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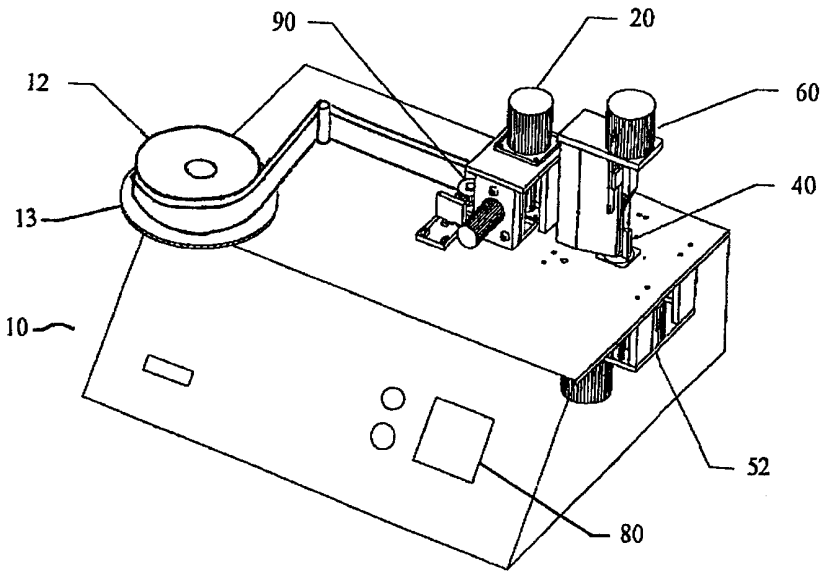
(54) Title: AUTOMATIC RETAINER BENDING MACHINE FOR CHANNEL LETTERS



(57) Abstract: In a machine for automatically forming a retainer for a channel letter, a desired configuration of the channel letter is input into a controller. The controller controls the feed of a strip of retainer material into the machine and the bending of the strip of retainer material into the desired shape. At least one feed assembly feeds the material along a material feed path of the machine. A bending assembly bends the strip of material into the desired form, with the bending arm moving from one side to the other of the material as necessary. The bending assembly incorporates a bending clamp that generally matches the profile of the strip of retainer material. The material is cut at a cutting assembly when the length of the material needed for the formation of the retainer has been fed to the appropriate point at the cutting assembly along the material feed path.

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AUTOMATIC RETAINER BENDING MACHINE FOR CHANNEL LETTERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a machine for bending a strip of retainer material to form a retainer for channel letters for signs, wherein the retainer couples the face of the channel letters to the outside skins of the channel letters. More particularly, the present invention relates to a machine that can automatically feed, bend, and cut a strip of retainer material, thereby forming the strip of retainer material into a retainer configured to follow the perimeter of any given channel letter. Even more particularly, this invention can automatically configure a strip of retainer material to the perimeter of a given channel letter while minimizing undesirable deformations and stresses in the finished retainer.

U.S. Patent No. 5,881,591, filed August 13, 1996 is hereby incorporated herein by reference in its entirety.

2. Related Art

At most shopping strip malls, restaurants and other stores, the main electrically illuminated sign which is out front, typically displaying the name of the business, will be made of channel letters. Each channel letter is composed of a front face that is usually made of plastic, and can be any of various colors. The front face forms the letter seen by the public in viewing the sign. Each channel letter also has a back, which is commonly made of aluminum. The front face and back can be cut manually or by using computer controlled routers. Between the front and the back, however, there is an outside skin, usually made of metal, connecting the front face and the back. A retainer attaches the front face to the outside skin.

The outside skin is usually made of metal. The outside skin has to be formed into the shape of the letter that matches the same shape of the cut out front face and back.

The retainer is usually made of an extruded plastic strip that normally has a thin metal strip molded into it. Similar, to the outside skin, the retainer has to be formed into the shape of the letter that matches the same shape of the cut out front face and back. To date, all of the retainers of channel letters are manually bent. This is a very labor intensive job, and for this reason channel letters make up the highest dollar segment of the multi-billion dollar sign industry.

Various apparatus are known in the prior art for bending sheet or sheet-like material. In one related attempt, a method and apparatus for bending steel rule is disclosed in which a coil of steel rule material is unwound and fed to a notcher/cutter that cuts notches in the rule at selected locations prior to bending. The rule is then bent by a clamping device holding the rule and a bending tool rotating to bend the rule. The bending tool can be positioned on either side of the rule for making bends in opposite directions. Other bending devices are known that are similar in operation.

In other related attempts, bending mechanisms that operate slightly differently from that described above are disclosed. For instance, a strip of material is passed through a clamping or holding portion, and a bending portion can be relatively rotated in either rotary direction to cause the bend of the material to occur.

In even other related attempts, various methods of bending metal materials which also include the formation of notches in the material to aid in the bending are disclosed.

However, none of the above-disclosed apparatus and methods for bending metal materials are suitable for forming the retainers for channel letters. Retainers are typically formed from an extruded plastic strip that normally has a thin metal strip molded into it. The extruded plastic strip typically has a small lip or overhang at one edge, thus forming a non-flat profile on one side of the strip. None of the above described devices can automatically form a strip of retainer material having such a non-flat profile into a retainer for channel letters without undesirably stressing or deforming the strip of retainer material.

