March 14, 1967 F. B. OGILVIE 3,308,580

DOOR STRUCTURE HAVING TORQUE TUBE

Filed Nov. 9, 1964

2 Sheets-Sheet 1

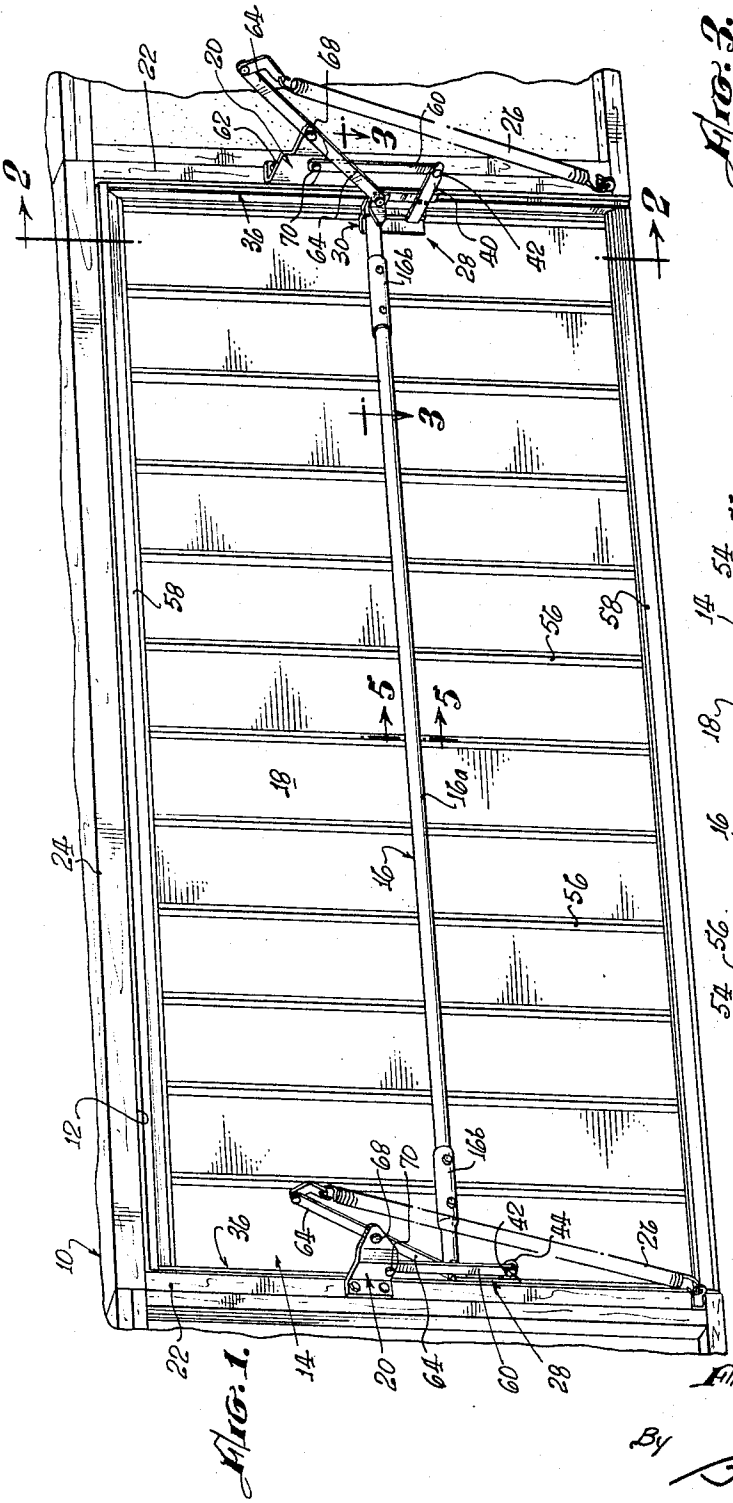


FIG. 1.

