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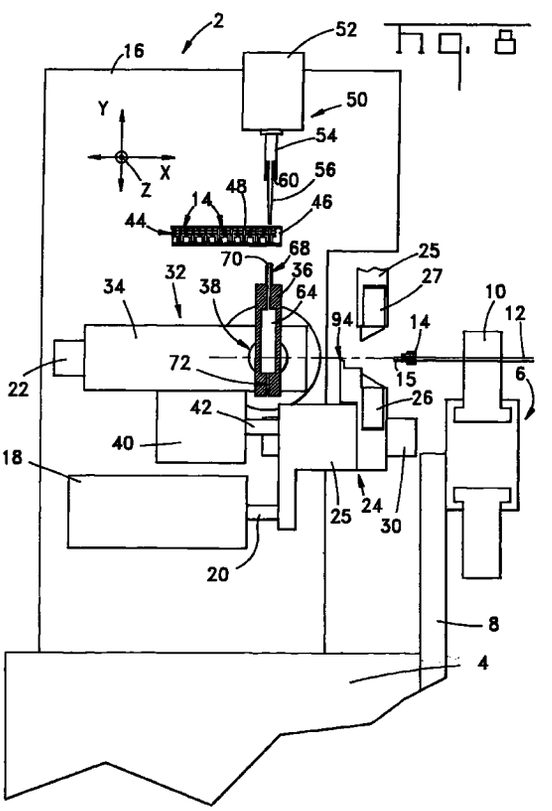
(54) Apparatus for assembling grommet to lead

(57) A grommet assembly apparatus comprises a grommet mounting device (32) having an expansion sleeve (68) for receiving grommets (14) thereon. Grommets (14) are transferred from a grommet feed channel (44) onto the expansion sleeve (68) by a movable transfer pin (56) having a pointed tip (58) that inserts into the expansion sleeve cavity (70). Compressed air is provided in the expansion sleeve cavity (70) to prevent the grommet pinching between the cavity and pin, thereby ensuring a smooth insertion of the grommet over the expansion sleeve (68).



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Description

This invention relates to an apparatus for assembling seal grommets onto wires, for example electrical or optical leads.

There are various methods of assembling an elastic seal grommet onto a lead, for example by: simply pushing the lead through the seal as described in EP 159006; or projecting the seal with compressed air onto the lead as described US 5007164 and EP 290721, or by fitting the seal on a hollow tube or sleeve in which the lead is received, and subsequently pushing the seal off the tube onto the lead. The latter seal assembly method for example is described in US 5016346 or EP 462923. This method is particularly reliable because the lead is received safely within the grommet expansion sleeve prior to mounting of the seal on the lead. The risk of buckling of the lead, particularly for very thin leads, is thereby eliminated. One of the problems with the latter assembly device is that the seal expansion pins and sleeves are small parts moving relative to each other and requiring high precision. The cost and life time of the machine is adversely effected by relatively delicate movable parts.

It would also be desirable to provide a particularly flexible seal assembly machine that can easily adapt to automated assembly of various seals and wires such that complete cable harnesses can be automatically processed. An important feature of flexible assembly machines is the ability to modify assembly operations rapidly, with a minimum of tooling changes.

It is an object of this invention to provide a grommet assembly apparatus that is simple, yet reliable and versatile, for automated assembly.

Objects of this invention have been achieved by providing the grommet assembly apparatus according to claim 1. Disclosed herein is a grommet assembly apparatus for assembling grommets on leads, the apparatus comprising a grommet receiving device comprising a hollow sleeve having a cavity extending therethrough for receiving a lead or wire therein, an outer surface of the tube for receiving a grommet elastically compressed thereagainst for assembly onto the lead, the apparatus further comprising a pin insertable in the wire receiving cavity of the hollow sleeve for assisting assembly of the grommet onto the outer surface of the hollow sleeve, the pin having a tapered leading end in order to guide insertion of the pin through the grommet, wherein the pin leading end is insertable into the sleeve from the wire receiving end thereof.

Advantageously therefore, a very simple assembly of a grommet onto a sleeve section with few parts, is achieved.

In order to assist assembly of the grommet onto the sleeve, air may be blown out of the sleeve cavity in order to assist pushing of the grommet over the pin until abutment of the grommet against a stop, and subsequent insertion of the sleeve into the grommet central cavity causing resilient expansion thereof.

For a particularly simple assembly apparatus, the pin device may be provided in alignment with an end of a grommet supply device, such as a grommet supply channel, such that the pin device can pick the grommet directly from the supply device and insert it directly onto the grommet expansion sleeve.

Further advantageous aspects of this invention will be apparent from the claims or from the following description and drawings.

An embodiment of this invention will now be described by way of example with reference to the figures, in which;

figures 1-7 are simplified drawings of a grommet assembly apparatus showing the sequence of assembly operations of a grommet onto a lead;
figure 8 is a simplified view of the seal assembly apparatus;
figure 8a is a detailed view of grommet receiving abutment profile for removing the grommet from the hollow expansion sleeve;
figure 9 is a partial cross-sectional detailed view of assembly devices for mounting the grommet on a seal expansion sleeve;
figure 10 a view similar to that of figure 9 in an assembly stage just prior to that of figure 9.

Referring first to figure 8, a grommet assembly apparatus 2 is shown mounted on a base 4 and upstanding vertically (along the Y axis). The horizontal axis is defined as the axis X. A conveyor apparatus 6 is also fixed to the base 4 of a harness making machine via the support 8. The conveyor system 6 has a plurality of grippers 10 for gripping and conveying leads or wires 12 of electrical or optical cables. The grippers 10 are conveyed in a direction Z perpendicular to the X and Y directions, for transporting the wires 12 to various wire processing stations of the harness making machine, such as stations for cutting the wires ends, stations for crimping terminals to the wires ends, stations for inserting the wires ends into connectors housings etc. One of the wire processing stations is the grommet assembly apparatus 2 for positioning grommet seals on the wire ends for the purpose of sealing the wires in corresponding cavities of a connector housing. In figure 8, a grommet 14 is shown assembled onto an end 15 of the wire 12.

