

[54] **APPARATUS AND METHOD FOR PRODUCING A SILK SCREEN MATRIX**

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[52] U.S. Cl. **234/2, 101/128.4, 234/82**

[51] Int. Cl. **B41c 1/14**

[58] Field of Search **234/1, 2, 59, 89, 234/128, 129, 82, 83, 106, 107; 101/128.4**

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[57] **ABSTRACT**

A method and apparatus for producing a silk screen matrix wherein a master, having contrasting characters scribed thereon that are to be reproduced is scanned by an electronic scanning device. The scanning device converts light or dark images on the master to electronic impulses. These impulses are transmitted to a punching apparatus, where they are used to activate a punch, which may be pneumatically or mechanically powered. The punch either includes a single die that travels across a matrix of paper, or other suitable material, punching holes corresponding to the light or dark areas on the master as it travels, or it includes a plurality of individually operated dies arranged in series across the mat and arranged such that operation of the dies in response to sensing of light or dark by the scanning device will punch holes through the mat. Either disclosed apparatus will thereby produce a punched matrix suitable for use in a silk screen printing operation.

1 Claim, 7 Drawing Figures

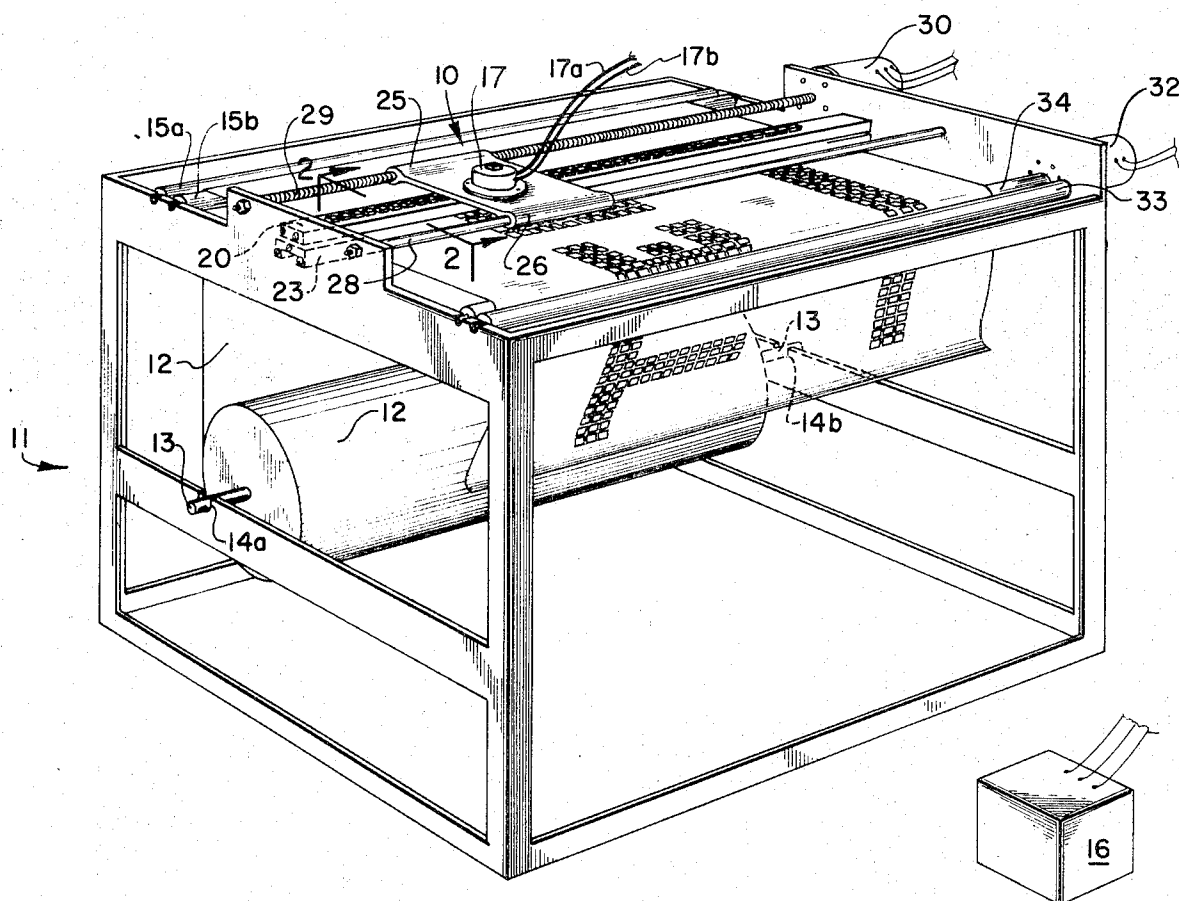


FIG 1

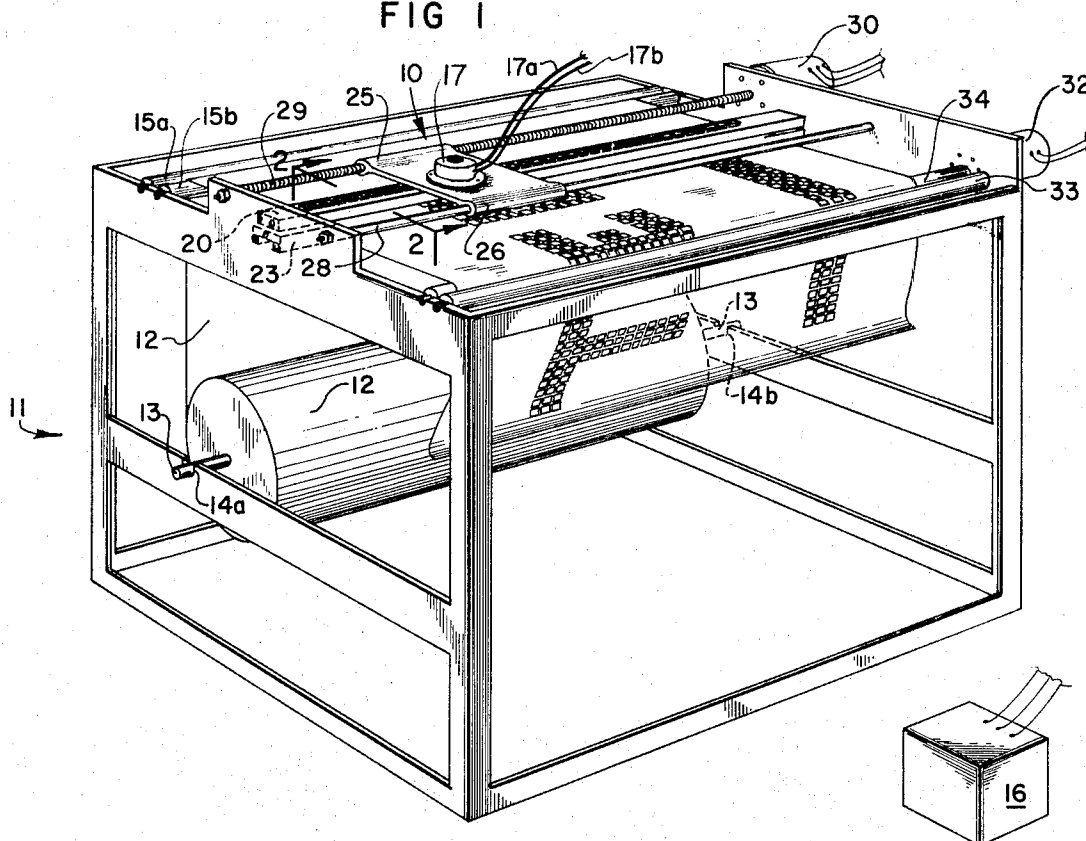
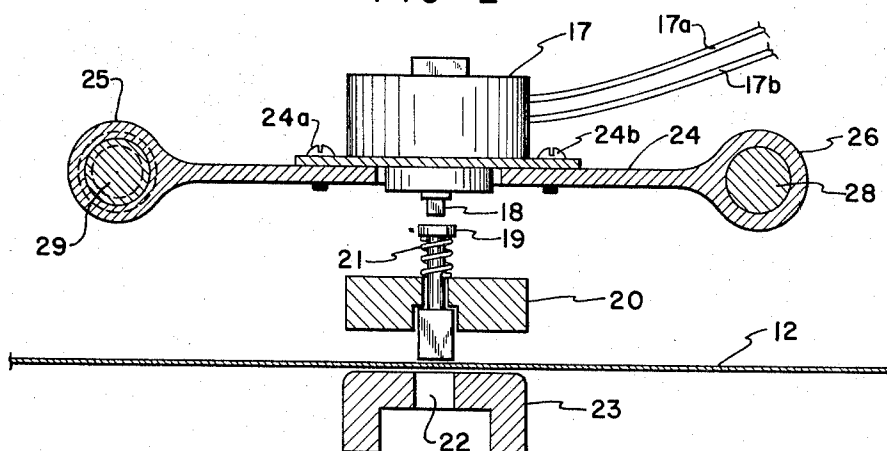


