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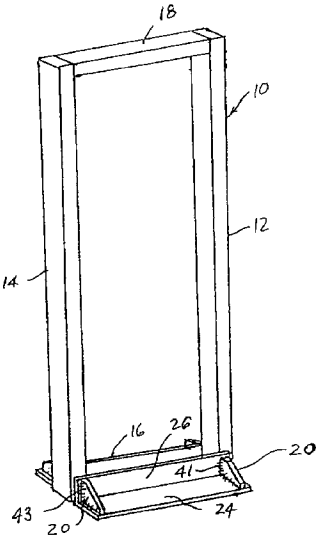
(54) **BATI D'EQUIPEMENT PARASISMIQUE**
(54) **SEISMIC RESISTANT EQUIPMENT RACK**



(57) Bâti d'équipement parasismique qui possède deux montants creux tubulaires de section rectangulaire et un élément transversal creux tubulaire qui s'étend sur les extrémités supérieures des montants à partir d'un des deux montants jusqu'à l'autre et qui est soudé aux montants sur le périmètre de chaque extrémité de l'élément transversal. Une pièce de renfort est installée dans chaque montant près de son extrémité supérieure afin de solidifier le haut du bâti. Deux plaques-goussets vont de la base d'un des montants jusqu'à l'autre montant. Les plaques-goussets sont soudées aux montants à leur sommet et à leur base. Deux éléments de renfort sont soudés de chaque côté du bâti à chaque plaque-gousset et s'étendent transversalement jusqu'aux plaques-goussets.

(57) A seismic resistant equipment rack which has a pair of hollow tubular uprights having a rectangular cross section and a hollow tubular cross member extending across the top of the uprights from one of the pair to another and welded to the uprights around a perimeter of each end of the cross member. A stiffening device is mounted in each of the uprights proximate a top thereof for stiffening the top of the rack. A pair of gusset plates extends from a base of one of the uprights to another. The gusset plates are welded to the uprights along a top and bottom thereof. A pair of stiffening elements are welded at each side of the rack to each of the gusset plates and extend transversely to the plates.

ABSTRACT

A seismic resistant equipment rack which has a pair of hollow tubular uprights having a rectangular cross section and a hollow tubular cross member extending across the top of the uprights from one of the pair to another and welded to the uprights around a perimeter of each end of the cross member. A stiffening device is mounted in each of the uprights proximate a top thereof for stiffening the top of the rack. A pair of gusset plates extends from a base of one of the uprights to another. The gusset plates are welded to the uprights along a top and bottom thereof. A pair of stiffening elements are welded at each side of the rack to each of the gusset plates and extend transversely to the plates.

SEISMIC RESISTANT EQUIPMENT RACK

FIELD

The present invention relates to an equipment rack typically used for telephone relays which have been made resistant to damage from seismic disturbances.

BACKGROUND

Telephone companies typically have several sites around a major metropolitan area where racks of relays are stored together with other equipment. The purpose of these sites known as central offices, is to operate as switching centers for telecommunication within a region of subscribers. The relays located at these sites are critically important to the maintenance of telephone communications within the area and with other areas. One of the main potential causes of damage is due to seismic disturbances, particularly in regions of high earthquake activity. In such areas as well as other areas it is important to design racks for holding these relays which are resistant to damage from seismic disturbances. Typically such racks have been made from aluminum formed into a rectangular frame with a cross bar at the top and bolted and/or welded to a common base. Dynamic testing of such racks has disclosed them to be unable to withstand even relatively small earthquakes when subjected to lateral vibrations. Often the upstanding frame elements twisted dramatically.

Known telephone racks include that disclosed in U.S. Patent No. 4,715,502 issued to Salmon. The Salmon rack is made up of a pair of U-shaped upright members joined at the top by a U-shaped cross member and bolted at the bottom to base plates transverse to the plane defined by the upright and cross members. The base plates are described as the means by which the upright members are prevented from tilting forward or backwards. The U-shaped channels are inherently stronger than a flat plate but not

sufficiently strong to prevent twisting and/or bending when strong seismic forces are imposed.

