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## Description

This invention relates to an insulation for furnace members, particularly to the type utilizing a spring-clip for attachment to the member.

In general, there are two types of insulation commonly used on pipes in slab furnaces. In one, an imbedded metal clip or wire mesh is welded to the pipe. Though resistant to vibration, this type is time consuming and costly to install. The other type is simply hung on lugs secured to the pipe. Of course the lugs must be accurately positioned so that not much time is saved in installation.

In U.S. 4,140,483 Errington, a spring-clip having outward radial projections is attached to the pipe. Subsequently, refractory tiles having holes for the projections are hung on the clip. The holes are then closed with air-set cement. The service life of this insulation is diminished by cracking of the cement, especially where substantial vibration is present, ultimately causing the tiles to fall off.

The primary object of the instant invention is to provide a spring-clip type of insulation which is easy to install and has longer service life than any presently available.

### Summary of the Invention

According to this invention an improved insulation is provided for internally cooled furnace members. The product includes a generally C-shaped metal spring-clip substantially all of the inner surface of which is designed for making intimate contact with the exterior surface of the furnace member. This assures proper cooling of the clip itself and retention of its spring-like properties. The clip has inwardly protruding end portions partially closing its interior opening. The spacing between these end portions is intentionally made significantly less than the cross sectional dimension of the furnace member at the location to be abutted by the clip. This assures proper spring action after the clip is spread open for insertion transversely over, and on to the periphery, of the member. The springiness of the clip itself and the spacing just mentioned are correlated so as to permit both 1) spreading of the clip for insertion, and 2) retention of it at elevated furnace temperatures by continued spring action.

The clip has a plurality of spaced outwardly extending projections, and at least two circumferentially segmented refractory tiles formed on its outer surface covering the projections. By forming we refer to either conventional casting or pressing techniques. It is important that the tiles be so formed as to completely cover the surface of the projections and thus be joined thereby to the clip so as to withstand furnace vibration. The tiles are spaced apart at adjacent ends remote from the C-opening, sufficiently to prevent their abutment when the clip is spread for insertion. An important feature of the invention is that, prior to formation of the tiles on the clip, an organic lubricant coating is applied to the outer clip surface. After forming of the refractory and then curing to dry it, the lubricant prevents bonding of the tiles to the clip and excessive adhesion thereto. The lubricant preferably is of petroleum base and may be, for example, automotive grease. Also, in preferred form an insert is provided where it is desired to cover the entire periphery of the furnace member. The insert includes a metal clip, also having spaced outward projections, and a refractory tile formed thereon. Since the insert is not required to flex for insertion no lubricant coating is required.

The invention also provides a method for making insulation for furnace members. It includes forming a generally C-shaped metal spring-clip with spaced projections extending outwardly from it. Preferably the clip is of heat-treatable steel composition and the method includes heat treatment of the clip to Rockwell C 45/55 aim 50 after forming. An organic lubricant is applied to the outer clip surface prior to formation of refractory tiles covering the projections. The tiles are formed by either casting or pressing, in either case making intimate contact with and covering the projections. After this the tiles are cured by conventional methods to dry them. Thus, a method is provided for making a spring-clip type insulation which can be installed as a unit on the furnace member.

### Description of the Drawings

Figure 1 is a side elevation view of the insulation of the present invention;

Figure 2 is a side elevation of an insert for completing coverage of the periphery of a furnace member to which the insulation of Figure 1 is attached;

Figure 3 is a side elevation view of the insulations of Figures 1 and 2 shown as combined on a furnace member;

Figure 4 is a view taken at IV—IV of Figure 1; and

Figure 5 is a view taken at V—V of Figure 2.

Referring to Figures 1 and 3, the product of this invention includes spring-clip 10 having projections 12 on which refractory tiles 14, 16 are formed. It is essential that the clip have sufficient springiness to remain attached to member 17 (shown in Figure 3) at service temperature in the furnace. Where used on water cooled verticals, cross supports and skid pipes in steel slab reheating furnaces, it is important that substantially all of the inner surface of clip 10 maintain contact with the pipe so that the clip will remain cool and not lose spring action. Desirably, a heat treatable steel composition is used for the clip material so that it may be formed readily then austenitized, quenched and tempered to achieve desired springiness. Either SAE 1050 steel or 410 stainless steel are examples of compositions which may be used. We have found that a hardness aim of Rockwell C 50 after heat treatment provides sufficient springiness. It will be apparent that the clip must cover at least slightly more than 180° of a circular pipe in order to remain attached by spring action. Preferably, about 270° of the circumference is covered.