FIG 2



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FIG. 3

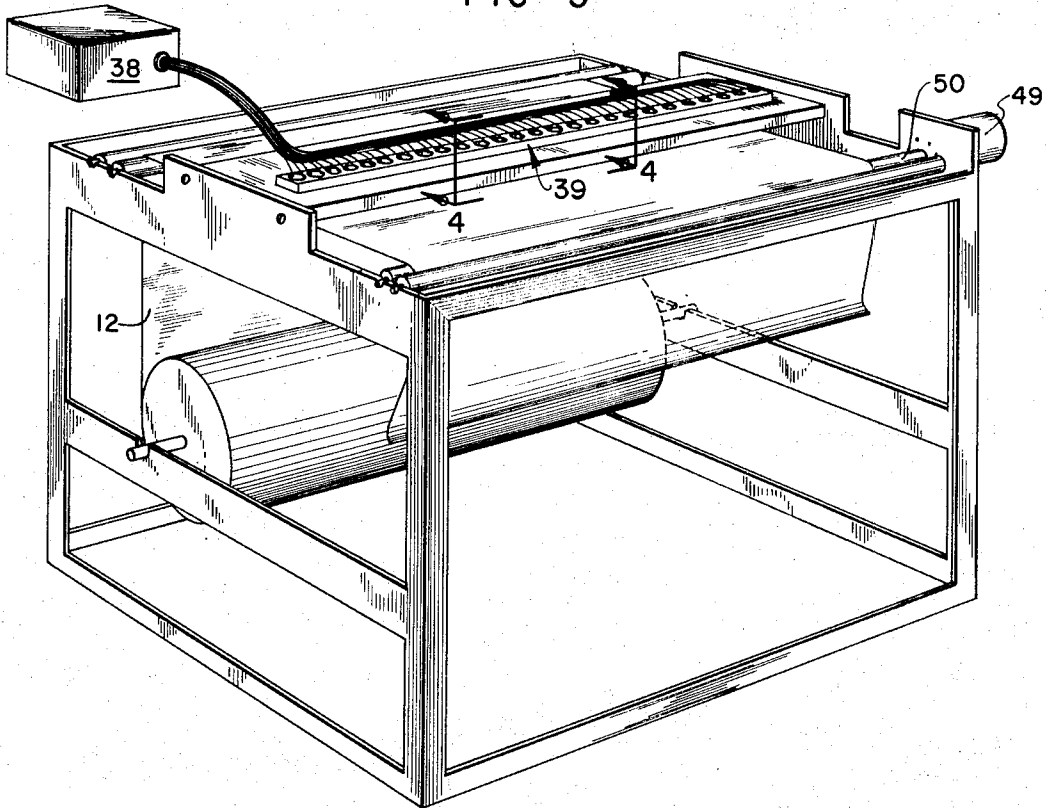


FIG 4

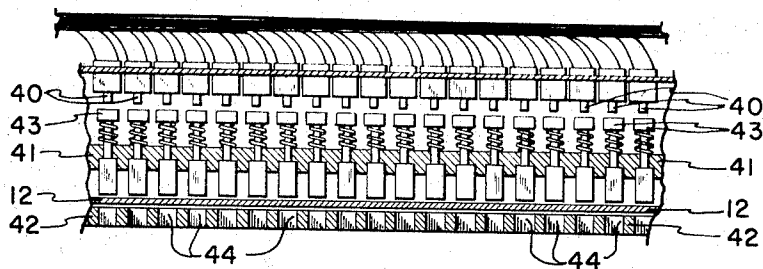
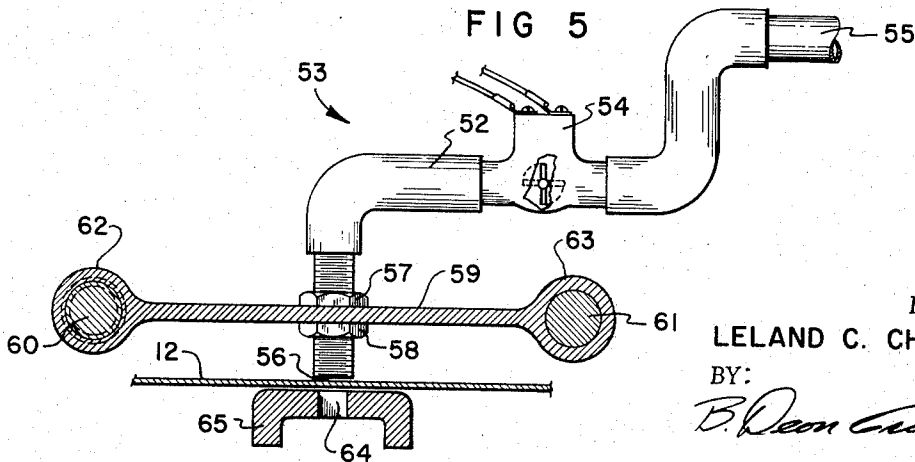