The grommet assembly apparatus 2 comprises a fixed structure 16 mounted on the base 4. Fixed to the structure 16 is a primary motor 18 that drives a piston or rod 20 in the horizontal direction X. A slide 22 is also mounted in a fixed manner to the structure 16. A gripper device 24 comprising a support structure 25 and movable jaws 26,27 is fixed to the primary piston 20. The gripper device 24 is therefore movable in the X direction by means of the motor 18. The movable jaws 26,27 are movable in a vertical direction towards and away from

each other by means of a motor (not shown) mounted on the gripper support 25. For clarity, the upper jaw 26 is shown separated from the gripper device, but in fact it is mounted within a portion of the support 25 that forms a single assembled structure movably fixed to the rod 20. In order to provide stabil support of the device 24, the gripper support 25 is slidably mounted on a slide 30 extending in the X direction and rigidly fixed to the apparatus support 16.

A grommet mounting device 32 comprises a mounting device support 35 that is slidably mounted in the X direction on the fixed slide 22, the device further comprising a grommet receiving member 36 rotatably mounted about a Z axis to the device support 34 as indicated by the mounting portion 38. A secondary motor 40 is mounted in a fixed manner to the grommet mounting device support 34, and drives a secondary piston or rod 42 in the X direction. The secondary rod 42 is secured to the gripper support 25 such that the gripper device 24 and the grommet mounting device 32 are relatively slidable in the X direction with respect to each other and with respect to the apparatus fixed structure 16.

The grommet assembly apparatus further comprises a grommet transport device having a grommet supply of feed channel 44 that feeds grommets 14 to an end 46 of the channel 44 for mounting on the grommet receiving member 36. The grommets 14 are positioned vertically in the feed channel 44 proximite the end 46, such that central channels 48 traversing the grommets 14 extend in the Y direction.

The apparatus further comprises a grommet transfer device 50 for transferring and loading grommets 14 on to the mounting device 32. The transfer device 50 comprises a motor 52 that drives a grommet transfer element 54 in the vertical direction Y. The transfer element 54 is provided in alignment with a grommet 14 at the end portion 46 of the feed channel 44.

Referring to figures 9 and 10 in conjunction with figure 8, transfer of a grommet from the feed channel to the mounting device will now be explained. Referring first to figure 9, the transfer element 54 is shown comprising a pin 56 extending to a free end 58, and a stop 60 concentrically surrounding the pin 56 at a certain distance remote from the free end 58 for providing an abutment surface to limit insertion of the grommet 14 along the pin 56. The free end 58 is pointed and extends towards the stop 60 in a tapered or conical manner, thereby providing a smooth guide or insertion tip 62 for smoothly inserting and locating in the central cavity 48 of the grommet 14.

The rotatable grommet receiving mounting device 36 comprises a chamber 64 positioned centrally within a housing 66, the device further comprising a grommet expansion sleeve 68 attached to the housing 66 and forming a cavity 70 extending therethrough in communication with the chamber 64. The cavity 70 is a wire receiving cavity which is also adapted to receive the transfer pin 56 therein as shown in figures 9 and 10, during mounting of the grommet 14 on the expansion sleeve 68. The chamber 64 is supplied with compressed air through a supply channel 72 which is connected to a flexible tube (not shown) for supplying the compressed air into the chamber 64. The compressed air may be supplied intermittently during operation by automatically regulated control valves.

Mounting of the grommet 14 onto the expansion sleeve 68 is achieved as follows. A grommet 14 in abutment against the end 46 of the feed channel 44 is in alignment with the transfer element 54. The transfer element 54 is driven in the Y direction towards to the grommet 14 whereby the tip 58, 62 of the pin 56 is inserted partially into the grommet central cavity 48. The movement of the pin 56 and partial engagement in the grommet cavity 48 pushes the grommet 14 through the exit cut-out 78 in the bottom wall 80 of the feed channel 44. The grommet outer diameter is slightly larger than the cut-out 78 such that the grommet remains within the feed channel 44 until pushed by the transfer element. As shown in figure 10, when the grommet 14 is pushed through the cut-out 78, it is only partly inserted over the transfer pin 56, and enters into abutment with the free end or tip 82 of the expansion sleeve 68. The expansion sleeve pushes the grommet 14 further along the pin 56 towards the stop 60. In order to facilitate pushing of the grommet 14 along the pin 56 , in particular past the concial section 62, compressed air is provided in the chamber and cavity 64,70 such that air pressure presses against the front end of the grommet 14 at the positions denoted 84 in figure 10. The latter ensures that the front end 83 of the grommet does not get pinched into the wire receiving cavity 70 of the expansion sleeve 78. The transfer element 54 is driven along the Y axis until the grommet 14 abuts the stop 60 and the expansion sleeve 68 is subsequently inserted between the grommet and the pin 56. The grommet is thereby elastically expanded over the outer surface 84 of the expansion sleeve 68. Continued provision of air pressure in the cavity 70 ensures that the expansion sleeve 68 smoothly inserts between the grommet and the pin 56. A recess 90 extends into the transfer element 54 between the pin 56 and a concentric wall 88 that forms the abutment shoulder 60 in order to allow extension of the expansion sleeve 68 therein. The concentric wall 88 may be provided with a cavity 89 to allow air to escape from the recess or cavity 90 if necessary. Once the grommet 14 is mounted on the expansion sleeve 68 as shown in figure 9, the transfer element 54 can than be retracted and a new grommet fed to the end portion 46.