U.S. Patent No. 5,566,836 issued to Lerman also discloses a telecommunication rack having a pair of U-shaped channel uprights joined at the bottom by plates extending across the bottom of the uprights and bolted to the latter with the ends bent transverse to the plates so as to provide some stiffening to the plates. It is doubtful that the base bolts which affix the uprights to the base plates or the U-shaped uprights could withstand any significant seismic activity.

U.S. Patent No. 4,493,422 issued to Kaegebein discloses a rack having a pair of U-shaped channel members as uprights, a U-shaped cross member and a pair of base plates the extend transversely to the plane defined by the uprights and cross member and a pair of oppositely disposed stiffening members affixed to each base plate and associated upright. Kaegebein discloses no cross member joining the base of the uprights. Although the stiffening members would assist in resisting vibrations transverse to the plane of the uprights and cross member, the bolts between the base plate and the stiffeners would be subject to shear. Also horizontal vibration forces parallel to the latter plane would be resisted only by the bolts between the stiffeners and the base of the uprights. The latter bolts are also in shear.

Accordingly, it is an object to provide an improved rack for holding equipment that provides improved resistance to seismic vibrations.

SUMMARY OF THE INVENTION

According to the invention there is provided a seismic resistant equipment rack which has a pair of hollow tubular uprights having a rectangular cross section and a hollow tubular cross member extending across the top of the uprights from one of the pair to another and welded to the uprights around a

perimeter of each end of the cross member. A stiffening device is mounted in each of the uprights proximate a top thereof for stiffening the top of the rack. A pair of gusset plates extends from a base of one of the uprights to another. The gusset plates are welded to the uprights along a top and bottom thereof. A pair of stiffening elements are welded at each side of the rack to each of the gusset plates and extend transversely to the plates. The above rack is simpler than known racks, much lighter and less expensive. Utilizing gusset plates together with stiffeners for the gusset plates and welding the uprights to the gusset plates provides hitherto unachieved stability. Added to this is the strength of rectangular tubular steel frame members and cross members.

A pair of stiffening plates may be aligned with top and bottom surfaces of the cross member and welded in an interior of each of the uprights proximate a top thereof. The stiffening plates provide continuity of material from an outside surface on one side of the rack to an outside surface of the other side. This makes any deformation of the upper end of the rack much more difficult.

The tubular uprights and cross bar are preferably made of steel. However, other metal alloys which are as strong or stronger than steel may be used.

The uprights may have a cross section with dimensions of 2 inches by 4 inches by 1/8 inch. The gusset plate may be 1/2 inch thick and also may be made of steel.

Advantageously, the natural frequency of the rack in either a direction parallel to a plane of the uprights or transverse thereto preferably exceeds 6 Hertz.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages will be apparent from the following detailed description, given by way of example, of a preferred embodiment taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a perspective view of the seismic resistant equipment rack;

Fig. 2 is a front elevation view of the equipment rack;

Fig. 3 is a detail diagram of an upper corner of the rack;

Fig. 4 is a partial section of the upper corner of the rack; and

Fig. 5 is a side elevation view of a bottom portion of the rack.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

Referring to Figures **1** and **2** the equipment rack **10** has two upright parallel tubular members **12** and **14** of rectangular cross section. These uprights are 4 inch by 2 inch by 1/8 inch hollow structural steel sections. Metal such as aluminum is too soft to provide sufficient strength. A cross member **18** joins upright members **12** and **14** at the top and is welded around the perimeter of the ends of cross bar **18**. The cross member **18** is of the same cross sectional dimensions and the same material as uprights **12** and **14**. In addition, as seen in Figures **3** and **4** two stiffening plates **30** and **32** are positioned to align with the top and bottom surfaces of cross bar **32** when the latter is in position to be welded to the uprights. The stiffening plates **30** and **32** have welds **34** and **36**, respectively, extending around their perimeter which bond them to the inside of the respective uprights **12** and **14**. Thus, there is a continuity of material all across the top through to the outside surfaces of uprights **12** and **14**.

