

[54] RESISTANCE HEATING ELEMENT FOR VACUUM FURNACES

3,737,553 6/1973 Kreider 13/25

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[57] ABSTRACT

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A resistance heating element and an improved mounting therefor for vacuum furnaces is described, the mounting element supports preferably being supported by internal metal heat shields so that the expansion and contraction of the heating element is independent of the expansion and contraction of the vessel in which it is used and of the heat shields therein. The supports are generally T-shaped with a limited internal pivot, with the heating element secured to the support for limited movement to accommodate expansion and contraction, and with internal electrical insulators.

[52] U.S. Cl. 13/25

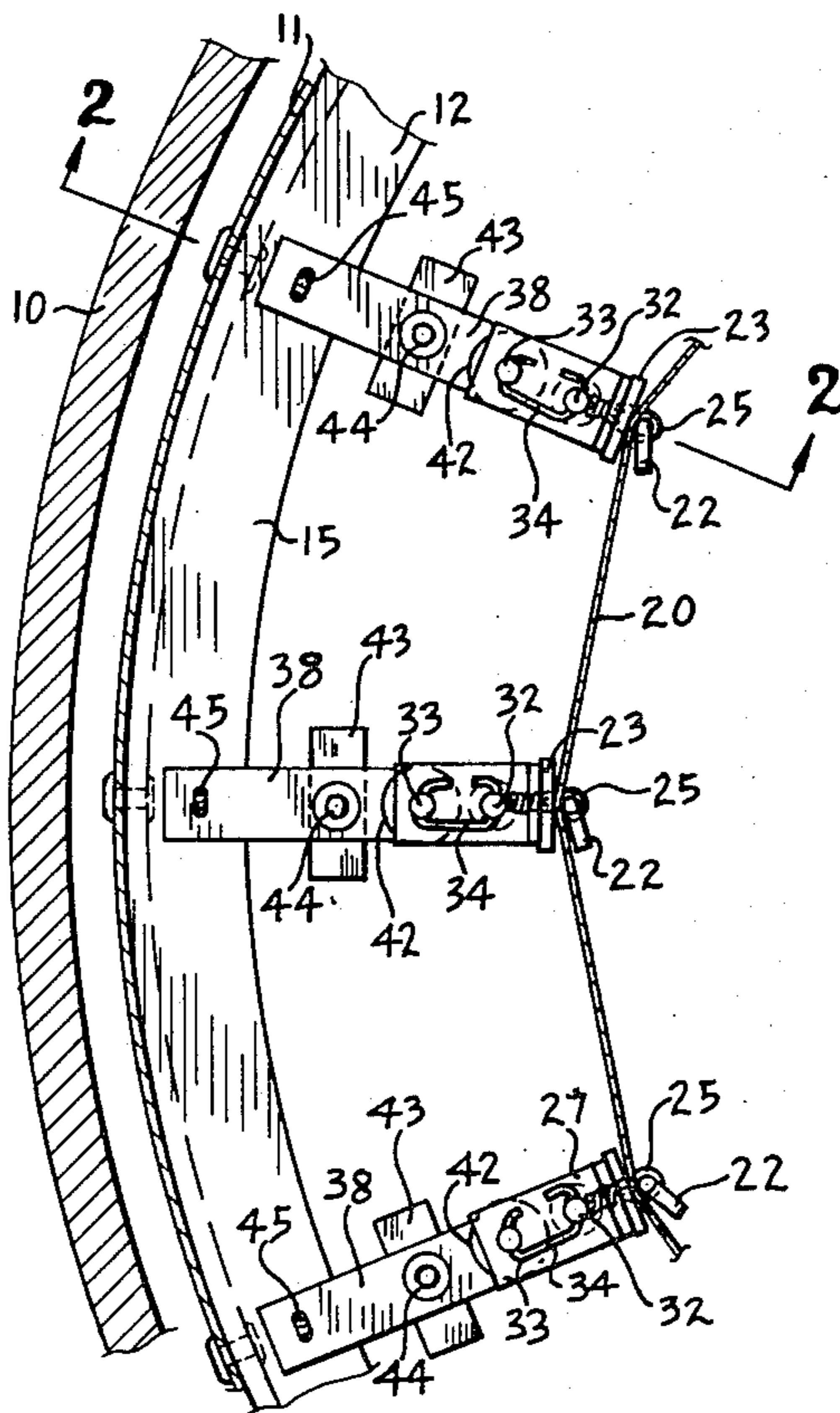
[51] Int. Cl. F27d 11/02, H05b 3/06

[58] Field of Search. 13/20, 25, 31

[56] References Cited
UNITED STATES PATENTS

3,456,935	7/1969	Borner	13/25 UX
3,558,113	1/1971	Strohmeier et al.	13/25 UX
3,644,655	2/1972	Vollmer	13/31

