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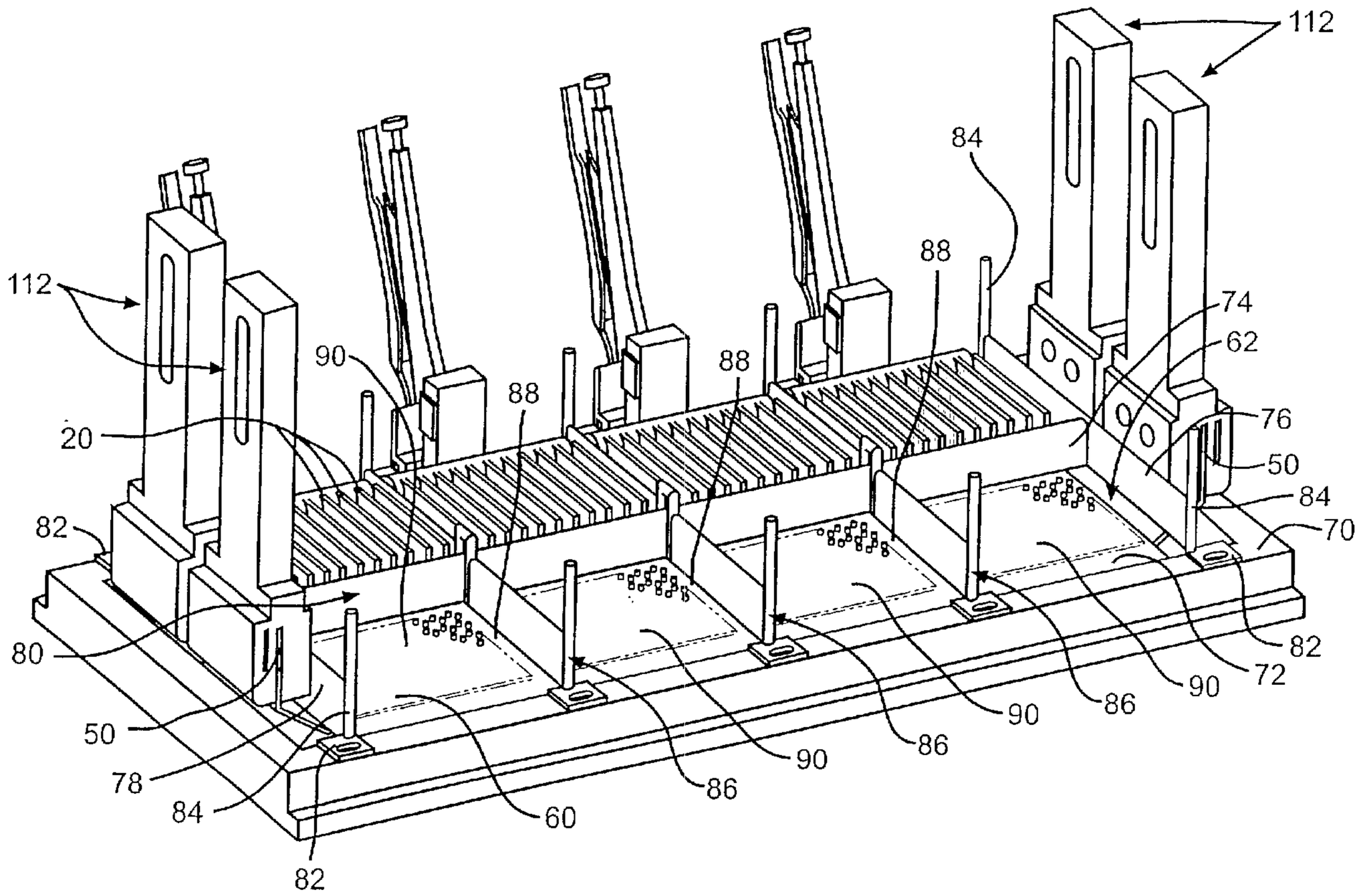
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(54) Title: FIBER-FORMING BUSHING WITH SUPPORT



(57) Abrégé/Abstract:
A fiber-forming bushing (30) comprises a tip plate (60) and a lateral support (86). The tip plate comprises at least two tip sections (90) and the section spacing (88) between the tip sections. The lateral support extends laterally along the section spacing.

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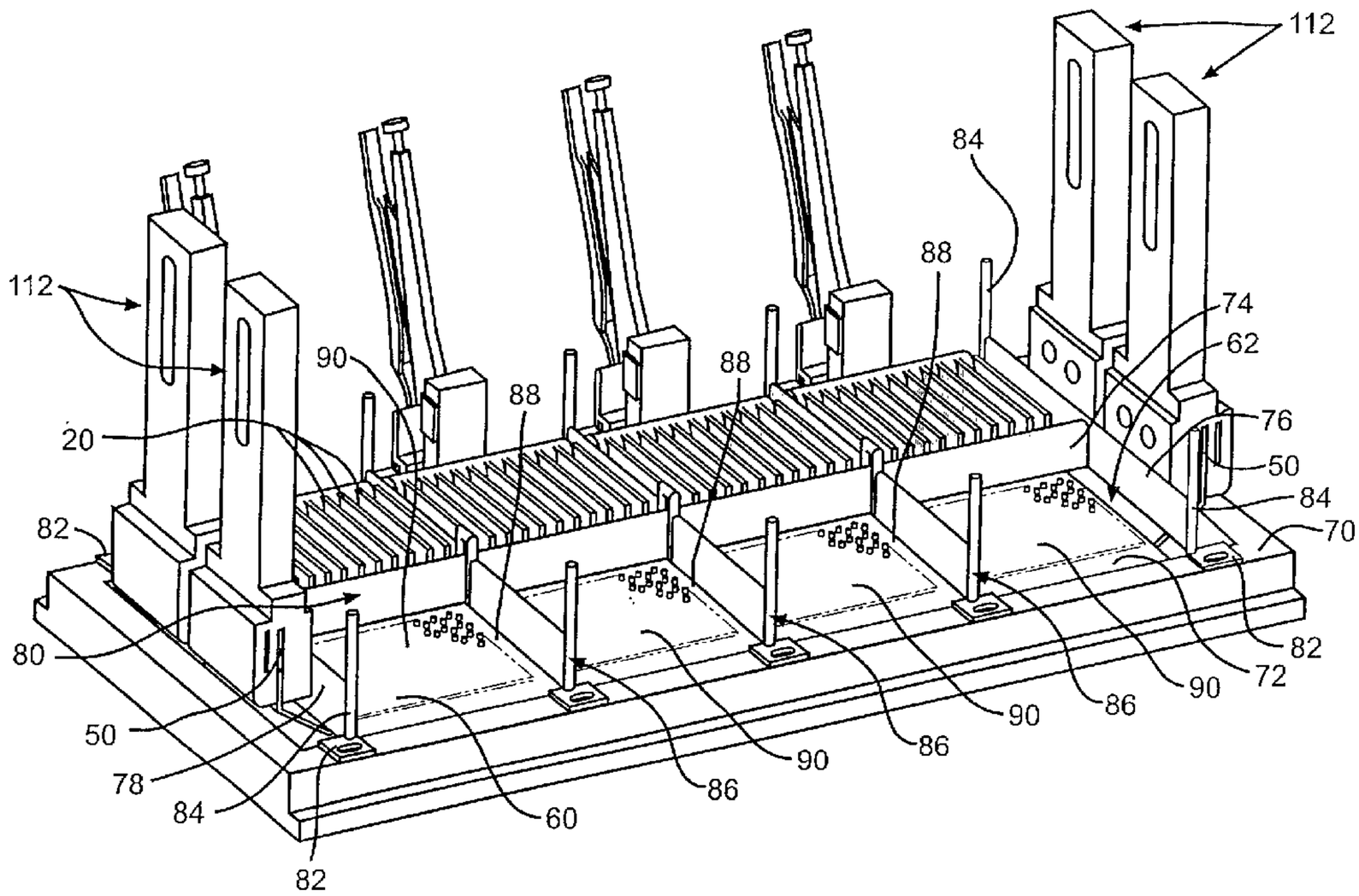
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(54) Title: FIBER-FORMING BUSHING WITH SUPPORT