The bottom of the two uprights **12** and **14** are welded to two right angle 1/2 inch thick steel gusset plates **16** and **26** with welds **44** and **42** formed along the top and bottom, respectively, of each plate at each upright **12** and **14** and by welds 41 and **43** along the sides of each upright at each of plates **16** and **26**. In addition, steel stiffeners **20** are welded at each end on each side of the rack **10.** The stiffeners **20** have welds **41** and **43** along each side of their line of contact with the plates **16** and **26**. They provide resistance to vibrational motion perpendicular to the plane of the rack. Welds **44** and **42** of the plates **16** and **26** to the bottom of the uprights **12** and **14** serve to resist shear due to vibrations in the plane of the rack **10**. The bottom portion **24** of base plates **26** and **16** is anchored to a base support (not shown) which is usually a thick reinforced concrete slab. Heavy plate washers **38** and seismically rated anchors **40** are used to fasten the rack base to a concrete floor through slots **22**.

Utilizing strong steel members of rectangular cross section improves the resistance of the rack to fracture of these members and twisting. Ordinarily, shelving and equipment is screwed to the front of the uprights through with self-tapping screws engaging screw holes which pass through the front of the uprights.

Such units were subjected to test protocols in accordance with the Generic Requirements document (GR-63-CORE of 1 October 1995) published by Bell Communications Research, Inc.(Bellcore) and titled: Network Equipment-Building System (NEBS) Requirements: Physical Protection. It was found that full compliance was achieved with static testing, with the requirements for natural mechanical frequency and all of the dynamic tests that were run.

Accordingly, while this invention has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications of the illustrative embodiments, as well as other embodiments of the invention, will be apparent to persons skilled in the art upon reference to this description. It is therefore contemplated that the appended claims will cover any such modifications or embodiments as fall within the true scope of the invention.

WHAT IS CLAIMED IS:

1. A seismic resistant equipment rack, comprising:

(a) a pair of hollow tubular uprights having a rectangular cross section;

(b) a hollow tubular cross member extending across the top of said uprights from one of said pair to another and welded to said uprights around a perimeter of each end of said cross member;

(c) a stiffening device in each of said uprights proximate a top thereof for stiffening the top of the rack;

(d) a pair of gusset plates extending from a base of one of said uprights to another, said gusset plates welded to said uprights along a top and bottom thereof; and

(e) a pair of stiffening elements welded at each side of said rack to each of said gusset plates and extending transversely to said plates.

2. A rack according to claim 1, including a pair of stiffening plates aligned with top and bottom surfaces of said cross member and welded in an interior of each of said uprights proximate a top thereof;

3. A rack according to claim 1, wherein said tubular uprights and cross bar are steel.

4. A rack according to claim 1, wherein said uprights have a cross section with dimensions of 2 inches by 4 inches by 1/8 inch.

5. A rack according to claim 1, said gusset plate is 1/2 inch thick and is made of steel.

6. A rack according to claim 1, wherein the natural frequency of the rack in either a direction parallel to a plane of the uprights or transverse thereto exceeds 6 Hertz.