15 Claims, 7 Drawing Figures



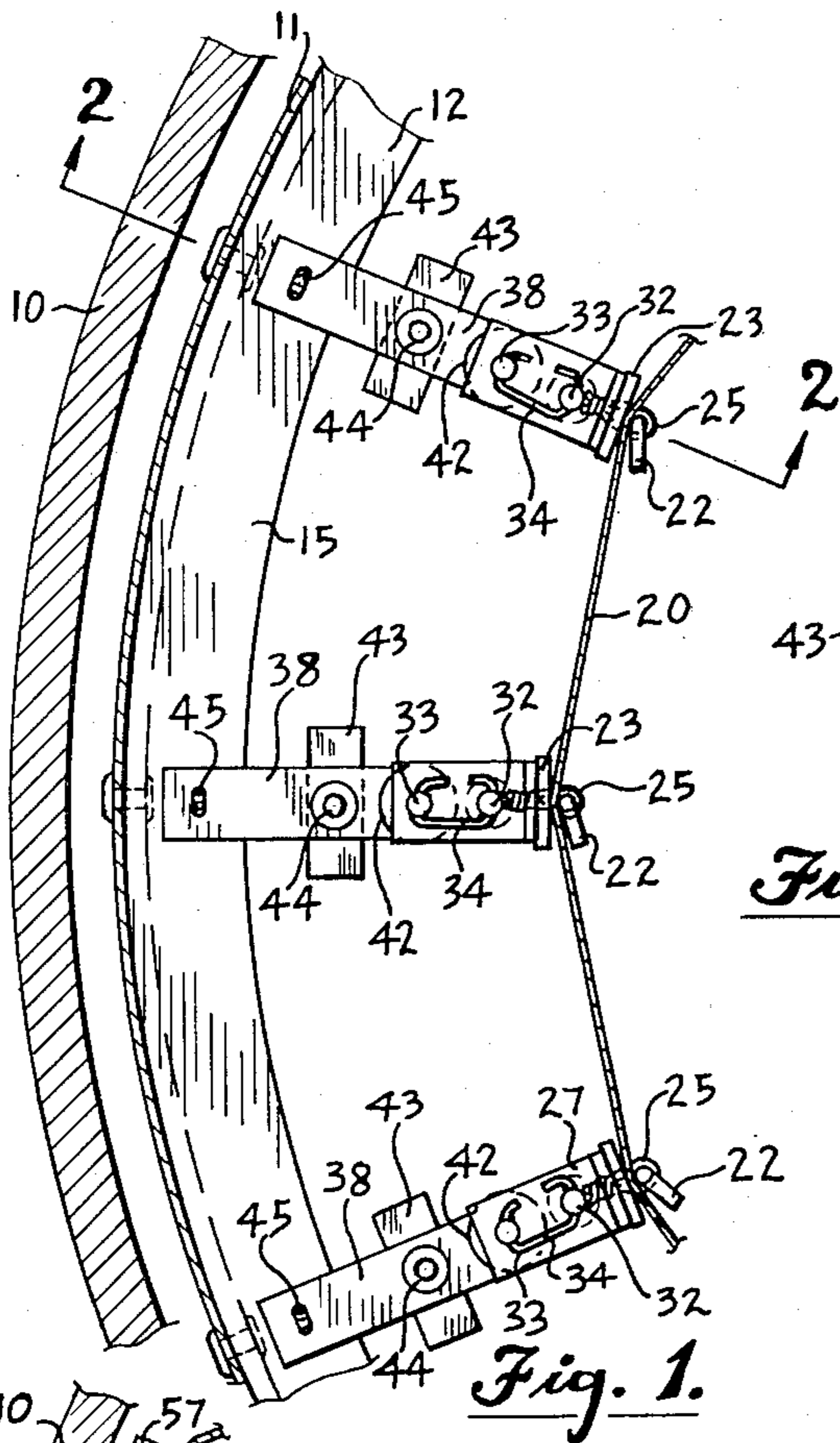


Fig. 1.