(57) Abstract: A fiber-forming bushing (30) comprises a tip plate (60) and a lateral support (86). The tip plate comprises at least two tip sections (90) and the section spacing (88) between the tip sections. The lateral support extends laterally along the section spacing.

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FIBER-FORMING BUSHING WITH SUPPORT

TECHNICAL FIELD AND INDUSTRIAL APPLICABILITY OF THE INVENTION

This invention relates in general to an apparatus for producing continuous materials, and in particular, to a bushing for producing glass fibers. Most particularly, the invention relates to a lateral support for a fiber bushing tip plate and a fiber bushing with the same.

BACKGROUND OF THE INVENTION

Apparatus for producing continuous materials are well known. A conventional apparatus comprises a melter, into which a batch of material is fed, or a remelt apparatus or foremelter, into which marbles or cullet is fed. The melter melts the material to form molten glass. In a direct melt operation, the molten glass exits from the melter through a throat into a main channel. The main channel feeds a plurality of cross channels. Each cross channel, in turn, feeds molten glass to a plurality of forehearths. Each forehearth feeds molten glass downward through a plurality of bushing blocks. Each bushing block feeds molten glass into a bushing supported by a frame, which is mounted beneath the bushing block. In a remelt operation, the molten glass is fed directly into each bushing. The molten glass exits from each bushing in the form of glass fibers. A typical bushing produces hundreds to thousands of glass fibers.

As shown in Fig. 1A, the glass fibers 10 are produced by passing the molten glass 12 through a tip plate 14. The tip plate 14 has a plurality of tips 16. Each tip 16 has an orifice 18 through which molten glass 12 passes. Glass exiting the tip 16 is in the form of a fiber 10. The fibers 10 are cooled by cooling fins 20 supported beneath the tip plate 14 and attenuated to a desired filament diameter with a rotating cylindrical winder or chopper.

As shown in Fig. 1B, heating a tip plate 14 decreases the structural properties of the tip plate material 14. Stresses resulting from the hydrostatic glass pressure, gravitational force, and forming tension result in high temperature creep of the alloy from which the tip plate is formed. This alloy creep causes deformation of the tip plate 14, causing it to sag downward. As the tip plate 14 sags, tips 16 assume different orientations.

Consequently, some of the tips 16 are situated closer the cooling fins 20 than others. The cooling fins 20 must be lowered to the bottom of the lowest tips 16. Consequently, the cooling fins 20 are not equidistant from all the tips 16. Hence, some of the tips 16 are too close to the cooling fins 20 and therefore too cold and some of the tips 16 are too far from the cooling fins 20 and therefore too hot. If a tip 16 is too cold, the fiber 10 produced by the tip will decrease in diameter. This along a subsequent increase in forming tension may cause a breakout. The tips that are too hot have an increase in glass flow and a reduction in viscosity, which leads to flow instability that can also cause a breakout. A breakout is an interruption or separation of the fiber 10 formed from the tip 16. After the fiber breaks, a globule or bead forms on the tip 16.

When producing high temperature fiber products, such as the Advantex glass fiber product produced by Owens Corning, of Toledo, Ohio, U.S.A., the bushing must be heated to greater elevations, which further assaults the integrity of the tip plate 14, further reducing the life expectancy of the bushing.

At the end of the life of the bushing, the bushing is chopped up, refined and used to construct a new bushing. This process is labor intensive and results in some loss of precious resources.

What is needed is a support for a fiber bushing and a bushing construction that further resists tip plate deformation.

SUMMARY OF THE INVENTION

The present invention is directed toward a support for a fiber bushing. More particularly, the invention is directed toward a fiber-forming bushing comprising a tip plate and a lateral support. The tip plate comprises at least two tip sections and a section spacing between the tip sections. The lateral support extends laterally along the section spacing.

According to the invention, there is also provided a fiber bushing comprising a bushing body. A throat is provided at an upper end of the bushing. An elongate tip plate is provided at a lower end of the bushing. The tip plate comprises at least two tip sections and a section spacing between the tip sections. A support extends longitudinally along the tip plate. A lateral support extends laterally along the section spacing.

According to the invention, there is further provided a fiber bushing comprising a bushing body. A throat is provided at an upper end of the bushing. An elongate tip plate is provided at a lower end of the bushing. The tip plate comprises at least two tip sections and a section spacing between the tip sections. A support comprises an elongate center support extending between a pair of laterally extending end supports. The center support extends longitudinally along the tip plate. The end supports extend laterally along opposing ends of the tip plate. A lateral support extends laterally along the section spacings.

Various objects and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A is an enlarged partial side elevational view of a prior art fiber bushing with a non-deformed tip plate and cooling fins below the tip plate.

Fig. 1B is an enlarged partial side elevational view of the prior art fiber bushing with a deformed tip plate and cooling fins below the tip plate.

Fig. 2 is a top perspective view of a bushing according to a preferred embodiment of the invention.