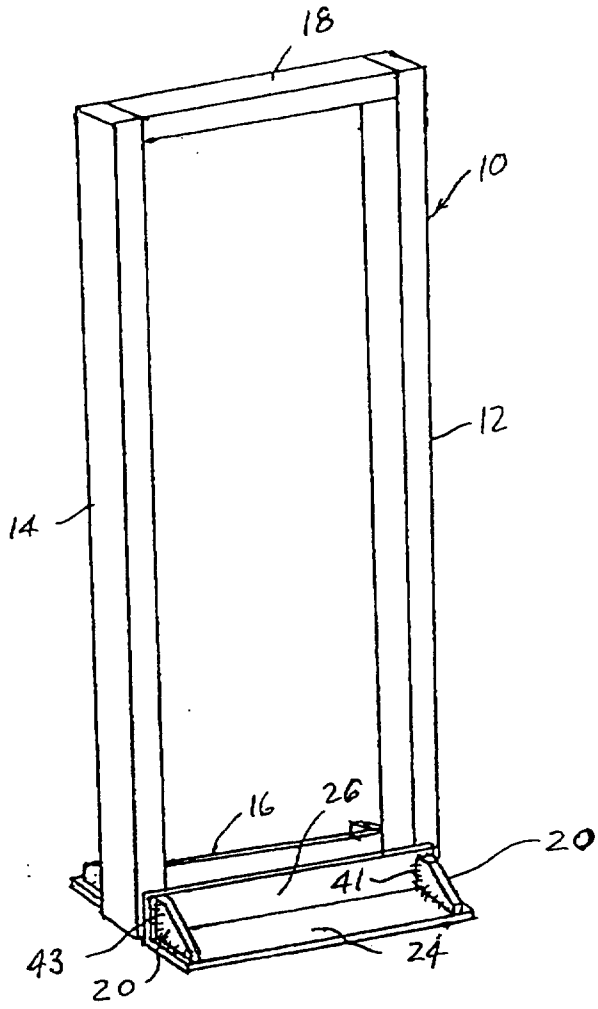


Fig. 1

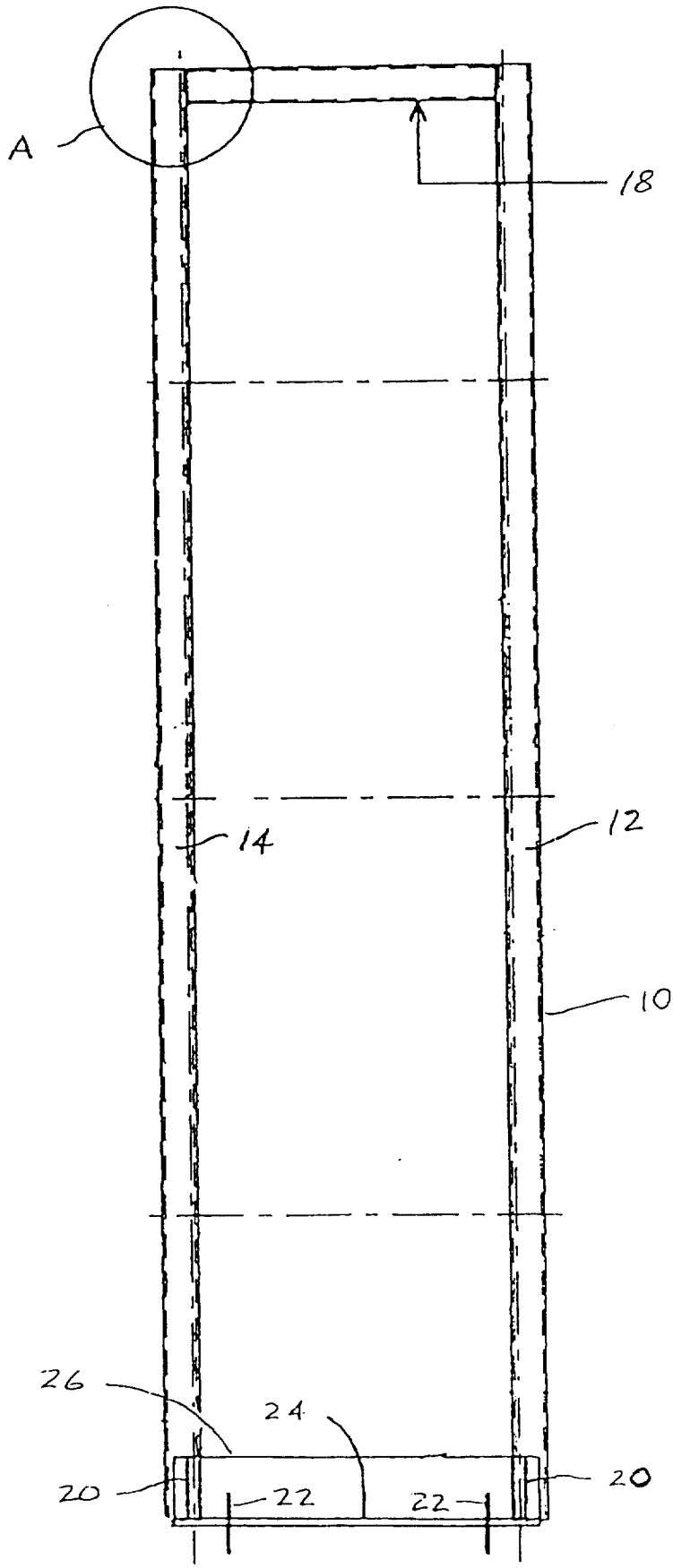


Fig. 2