FIG 5



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FIG 6

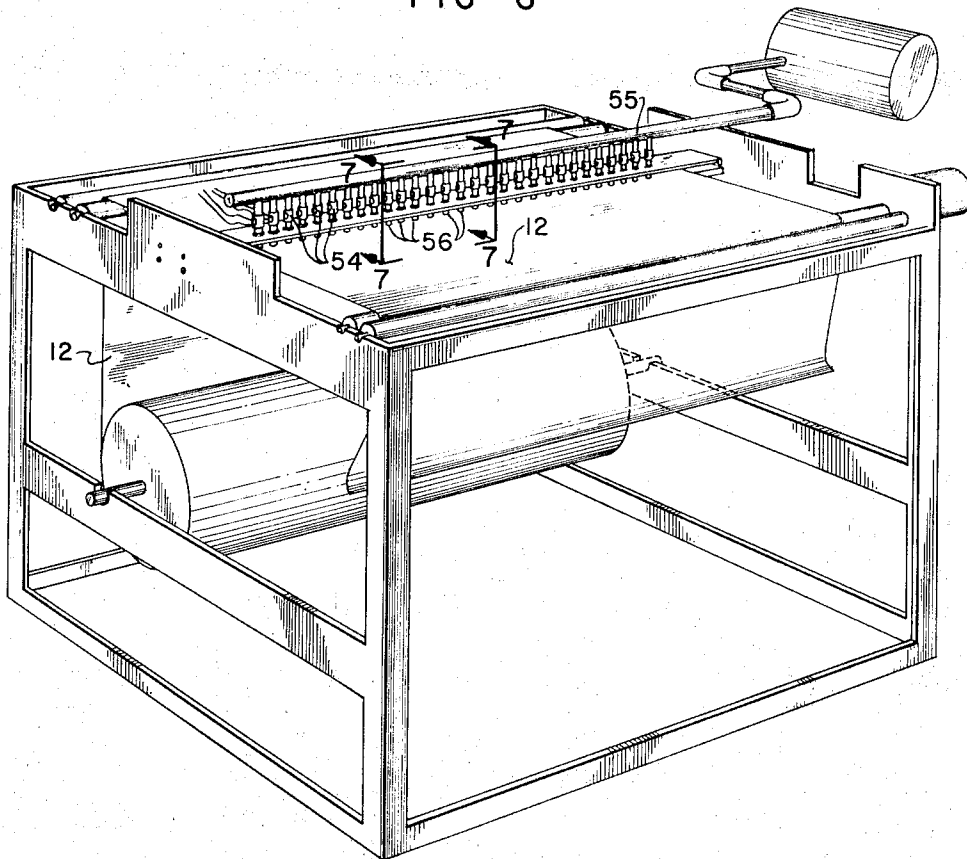
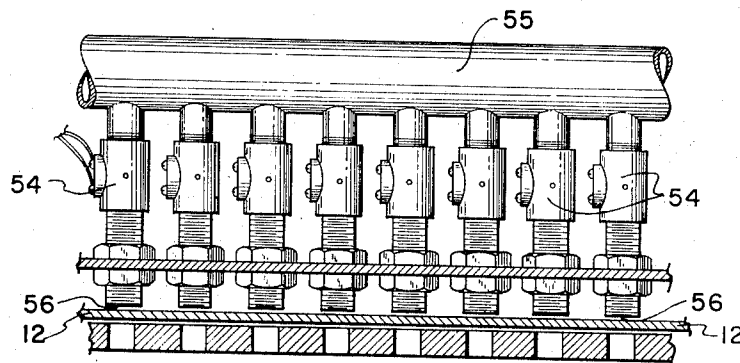


FIG 7



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APPARATUS AND METHOD FOR PRODUCING A SILK SCREEN MATRIX

BRIEF DESCRIPTION OF THE INVENTION

1. Field of the Invention

This invention relates to the production of a matrix suitable for use in a silk screen printing process.

2. Prior Art

The introduction of the printing press has been credited for launching the world into the industrial revolution. Since its inception printing has been practiced utilizing a multitude of devices and techniques, among them silk screen printing. Silk screen printing was originally developed by the Chinese at least 1,000 years ago, and has been utilized and perfected by them to a high degree for the production of art. Numerous refinements have been added to this printing technique since its acceptance in this country. Silk screen printing encompasses many processes and procedures such as, for example, a "photo silk screen process" which is slow and expensive, but which is capable of an extremely high quality reproduction even of full color photography. A method involving the cutting out of areas on a soluble plastic film produced for this purpose, and then adhering the film to the silk is also extensively used. The soluble film bonds itself to the silk, blocking out portions of the silk permanently or may be removed with the proper solvent for the type of film being used. A process devised by the orientals involves applying paint or other suitable material to the silk, thereby blocking out that portion of the silk. Another process utilizes a stencil or matrix having a design cut therein, which stencil or matrix is placed in a frame between a silk screen and the material to be printed. Silk screen paint or dye is applied to the screen and is distributed evenly thereon. The silk allows passage through to the stencil or matrix which passes said dye or paint to the material to be printed through holes cut therein. The result is a design that is both distinctive and attractive. The present invention constitutes an improvement in the known techniques involving silk screen printing.

Prior to the present invention the methods used in preparing the matrix or stencil have been generally difficult to employ and inefficient, with the quality of the finished matrix varying with the skill of the individual workers practicing the method. As the quality of the matrix controls or dictates the quality of the finished product, the value of the finished work has varied. The present invention eliminates the hand cutting of the design into the matrix. Rather, the process of matrix preparation is completely automated and there is produced in far less time than can be achieved by hand operations, a finished matrix of uniform quality for use in silk screen printing. The process and apparatus of the invention are especially useful in the production of posters and other large articles of printed materials. Artistry of a unique and original character can be obtained with the method and apparatus of the present invention.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide a method and an automated apparatus for electronically and mechanically producing a silk screen matrix directly from a master pattern.