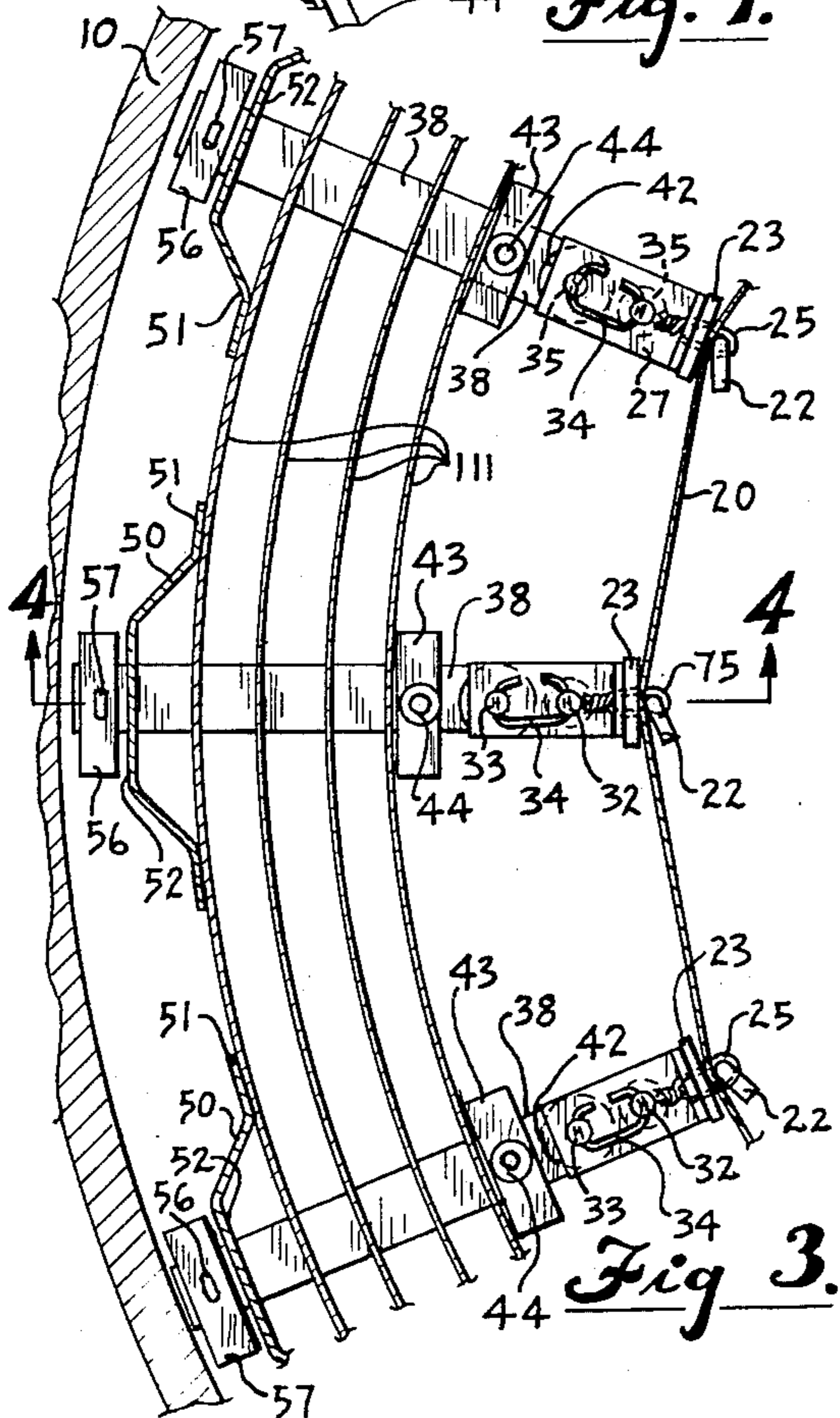


Fig. 3.

