and the like.

In the present day practice of marking articles such as steel plate, for identification and the like, a hand stencil operation is employed which requires a precut stencil and hand painting. This is a relatively slow process which involves considerable time and expense.

In an attempt to reduce this required time, a circular stencil for the generation of each identification digit has been employed. However, this process merely increases the speed with which the operator may substitute one hand stencil for another in forming the identification mark. The operator is still required, however, to hand paint or spray the character on the object.

SUMMARY OF THE INVENTION

The character generation marking as taught by the present invention provides a selection or plurality of liquid spray nozzles each adapted to spray a line segment on an object to be marked. The nozzles are disposed in a predetermined arrangement to permit the sprayed line segments from a selected combination of the nozzles to produce any desired character. Marking fluid is supplied to each of the nozzles which are selectively actuated to employ their respective line segments in combination to generate a desired character.

The nozzles are preferably and selectively actuated by an electric valve means such as a series of independent electromagnetically operated valves or switches which are in turn selectively energized by a character selection circuit. For example, the nozzles may be each a part of independent liquid spray guns or distributors which are independently operated by corresponding solenoids which are selectively energized by a character selection network.

The nozzles may be arranged such that their respective sprayed line segments will form or produce a segmented character master matrix if all the nozzles are simultaneously actuated. For example, if digits are the desired characters to be generated, a square or right angle figure or digit eight may be employed as the character master matrix since all the other digits, namely, zero through nine, may be produced or originated from the segmented square figure eight by employing only those sprayed line segments of the square figure eight necessary to generate the desired square or right angle digit.

The character size and resolution may be varied according to the distance that the nozzles are placed from the work and by the type of nozzle employed.

The marking fluid supply to the distributors or nozzles is preferably a continuously recirculating fluid supply. Such a fluid supply may comprise a closed loop fluid series circuit including a marking fluid source, such as an ink reservoir, a pump and the spray distributors themselves. Thus a continuously recirculating marking fluid feed is provided to the distributors or spray guns. This prevents coagulating or settling of the particles and hardening of the ink in the supply lines. The ink supply lines to the different distributors may be connected in parallel with one another requiring a single source of ink and one pump. The ink is preferably filtered to remove particles or small coagulations found in the continuously flowing ink supply lines.

The distributors may be pneumatically operated spray guns which are individually valved or shut on or off by solenoid operated pneumatic valves. A character selection circuit is connected with the solenoid operated valves to preselect the desired combination of distributors or spray guns to be activated. When the desired character selection has been made a spray switch is depressed to energize the corresponding solenoids.

The character selection circuit or circuit means preferably comprises a closed loop series circuit including a power source and a switch and a character selection network. The character selection network consists of a parallel connection of subnetworks which are equal in number to the number of the solenoids employed to activate the spray guns which would be one solenoid for each distributor employed. Each subnetwork includes a series connection of one of the solenoids and a switch. Thus a character may be selected by closing a predetermined selection of the switches. When the main switch or spray switch is depressed only the preselected solenoids will be activated and in turn their corresponding spray guns which will generate the desired segmented character.

The spray switch may be a semiconductor controlled rectifier such as a silicon controlled rectifier with associated circuit means to switch the rectifier on and off for a timed interval.

The switches provided in the aforementioned subnetwork may be ganged rotary switches which have a number of switch positions each which are equal to the number of the characters to be generated or characters which may be generated from the master matrix. The switch positions found about each individual rotary switch are selectively connected or not connected with the solenoid in its subnetwork to successively generate a different character with each ganged switch position.

This circuit means requires manual operation in selecting the desired character; however, the circuit may be readily adapted to accommodate automatic character selection. This is accomplished by operating each of the subnetwork switches by corresponding electromagnets. Each of the electromagnets have one terminal end connected to one terminal of a power source such as a DC power supply. A plurality of character selection switches which are equal in number to the different characters which may be generated from the character master matrix, are provided with one end connected to the other terminal of the power source or supply. The other terminal end or connection of each of the switches are each connected to an independent selection of the open ends of the electromagnets to generate the desired segmented character corresponding to the character selection switch which is selectively depressed. Thus the character selection switch may be automatically selected and depressed by a computer tape reader for example.