Referring particularly to figures 1-7, assembly of a grommet to a wire will now be described. Initially, as shown in figure 1, the primary rod 20 and the secondary rod 42 are both in retracted positions, and the grommet receiving member 36 is in the vertical position in alignment with the transfer element 54. A grommet 14 is then mounted on the expansion sleeve 68 as previously

described with reference to figure 9 and 10, and as depicted in figure 2. After assembly of the grommet on the expansion sleeve as shown in figure 3, the grommet receiving member 36 is rotated 90 degrees to the horizontal position in alignment with a wire 12 carried by the conveying system to the grommet assembly apparatus. In the position of figure 4, the expansion sleeve 68 is received within a U-shaped recess 92 of a retention wall 94 (see figure 8a) that serves to retain the seal in an axial position along the X axis with respect to the gripper device 24. The U-shaped recess 92 of the retention wall 94 has a smaller radius than the grommet 14, such that when the expansion sleeve 68 is retracted with respect to the retention wall 94, the grommet slides off the expansion tube.

As shown in figure 4, the jaws 26,27 are closed towards to each other. The jaws 26,27 are provided with a funnel shaped wire guide surface 96 that serves to guide the end 15 of the wire 12 into the expansion sleeve cavity 70 as shown in figure 5. Insertion of the wire end 15 into the cavity 70 is effected by activating the motor 18 and driving the primary road 20 to an extended position. Both the gripper device 24 and the mounting device 32 slide on their slides 30,22 respectively.

In the next step, as shown in figure 6, the secondary rod 42 is driven into the extended position by the secondary motor 40 such that the mounting device 32 is retracted relative to the gripper device 24, such that the retention wall 94 of the gripper pulls the grommet 14 off the expansion sleeve and onto the wire 12. The jaws 26,27 are moved to the open position as shown in figure 6, and the primary motor 18 subsequently driving the primary rod 20 to the initial retracted position such that the wire end 15 is freed. The wire end can then be moved by the conveyor system and a new wire presented before the grommet assembly apparatus. As shown in figure 7 the secondary rod 42 is also driven to the retracted position by the secondary motor 40, and the grommet receiving member 36 rotated to the vertical position such a new cycle may commence.

It is particularly advantageous to move the expansion sleeve towards the wire, rather than moving the wire such that a simple conveying system may be provided. In other words, the wire may be held in a fixed relation with respect to grippers 10 of the conveying system 6 whereas the assembly movements are provided by the grommet assembly apparatus. A simpler harness making machine and conveying system is thus provided. Further advantageous is the simple assembly of grommet to the expansion sleeve, and in particular the relatively simple construction of the expansion sleeve mechanism which does not require complex internal movable pins and sleeves. The transfer element is of relatively simple construction and operation. Rotation of the grommet mounting device and transport of the grommet on the expansion sleeve also provides a relatively versatile adaptable system that enables picking and transferring a grommet from supply channel remote from the wire, to the wire.

Claims

1. A grommet assembly apparatus (2) for assembling grommets (14) on leads (12), the apparatus comprising a grommet mounting device (32) comprising a hollow sleeve (68) having a cavity (70) extending therethrough for receiving a lead (12) therein, an outer surface (84) of the sleeve for receiving a grommet (14) elastically compressed thereagainst for assembly onto the lead, the apparatus further comprising a pin (56) insertable in the wire receiving cavity (70) of the hollow sleeve for assisting assembly of the grommet onto the outer surface (84) of the sleeve, the pin having a tapered end (62) in order to guide insertion of the pin through the grommet, characterised in that the pin (56) is insertable into the hollow sleeve from a wire receiving end (82) thereof.

2. The assembly apparatus of claim 1 wherein air is blown out of the sleeve (68) in order to assist pushing of the grommet (14) over the pin (56).

3. The apparatus of claim 1 or 2 wherein the pin (56) is provided on a transfer element (54) movable in a direction (Y) along an axis aligned with a grommet (14) positioned in a loading position (46) of a grommet feed channel (44) arranged between the expansion sleeve and a transfer device (50) that drives the transfer element (54).

4. The apparatus of any one of the preceding claims wherein the expansion sleeve (68) is provided on a grommet receiving member (36) device rotatably mounted on a grommet mounting device (32).

5. The apparatus of claim 4 wherein the grommet mounting device (32) is slidably mounted in a direction (X) parallel to a wire end (15) of a wire end (12) to be processed, on a slide (22) fixed to a fixed structure (16) of the apparatus.

6. The apparatus of any one of the preceding claims wherein the pin (56) is part of a movable transfer element (54) that comprises a stop (60) remote from a pointed tip (58) of the pin for limiting insertion of the grommet (14) on the pin.

7. The apparatus of any one of the preceding claims wherein the expansion sleeve (68) is fixed on a rotatable grommet receiving member (36) that can rotate from a grommet receiving position to a loading position for loading the grommet on the wire (12), the grommet receiving member being rotatable about a Z axis orthogonal to X and Y axes.

8. The apparatus of any one of the preceding claims wherein the apparatus comprises a gripper device (24) comprising a gripper device support (25) on which are movably mounted jaws (26, 27) that provide a funnel shaped guide in the closed position for guiding an end (15) of the wire (12) into the expansion sleeve (68), and wherein the gripper device (24) is slidably mounted on a slide (30) fixed to the apparatus fixed structure (16), the sliding movement in an X direction parallel to the direction of the wire end (15).

9. The apparatus of any one of the preceding claims wherein the mounting device (32) is coupled to the gripper device (24) in a movable manner such that the mounting device (32) can be moved relative to the gripper device (24) in the X direction.

10. The apparatus of claim 8 or 9 wherein the gripper device is movably coupled to a motor (18) fixed to the fixed structure (16) for driving the gripper device (24) in the X direction.