Principal features of the present invention include the use of a conventional Xerox Photocopier II pro-

duced and sold by the Xerox Corporation, or similar electronic scanning device, to transform either the light or the dark portions of an original or master design to electrical impulses. These impulses are transmitted electronically to a hole punching means which acts across a width of matrix of paper, fabric, or other suitable sheet material as it is travelling through the apparatus. The punching means is automatically operated in accordance with the electrical impulses to punch holes in the matrix such that the pattern of punched holes then reproduces either the light or the dark areas of the master.

A variety of hole punching means have been found suitable for use. In the preferred embodiments, these are all solenoid activated with each operating to punch holes that correspond to either the light or dark areas of the master. In one embodiment, there is only one solenoid involved in the punching operation. This solenoid operates a hammer to strike the head of a selected punch that is one of a plurality of punches arranged in a punch bar extending across the width of matrix material as it travels beneath the punch means. The solenoid travels on a threaded track positioned above the punch bar striking the heads of the punches in accordance with the master design. In this embodiment, the speed of hole punching is governed by how fast the solenoid operated hammer can reciprocate across the paper but there is no physical restriction on the proximity of adjacent punches.

In another embodiment, the hole punching means comprises a number of aligned solenoid operated hammers which are fixed in position to extend across the width of the matrix material. Each hammer is positioned to operate a punch on a punch bar which also extends across the width of the matrix material. In this embodiment, as the matrix material is drawn through the assembly the stationary solenoid operated punches are electrically operated to punch holes corresponding to the light or dark areas of the master design. Punched matrixes can be produced much more rapidly in this embodiment as no solenoid movement is required, but it is more expensive due to the number of individual solenoid hammers that are needed and the physical arrangement of heads may limit the proximity of adjacent punches.

Still another embodiment of the hole punching means utilizes an air punch rather than the electro-mechanical punch previously described as being used in the hole punching means. This punch utilizes a high pressure jet of compressed air directed against a sharp edged backing member to punch a clean hole in the matrix material. The air jet can be programmed to reciprocate across the width of the material on a track, or it can consist of a number of jets arranged above the material and operated by the electronic scanning device to release jets of compressed air so as to punch holes corresponding to either a light or a dark portion of the master. This embodiment can effectively use solenoid operators to open and close valves controlling the entrance of compressed air into the air jet but other quick acting controls can be used.

It will be apparent that the apparatus can utilize punches of varying size to correspond to different sized light dark images sensed and that the size punch used can be selected from a plurality of sizes available for punching use. Thus, if the sensed signal indicates that one size punch should be used a corresponding punch

will be operated. If the next signal indicates that a different sized punch should be used, a different sized punch will next be operated. While not specifically shown, a rotating punch head having a plurality of punches of different size can be provided or the punches can be telescopically arranged such that a punch of selected size will be operated in response to a signal from a sensing device. Thus the same matrix may have punch holes therethrough of several different sizes corresponding to light-dark images of different sizes on the master.

Further objects and features of the invention will become apparent from the following detailed description, taken together with the accompanying drawings.

THE DRAWINGS

FIG. 1 is a perspective view of a hole punching apparatus consisting of one solenoid operated hammer which traverses the width of a sheet of matrix paper acting upon punches in a punch block;

FIG. 2, an enlarged section taken on the line 2—2 of FIG. 1, and showing the solenoid operated hammer acting upon a punch in the punch bar;

FIG. 3, a perspective view of a hole punching apparatus consisting of a number of stationary solenoids and hammers positioned so as to act upon punches in the punch bar; and

FIG. 4, an enlarged section taken on the line 4—4 of FIG. 3, and showing the row of fixed solenoid operated hammers acting upon punches in the punch bar;

FIG. 5, an enlarged view of a solenoid operated air punch positioned so as to operate to punch a hole in matrix paper;

FIG. 6, a perspective view of a hole punching apparatus consisting of a number of stationary solenoid operated air punches positioned so as to operate to punch holes in matrix paper; and

FIG. 7, an enlarged fragmentary section taken on the line 7—7 of FIG. 6, and showing the row of fixed solenoid operated air punches positioned to be operable to punch holes in a matrix material.