Projections 12 serve to lock the tiles so that they will remain attached to the clip. It is desirable that they be of stainless steel (AISI Type 304 for example) so as to resist oxidation by the furnace atmosphere. A V-shape is preferred for best locking action. To prevent breakage of the tiles upon installation, the prongs of V-projections 12' remote from clip opening 13 preferably lie in a plane normal to the axis of the pipe 17 (see Figure 1 or 3). Thus, if the product is installed by using a board applied to the lower end of the tiles for pushing them on to the pipe this configuration withstands the forces applied.

The tiles may be of any refractory composition suitable for the temperatures to which they will be exposed in the furnaces. However, the invention is limited to tiles which are formed by casting or pressing of particulates, into a mold so as to be formed directly on to and covering the projections. Refractory of sufficient thermal resistance must be used to protect the clip. Adequate spacing 18 must be provided between the tiles at their adjacent lower ends as shown to permit spreading of the clip for insertion without abutment and breakage of the tile sections. An essential feature of the present invention is that prior to forming the tiles, an organic lubricant coating is applied to the outer surface of clip 10. This prevents adhesion and reduces the coefficient of friction between the tiles and the clip. Thus, when the clip is spread for insertion on to the pipe, it may flex without breaking the tiles. The tiles remain joined to the clip since they are formed directly on to and locked in place by projections 12. Although any organic lubricant or other conventional mold parting compound may be used, we prefer a petroleum base material such as automotive grease.

To complete insulation of the entire circumference of vertical or cross supports, an insert 20 is provided as shown in Figures 2 and 3. A metal clip 22 is provided of circular segmental shape and has spaced projections 24, 26. Refractory tile 28 is formed covering the projections so as to be joined to the clip. It will be quite apparent that insert clip 22 need not have the springiness which is essential for clip 10. Clip 22 has a dimple or button-like projection 27 (Figures 2 and 5) protruding from its opposite ends for engaging mateable slots 29 (Figure 4) in adjoining ends of spring clip 10. The total assembly is shown in Figure 3 mounted on pipe 17. Ceramic fiber blanket 32 is used to partially fill the space between tiles 14 and 16, and air-set mortar is used to fully close the joint and remains locked in place by grooves 34, 36 adjacent to the outer tile surfaces. Mateable step-joints 38, 40 which are sealed with refractory cement are provided on adjacent edges of tiles 14, 16 and insert tile 28. These mortared steps are essential for providing protection of the exposed portions of the clips from the furnace atmosphere and temperature. When the insulation is used on skid pipes, thus not permitting use of an insert for complete covering of the pipe, the exposed parts of the spring clip are covered by air-set refractory cement.

The insulation is made first by rolling or forming a band to a shape and of dimensions closely conforming to that of the member on which it is to be mounted. Then, either as a separate step or part of the initial forming operation, the opposed ends of the clip are crimped to an intentionally and significantly smaller spacing than the cross sectional distance of the location to be abutted by those ends on the pipe or member on which the clip is to be mounted. This distance will depend on the springiness of the clip itself and other factors e.g. pipe diameter etc. For a 5-1/2 inch (14 cm) pipe covered 270° of its circumference we crimp from a normal spacing of 4-1/2 inches (11.4 cm) to anywhere from 3-1/2—5-5/8 inches (8.9—9.2 cm). We form the projections, desirably by welding Type 304 stainless rod to the clip surface in V-shapes. Then, the clip is heat treated by austenitizing at about 1650°F (899°C), water or oil quenching as indicated and then tempering between 400—1000°F (204—538°C) to attain a Rockwell C hardness of 50. As previously mentioned, an essential feature involves applying an organic lubricant to outer surface 42 of clip 10. A mold is then placed around the clip and refractory material cast or pressed in place covering the projections. Finally, the refractory is cured by drying in conventional fashion forming an insulation which can be easily mounted on furnace members.