Fig. 1

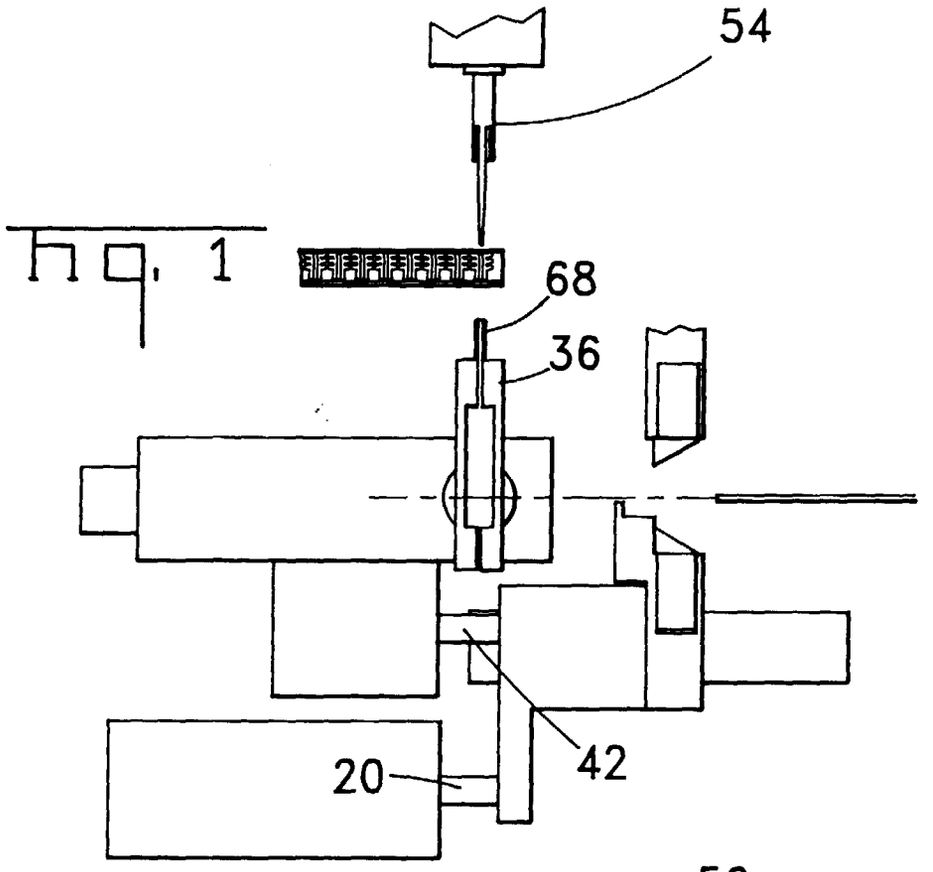

Fig. 2

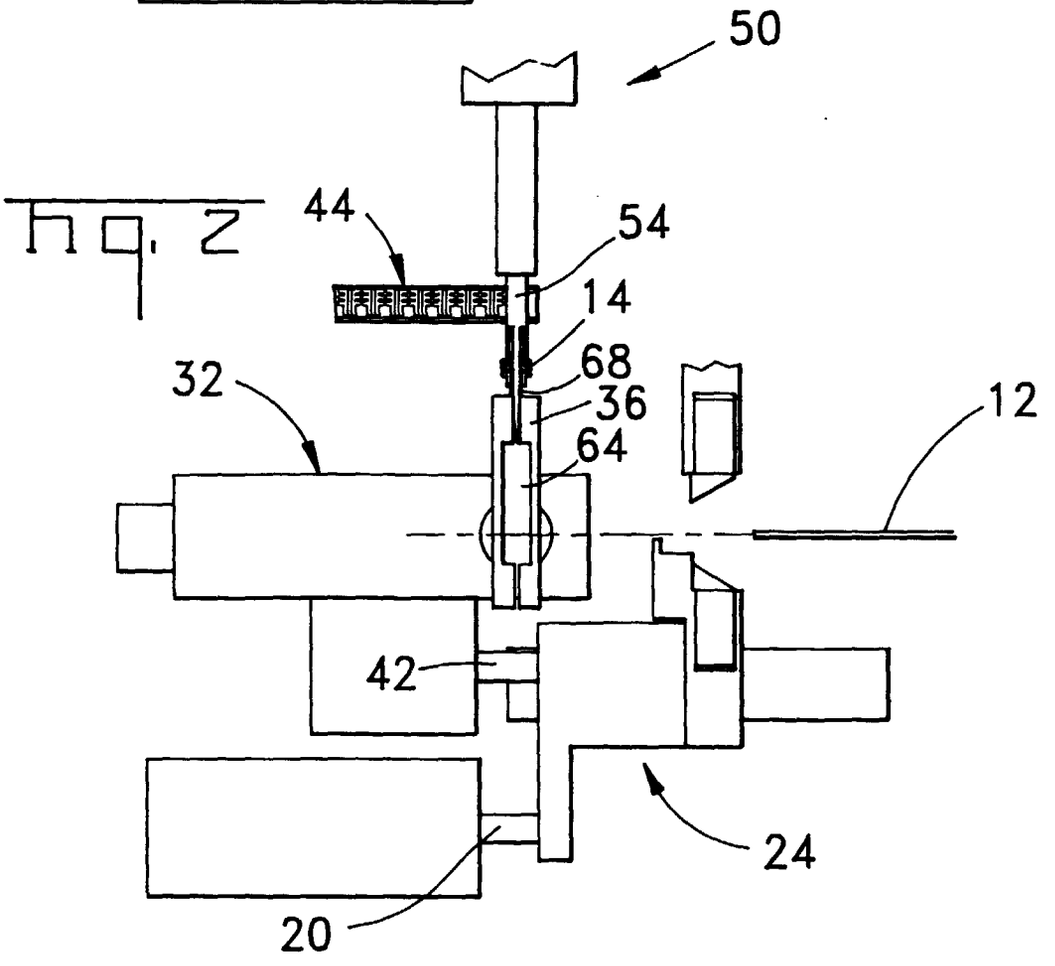

Fig. 3

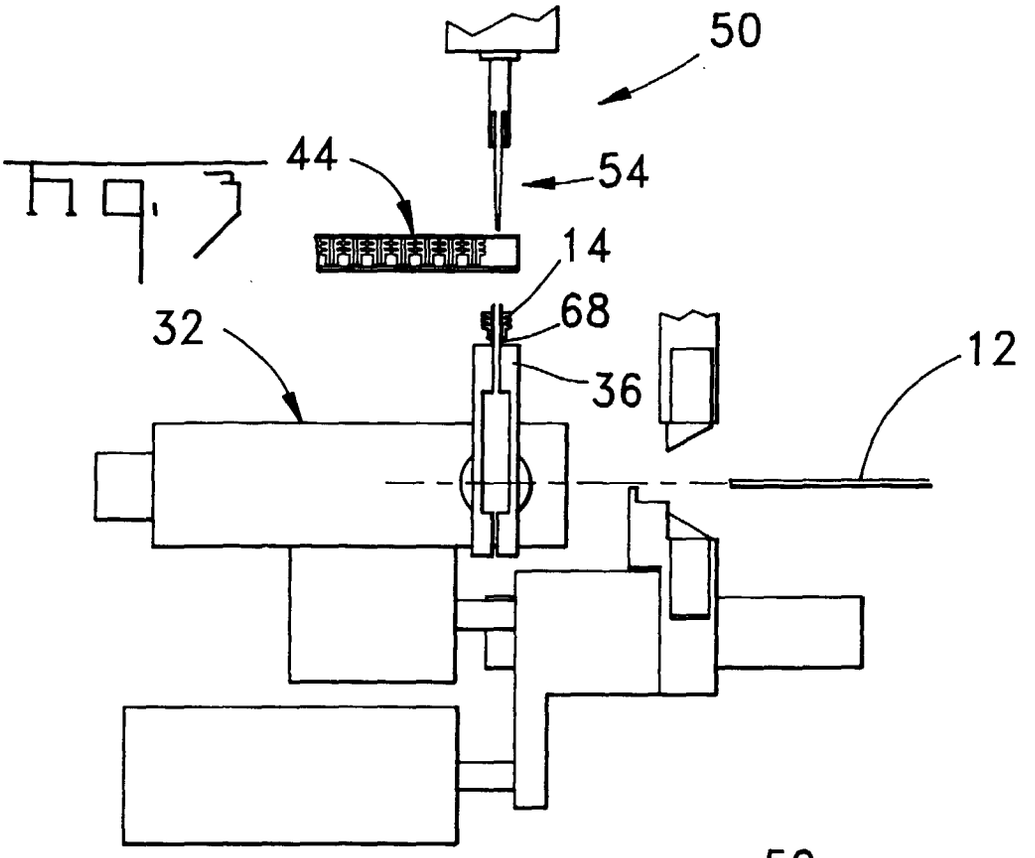