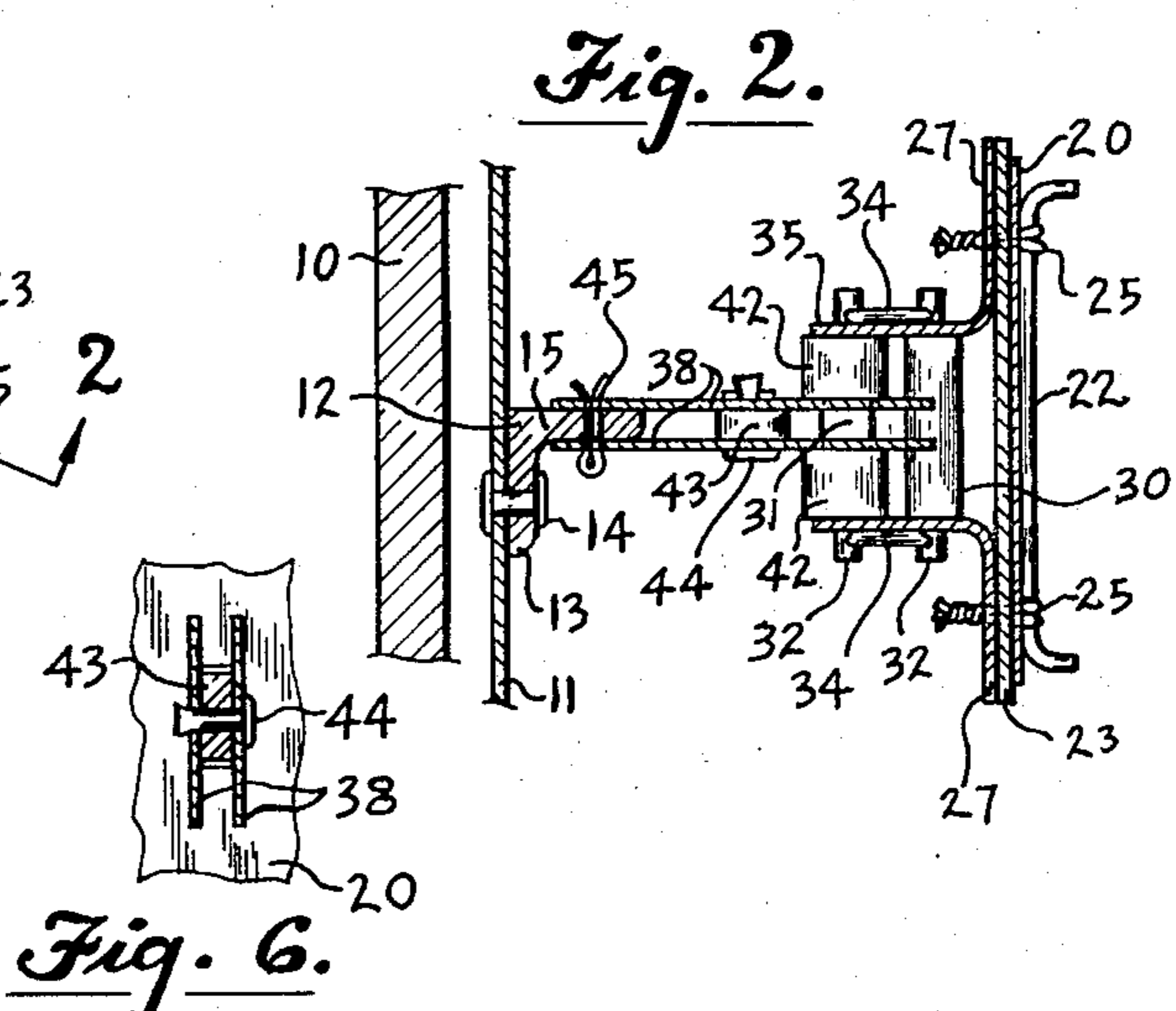


Fig. 2.

Fig. 6.