Various alternative configurations may be contemplated. For example the invention would seemingly work quite well on support members of other than circular shape for example triangular, trapezoidal, or rectangular with side indentations. The only requirements would be that the member have sufficient indentation in its cross section to permit gripping action of a spring-clip thereon, and that the member have corners of sufficiently large curvature that the clip can tightly engage those areas to remain cooled by the member itself where it is used in high temperature environments. Similarly, many different materials might be used for the spring-clip provided it has sufficient springiness to remain in position under the service conditions of the particular application. The furnace temperature, atmosphere and degree of vibration may be important factors in selection of the material. Also, projections other than V-shape would presumably work. These and other embodiments are within the scope of the invention covered by the appended claims.

**Claims**

1. An exterior insulation for an internally cooled, elongate furnace member, the insulation comprising a spring-clip for attachment to the member and a plurality of circumferentially segmented refractory tiles supported by the clip, the clip being generally C-shaped and being dimen-

sioned to fit closely over and resiliently grip the support in heat-conductive contact therewith, and having external projections for supporting the said tiles, characterized in that: the said tiles (14, 16) are formed *in situ* against the external surface of the clip (10) so as to be permanently joined to the clip by embedding of the projections (12, 12') in the refractory tile material, the tiles covering the clip (10) and the projections (12, 12'), and that a layer of organic lubricant is interposed between the clip (10) and the tiles (14, 16).

2. An exterior insulation according to claim 1, characterized in that the said projections (12, 12') comprise a pair of outwardly diverging legs of V-form.

3. An exterior insulation according to claim 1 or 2, wherein the organic lubricant is of a petroleum base composition.

4. An exterior insulation according to claim 1, 2 or 3, characterized by an insert (20) dimensioned to cover the support between the open ends of the clip (10), the insert comprising an insert clip (22) shaped to fit closely against the support member and whose ends interengage with the ends of first clip (10), and that said insert clip (22) has outwardly directed projections (24, 26) and a refractory tile (28) formed against its external surface and over the said projections (24, 26).

5. A method of making exterior insulation for an internally cooled elongated furnace member, said method comprising:

forming a generally C-shaped metal spring-clip for making intimate contact along substantially all of the inner surface thereof with said member so as to be cooled thereby and remain installed thereon by spring action, and

providing a plurality of spaced projections extending outwardly from said spring-clip, said method being characterized by the steps of:

applying an organic lubricant to the outer surface of said spring-clip, and then

forming circumferentially segmented refractory tiles on said clip covering said projections and curing said refractory.

6. The method of claim 5 wherein said metal spring-clip is a heat-treatable steel composition and said method further comprises heat treating said spring-clip, prior to applying lubricant thereon, to a hardness of 45/55 aim 50 Rockwell C.

7. The method of claim 5 or 6 wherein said lubricant is a petroleum base composition.

8. The method of claim 5, 6 or 7, wherein said forming of the spring-clip includes crimping opposed end portions of said clip to provide spacing therebetween significantly less than the cross sectional dimension of said member at a location to be abutted by said portions after installation.

**Revendications**

1. Isolation extérieure pour un élément de four de forme allongée et refroidi intérieurement, comprenant une agrafe ou un collier ouvert à ressort pour l'attache à l'élément et plusieurs pièces de forme ou briques réfractaires segmentées circonférentiellement et supportées par le collier, le collier ayant une forme générale en C et étant dimensionné pour s'ajuster sur et pour serrer élastiquement l'élément, en établissant avec lui un contact conducteur de chaleur, le collier présentant extérieurement des saillies ou crampons pour supporter les briques, caractérisée en ce que les briques (14, 16) sont formées sur place, contre la surface extérieure du collier (10), de manière qu'elles soient assemblées de façon permanente au collier du fait que les crampons (12, 12') sont noyés dans le matériau réfractaire formant les briques, lesquelles recouvrent le collier (10) et les crampons (12, 12'), et en ce qu'une couche de lubrifiant organique est disposée entre le collier (10) et les briques (14, 16).

2. Isolation selon la revendication 1, caractérisée en ce que les crampons (12, 12') sont formés chacun de deux branches qui divergent vers l'extérieur un forme de V.

3. Isolation selon la revendication 1 ou 2, caractérisée en ce que le lubrifiant organique est une composition à base de pétrole.