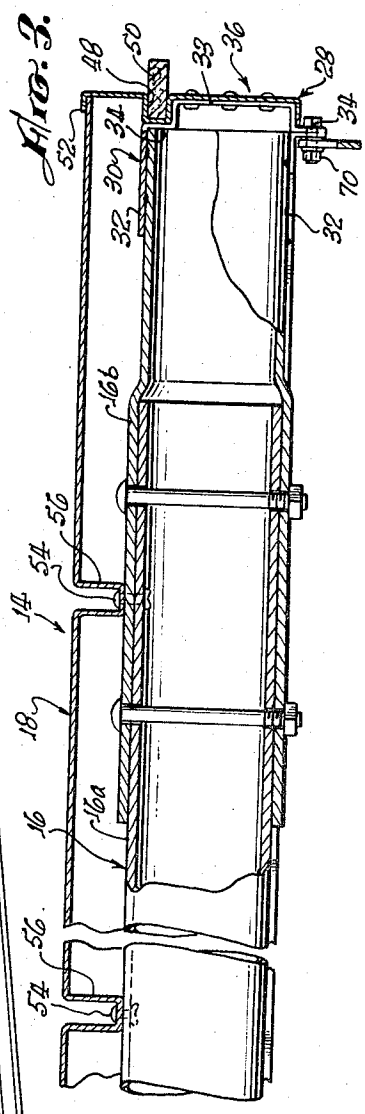


FIG. 2.

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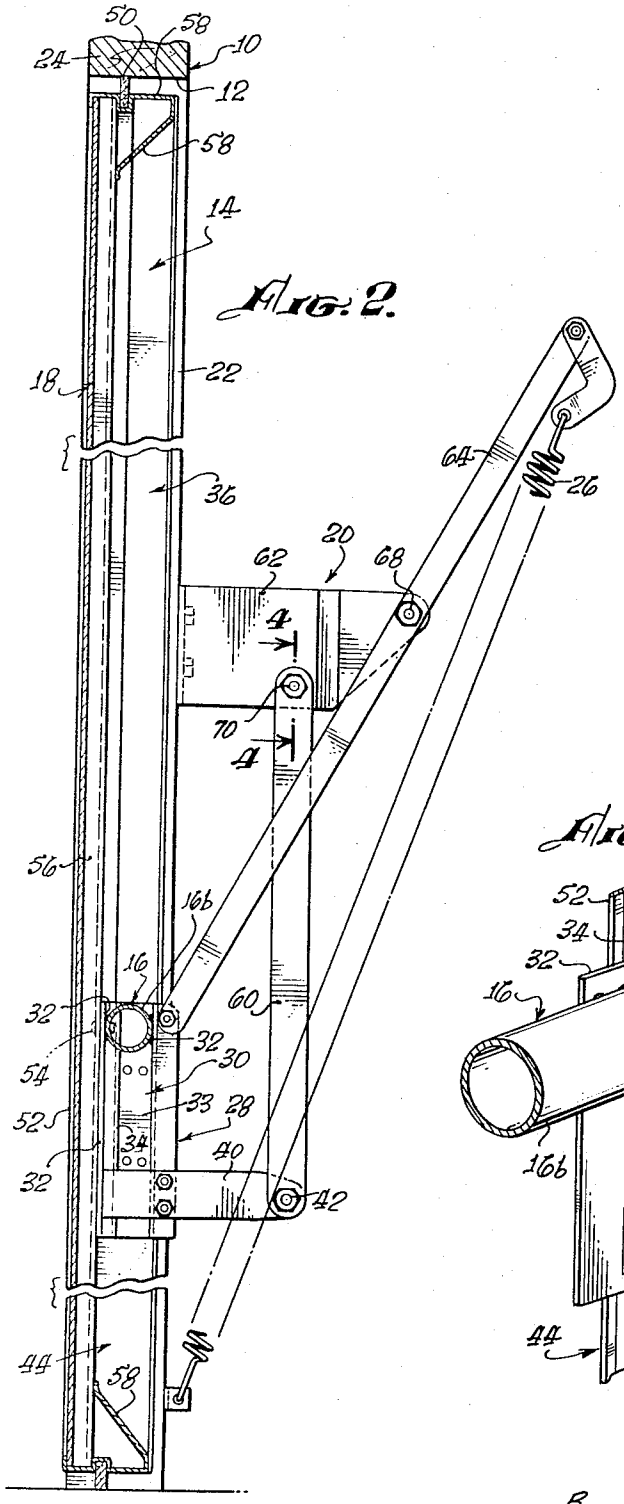


Fig. 2.

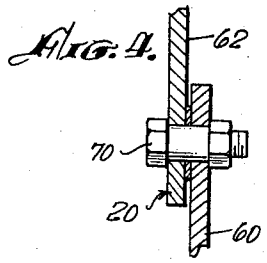


Fig. 4.

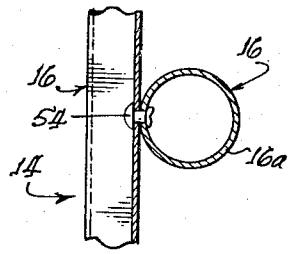


Fig. 5.