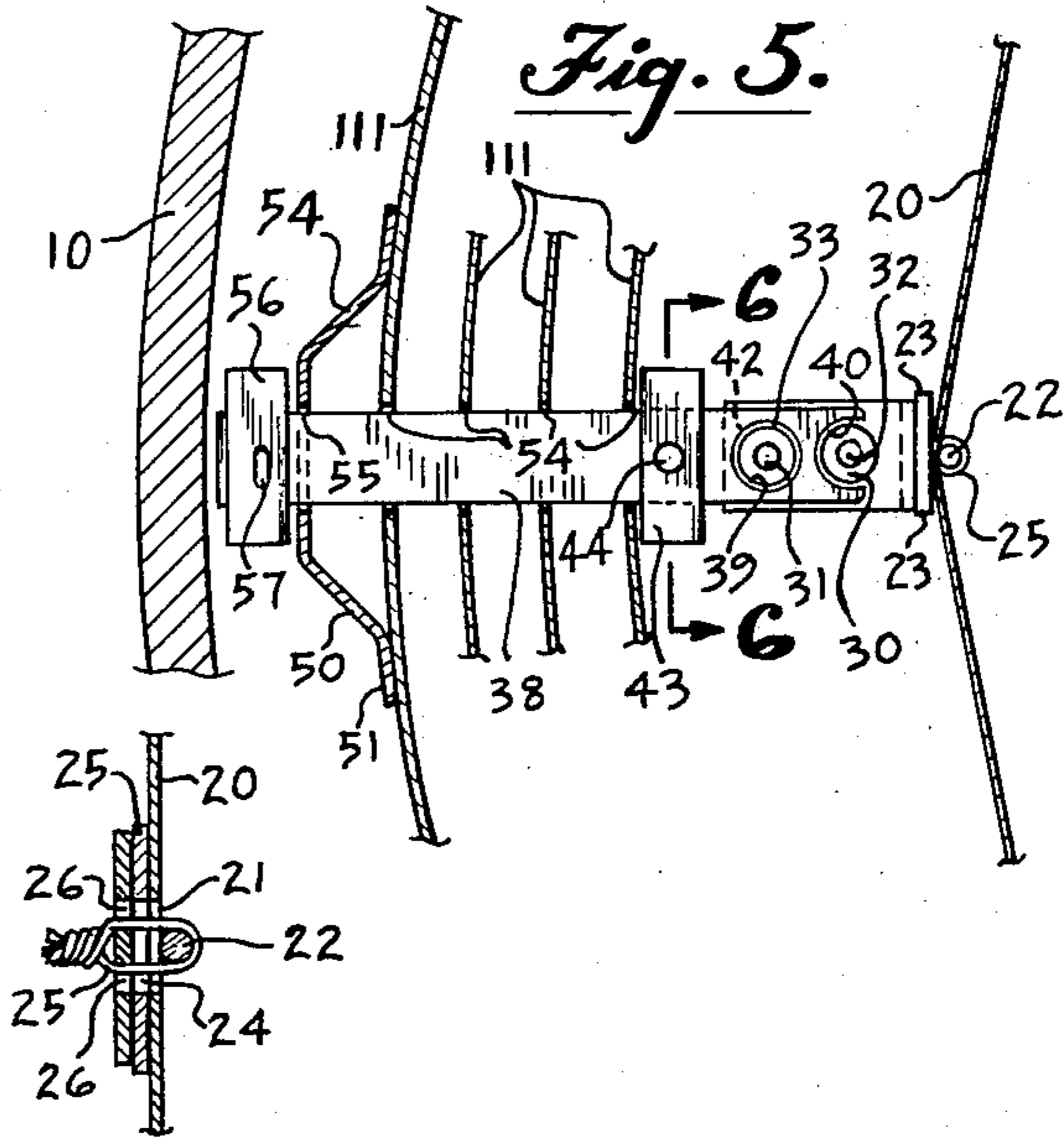


Fig. 5.

Fig. 7.

Fig. 4.

RESISTANCE HEATING ELEMENT FOR VACUUM FURNACES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to resistance heating elements for vacuum furnaces and supports therefor.

2. Description of the Prior Art

Various types of resistance heating elements for vacuum furnaces have heretofore been proposed.

The common practice has been to support the heating elements on or through the wall of the furnace. Typical examples are shown in the U.S. Pat. Nos. to McMaster, 3,295,843, and Mescher et al., No. 3,368,022.

Other mountings for resistance heating elements are shown in the U.S. Pat. Nos. to Robinson, 3,179,735 and Poland, 2,697,127.

Jeru, in U.S. Pat. No. 3,122,735, shows brackets on an interior framework for electric heating elements but these have serious shortcomings, including limited capacity and ineffective interior utilization of the space in the furnace.

It is known to provide heat shields in the interior of a vacuum furnace with the heating elements interiorly thereof as shown in the U.S. Pat. No. 3,263,015 to Hill, and in the U.S. Pat. No. 3,737,553 to Benjamin H. Kreider et al., issued June 5, 1973. The heating elements and their supports as heretofore available had various shortcomings, including subjecting the heating elements to stresses attendant upon expansion and contraction of the outer shell or vacuum vessel, and complexity of attachment of the heating element support to the heating element and to its support.

SUMMARY OF THE INVENTION

In accordance with the invention a resistance heating element for vacuum furnaces and an improved mounting therefor is provided the mounting being carried by an internal heat shield, the mounting being of generally T-shape with an end clamp bar for engagement by the heating element, angle brackets to which the end clamp bar and the heating element are secured, the angle brackets being carried on spaced pins separated and electrically insulated by heat resistant refractory tubes, spaced parallel mounting plates engaging the insulating tubes at one pair of ends being detachably and pivotably secured to an outer heat shield or to an inwardly extending rim carried by an outer heat shield.

It is the principal object of the invention to provide a resistance heating element and a mounting therefor which is particularly suited for mounting independently of the furnace wall and on an interior heat shield.

It is a further object of the invention to provide a resistance heating element and a mounting therefor which is constructed of simple components, capable of ready assembly and mounting in place and which can be readily disassembled for maintenance, repair and replacement of components if required.

It is a further object of the invention to provide a support for resistance heating elements which permits of limited movement of the support with respect to the heating elements and of the support with respect to its location of mounting.