4. Isolation selon la revendication 1, 2 ou 3, caractérisée en ce qu'elle comprend en outre une pièce isolante complémentaire (20) à insérer, qui est dimensionnée pour recouvrir l'élément dans l'ouverture située entre les extrémités du collier en C (10), cette pièce complémentaire possédant un segment de collier (22) conformé pour s'appliquer intimement contre l'élément et dont les extrémités viennent en contact avec les extrémités du collier (10) mentionné en premier, et en ce que le segment de collier (22) de la pièce isolante complémentaire présente des renflements (24, 26) dirigés vers l'extérieur, la pièce isolante complémentaire possédant en outre une brique réfractaire (28) qui est formée contre la surface extérieure dudit segment de collier (22) et par-dessus des crampons (24, 26) disposés sur ce segment de collier.

5. Procédé pour confectionner une isolation extérieure pour un élément de four de forme allongée et refroidi à l'intérieur, comprenant des étapes qui consistent:

à façonner une agrafe ou un collier à ressort, en métal, de forme générale en C, de manière qu'il reste en contact intime sur pratiquement sur toute sa surface intérieure avec ledit élément, de sorte qu'il est refroidi par cet élément et qu'il reste en place sur lui sous l'effet de son élasticité, et

à disposer des saillies ou des crampons s'étendant vers l'extérieur et mutuellement espacés sur ce collier à ressort, caractérisé en ce qu'il comprend en outre:

l'application d'un lubrifiant organique à la surface extérieure du collier à ressort puis

la formation des briques réfractaires segmentées circonférentiellement sur ce collier, avec recouvrement des crampons, et le durcissement de ce matériau réfractaire.

6. Procédé selon la revendication 5, où le collier à ressort métallique est en acier de traitement et le procédé comprend en outre le traitement ther-

mique du collier à ressort, avant l'application du lubrifiant sur lui, pour lui conférer une dureté Rockwell C de 45/55, de préférence une dureté Rockwell C de 50.

7. Procédé selon la revendication 5 ou 6, où le lubrifiant est une composition à base de pétrole.

8. Procédé selon la revendication 5, 6 ou 7, où le façonnage du collier à ressort comprend la réduction de l'écartement des parties extrêmes opposées du collier, jusqu'à en écartement qui est nettement inférieur à la distance qui subsiste entre les extrémités du collier après sa mise en place sur ledit élément.

**Patentansprüche**

1. Eine äußere Isolierauskleidung für ein von innen gekühltes, langgestrecktes Ofenteil, die Isolierauskleidung enthaltend eine Federklemme zur Anbringung am Teil und eine Mehrzahl von in Umfangsrichtung unterteilten feuerfesten Keramikplatten, die von der Klemme getragen werden, wobei die Klemme im wesentlichen C-förmig ist und so dimensioniert ist, daß sie eng über den Träger paßt und ihn elastisch in wärmeleitendem Kontakt damit greift und äußere Vorsprünge zum Halten der genannten Keramikplatten hat, dadurch gekennzeichnet, daß: die genannten Keramikplatten (14, 16) in situ auf der Außenfläche der Klemme (10) ausgebildet sind, so daß sie immerwährend mit der Klemme verbunden sind, indem die Vorsprünge (12, 12') in dem feuerfesten Keramikplattenmaterial eingebettet sind, die Keramikplatten die Klemme (10) und die Vorsprünge (12, 12') bedecken und daß eine Schicht eines organischen Schmierstoffes zwischen die Klemme (10) und die Keramikplatten (14, 16) eingefügt ist.

2. Eine äußere Isolierauskleidung nach Anspruch 1, dadurch gekennzeichnet, daß die Vorsprünge (12, 12') ein Paar nach außen divergierende Schenkel von V-Form enthalten.

3. Eine äußere Isolierauskleidung nach Anspruch 1 oder 2, worin der organische Schmierstoff eine Zusammensetzung auf Erdölbasis ist.

4. Eine äußere Isolierauskleidung nach Anspruch 1, 2 oder 3, gekennzeichnet durch ein Einsatzstück (20), das so dimensioniert ist, daß der Träger zwischen den offenen Enden der Klemme (10) bedeckt wird, wobei das Einsatzstück eine Einsatzklemme (22) aufweist, die so geformt ist, daß sie eng auf das Tragteil paßt und deren Enden in die Enden der ersten Klemme (10) eingreifen, und daß die genannte Einsatzklemme (22) nach außen gerichtete Vorsprünge (24, 26) und eine feuerfeste Keramikplatte (28) aufweist, die auf ihrer Außenfläche und über den genannten Vorsprüngen (24, 26) ausgebildet ist.