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Fig. 4

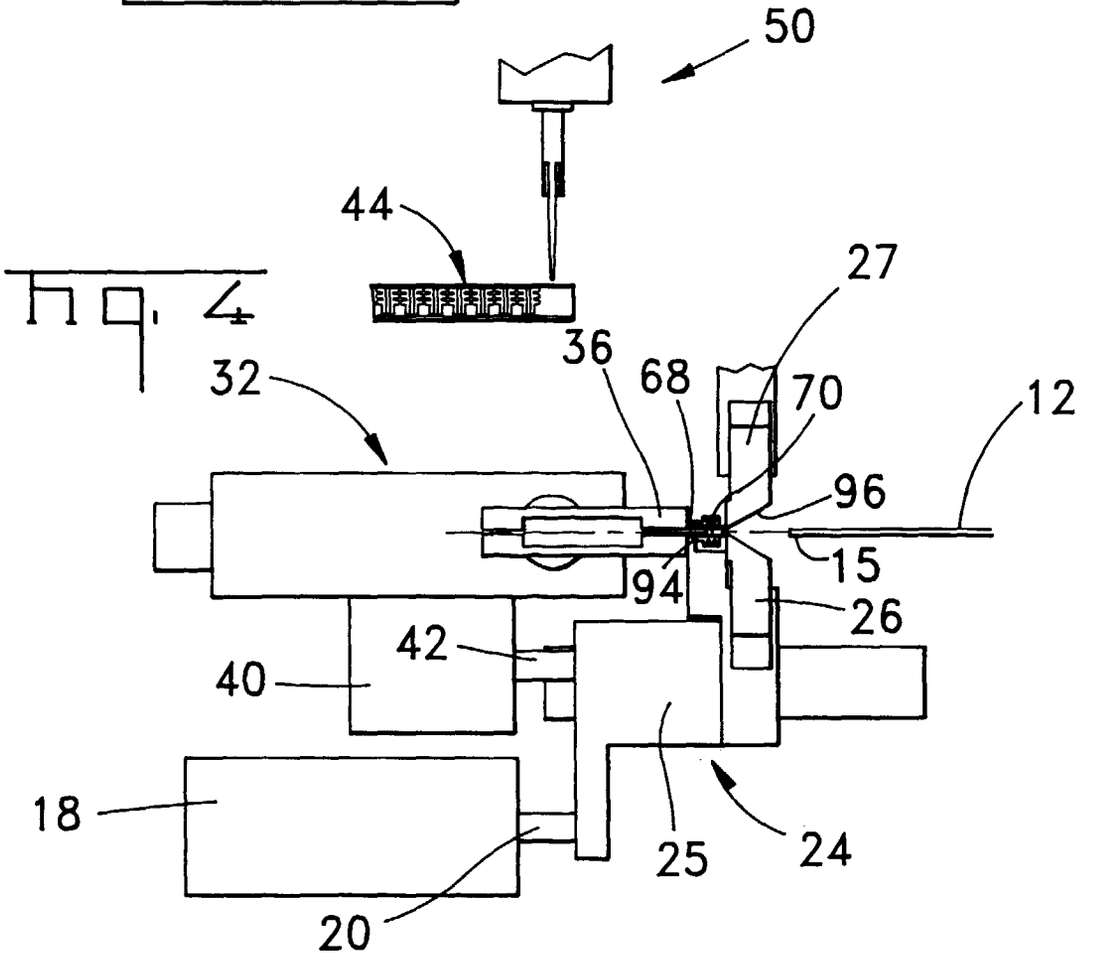
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Fig. 5