Fig. 3 is an environmental bottom perspective view of a bushing with lateral supports extending along the section spacing of the tip plates according to a preferred embodiment of the invention.

Fig. 4 is an enlarged bottom plan view of the bushing shown in Fig. 3.

Fig. 5 is an enlarged sectional view of the bushing taken along line 5-5 in Fig. 4.

Fig. 6 is an enlarged sectional view of the lateral support shown in Fig. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is illustrated in Fig. 2 a bushing 30 comprising a bushing body 32 having opposing ends 34, 36. The bushing body 32 is constructed of a pair of longitudinally spaced end plates 38, 40 and a pair of laterally spaced side walls 42, 44, triangulated to form a substantially rectangular structure. Each side wall 42, 44 includes a upper side wall 46 and a lower side wall, or tip side plate 48.

An ear 50 extends laterally from each end plate 38, 40. A side rail support bar 52 extends longitudinally along each tip side plate 48.

A throat 54 is provided at an upper end 56 of the bushing 30. A flange 58 is provided at an upper end of the throat 54. As shown in Figs. 3-5, an elongate tip plate 60 is provided at a lower end 62 of the bushing 30. In a preferred embodiment of the invention, a pair of laterally spaced tip plates 60 is provided. An elongate (inverted) center-V 64 extends between the laterally spaced tip plates 60. As shown in Fig. 5, a screen 66 is provided within an upper region of the bushing 30. A plurality of elongate gussets 68 is provided within a lower region of the bushing 30. More particularly, the gussets 68 are spaced discrete longitudinal distances apart and tacked to an upper surface of the tip plate 60.

As shown in Figs. 3-5, the bushing 30 is suspended within a frame 70. Refractory material 72 is poured around the bushing 30, between the frame 70 and the bushing 30. Refractory material 72 is also poured into the center-V 64. The refractory material 72 is permitted to harden.

An elongate center support 74 may extend longitudinally along the center-V 64, adjacent the refractory material 72 therein. In a preferred embodiment of the invention, the center support 74 extends between, and is connected to, a pair of laterally extending end supports 76, 78 to form a generally H-shaped support, generally indicated at 80. Mounting pads 82 extending from the end supports 76, 78 are secured to the frame 70 to hold the support 80 in a fixed position relative to the bushing 30. The center support 74 and the end supports 76, 78 are hollow and in fluid communication with each other. A nipple 84 extending from each end of each end support 76, 78 is in fluid communication with the end supports 76, 78. The term "nipple" used throughout this description is intended to be broadly interpreted to encompass any junction for the connection of fluid conduit.

A lateral support 86 extends laterally along the section spacing 88 between the tip sections 90 of the tip plates 60. As shown in Figs. 5 and 6, the lateral support 86 is an elongate support having opposing ends 92, 94. Mounting pads 96 extending from the ends 92, 94 are secured to the frame 70 (as clearly shown in Fig. 5) to hold the lateral support 86 in a fixed position relative to the bushing 30. A nipple 98 extends from each end 92, 94 of the lateral support 86. As shown in Fig. 6, the lateral support 86 is hollow and in fluid communication with the nipples 98.

The center and lateral supports 74 and 86 traverse one another. In a preferred embodiment of the invention, the lateral support 86 is comprised of two hollow members 100, 102 having a fluid conduit 104 extending therebetween. The conduit 104 is preferably a generally U-shaped conduit having two legs 106, 108, each of which is connected to a corresponding hollow member 100, 102 so that the conduit 104 is in fluid communication with the hollow members 100, 102. The U-shaped conduit 104 extends downward and crosses over the center support 74.

The supports 80, 86 are preferably thermally and electrically insulated from the tip plate 60, as shown in Fig. 5. In a preferred embodiment of the invention, the top of each support 80, 86 is sprayed with a ceramic material 110. In the most preferred embodiment of the invention, an eighth inch layer of zirconium oxide is applied to the bottom of the lateral support 86.

In operation, a terminal clamp, generally indicated at 112, is connected to each ear 50. Each terminal clamp 112 is connected to a flexible bus bar (not shown). Each flexible bus bar is connected to a transformer pad via a tubular bus bar (not shown). The clamps 112, the tubular bus bars and the pads are hollow and water cooled. Supply and discharge lines (not shown) are connected to the nipples 84, 98. In a preferred embodiment of the invention, high-pressure hoses are connected to the nipples 84, 98 with compression fittings. A cooling fluid is passed through each of the clamps 112, bus bars, and supports 80, 86.

The bushing 30 is resistance heated by passing a high current (for example, 2,000 to 10,000 amps) through the ears 50 and bushing body 32. The bushing 30 is gradually heated until it reaches an operating temperature that can range from 2,100 to 2,800 degrees Fahrenheit, depending on the glass composition that is being formed. The heated bushing 30 is intended to condition the state of the molten glass, rather than melt the glass. The resistance heat is retained in the bushing body 32 by the hardened refractory material 72 formed about the bushing body 32.

Molten glass 12 (shown in Fig. 1) is introduced into the bushing 30 through its throat 54. The flange 58 forms a seal between the bushing block (not shown) and the throat 54. A coolant conduit (not shown) is provided about the periphery of the flange 58 to cool any molten glass 12 that may exit between the bushing block and the flange 58.

This cooled glass blocks other molten glass 12 from exiting between the bushing block and the flange 58.

The molten glass 12 passes through the screen 66 as it passes through the bushing body 32. The screen 66 functions to capture solid matter suspended in the molten glass and assist in distributing the resistance heat uniformly throughout the molten glass 12.

As stated above, the tip plate 60 is provided with a plurality of tip sections 90, each separated by dead space, or section spacing 88. A plurality of tips 16 (best shown in Fig. 1) occupies each tip section 90. No tips 16 occupy the section spacing 88. Each tip 16 has an orifice 18 (shown in Fig. 1) through which molten glass 12 passes. Glass fibers 10 are formed from molten glass 12 exiting the tips 16, passing the fibers 10 between cooling fins 20 (shown in Figs. 1 and 3) beneath the tip plates 60. The cooling fins 20 cool the tips 16 and consequently the glass fibers 10 exiting the tips 16.

In a preferred embodiment of the invention, the tip plate 60 has an easily divisible number of tips 16. For example, the tip plate 60 may have 4,000 tips 16, and may be separated into four sections 90, each having 1,000 tips 16. Consequently, the bushing 30 may produce 4,000 fibers 10. The fibers 10 may be gathered into one or more strands, which are used to produce packages. The fibers 10 can be gathered in discrete amounts (for example, 1,000, 2,000, 3,000 or 4,000) to produce various strands for various packages.