5. Ein Verfahren zum Herstellen einer äußeren Isolierauskleidung für ein von innen gekühltes, langgestrecktes Ofenteil, genanntes Verfahren umfassend:

Ausformen einer im wesentlichen C-förmigen Metallfederklemme zur Herstellung eines innigen Kontaktes auf im wesentlichen ihrer gesamten inneren Oberfläche mit dem Teil, damit sie davon gekühlt wird und daran unter Federwirkung installiert bleibt, und

Herstellung einer Mehrzahl von beabstandeten Vorsprüngen, die sich nach außen von der Federklemme erstrecken, gekennzeichnet durch die Schritte:

Anbringen eines organischen Schmierstoffs an der Außenfläche der genannten Federklemme und anschließendes

Ausbilden in Umfangsrichtung unterteilter feuerfester Keramikplatten auf der Klemme, die die Vorsprünge bedecken, und Härten des feuerfesten Materials.

6. Das Verfahren nach Anspruch 5, worin die Metallfederklemme ine wärme-behandelbare Stahlzusammensetzung ist und das genannte Verfahren weiterhin die Wärmebehandlung der Federklemme vor dem Aufbringen des Schmierstoffs darauf auf eine Rockwell-C-Härte von 45/55 bevorzugt 50 umfaßt.

7. Das Verfahren nach Anspruch 5 oder 6, worin der Schmierstoff eine Zusammensetzung auf Erdölbasis ist.

8. Das Verfahren nach den Ansprüchen 5, 6 oder 7, worin das Ausformen der Federklemme das Einbiegen entgegengesetzter Endbereiche der Klemme umfaßt, um einen Abstand zwischen ihnen herzustellen, der bedeutsam geringer ist, als die Querschnittsabmessung des Teiles an der Stelle, an denen genannte Endbereiche nach der Installation anstoßen.

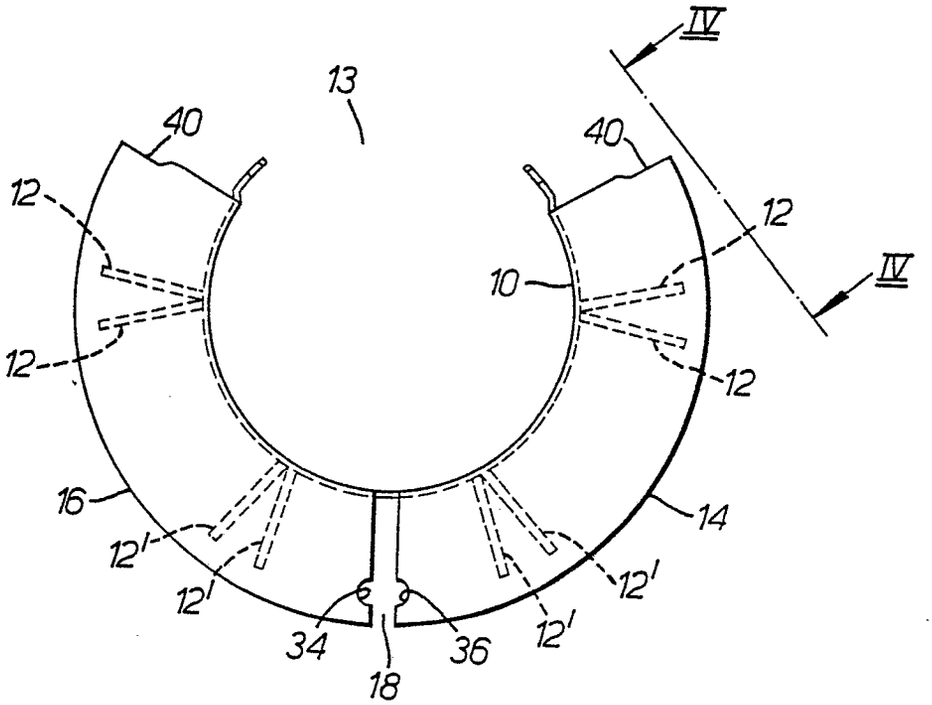
IV
13
40
40
12
12
IV
10
12
12
12
16
14
12'
12'
12'
12'
34
36
18

FIG. 1.