Other objects and advantages appear hereinafter in the following description and claims.

The accompanying drawings show, for the purpose of exemplification without limiting the invention or the claims thereto, certain practical embodiments illustrating the principles of this invention wherein:

FIG. 1 is a plan view of the ink distributors with their nozzles placed in a predetermined master matrix character arrangement.

FIG. 2 is a view in side elevation of the distributor arrangement shown in FIG. 1.

FIG. 3 is a pictorial plan view illustrating a segmented character master matrix which may be employed in the present invention.

FIG. 4 is a schematic diagram of the ink distributor system illustrating an embodiment of the present invention.

FIG. 5 is a schematic diagram of the character selection circuit which may be employed as one embodiment of the present invention.

FIG. 6 is a schematic diagram of the character selection circuit illustrating another embodiment of the present invention.

Referring to FIGS. 1 and 2 of the drawings, the distributors or spray guns 1 are consecutively designated as guns A, B, C, D, E, F, and G. Each of the guns 1 are pneumatically operated and provided with air inlets 2 which are connected to a pneumatic pressure source.

The distributors 1 are slidably mounted on mounting rods 3 in order that the arrangement of the distributors may be changed as desired.

The mounting rods 3 are grouped in pairs 4, 5 and 6. Each of these mounting rod pairs may be slidably mounted to a frame such that they may be slid apart from one another, or left and right as appears in FIG. 1, to permit even more versatility in the arrangement of the distributors 1 to make up a desired character master matrix.

Locking screws or bolts 7 are provided on each distributor 1 and extend therethrough to one of the mounting rods 3 to lock each of the spray generators in position.

Each generator 1 has an ink inlet 10 and an ink outlet 11 to provide continuous circulation of the marking fluid through the distributors.

A nozzle 12 is provided for each spray gun along with nozzle extensions 13 which permit the nozzles 12 to be grouped or arranged in closer proximity than do the bulkier spray generators alone to obtain touching line segments as sprayed by the nozzles.

The nozzle extensions 13 are coupled to the spray generators 1 through couplings 14. Couplings 14 are swivel couplings which permit extensions 13 and nozzles 12 to be properly positioned. Each of the nuts provided on the couplings 14 are then tightened to maintain the nozzles 12 in position.

Similar couplings 15 are provided on each of the nozzles 12 to permit individual positioning of the nozzles such that the sprayed line segments adjoin one another to form the desired character master matrix on the material to be marked which is designated 16.

The mounting rods 3 are mounted to a frame positioned over the work 16. This frame may be stationary if the work 16 is to be moved under the spray generators for marking or the frame may be a driven carriage which moves over the work 16 when the latter is stationary.

The nozzles 12 spray the marking fluid in a fan shaped pattern as indicated at 17 to provide a relatively thin line segment on the material 16. This is illustrated by the spray segmented character shown in FIG. 3.

The embodiments illustrated are set up for digital generation; however, additional spray generators 1 may be added to the system or taken away as required to provide a nozzle arrangement which will generate any desired segmented character.

The digit master matrix shown in FIG. 3 is the numeral 8, from which the numerals 0 through 9 may be composed or derived. Each of the segments making up the FIG. 8 are alphabetically designated in correspondence with their respective or corresponding spray generator 1.

The desired character or digit may be generated by selecting the proper combination of the generators 1 to be activated. For example, to form the digit 0, the spray generators A, B, C, D and F would be simultaneously activated. The digit 1 would be generated by activating spray generators A and B. Thus any segmented digit may be generated by activating its corresponding selection of spray generators 1.

The schematic diagram of FIG. 4 illustrates the piping connections for the marking fluid supply and the pneumatic pressure supplied to the generators 1. The inlets 10 and outlets 11 of the spray generators are connected in parallel by means of the inlet manifold 18 and outlet manifold 20. The inlet 21 of manifold 18 is connected to filter 22 which is in turn connected to outlet 26 of pump 23.

The filter 22 serves to remove coagulations or particles from the circulating marking fluid or ink. The outlet 24 of outlet manifold 20 is connected with hose or the like to the pump inlet 25.