Other objects and advantageous features of the invention will be apparent from the description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The nature and characteristic features of the invention will be more readily understood from the following description taken in connection with the accompanying drawings forming part hereof, in which:

FIG. 1 is a fragmentary view partly in section and partly in elevation of a preferred form of resistance heating element and its mounting;

FIG. 2 is a sectional view taken approximately on the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary view partly in section and partly in elevation of another preferred form of mounting;

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 3;

FIG. 5 is a sectional view taken approximately on the line 5—5 of FIG. 4;

FIG. 6 is a sectional view, enlarged, taken approximately on the line 6—6 of FIG. 5; and

FIG. 7 is a sectional view, enlarged, taken approximately on the line 7—7 of FIG. 4.

It should, of course, be understood that the description and drawings herein are illustrative merely and that various modifications and changes can be made in the structure disclosed without departing from the spirit of the invention.

Like numerals refer to like parts throughout the several views.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings, a fragmentary portion of a generally cylindrical metal furnace wall 10 of a vacuum furnace is shown.

The furnace wall 10 may have spaced inwardly therefrom a cylindrical metallic shield 11, of reflective material, supported within the furnace wall 10 in any desired manner.

In the form of the invention shown in FIGS. 1 and 2, a single reflective shield 11 is shown and this is provided on the interior thereof and spaced along the shield 11, and at each location where a heating element is desired, with a circular supporting ring 12 of angle cross section. The ring 12 has one flange portion 13 thereof secured to the shield 11 by rivets 14, and the other flange 15 of the ring 12 circumferentially inwardly.

The resistance heating element 20 is preferably an elongated continuous thin flat strip, disposed in substantially circular or polygonal arrangement within the furnace wall 10, of high temperature refractory material such as nickel, molybdenum, columbian, tantalum, tungsten, tantalum-tungsten alloys, tungsten-rhenium alloys, rhenium, osmium, iridium, or alloys including binary or ternary alloys of these metals, or conductive non-metals so long as they have the desired resistivity, and the desired temperature resistant qualities in use.

The heating element 20, at desired locations around its periphery, is provided with elongated openings 21.

An elongated U-shaped clamping rod 22 is held in engagement with the heating element 20 and the heat-

ing element 20 is held in engagement with an end clamp bar 23 by wires 25 which extend around the rod 22, through the openings 21, through spaced openings 24 in the clamp bar 23, and through openings 26 in spaced angle brackets 27.

The elongated openings 21 permit of limited relative movement of the heating element 20 and the contiguous structure to accommodate expansion and contraction of the heating element 20 and of the shield 11.

The brackets 27 are held in spaced relation by refractory heat resistant and electric insulating tubes 30 within which pins 32 and 33 disposed and held in assembled relation by end clamp hooks 34 which extend through openings 35 near the ends of the pins 32 and 33, and engage the outer faces of the angle brackets 27.

The pin 32 and the tube 30 thereon can be omitted if a greater pivotal action is desired at this location for greater accommodation of expansion and contraction.

A pair of spaced mounting plates 38 is provided having openings 39 for assembly on the exterior of the tube 31 and end notches 40 for engagement with the exterior of the tube 30. The tube 31 loosely diametrically mounted on the exterior thereof and between the mounting plates 38 and the angle brackets 27 has spacer tubes 42 of electrical insulating and heat resistant refractory material like that of the tubes 30 and 31.

The mounting plates 38, contiguous to the spacer tubes 42, are held in spaced relation by inner abutment bars 43 engaged by rivets 44.

In the embodiment of the invention shown in FIGS. 1 and 2 the ends of the mounting plates 38 are pivotally connected to the flange portion 15 by wire clips 45. This construction is suitable for certain types of vacuum furnaces where the temperatures attained are such that a single-layer reflective shield 11 suffices.

In other furnaces, where higher operating temperatures are required, and as shown in FIGS. 3 to 7, inclusive, a plurality of metallic reflective shields 111 may be employed and without the supporting ring 12 previously described.