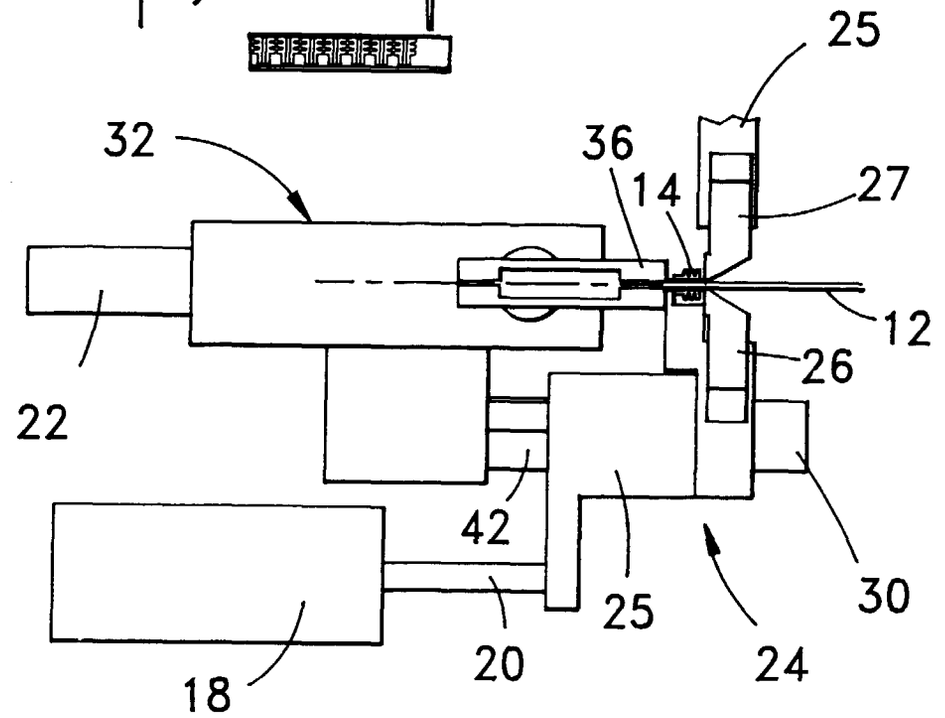
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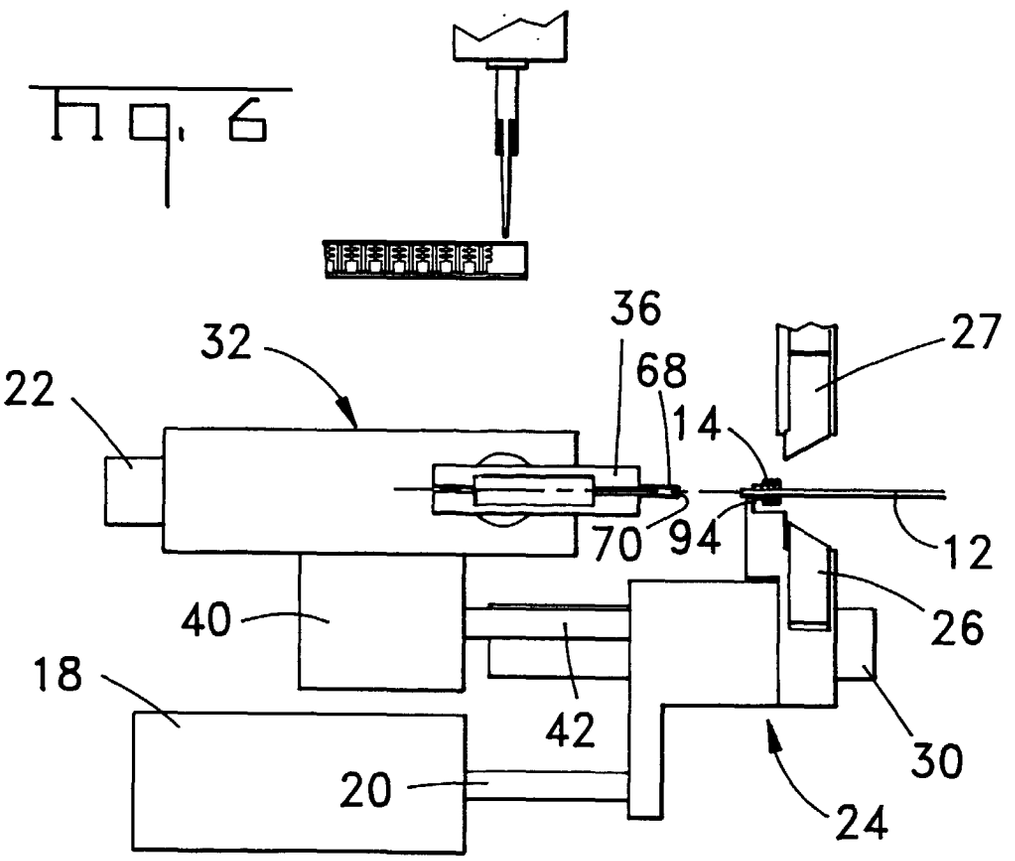
Fig. 6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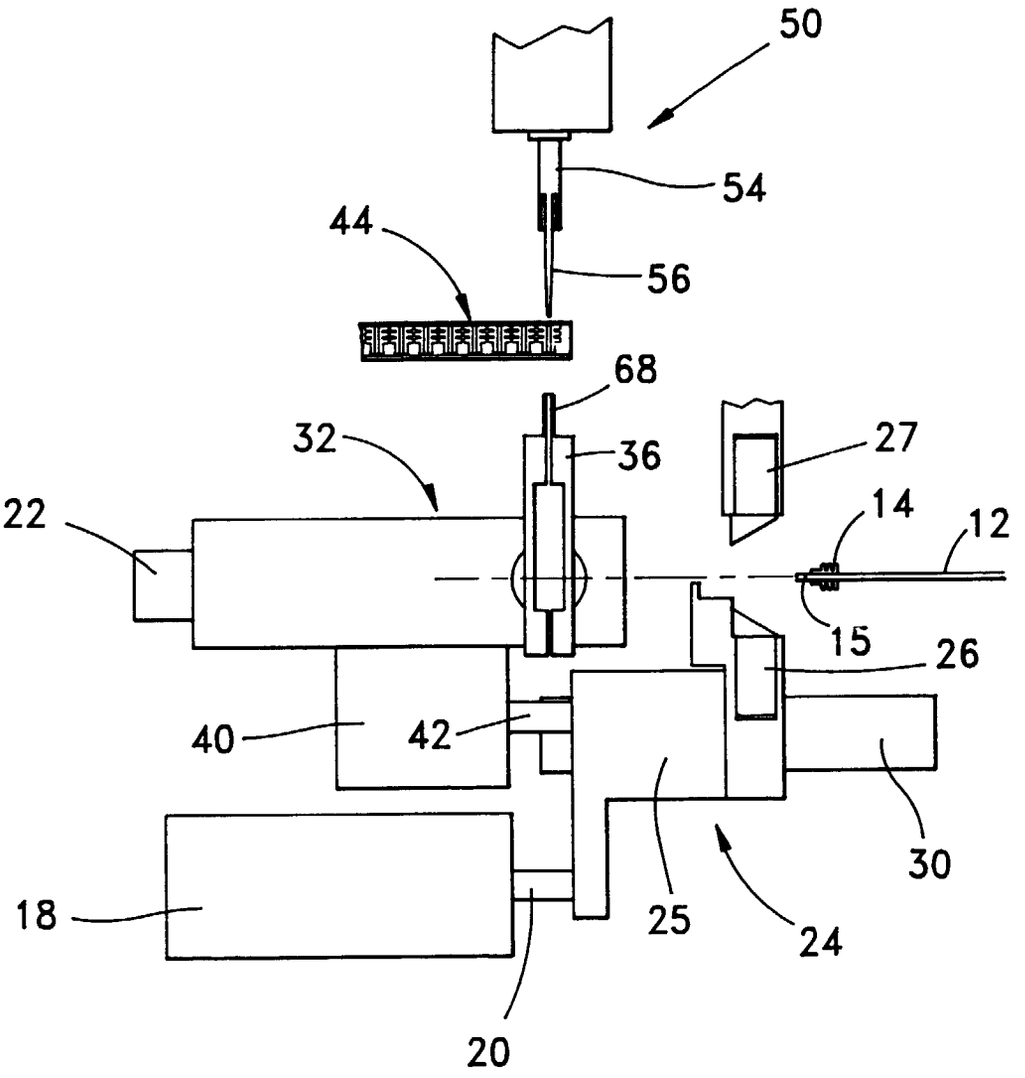