The housing 27 contains the pump 23 and a marking fluid reservoir to continuously supply marking fluid to the system.

This piping arrangement permits the marking fluid or ink to be continuously recirculated through the generators 1 thus preventing the ink from hardening in the pipes. The pump 23 is preferably of the reciprocating piston type.

The pneumatic inlet connections 2 on each of the generators 1 are connected respectively to the solenoid operated valves 28. The solenoids operating the valves 28 are respec-

tively designated A, B, C, D, E, F, and G in correspondence with their respective spray generators A through G. Thus the generators 1 are selectively activated by activating a corresponding selection of solenoids A through G.

The inlets of valves 28 are connected to a common high pressure pneumatic source of approximately 100 pounds per square inch. When valves 28 are in their open position, as determined by the energization of their respective solenoids, the piping circuit from the respective inlet 2 of the spray generator 1 to the pneumatic source 30 is completed. When valves 28 are in their closed or off position the pneumatic inlets 2 are open to the exterior atmosphere to immediately exhaust the pneumatic pressure within the spray guns 1 upon deenergization of the solenoids A through G. Otherwise, the distributors 1 would continue to distribute the marking fluid for a short period after the valves 28 are closed.

The solenoids A through G which operate the valves 28 are independently and selectively energized by means of a character selection circuit such as shown in the schematic diagram of FIG. 5.

The circuit of FIG. 5 consists primarily of a closed loop series circuit consisting of the DC power supply 30, the character selection network 31 and the switch 32 which in this instance is a semiconductor or silicon control rectifier with its associated circuitry to switch the same on and off for timed intervals. However, a simple switch will serve the same purpose but will not provide the accurate and short timing given by the silicon controlled rectifier and its associated circuitry.

The character selection circuit 31 consists of a parallel connection of subnetworks, all of which are conductive loads. Each subnetwork is a series circuit of one of the solenoids A through G, one of the resistors R_1 and one of the rotary digit selector switches S_A through S_G . Rotary switches S_A through S_G are ganged, 10-position switches. Each rotary switch S_A through S_G has its respective 10 positions, which are indicated by the digits 0 through 9 successively, selectively connected or left unconnected to its respective resistor R_1 and solenoid S_A through S_G . Thus each ganged switch position 0 through 9 will generate its respective character or digit when switch 32 is closed.

For example, when the ganged digit selector switch is positioned at the 0 digit position as indicated in FIG. 5, rotary switch S_A is closed, S_B is closed, S_C is closed, S_D is closed, S_E is closed, S_F is closed, but S_G remains open. Thus by referring to FIGS. 3 and 4 it can be readily seen that the segment G of the master matrix will be omitted when switch 32 is closed as solenoid G and spray distributor G will not be activated.

The SCR or switch 32 is turned on by applying a small positive voltage spike to the gate G of the SCR. Resistors R_2 and R_3 act as a voltage divider which supplies a small positive voltage to capacitor C_1 through the back contact of spray switch 33 when it is in its closed position as shown in FIG. 5. Thus capacitor C_1 acquires a small positive charge which is released to the gate G of SCR 32 when switch 33 is depressed to close its front contacts.

When SCR 32 conducts, capacitor C_2 acquires a positive charge through resistor R_4 and the normally closed or back contact CR_{1A} of relay CR_1 . Relay CR_1 is activated from the power supply 30 through the variable resistor or potentiometer R_5 , blocking diode D_1 and on through SCR 32 to the ground terminal of power supply 30.

The time within which relay CR_1 will open after SCR 32 begins conduction is dependent upon the setting of the potentiometer R_5 by which the spray time may be varied from 10 milliseconds to infinity.

After the time delay relay CR_1 pulls in, the positive side of charged capacitor C_2 is referenced to ground and the cathode C of SCR 32 through the now closed but normally open front contact CR_{1B} of CR_1 . Thus the cathode C of SCR 32 is driven positive by the discharge of C_2 with respect to its anode A causing SCR 32 to turn off and in turn causing spray distributors 1 to stop.