The center-V 64 provides external resistance to deformation of the tip plates 60. Filling the center-V 64 with refractory material insulates the center support from the tip plates 60. The gussets 68 support the tip plates 60 internally from above, also resisting deformation of the tip plates 60. To further resist deformation, the supports 80, 86 provide subjacent external support for the tip plates 60. The center support 74 provides longitudinal support for the tip plate 60 along the center-V 64. The end supports 76, 78 support the center support. The lateral support 86 provides lateral support for the tip plate 60 along the section spacing 88 between the tip sections 90. Resisting tip plate deformation prolongs the life of the bushing 30.

In accordance with the provisions of the patent statutes, the principle and mode of operation of this invention have been explained and illustrated in its preferred embodiment. However, it must be understood that this invention can be practiced

otherwise than as specifically explained and illustrated without departing from its spirit or scope.

WHAT IS CLAIMED IS:

1. A fiber-forming bushing (30) comprising:

a tip plate (60) comprising at least two tip sections (90) and section spacing (88) between the tip sections;

a longitudinal support (74) extending longitudinally across the center (64) of the tip plate (60)

a lateral support (86) extending laterally along the section spacing and substantially perpendicular to and structurally independent of the longitudinal support (74) wherein the lateral support has opposing ends (92, 94) and a nipple (98) extending from each of the opposing ends so that the nipples are in fluid communication with the lateral support.

2. The bushing according to claim 1, wherein the lateral support is thermally and electrically insulated from the tip plate.

3. The bushing according to claim 1, wherein the lateral support is coated with a ceramic material.

4. The bushing according to claim 1, wherein a layer of zirconium oxide is applied to the lateral support.

5. The bushing according to claim 1, wherein the lateral support is hollow.

6. The bushing according to claim 1, wherein the lateral support is comprised of two hollow members (100, 102) having a fluid conduit (104) extending across the support and between the hollow members.

7. The bushing according to claim 1, wherein the conduit is a generally U-shaped conduit having two legs (106, 108), each of the legs being connected to a corresponding one of the hollow members so that the conduit is in fluid communication with the hollow members, the U-shaped conduit extending downward and across the support.

8. A fiber-forming bushing (30) comprising:

a bushing body (32);

a throat (54) provided at an upper end (56) of the bushing body;

an elongate tip plate (60) provided at a lower end (62) of the bushing body, the tip plate comprising at least two tip sections (90) and section spacing (88) between the tip sections;

a support comprising an elongate center support (74) extending between a pair of laterally extending end supports (76, 78), the center support extending longitudinally along the tip plate, the end supports extending laterally along opposing ends of the tip plate; and

a lateral support (86) structurally independent of the center support and extending laterally along the section spacing and between the end supports.

9. The bushing according to claim 8, wherein the supports are thermally and electrically insulated from the tip plate.

10. The bushing according to claim 8, wherein each of the supports is coated with a ceramic material.

11. The bushing according to claim 8, wherein a layer of zirconium oxide is applied to the supports.

12. The bushing according to claim 8, wherein the supports are hollow and the center support is in fluid communication with the end supports.

13. The bushing according to claim 12, wherein the end supports (76, 78) and opposing ends (92, 94) of the lateral support have a nipple (84, 98) extending therefrom so that the nipples are in fluid communication with the end supports and the lateral support.

14. The bushing according to claim 12, wherein the center support and the lateral support traverse one another.

15. The bushing according to claim 20, wherein the lateral support is comprised of two hollow members (100, 102) having a fluid conduit (104) extending across the center support and between the hollow members.

16. The bushing according to claim 15, wherein the conduit is a generally U-shaped conduit having two legs (106, 108), each of the legs being connected to a corresponding one of the hollow members so that the conduit is in fluid communication with the hollow members, the U-shaped conduit extending downward and across the center support.