SUMMARY OF THE INVENTION

In view of the above-described deficiencies of the prior art recognized by the present inventors, it is a primary object of the present invention to provide a retainer bending machine that is capable of automatically forming the retainers of channel letters. It is a corresponding object of the invention to provide a retainer bending machine and a method of operating such a machine that avoids the necessity of intensive manual labor for bending the retainers of channel letters so as to save labor costs in the manufacture of signs.

A machine for forming a retainer for channel letters is provided and generally includes a material feed assembly, a bending assembly, a cutter assembly, and a controller device.

According to a first aspect of the invention, the machine forms a retainer for channel letters from a roll of retainer material. According to a second aspect of the invention, the machine forms a retainer for channel letters from a roll of retainer material and the retainer material has at least one profile that includes a flat portion and a lip portion.

According to a further aspect of the invention, the material feed assembly feeds a strip of retainer material from the roll of retainer material. The feed assembly has at least one feed roller. The feed roller may have a profile that complements the flat portion of the strip of retainer material.

According to another aspect of the invention, the bending assembly receives the strip of retainer material from the feed assembly and bends the strip of retainer material. The bending assembly may have at least one bending clamp and the bending clamp may have a profile that generally matches, or complements, the profile of the retainer material. The bending assembly may also have at least one bending head and the bending head may also have a profile that generally matches, or complements, the profile of the retainer material.

In an additional aspect of the invention, the cutter assembly cuts the strip of retainer material.

The machine of the present invention may also be provided with an encoder and a computer controller. The encoder may be electronically or otherwise coupled to the material feed assembly for measuring the feed of the strip of retainer material. The computer controller may control the material feed assembly, the bending assembly and/or the cutter assembly.

In an even further aspect of the invention a method is provided for forming a retainer for channel letters from a retainer material having a profile. The method includes feeding the retainer material with a material feed assembly, stopping the retainer material at a predetermined point, bending the retainer material with a bending assembly, and cutting the retainer material with a cutter assembly. These steps may be repeated to form a retainer having multiple bends.

In a further aspect of the invention the material feed assembly is controlled by a controller, the bending assembly is controlled by a controller, and the cutter assembly is controlled by a controller.

In other aspects, the the bending assembly includes a bending arm having a bending arm profile that generally matches at least a portion of the profile of the retainer material, and the material feed assembly includes a feed roller, the feed roller having a material feed profile that generally matches at least a portion of the profile of the retainer material.

Additional objects and advantages of the invention will become apparent to those skilled in the art upon reference to the detailed description taken in conjunction with the provided Figures.

Besides the structural arrangements and procedural aspects described above, the invention could include a number of arrangements, such as those explained hereinafter. It is to be understood that both the foregoing description and the following description are exemplary, and are intended to proved further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention. In the drawings,

Fig. 1 is a perspective view of a machine according to one preferred embodiment of the invention;

Fig. 2 is a perspective view of a material feed assembly of the embodiment of Fig. 1;

Fig. 3 is a perspective view of a portion of the bending assembly of the embodiment of Fig. 1;

Fig. 4 is a perspective view of another portion of the bending assembly of the embodiment of Fig. 1;

Fig. 5 is a perspective view of a cutting assembly of the embodiment of Fig. 1; and

Fig. 6 is a perspective view of an encoder of the embodiment of Fig. 1.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

According to a preferred embodiment of the invention, there is provided a retainer bending machine 10 that has a supply of retainer material 12 to be bent. As shown in Fig. 1, the retainer bending machine 10 has a material feed assembly 20, a bending assembly 40 and a cutting assembly 60. At least one material feed assembly 20 is disposed along the path of travel of the material 12 to be bent so as to feed the material 12 along the path of travel. The bending assembly 40 bends the material 12 into the appropriate letter shape for the retainer. The cutting assembly 60 is typically disposed downstream of the bending assembly 40 for cutting the material 12.

In a preferred embodiment, the supply of material 12 comprises a roll of retaining material which is positioned on a motorized or free spinning rotary material feed table 13. The material 12 is fed into the material feed assembly 20. Typically, the retaining material 12 has a profile 14 other than a flat profile, as best shown in Fig. 6. The present invention may operate with any of a variety of retaining material profiles, including flat.

As shown in Fig. 2, the material feed assembly 20 preferably has a driven feed roller 22 that is positioned on one side of the path of travel, with the feed roller 22 being connected to a motor 24 for rotation thereof. A press roller 26 may be disposed on the other side of the path of travel, the press roller 26 being mounted for pressing movement toward the feed roller 22 so as to be able to hold the material 12 against the feed roller 22 such that the driven feed roller 22 can feed the material. Preferably, the press roller 26 is movably mounted on linear bearings for linear movement toward and away from the driven feed roller 22. A fluid cylinder or motor 28 having rods or guides 25 thereof connected to the press roller 26 may be used to move the press roller toward or away from the feed roller 22.