DETAILED DESCRIPTION

Referring now to the drawings:

FIG. 1 illustrates one preferred embodiment of a matrix punching apparatus of the present invention. The hole punching apparatus shown generally at 10, includes a frame 11 which supports a roll of matrix paper 12. The roll of matrix paper is mounted on an axle 13 that is journaled at its ends in notches 14a and 14b inside rolls of frame 11 so that the roll turns freely, thereby allowing the matrix paper 12 to be unrolled.

The matrix paper 12 travels over rollers 15a and 15b, that are also journaled between the side rails of frame 11, then travels through the proximity of the assemblies hold punching means shown generally at 10. As shown in FIGS. 1 and 2, the hole punching means consists of a single solenoid 17 which is electrically connected by wires 17a and 17b to a conventional electronic scanning device, shown schematically at 16. The solenoid 17, when electrically activated by signals from the scanning device, causes a hammer 18 (FIG. 2) to strike a punch 19, which is one of a number of punches in a punch bar 20 that is supported by frame 11 in such a manner that it extends over the width of matrix paper 12. A spring 21 normally biases punch 19 to a raised, retracted position, out of contact with the matrix paper

12 passing therebeneath. When a punch 19 is actuated to punch a hole in the matrix paper 12 it travels through the paper and into a hole 22, formed in a die or punch block 23 that is also supported by the frame 11, and beneath punch bar 20.

The solenoid 17 and hammer 18 are attached to a bracket 24 by screws 24a and 24b. The bracket 24 has parallel sleeves 25 and 26 at opposite sides thereof, and sleeve 26 is slidably telescoped over a rod 28 that is connected at both ends to the side rails of the frame. In operation the solenoid hammer assembly is guided by rod 28 to reciprocate above the punch bar 20. The solenoid hammer assembly is reciprocated by the rotation of a threaded rod 29 which is operated by a reversible motor 30 and that is threaded to cooperate with threads on the inside of sleeve 25.

Motor 30 is electrically connected to the electrical scanning device 16 which is also electrically connected to solenoid 17. Motor 30 turns threaded rod 29 to position the solenoid hammer assembly in conjunction with the sensed position of the electrical scanner. When the scanner senses an area programmed to cause a hole to be punched in matrix paper 12, a signal is transmitted to solenoid 17 which causes hammer 18 to strike the punch 19 then beneath it, forcing the punch through matrix paper 12. Thereafter, the punch 19 is retracted by its associated spring 21.

Another motor 32 drives a roller 34 which, along with idler roller 33, is journaled in the side rails of frame 11, motor 32 is also electrically connected to the electronic scanning device 16. On signal from the scanning device, motor 32 is operated, thereby turning drive roller 34 to pull matrix paper 12 through the hole punching assembly and between the drive and idler rollers 34 and 33. The direction of travel of bracket 24 is determined by the direction of rotation of motor 30, and this is determined by the sensing device 16. In practice the bracket is moved in one direction across the matrix, the matrix is stepped by operation of motor 32 and the bracket and solenoid and hammer carried thereby are moved in a reverse direction across the matrix.

In the embodiment shown in FIG. 3, an electronic scanning device 38 again transmits signals to means for moving a matrix paper 12, such that it can be acted upon by a hole punching assembly 39, and to the hole punching assembly. In this embodiment, as is shown best in FIG. 4, however, a plurality of solenoid operated hammers 40 (corresponding to hammer 18, previously described) are permanently positioned above a punch bar 41 and a punch block 42. The number of hammers corresponds to the number of individual punches 43 and to the holes 44 in the bar 41. The solenoid operated hammers 40 are permanently installed above and act upon the punch bar 41 and the punch block 42 so that no motor, such as the motor 30 of the previously described embodiment is needed and no threaded rod such as the rod 29 is required. A motor 49, corresponding to motor 32 previously described, is connected electrically to the electronic scanning device and turns a roller 50, thereby pulling matrix paper 12 through the punching assembly. Since no solenoid hammer travel is involved, in this embodiment, hammer actuation is more rapid than is possible in the first embodiment which utilizes a travelling solenoid hammer. However, the physical arrangement may dictate

the number of hammers, punch bars, and punch holes that can be used.