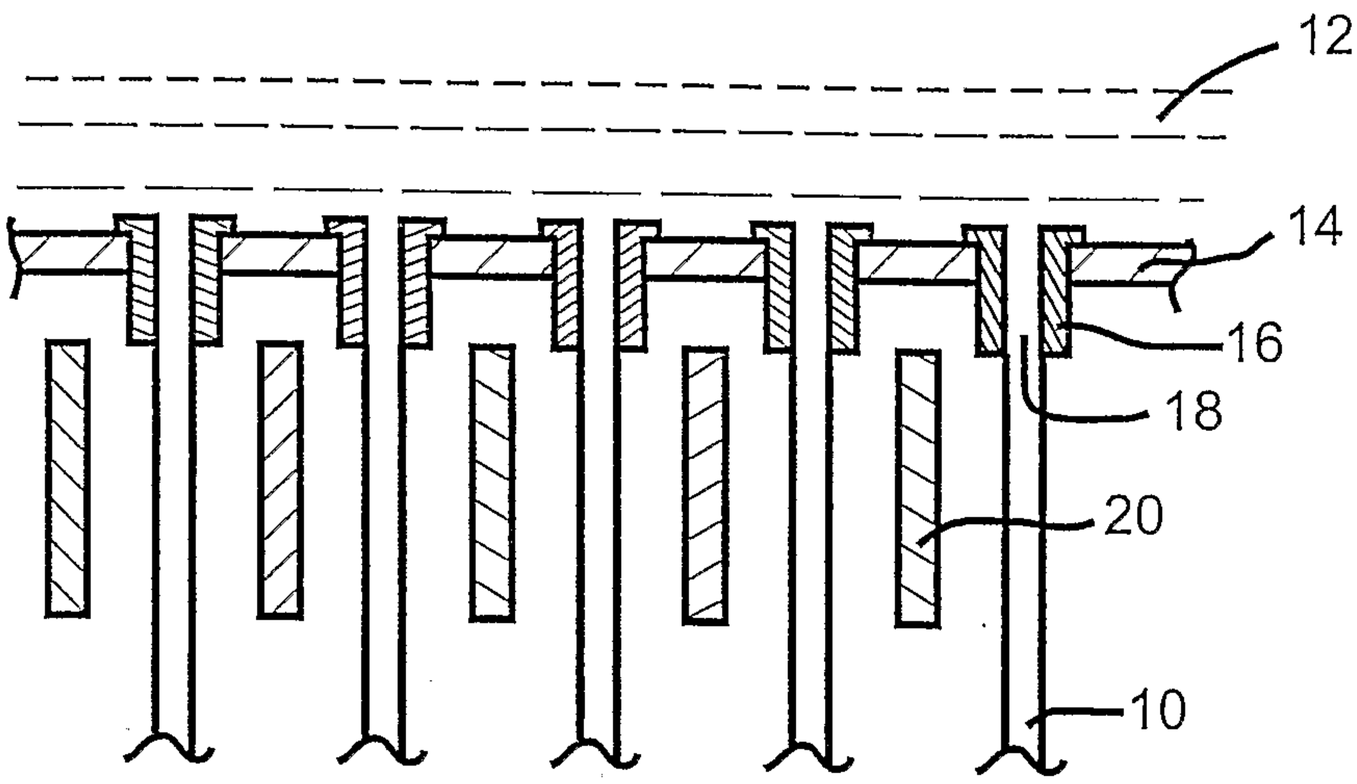


FIG.1A
PRIOR ART

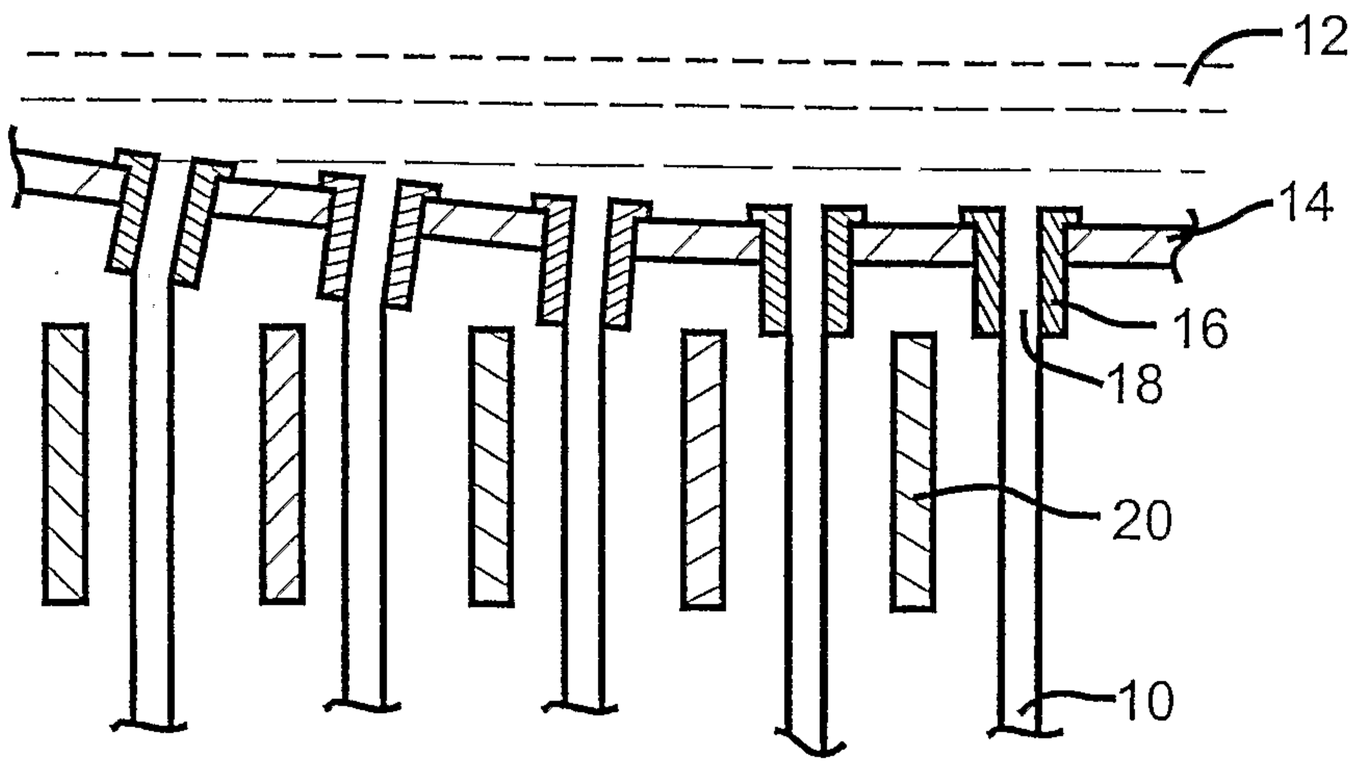


FIG.1B
PRIOR ART

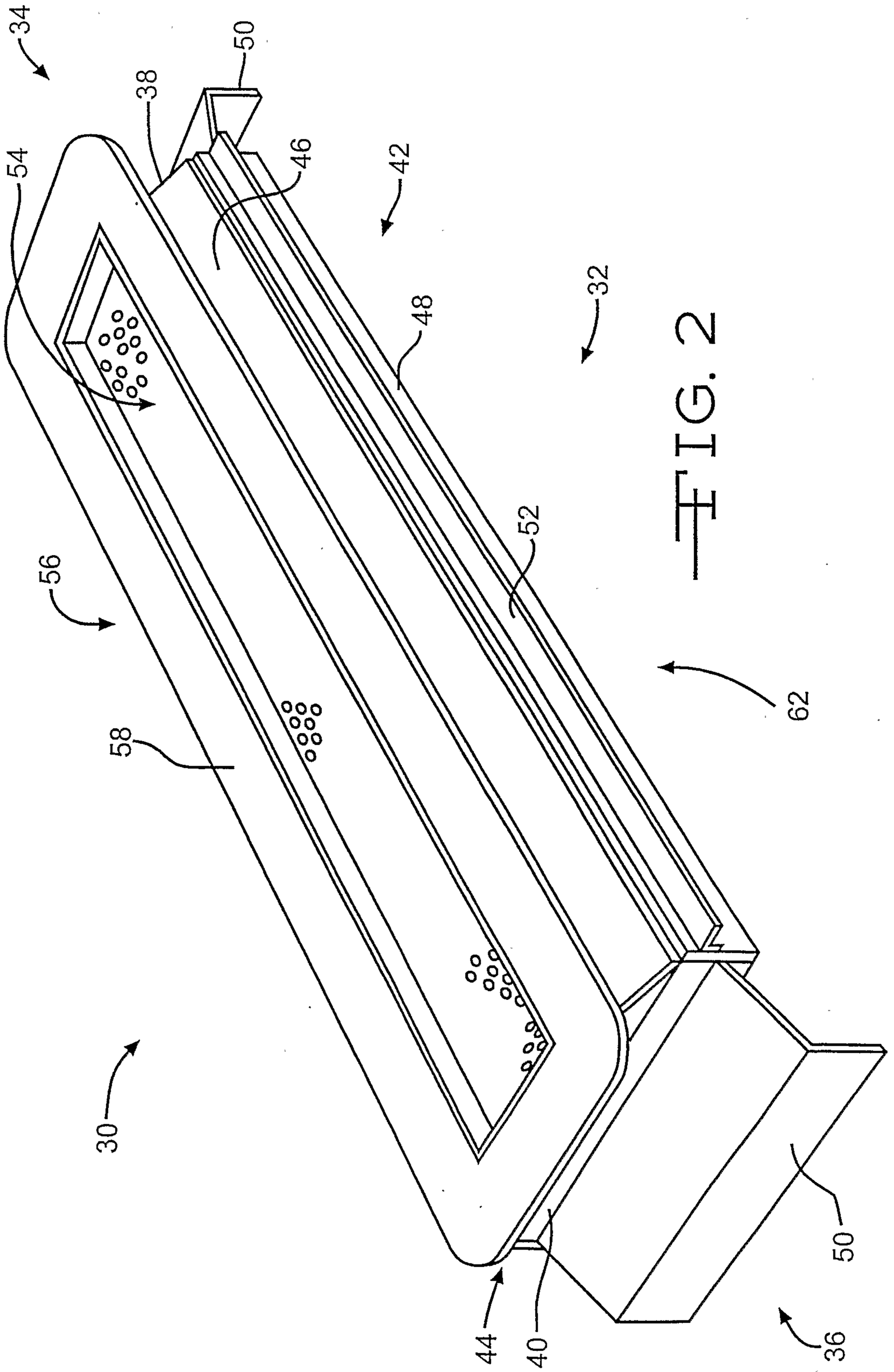