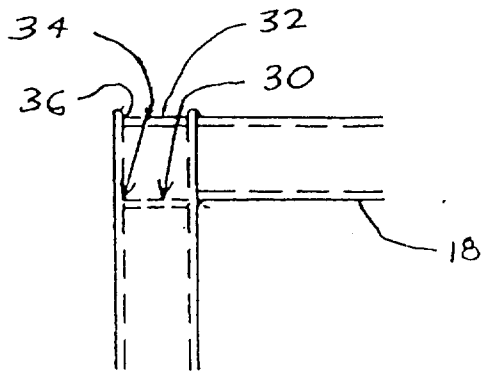


Fig. 3

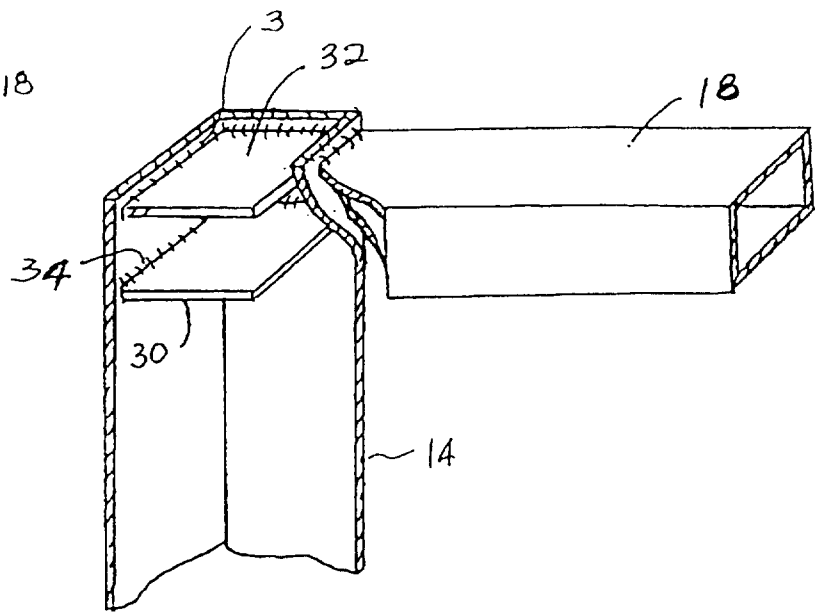


Fig 4

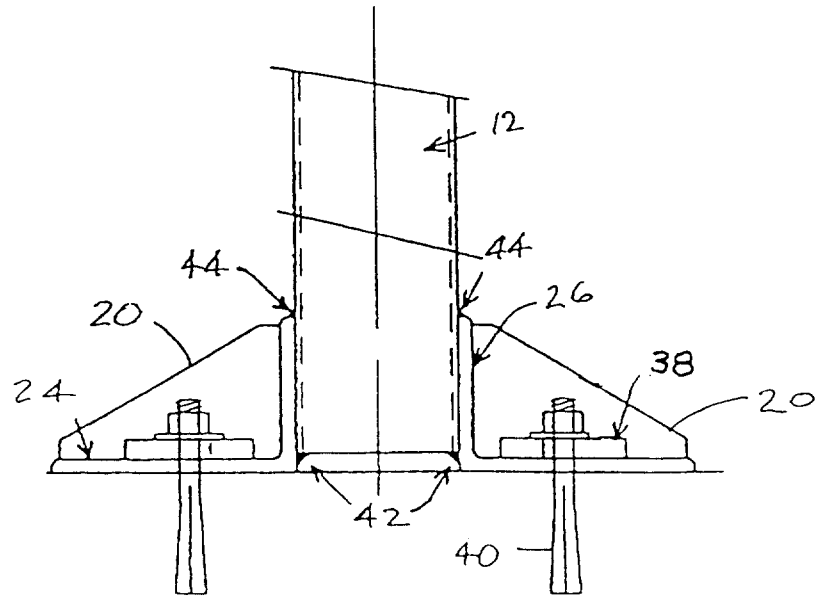