Fig. 7

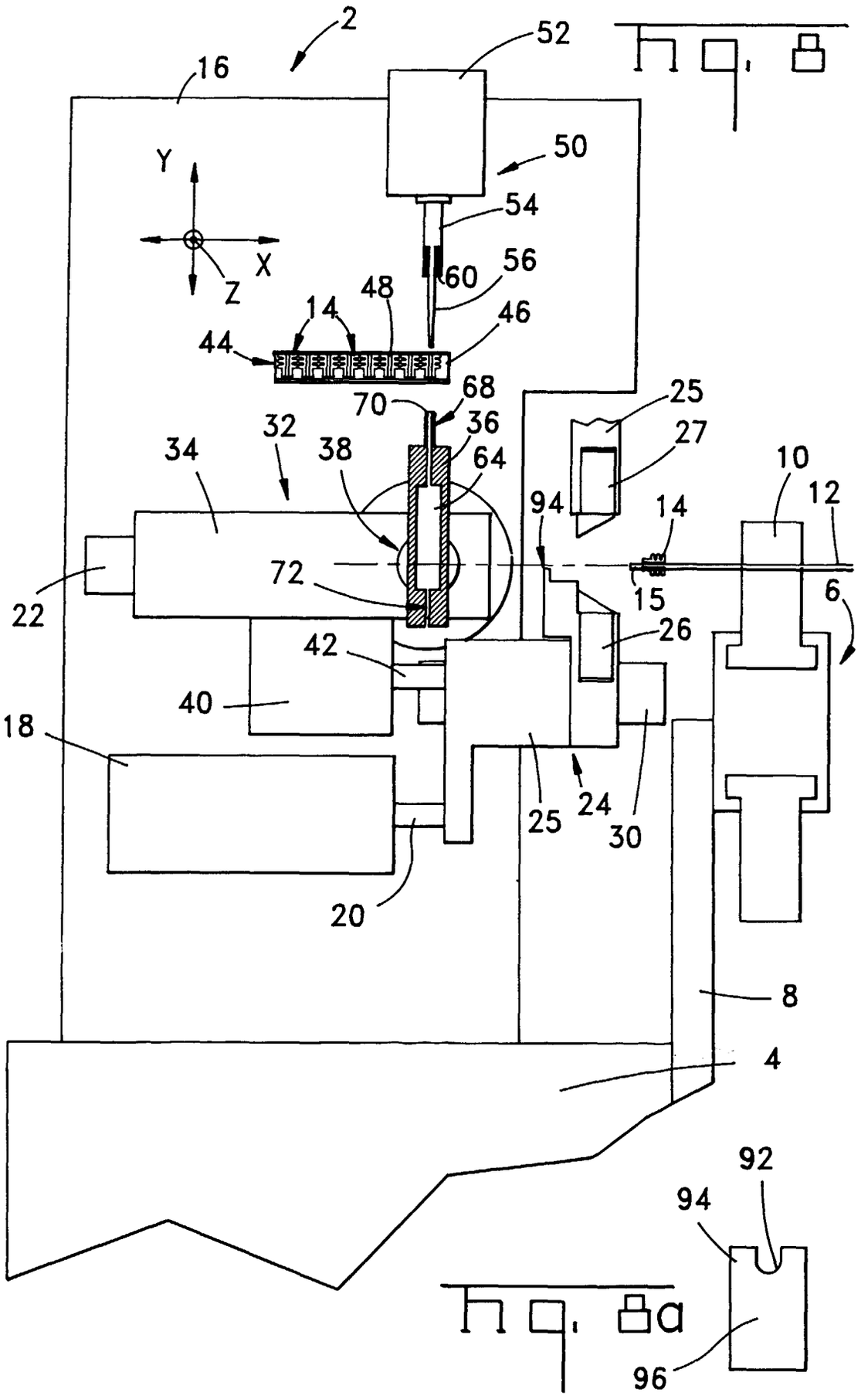
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Fig. 8a