FIG. 2

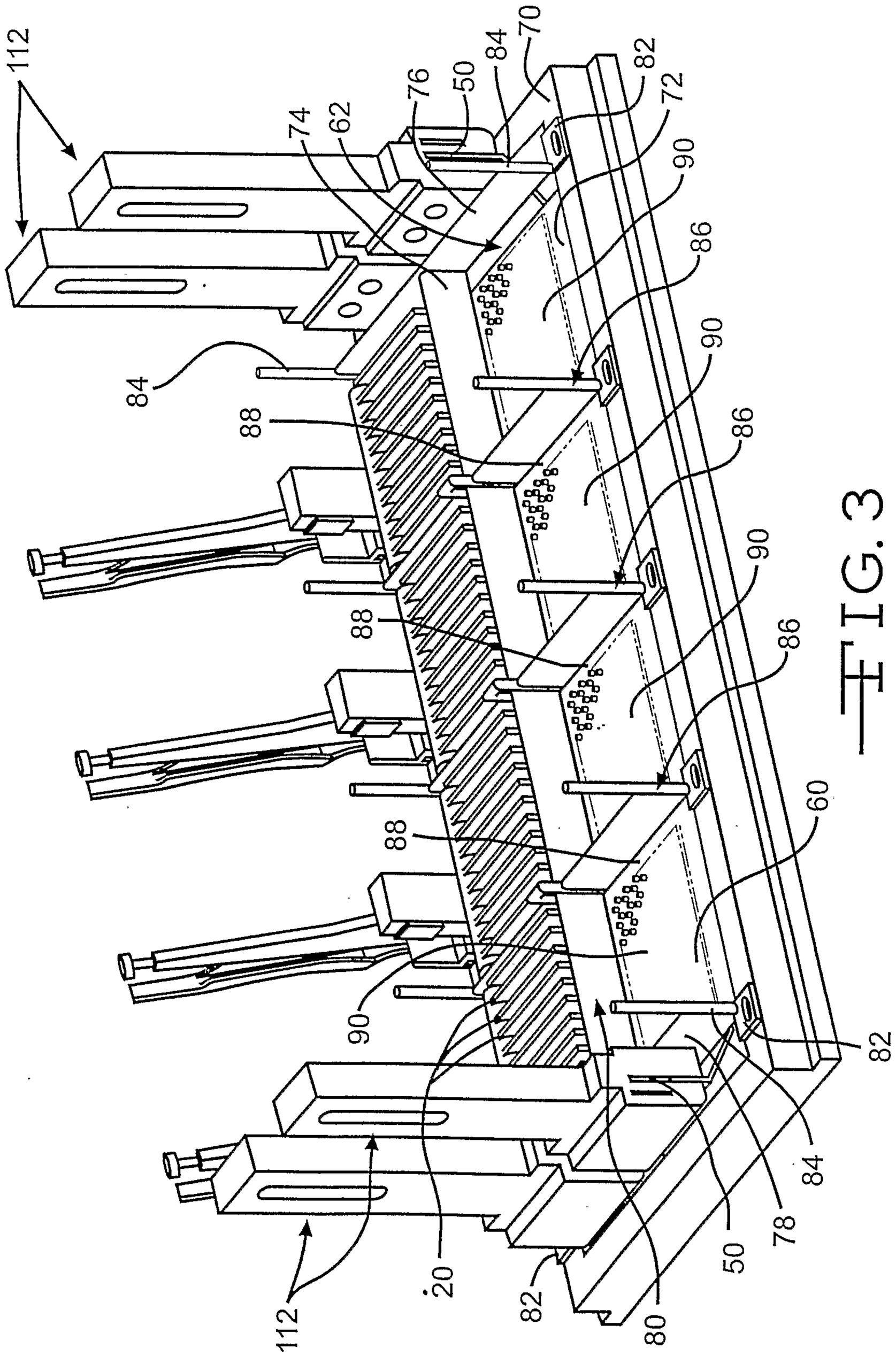

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FIG. 3

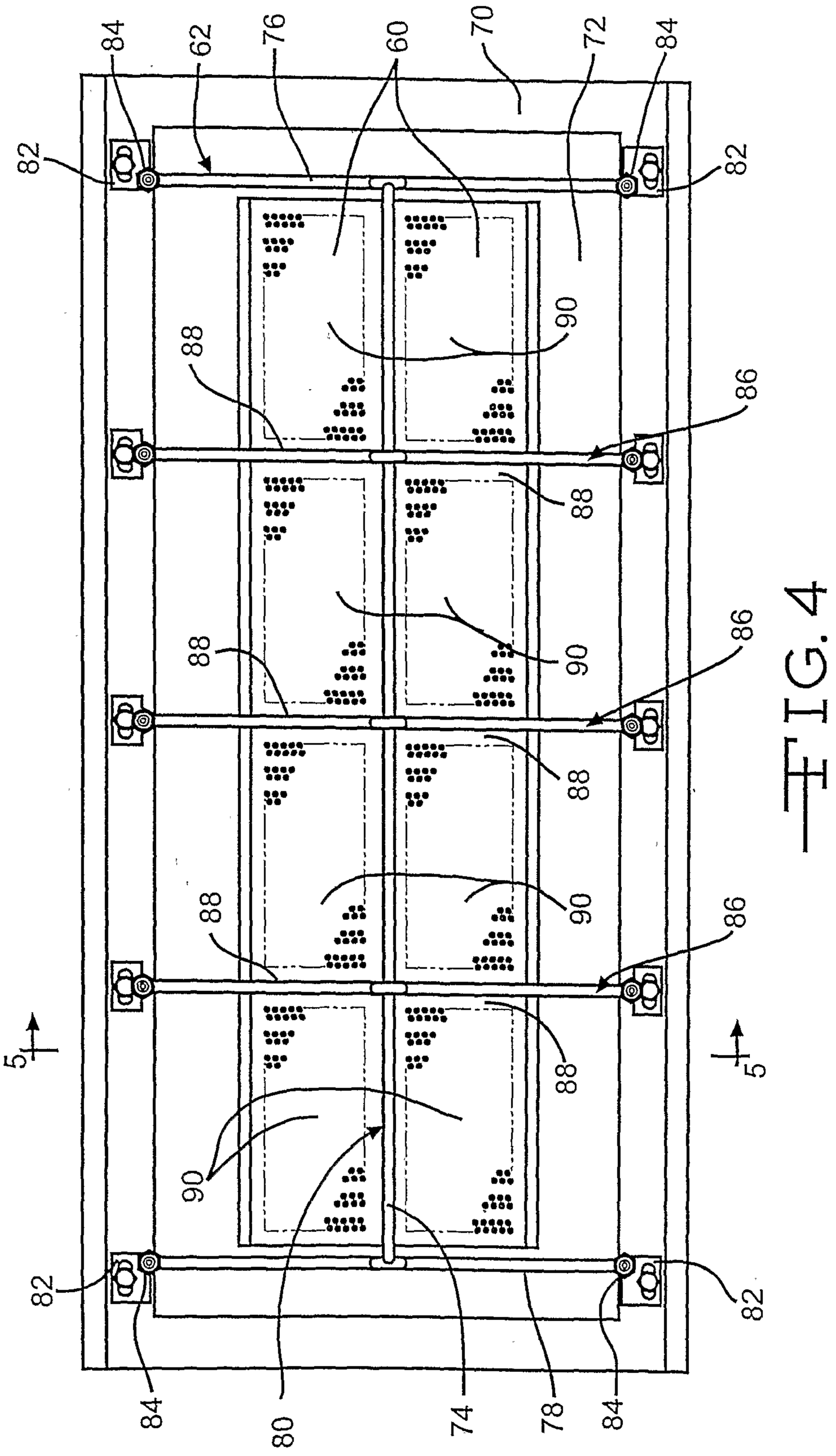