Diode D_2 is provided in the circuit parallel with the inductive loads of said subnetworks consisting of the solenoids A through G to protect the associated circuit elements from the back or counter electromotive force produced by the inductive loads.

The circuit shown in FIG. 6 is substantially identical to that shown in FIG. 5 with the exception that the character selection switches S_A through S_C are electromagnetically operated by means of relays CR_A through CR_C which are selectively energized by the digit selector switches S_0 through S_9 .

For example, if one desires to generate the character figure eight, switch S_8 is closed simultaneously activating all of the relays CR_A through CR_C which are connected in parallel with one another. As another example, if the digit one is to be generated, switch S_1 is closed thereby energizing relays CR_A and CR_B alone. Referring again to FIG. 3, it is readily determined that segments A and B of the master matrix would be generated thereby producing a segmented digit one.

Wherein the character selection circuit of FIG. 5 must be manually operated, the character selection circuit of FIG. 6 is adapted to automatic computer operation. The switches S_0 through S_9 may be independently and selectively actuated by a computer tape read out machine to generate the digit or character corresponding to the selected switch.

I claim:

1. A character generation marking device comprising a plurality of liquid spray nozzles each adapted to spray a line segment on an object to be marked, mounting means supporting said nozzles in a predetermined arrangement to permit the sprayed line segments from a combination of said nozzles to produce a desired character, marking fluid supply means connected with said nozzles to supply marking fluid thereto for spraying said line segments, and valve means to selectively actuate desired combinations of said nozzles, said valve means including a separate solenoid for each of said nozzles to independently actuate the same, a closed loop series electric circuit including a power source and a switch and a character selection network consisting of a parallel connection of subnetworks equal in number to the number of said solenoids and each including a series connection of one of said solenoids and a switch, said switch consisting of a semiconductor controlled rectifier with associated circuit means to switch said rectifier on for a predetermined period.

2. A character generation marking device comprising a plurality of liquid spray nozzles each adapted to spray a line segment on an object to be marked, mounting means supporting said nozzles in a predetermined arrangement to permit the sprayed line segments from a combination of said nozzles to produce a desired character, marking fluid supply means connected with said nozzles to supply marking fluid thereto for spraying said line segments, and valve means to selectively actuate desired combinations of said nozzles, said valve means including a separate solenoid for each of said nozzles to independently actuate the same, a closed loop series electric circuit including a power source and a switch and a character selection network consisting of a parallel connection of subnetworks equal in number to the number of said solenoids and each including a series connection of one of said solenoids and a switch, said subnetwork switches consisting of ganged rotary switches each having a number of switch positions equal to the number of characters to be generated, said switch positions of each of said rotary switches being selectively connected with its respective solenoid to successively generate a different character with each ganged switch position.

3. A character generation marking device comprising a plurality of liquid spray nozzles each adapted to spray a line segment on an object to be marked, mounting means supporting said nozzles in a predetermined arrangement to permit the sprayed line segments from a combination of said nozzles to produce a desired character, marking fluid supply means connected with said nozzles to supply marking fluid thereto for spraying said line segments, and valve means to selectively actuate desired combinations of said nozzles, said valve means

including a separate solenoid for each of said nozzles to independently actuate the same, a closed loop series electric circuit including a power source and a switch and a character selection network consisting of a parallel connection of subnetworks equal in number to the number of said solenoids and each including a series connection of one of said solenoids and a switch, electromagnets respectively connected to independently operate each of said subnetwork switches, each of said electromagnets having one terminal end connected to one terminal of a power source, a plurality of character selection switches equal in number to the different characters to be generated and each having one end connected to the other terminal of said power source, each other end of each of said switches being connected to an independent selection of the other terminal ends of said electromagnets to generate the segmented character corresponding to each of said character selection switches.

4. A character generation marking device comprising a plurality of liquid spray distributors each having a spray nozzle adapted to spray a line segment on an object to be marked, mounting means supporting said nozzles in cooperative arrangement with respect to one another to spray a segmented character master matrix on said object when simultaneously activated, fluid supply means connected with said distributors to supply marking fluid thereto, electromagnetic valve means operably coupled with said distributors to independently actuate the same, and electrical circuit means connected with said valve means to actuate a predetermined selection of said distributors, said fluid supply means comprising a closed loop fluid series circuit including a marking fluid source and a pump to provide a continuously recirculating marking fluid feed to said distributors.