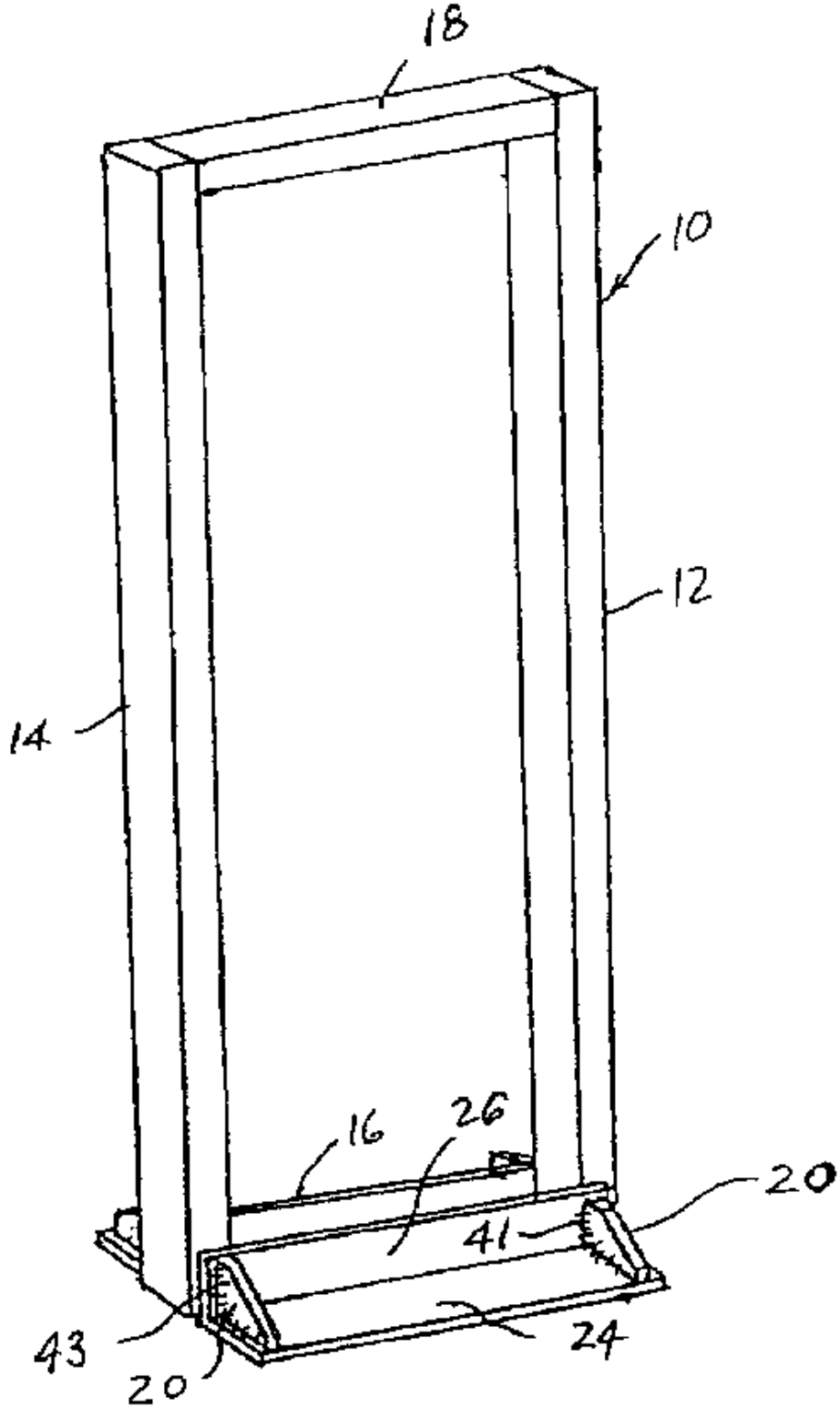


Fig 5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