In a preferred embodiment, the press roller 26 of the material feed assembly 20 is provided with a functional profile 30. The profile 30 of the press roller 26 preferably complements, at least partially, the profile 14 of the retaining material 12. Typically, the profile 30 would be formed so as to, at least partially, contact and roll on the flat portion, if any, of the profile 14 of the strip of retaining material 12. This would aid in maintaining the accuracy of the feeding of the retaining material.

In another preferred embodiment, the bending assembly 40, as shown in Fig. 3, may include a fixed support 42 that is positioned adjacent to the path of travel of the strip of material 12. The bending assembly 40 may also include a movable clamping support 44 that can move relative to the fixed support 42 and relative to the material 12. In a preferred embodiment, the clamping support 44 moves perpendicular to the path of the material. The bending assembly 40 may also include a movable bending arm 46 that is movable across the path of travel of the material 12 in order to bend the retainer material 12. The movable bending arm 46 may bend the material, for instance, against

either the fixed support 42 or the clamping support 44. A motor 55 may move the bending arm 46 to bend the material 12.

In a preferred embodiment, the bending arm 46 has a special shape or profile 49 to complement or match, at least partially, the profile 14 of the strip of retainer material 12. This aids in attaining accurate, non-distorted bending of the final retainer shape.

The movable bending arm 46 is preferably mounted on a rotatable base 48, as shown in Fig. 4, for movement across the path of travel of the material. The rotatable base 48 is rotatably mounted on a platform 52 below the material 12 to be bent. The platform 52 is movable in a direction along the axis of rotation of the rotatable base 48. Thus, for instance, platform 52 moves up and down and base 48 is rotatably mounted to platform 52. The bending arm 46 can rotate from one side of the material 12 at the bending assembly 40 to the other side of the material. The bending arm 46 is fixed at one end thereof to the rotatable base 48.

The bending arm 46 preferably includes a removable, replaceable bending head 47. The bending head 47 may have the special shape or profile 49 to match or complement, at least partially, the profile 14 of the strip of retainer material 12. Preferably the bending head 47 can accommodate the different sizes and/or shapes of plastic extrusions of the retainer material 12. The profile 49 of the bending head 47 aids in accurately bending the retainer material 12 and prevents deformation of the retaining material 12 due to the applied pressure of the bending arm 46 during the bending operation.

Furthermore, the movable clamping support 44 is preferably positioned on a side of the path of travel opposite to the side of the path of travel at which the fixed support 42 is located. A fluid cylinder or motor 53 may be fixedly mounted to a frame 51 and connected to the movable support 44 for movement of the movable clamping support 44 toward and away from the fixed support 42.

The bending assembly 40 preferably includes a frame 51 for mounting the various components thereof. Guide mechanisms may be mounted on the frame 51 for guiding the material 12 to be bent along the material feed path adjacent the bending assembly 40.

The movable platform 52, as shown in Fig. 4, of the bending assembly 40 is preferably movable between a first position in which the bending arm 46 is adjacent to the material feed path and a second position in which the bending arm 46 is remote from the material feed path. The platform 52 is mounted to a platform base plate 51 via supports 59. The bending arm 46 may thus be moved between the one and the other position thereof of the rotatable base 48 when the movable platform 52 is in the second position without interfering with any material 12 that is located at the bending assembly 40. Linear guides 50 are preferably used to guide the platform 52 as it is raised or lowered. This allows the bending arm 46 to re-position itself on one side of the material 12 or the other for, for instance, bending the material clockwise or counter-clockwise. The platform 52 may be is raised or lowered, for instance, by the use of an air cylinder 57. Alternatively, this raising or lowering may also be accomplished by the use of motor drives.

The bending arm 46, fixed to a movable or rotatable base 48, may be driven, preferably rotatably, by a motor 55 connected with the base 48 when in position for performing the bending operation.

In a preferred embodiment as shown in Fig. 5, the cutting assembly 60 may include a knife 62 or other cutting device that is movably mounted for movement across the path of travel of the retaining material 12. One or more support members 64 may be located beside the path of travel of the material 12. In a preferred embodiment, a pair of support members 64 are positioned on opposite sides of the path of travel of the material. These support members 64 may define a channel 66 or slit therebetween for receiving the material 12 therethrough. The knife 62 or other cutting device may be mounted on one side of the support members 64 adjacent to the channel 66 or slit. A fluid cylinder or motor 68 may be connected to the knife 62 for linear movement of the knife 62 across the channel 66 or slit for cutting the material. Other non-linear movements of the cutting device may also be performed.

Prior to the cutting operation, the material 12 is preferably positioned and/or clamped at or near the position of the cut. This clamp, as discussed above, preferably has a unique profile to complement or match, at least partially, the profile 14 of the strip

of retainer material 12. Matching the profiles aids in the manufacture of an accurate, distortion free cut and bend.