In still another embodiment of the invention, the hole punching assembly comprises a solenoid operated high pressure air punch. The punch of this embodiment is mounted on guide rods as in the other embodiments and can be installed so as to traverse the width of the matrix paper 12, as in the first described embodiment or can be one of a number of stationary air punches operated as in the second described embodiment. The distinction between the mechanical punch of the other described embodiments and the air punch of this embodiment is that the solenoid of the hole punching assembly, which is operated in response to a signal from an electronic scanning device, is connected to a valve. The valve, when opened, allows high pressure air flow from a compressed air source, not shown, through a header pipe and into and through a discharge orifice of the air punch, to act upon the matrix paper 12. This causes a shearing effect of the paper as it contacts the edges of an opposed hole in the punch block and leaves a hole in the paper of the same size and shape as in the punch block.

As shown in FIGS. 6 and 7, a plurality of discharge orifices 56 can be connected to a single header 55 such that they extend completely across the matrix paper 12 and that each orifice can be controlled by a separate valve 54. The valves 54 are operated in response to signals from the electronic scanning device such as is shown at 38 in FIG. 2. In this embodiment, as with the embodiment of FIG. 3, a fast response can be obtained, since the hole punching assembly does not have to move, but, also like the embodiment of FIG. 3, the physical arrangement of structure may dictate the distance between punches.

Alternatively as in the embodiment of FIGS. 1 and 2, a single punch can be used for the hole punching assembly 53. In this case, as shown in FIG. 5, a single discharge orifice 56 is arranged to reciprocate transversely to the direction of travel of matrix paper 12. The orifice 56 is exteriorly threaded and is fixed by nuts 57 and 58 to a bracket 59, (corresponding to the bracket 24 of FIGS. 1 and 2) that is guided by rods 60 and 61 passed through parallel sleeves 62 and 63 of the bracket and that is driven by engagement of interior

threads of sleeve 62 meshing with threads on rod 60. When compressed air is introduced through a valve 54, orifice 56 directs it through an oppositely positioned hole 64 in a punch block 65, thereby making a punched hole in the matrix paper 12 which passes between orifice 56 and hole 64. Rod 60 is driven in the same manner as is rod 29, previously described by a motor, not shown. A flexible conduit allows free travel of the hole punching assembly, while insuring air flow to the orifice. The valves used may be solenoid operated, in response to signals from the electrical scanning device, and can be of any conventional quick opening type.

While particular hole punching apparatus have been herein disclosed, and these apparatus are preferred for many purposes, other methods of punching holes in a paper to create a matrix or stencil conforming to a master design in response to an electrical sensing of said master design can be used to practice the method of the invention, which method I regard as my invention. For example, a movable punch and a correspondingly movable punch block (not shown) may be used to provide a system with wide versatility since it does not require punching at pre-set locations.

Although preferred forms of apparatus of my invention have been herein disclosed, it is to be understood that the present disclosure is by way of example and that variations are possible without departing from the subject matter coming within the scope of the following claims, which subject matter I regard as my invention.

I claim:

1. A method of producing a silk screen matrix from an imaged master comprising
 - sensing the images of a master to be copied;
 - generating electrical signals corresponding to the sensed images;
 - transmitting said electrical signals on a row-by-row basis to punch means; and
 - feeding a matrix suitable for use in silk screen printing past said punch means such that said punch means is operated by said electrical signals to punch holes through the said matrix on a row-by-row basis, with each hole corresponding to a portion of a sensed image in a corresponding row on the master.

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