In this instance the outermost shield 111 may be made thicker than the interior shields 111 and provided with a supporting frame 50 with ends 51 secured to the exterior of the outer shield 111 and with a central portion 52 spaced outwardly from the outer shield. The shields 111 have aligned openings 54 through which the mounting plates 38 extend and the central portion 52 has an opening 55 through which the mounting plates extend.

An outer abutment bar 56 between the ends of the mounting plates 38 and held in assembled relation thereto by clips 57 to provide a loose connection and a slight pivotal action at this location. The inner abutment bar 43 is in engagement with the innermost shield 111 thus providing for a measure of stability radially considered.

It will thus be seen that a mounting for heating elements has been provided with which expansion and contraction of the heating element is accommodated, independently of expansion and contraction of the furnace wall and that for this purpose the heat reflective shields are effectively utilized and that the mounting itself can be easily assembled, and disassembled as desired.

We claim:

1. In combination a vacuum furnace having an exterior wall, a reflecting shield disposed within said wall, a resistance heating element of high temperature refractory material in strip form, and means for supporting said heating element from said shield, said means including supporting members in engagement with portions of said heating elements, retaining members in detachable engagement with a portion of said shield and in supporting relation to said supporting members, and electrical insulating members located between said shield and said heating element and interposed between said supporting members and said retaining members.
2. The combination defined in claim 1 in which said supporting members include a clamping rod and a clamp bar, and securing elements are provided holding said clamping rod and said clamp bar in engagement with said heating element.
3. The combination defined in claim 1 in which said retaining members include a mounting plate.
4. The combination defined in claim 1 in which said reflecting shield comprises a supporting element having a flange, and said retaining members are detachably secured to said flange.
5. The combination defined in claim 1 in which said reflecting shield comprises a bracket frame, said retaining members each includes a mounting plate extending through said shield and said bracket frame, and a fastener in engagement with said mounting plate exteriorly of said shield.
6. The combination defined in claim 5 in which additional reflective shields are provided between said reflecting shield and said supporting members, and said supporting means includes an abutment member engaging the innermost shield.
7. The combination defined in claim 5 in which additional reflective shields are provided between said reflecting shield and said supporting members, and said supporting means includes an abutment member engaged with a portion of said reflecting shield and with which said fastener is in engagement.
8. The combination defined in claim 1 in which said supporting members include angle brackets, and said angle brackets have said insulating members secured thereto, and said retaining members are in secured engagement with said insulating members.
9. The combination defined in claim 8 in which said insulating members include a pair of insulating tubes, and said means includes spaced mounting plates through which one of said tubes extends and in external engagement with the other of said tubes.
10. The combination defined in claim 9 in which one of said tubes has insulating spacer tubes thereon between said mounting plates and said angle brackets.

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11. The combination defined in claim 1 in which
 said supporting members include angle brackets,
 said electrical insulating members include an insulat-
 ing tube,
 said angle brackets have said insulating tube inter- 5
 posed therebetween,
 said means includes a mounting plate through which
 said insulating tube extends, and
 said tube has spacer tubes thereon between said
 mounting plate and said angle brackets. 10

12. In combination
 a resistance heating element of high temperature re-
 fractory material in strip form, and
 means for supporting said heating element,
 said supporting means including 15
 supporting members for engagement with said
 heating element,
 mounting plate means detachably connected to
 said supporting members, and 20

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electrical insulating means interposed between said
 mounting plate means and said supporting mem-
 bers.

13. The combination defined in claim 12 in which
 said supporting members comprise angle brackets,
 said angle brackets have an insulating tube therebe-
 tween, and
 said mounting plate members are in engagement with
 said insulating tube.

14. The combination defined in claim 1 in which
 said electrical insulating members includes a pair of
 insulating tubes, and
 said means includes spaced mounting plates through
 which one of said tubes extends and in external en-
 gagement with the other of said tubes.

15. The combination defined in claim 14 in which
 one of said tubes has spacer tubes thereon between
 said mounting plates and said angle brackets.

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