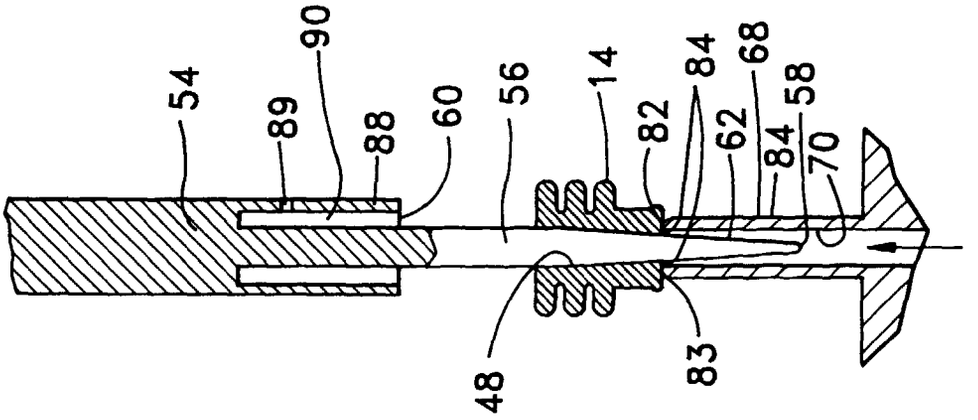
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Fig. 10

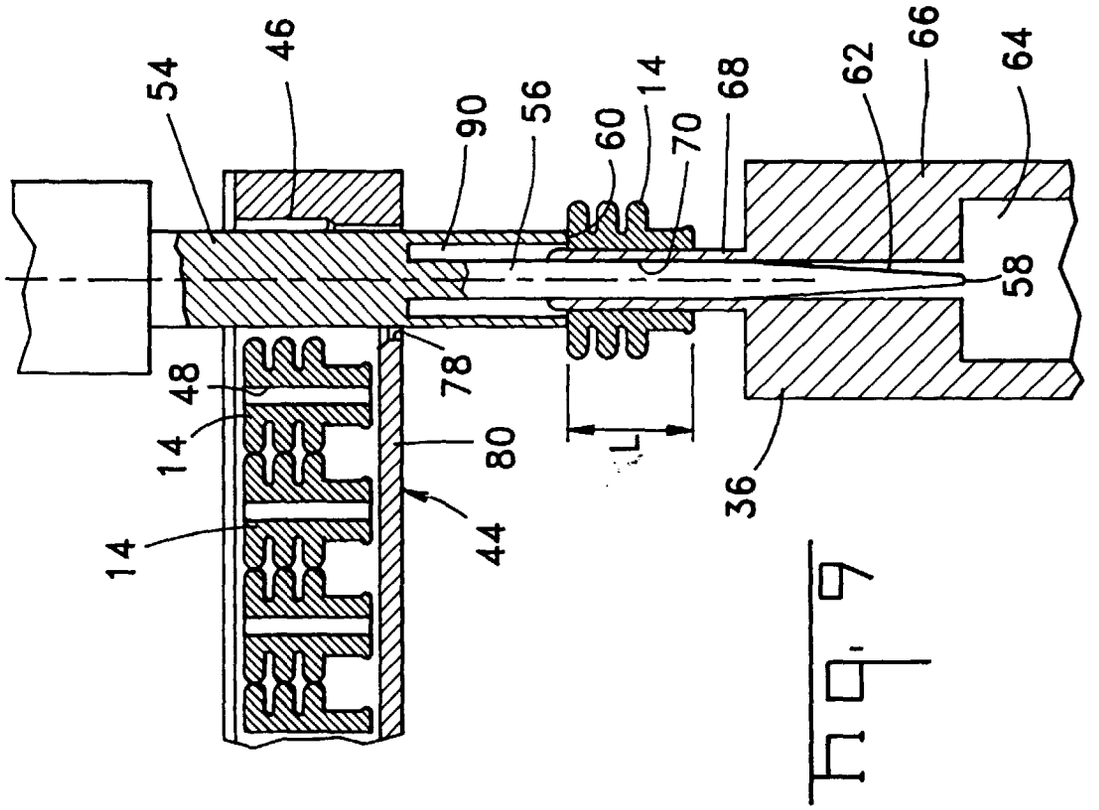
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Fig. 9