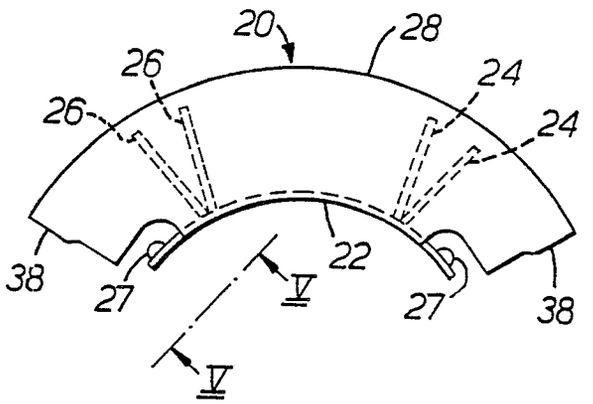
20
28
26
24
26
24
38
27
22
27
38
V
V

FIG. 2.

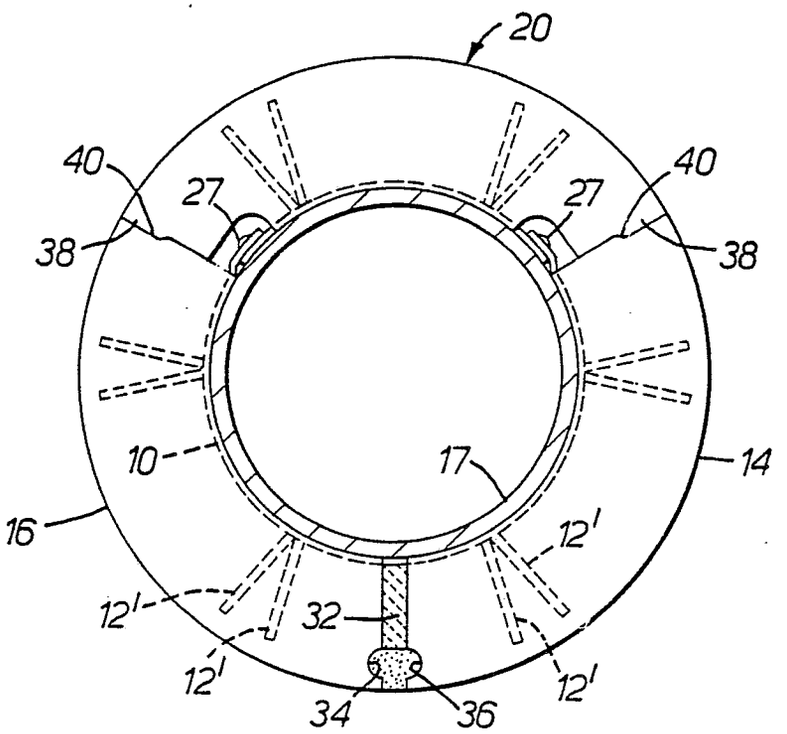


FIG. 3.

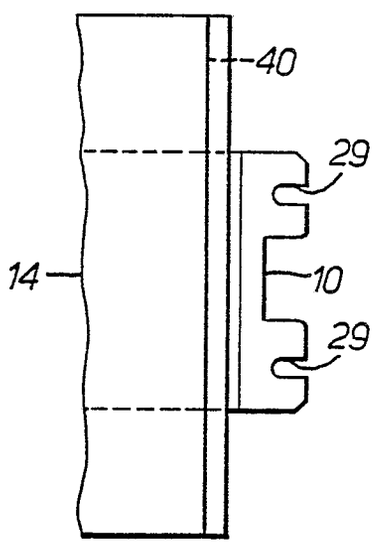


FIG. 4.

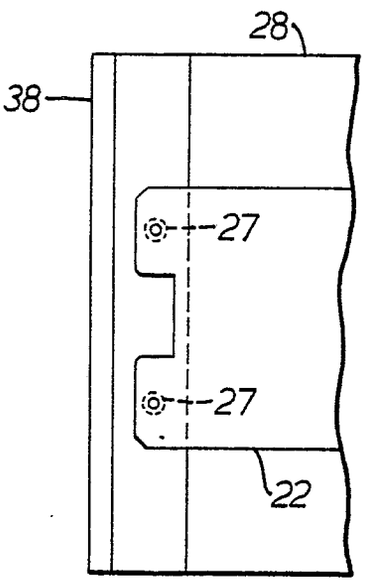


FIG. 5.