5. The character generation marking device of claim 4 characterized in that said distributors are connected to parallel with one another in said closed loop series circuit.

6. The character generation marking device of claim 4 wherein said closed loop series circuit also includes a filter.

7. A character generation marking device comprising a plurality of liquid spray distributors each having a spray nozzle adapted to spray a line segment on an object to be marked, mounting means supporting said nozzles in cooperative arrangement with respect to one another to spray a segmented character master matrix on said object when simultaneously activated, fluid supply means connected with said distributors to supply marking fluid thereto, electromagnetic valve means operably coupled with said distributors to independently actuate the same, and electrical circuit means connected with said valve means to actuate a predetermined selection of said distributors, said distributors comprising pneumatically operated spray guns, said valve means including a pneumatic pressure source operably connected with each of said guns and a solenoid operated pneumatic valve for each of said guns and connected intermediate each of said guns and said pneumatic source for independent actuation of said guns.

8. A character generation marking device comprising a plurality of liquid spray distributors each having a spray nozzle adapted to spray a line segment on an object to be marked, mounting means supporting said nozzles in cooperative arrangement with respect to one another to spray a segmented character master matrix on said object when simultaneously activated, fluid supply means connected with said distributors to supply marking fluid thereto, electromagnetic valve means operably coupled with said distributors to independently actuate the same, and electrical circuit means connected with said valve means to actuate a predetermined selection of said distributors, said electromagnetic valve means including a separate solenoid for each of said distributors, said circuit means comprising a closed loop series circuit including a power source and a switch and a character selection network consisting of a parallel connection of subnetworks equal in number to the number of said solenoids and each including a series connection of one of said solenoids and a switch, said switch comprising a semiconductor controlled rectifier with

associated circuit means to switch said rectifier on for a predetermined interval.

9. A character generation marking device comprising a plurality of liquid spray distributors each having a spray nozzle adapted to spray a line segment on an object to be marked, mounting means supporting said nozzles in cooperative arrangement with respect to one another to spray a segmented character master matrix on said object when simultaneously activated, fluid supply means connected with said distributors to supply marking fluid thereto, electromagnetic valve means operably coupled with said distributors to independently actuate the same, and electrical circuit means connected with said valve means to actuate a predetermined selection of said distributors, said electromagnetic valve means including a separate solenoid for each of said distributors, said circuit means comprising a closed loop series circuit including a power source and a switch and a character selection network consisting of a parallel connection of subnetworks equal in number to the number of said solenoids and each including a series connection of one of said solenoids and a switch, characterized in that said subnetwork switches are ganged rotary switches each having a number of switch positions equal to the number of characters to be generated, said switch positions of each of said rotary switches being selectively connected with its respective solenoid to successively generate a different character with each ganged switch position.

10. A character generation marking device comprising a plurality of liquid spray distributors each having a spray nozzle

adapted to spray a line segment on an object to be marked, mounting means supporting said nozzles in cooperative arrangement with respect to one another to spray a segmented character master matrix on said object when simultaneously activated, fluid supply means connected with said distributors to supply marking fluid thereto, electromagnetic valve means operably coupled with said distributors to independently actuate the same, and electrical circuit means connected with said valve means to actuate a predetermined selection of said distributors, said electromagnetic valve means including a separate solenoid for each of said distributors, said circuit means comprising a closed loop series circuit including a power source and a switch and a character selection network consisting of a parallel connection of subnetworks equal in number to the number of said solenoids and each including a series connection of one of said solenoids and a switch, characterized in that said subnetwork switches are operated by corresponding electromagnets, each of said electromagnets having one terminal end connected to one terminal of a power source, a plurality of character selection switches equal in number to the different characters to be generated and each having one end connected to the other terminal of said power source, each other end of each of said switches being connected to an independent selection of the other terminal ends of said electromagnets to generate the segmented character corresponding to each of said character selection switches.

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