In a preferred embodiment, the material feed assembly 20, the bending assembly 40 and the cutter assembly 60 may receive information from a controller 80, as schematically illustrated in Fig. 1. The controller 80 preferably includes a computer. Controller 80 may, among other things, direct the material feed assembly 20 to feed a certain amount of retainer material 12 at a given rate and/or to a predetermined length or point. Controller 80 may also, among other things, direct the bending assembly 40 to bend the material 12 the appropriate amount and in the appropriate direction. For instance, the bending arm 46 may be directly attached to a motor that may be controlled by controller 80 to rotate the bending arm 46 in either a clockwise or a counter-clockwise direction. The bending arm 46 and motor 55 may be attached to a platform 52 that may be controlled by the controller 80 so as to be raised or lowered. Moreover, the controller 80 may, among other things, direct the cutter assembly 60 to fire or release the knife 62 or cutting device, cut the material 12 and retract.

With the above-described apparatus, a strip of retainer material 12 can automatically be bent into a described configuration or shape corresponding to the perimeter or a portion of the perimeter of a channel letter. The finished retainer may comprise the whole channel letter or merely one piece of the channel letter. In a preferred embodiment, the desired configuration of the retainer for the channel letter is input into the controller 80. This may be done, for example, graphically via the use of a graphics package, or by inputting specific coordinate points used to define the letter. As discussed above, the controller 80 may control the feed of a strip of the retainer material 12 from the supply of retainer material to the bending assembly 40. The bending assembly 40 may also be controlled by the controller 80 to bend the material 12. The strip of material 12 is cut at the cutting assembly 60 when appropriate, i.e. when the last section of material necessary for the retainer of the letter being formed has been fed to the cutting assembly 60. As discussed above, this cutting assembly 60 may also be controlled by the controller 80.

Interface software may read and interpret, for instance, a standard CADCAM file generated from a graphics program. This CADCAM file may contain information used to define a particular graphic. The software preferably would allow the user to select starting and ending points for shapes to determine the appropriate portions of a shape to layout and bend. The software may then manipulate the inputted information, and derive any additional information necessary to create a process ready output file. The software, preferably then would place the information in a format which may then be sent to the retainer bending machine to process the final results.

In a preferred embodiment, the primary logic control for the machine are the controller electronics. The main component would be the controller which interprets the design criteria for a letter and sends the appropriate signals to the motors driving the feed, bending and cutting assemblies.

The feed assembly 20, for instance, receives information from the controller 80 which will direct the motors to feed the material the exact amount, in the correct direction. The assembly may consist of pinch rollers which are engaged by the feed rollers. The accurate positioning of the motors may be accomplished through the use of a feedback encoder 90, as shown in Fig. 6. Such a feedback encoder 90 may be attached to an encoder roller 92 which is preferably pushed firmly against the strip of retainer material 12 by a spring-loaded retainer 94. Retainer material 12 is held in place by back stop 96. As the retainer material 12 moves, the encoder roller 92 would allow the encoder 90 to also move, thus generating the necessary feedback for the controller to control the accurate positioning of the strip of retainer material 12.

By repeating the above steps, the retainer of a channel letter could be automatically formed to whatever letter or character configuration is desired by simply feeding the material where appropriate, positioning the bending arm on the proper side of the material, and bending to the appropriate degree at each point where the material needs to be bent to form the selected character. This process can be entirely controlled by the controller 80. Accordingly, the present invention avoids the necessity of manual bending of a strip of material.

It will be apparent to those skilled in the art that various modifications and variations can be made to the structure and methodology of the present invention without departing from the scope or spirit of the invention. For instance, the cutter assembly need not be located downstream of the bending assembly, more than one material feed assembly may be utilized, and components that are describe above as being rotatable need not rotate, but may be movable via non-rotation mechanisms, and vice versa. Thus, it should be understood that the invention is not limited to the examples discussed in the specification. Rather, the present invention is intended to cover modifications and variations of this invention, provided they fall within the scope of the following claims and their equivalents.

I claim:

1. A machine for forming a retainer for channel letters, the retainer material having a profile, the machine comprising:

a material feed assembly for feeding the retainer material;

a bending assembly for receiving the retainer material from the feed assembly and for bending the retainer material; and

a cutter assembly for cutting the retainer material.

2. The machine of claim 1, further comprising a controller.

3. The machine of claim 2 further comprising:

an encoder coupled to the material feed assembly for measuring the feed of the retainer material, the encoder providing information to the controller.

4. The machine of claim 2, wherein the controller includes a computer.

5. The machine of claim 4, wherein the controller controls the material feed assembly.

6. The machine of claim 4, wherein the controller controls the bending assembly.

7. The machine of claim 4, wherein the controller controls the cutting assembly.

8. The machine of claim 1, wherein the material feed assembly includes a feed roller, the feed roller having a material feed profile that generally matches at least a portion of the profile of the retainer material.

9. The machine of claim 2, wherein the feed roller is driven by a motor, said motor being controllable by the controller.

10. The machine of claim 1, wherein the bending assembly has at least one movable bending arm having a bending arm profile that generally matches at least a portion of the profile of the retainer material.

11. The machine of claim 10, wherein the bending arm includes a removable and replaceable bending head, the bending head being provided with the bending arm profile.

12. The machine of claim 10, wherein the bending assembly includes a movable platform for mounting the bending arm, the platform configured for movement from a first position adjacent the retainer material to a second position remote from the retainer material.

13. The machine of claim 12, wherein the bending arm is rotatably mounted to the platform.

14. The machine of claim 12, wherein the platform is configured for movement to a third position adjacent the retainer material and opposite the retainer material from the first position.