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FIG. 4

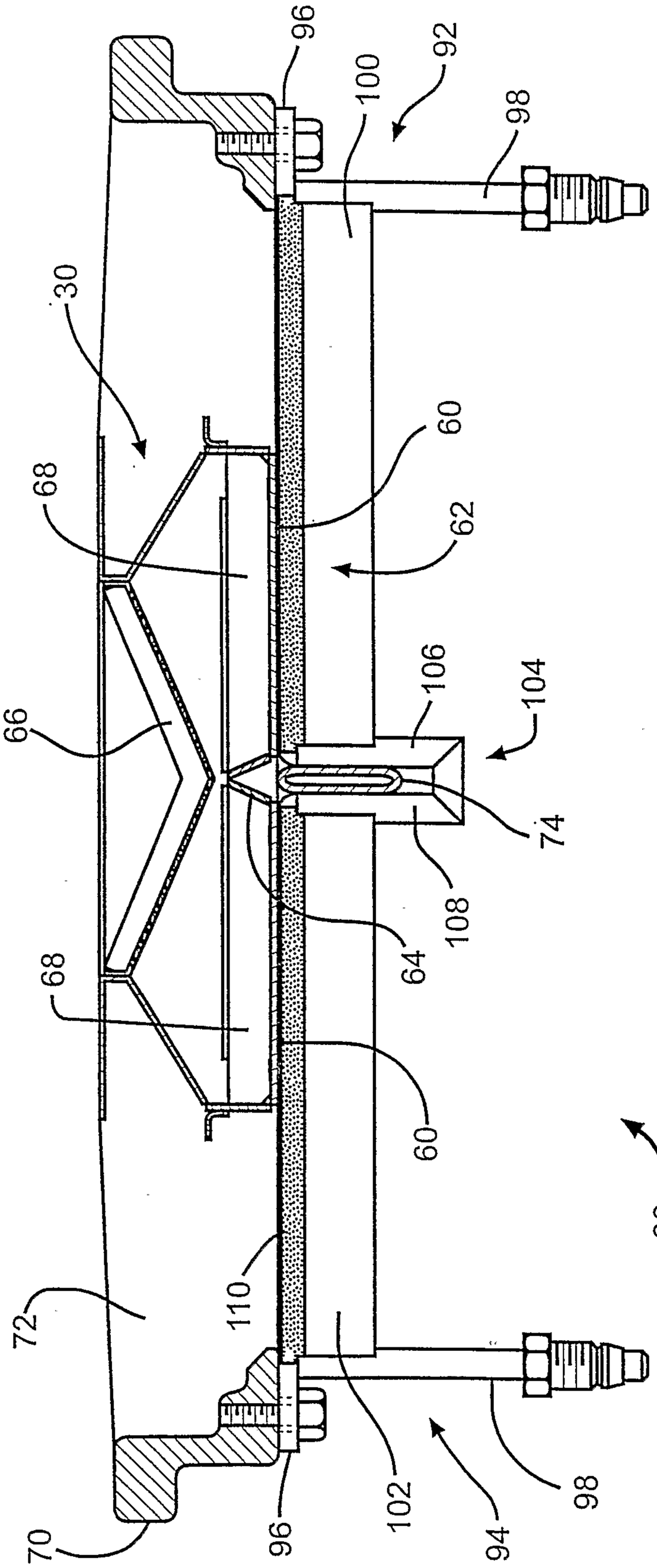

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FIG.5