15. The machine of claim 10, wherein the bending assembly has at least one movable clamping arm having a clamping arm profile that generally matches at least a portion of the profile of the retainer material.

16. A method of forming a retainer for channel letters, the retainer material having a profile, the method including:

feeding the retainer material with a material feed assembly;

stopping the retainer material at a predetermined point;

bending the retainer material with a bending assembly; and

cutting the retainer material with a cutter assembly.

17. The method of claim 16, wherein the steps of feeding, stopping and bending are repeated to form a retainer having multiple bends.

18. The method of claim 17, wherein the material feed assembly is controlled by a controller, the bending assembly is controlled by a controller, and the cutter assembly is controlled by a controller.

19. The method of claim 18, wherein the bending assembly includes a bending arm having a bending arm profile that generally matches at least a portion of the profile of the retainer material.

20. The method of claim 18, wherein the material feed assembly includes a feed roller, the feed roller having a material feed profile that generally matches at least a portion of the profile of the retainer material.

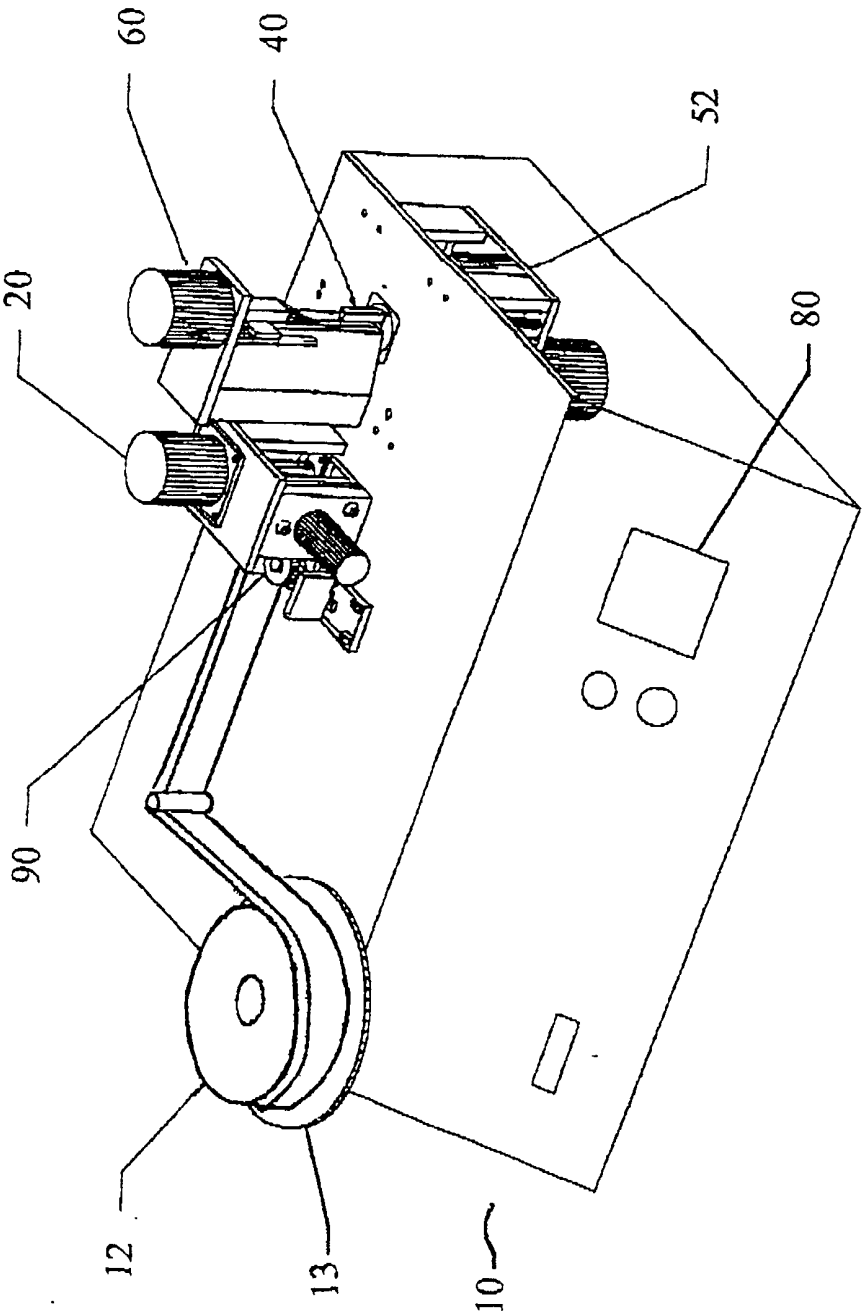

FIG. 1

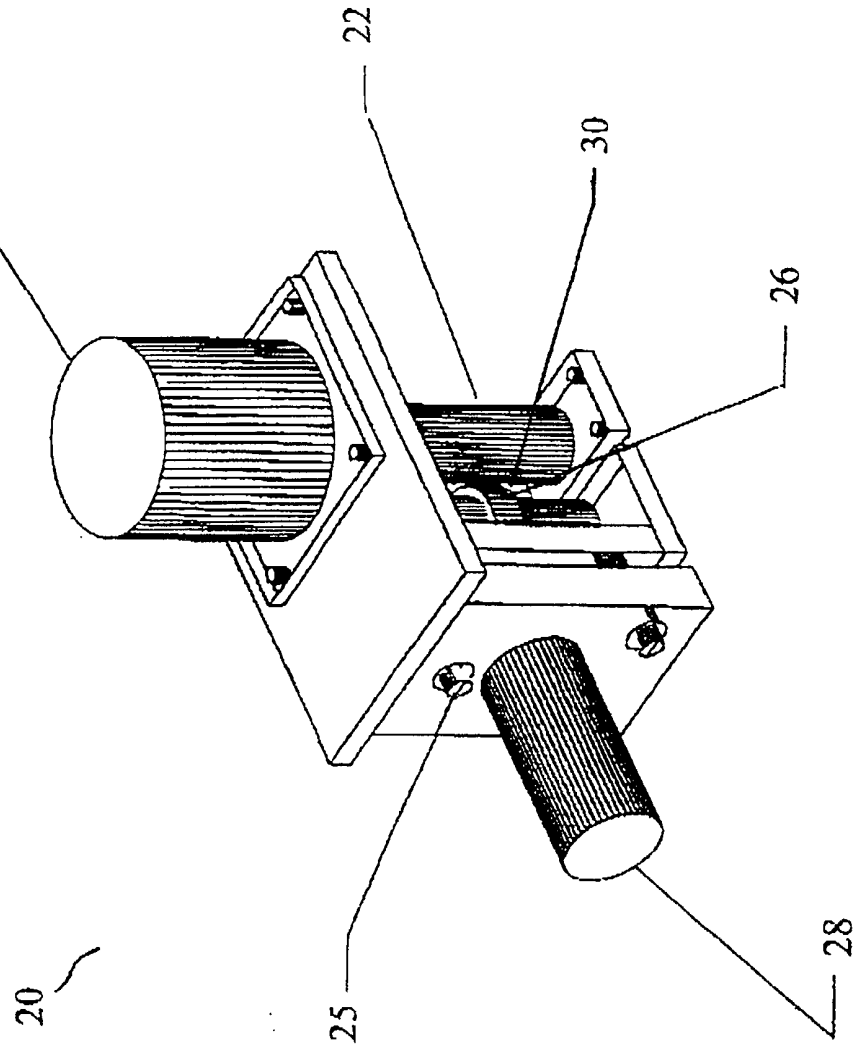

FIG. 2

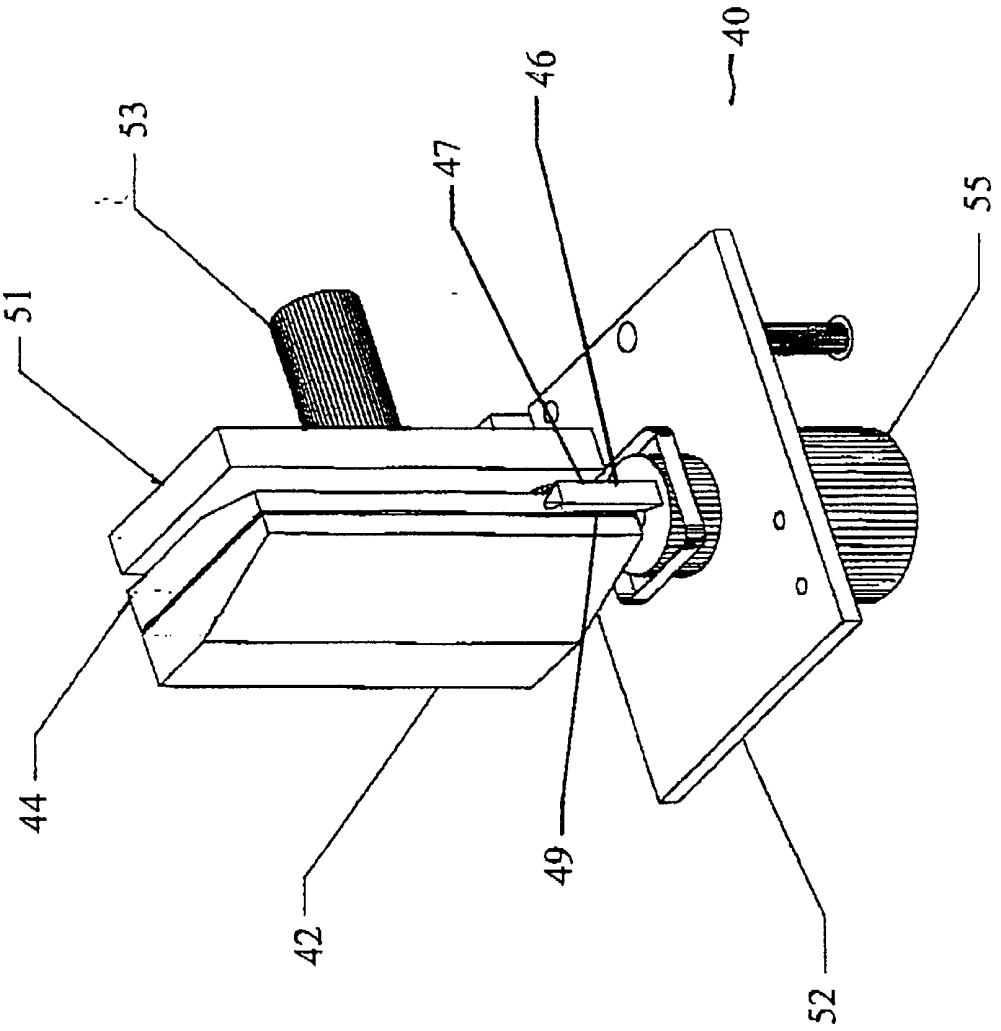

FIG. 3

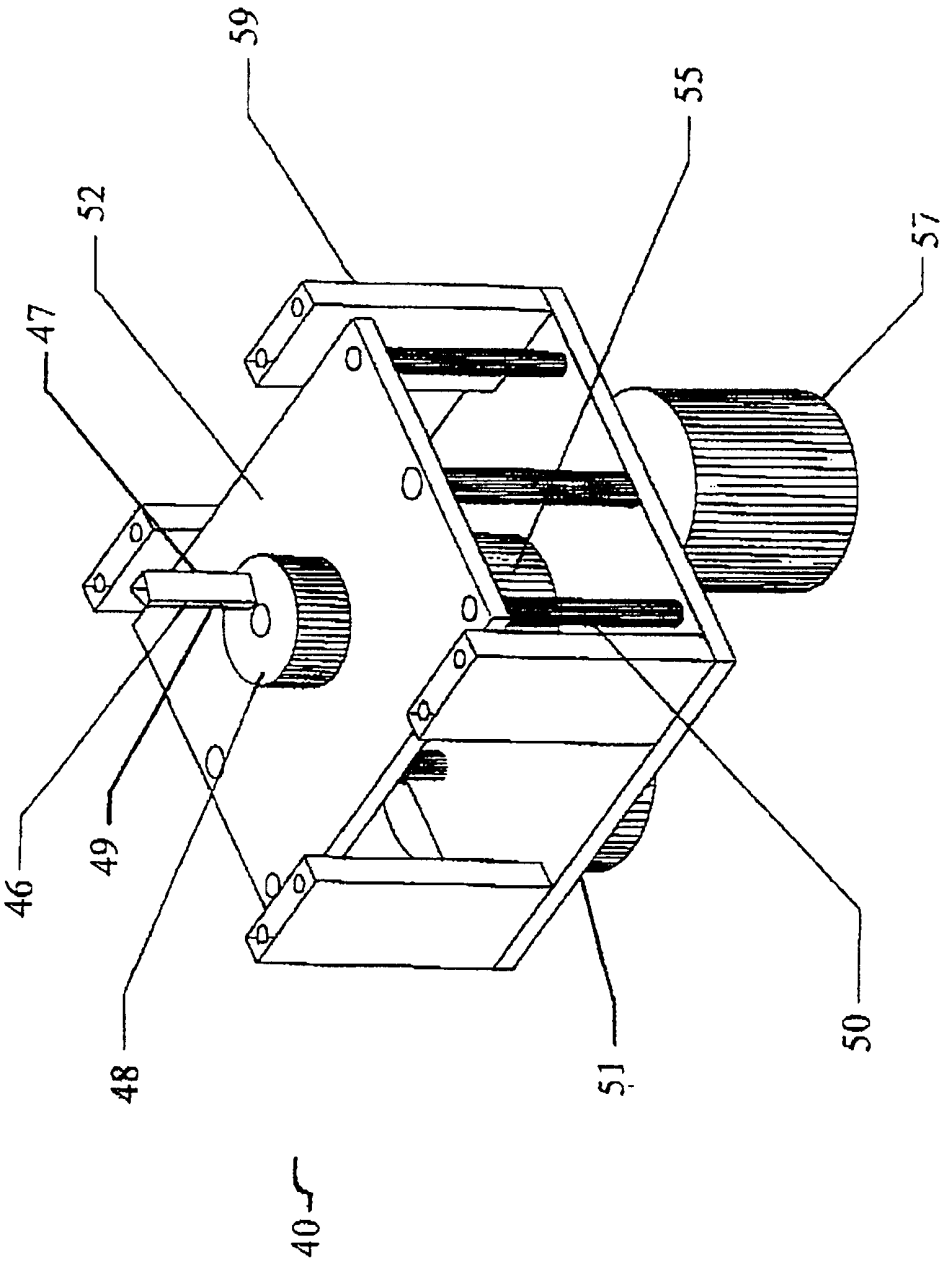

FIG. 4

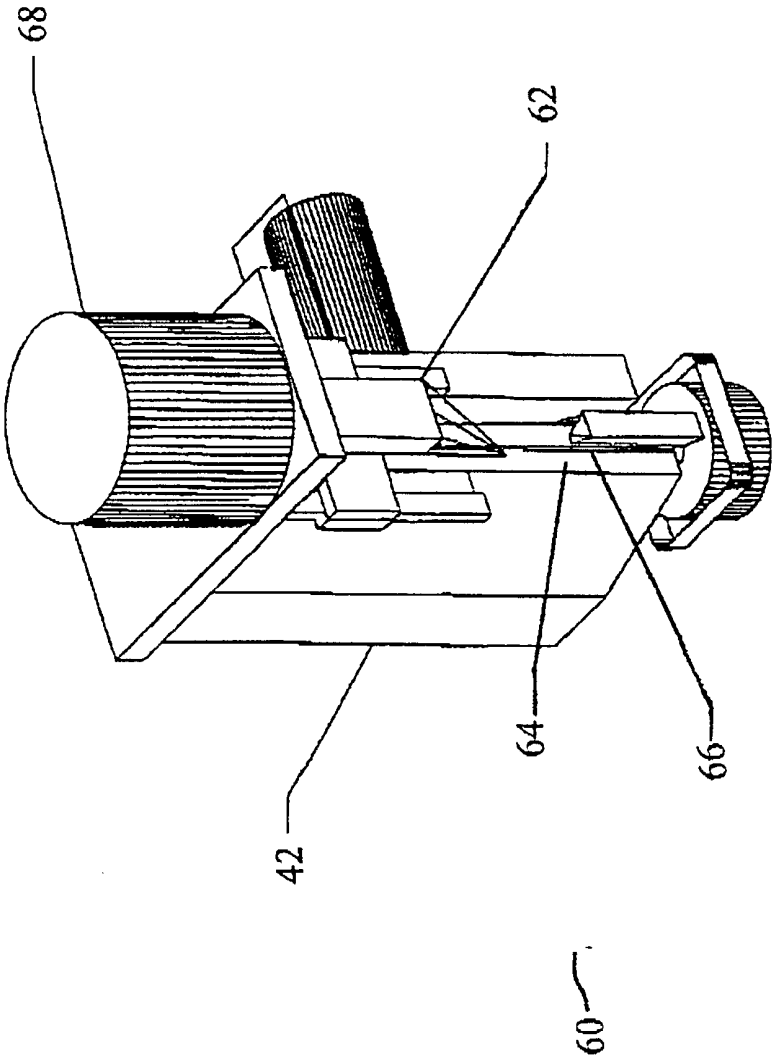

FIG. 5

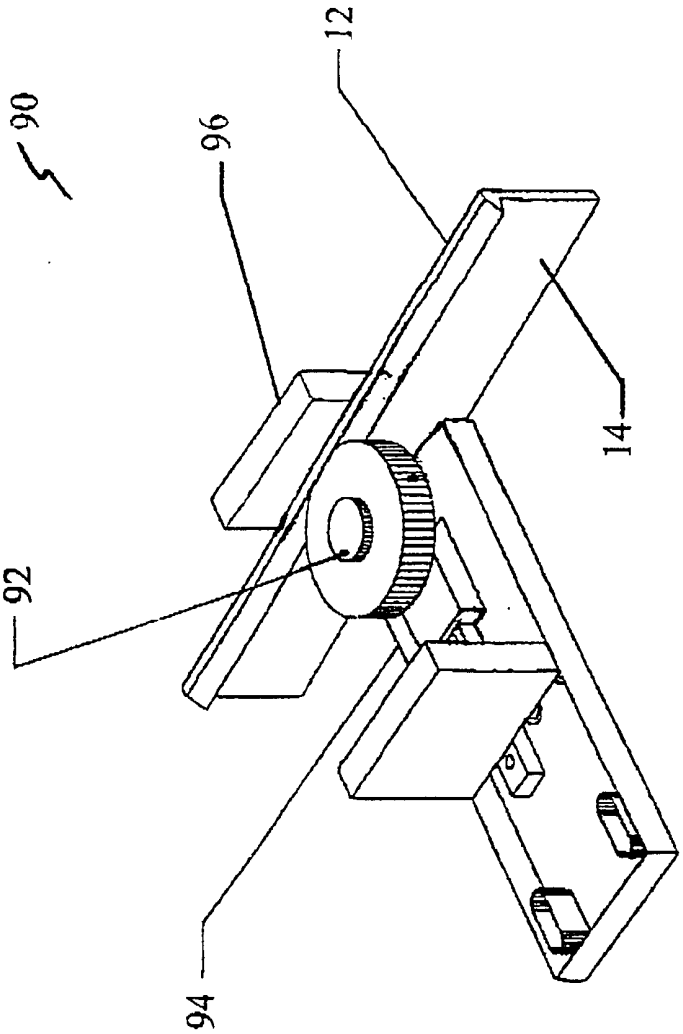

FIG. 6

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 00/25978

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B21D11/10 G09F13/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B21D G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 06516 A (ONDRACEK CARL) 19 February 1998 (1998-02-19) cited in the application	1-19
A	the whole document	20

X	US 5 697 138 A (SCHMITT DAVID ET AL) 16 December 1997 (1997-12-16)	1-19
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A	US 4 562 754 A (ARCHER JOHN R ET AL) 7 January 1986 (1986-01-07) the whole document	20

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 December 2000	02/01/2001

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Inte onal Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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