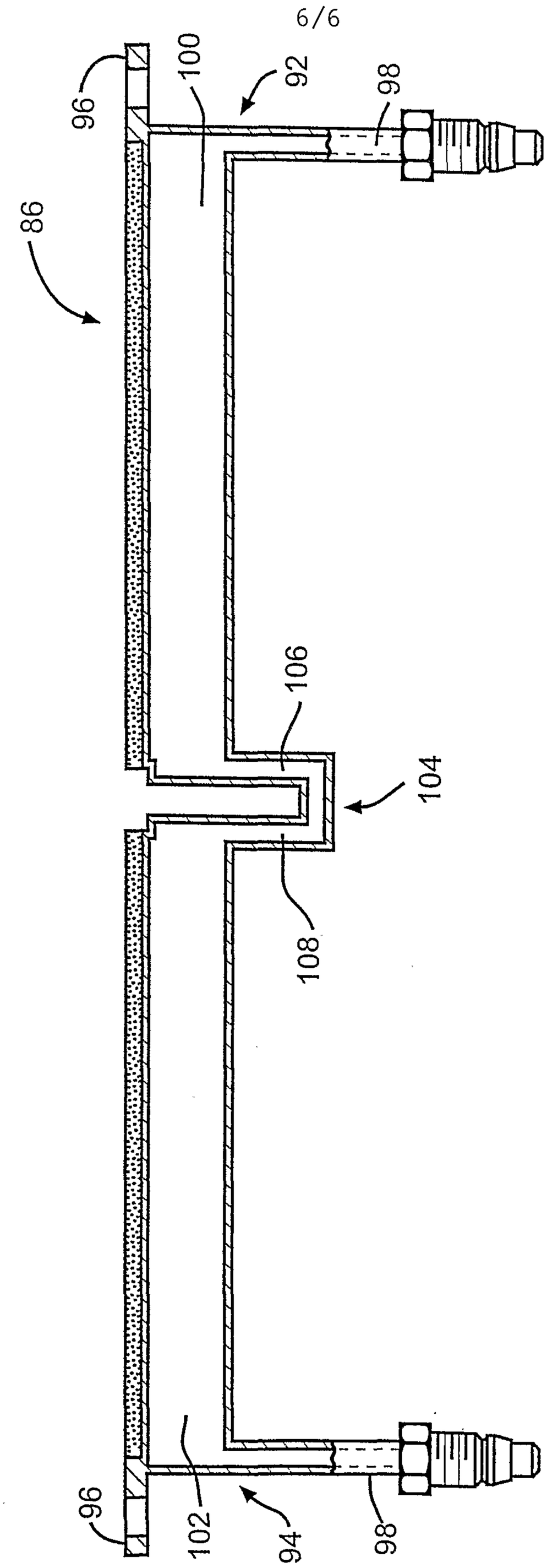
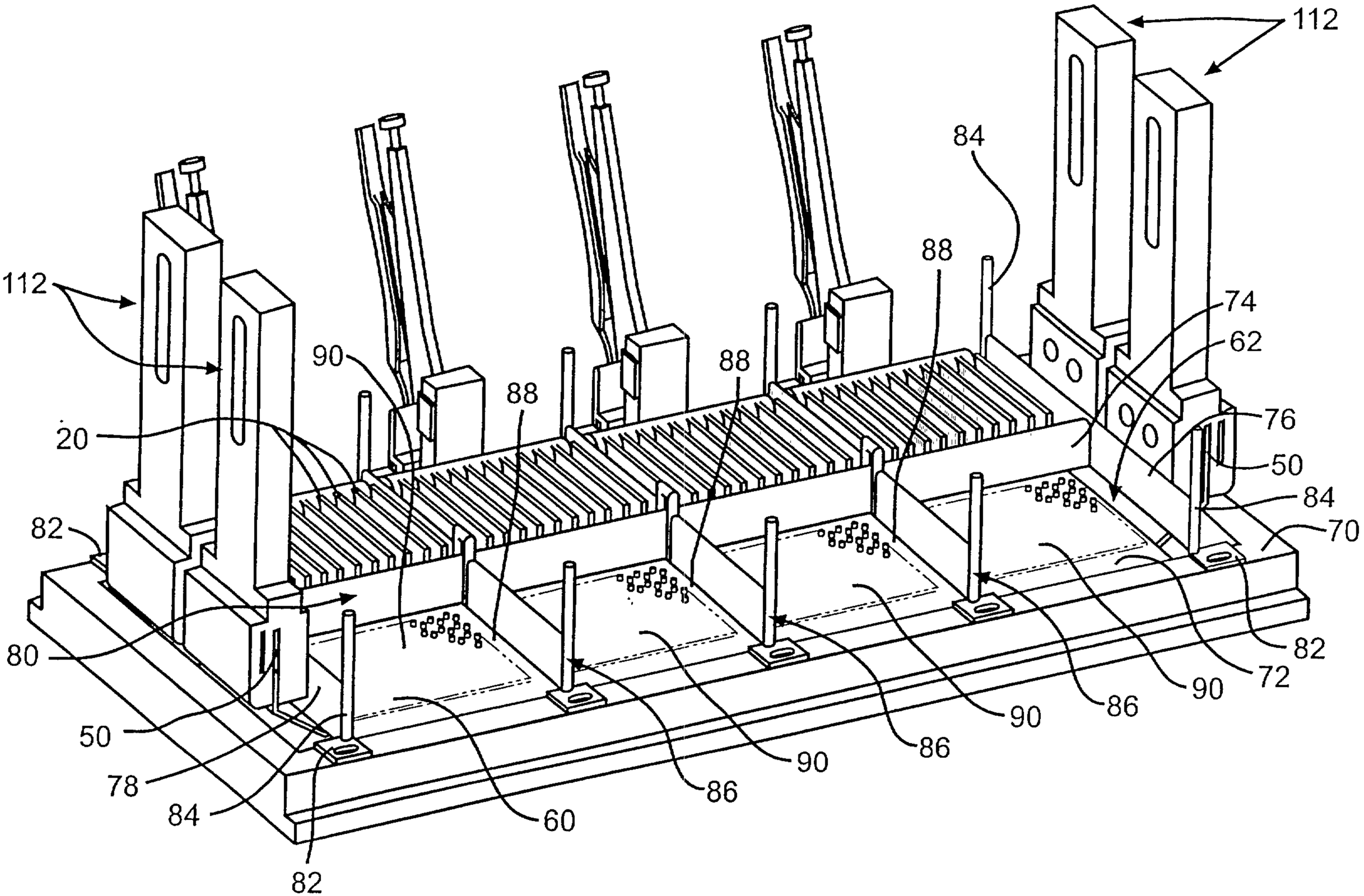


FIG.6


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