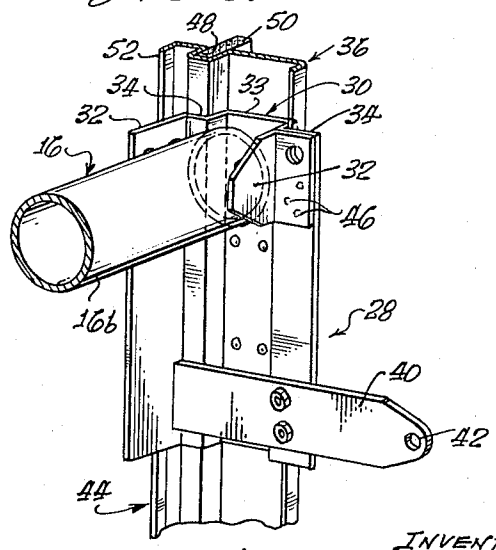


Fig. 6.

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DOOR STRUCTURE HAVING TORQUE TUBE

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10 Claims. (Cl. 49—206)

The present invention relates generally to doors of the class which are commonly used for garages and other building structures having relatively large access openings; more particularly, the invention relates to improvements in overhead doors of this class.

An overhead door of the class to which this invention pertains comprises a panel which is pivotally mounted at its ends on the sides of the door frame in such manner that the door is movable between a closed position, wherein the door panel is vertically disposed in the door opening, and an open position, wherein the panel occupies a horizontal, overhead position adjacent the upper horizontal edge of the door frame. The pivotal supports or hinges for overhead doors of this type comprise links which are pivotally connected between the door frame and door panel in such manner that the door undergoes both rotation and translation in moving between its open and closed positions. Accordingly, when the door is opened, it must be bodily raised, rather than simply rotated, from its closed position. Similarly, when the door is closed, it must be bodily lowered, rather than simply rotated, to its closed position.

Prior overhead doors have been characterized by long-standing shortcomings and disadvantages, which the present invention seeks to overcome. One such shortcoming resides in the fact that when an overhead door is manually raised and lowered in the customary way, that is by grasping the lower edge of the door panel or a handle fixed to the panel, the door is subjected to a twisting moment which is minimum when the door panel is grasped midway between its ends. This twisting moment increases progressively as the point of application of the operating force to the door is shifted toward one end of the door. Consider, for example, the situation that exists when an overhead door is raised by a force applied to one end of the door. Under these conditions, the force exerted on the door tends to rotate and bodily move the adjacent end of the door in one direction about its horizontal pivot axis. Gravity, on the other hand, tends to rotate and bodily move the remote end of the door in the opposite direction about its pivot axis. These two forces produce a combined bending and twisting load on the door which tends to twist or rotate the ends of the door relative to one another and to pull one end of the door down relative to its other end. When the door occupies its overhead open position, the center of the door is subjected to a downward bending load which tends to cause the center to sag.

In conventional overhead doors, these twisting and bending loads are transmitted through the door panel itself. As a consequence, the door panel must be constructed with sufficient strength and rigidity to withstand such loads without excessive torsional and bending deflection. The existing overhead doors, therefore, are quite heavy. Such doors require relatively strong, massive counter balance springs. Also, rods are required for reinforcing the doors against bending or sagging at their centers when in open position. The large counter balance springs required in these existing doors are quite costly and are difficult to properly install and adjust. Moreover,

even through the counter balance springs are initially properly adjusted, the counter balance force exerted by the springs may diminish over a period of time with the result that the springs must be periodically readjusted. If the springs are not periodically readjusted, the existing overhead doors may become progressively more difficult to raise and lower and, moreover, the doors tend to slam closed, thereby creating impact forces on the doors and their hinges which damage and weaken the same.

A series deficiency of conventional overhead doors is the safety hazard which they present. The required strong heavy counter balance springs are under considerable stress at all times and are subject to breaking while static or during opening or closing of the door. When such a spring breaks, it may typically be impelled with great force and thus can cause personal injuries and property damage. The great weight of the doors presents a hazard, particularly for children who may attempt to open or close the doors, and this hazard is increased if the counter balance springs are not adjusted to properly support the weight of the doors and prevent the doors from slamming to their closed position.

The requirement that the panels of conventional overhead doors resist or support the torsional and bending loads imposed on the doors presents a further inherent disadvantage. This disadvantage resides in the fact that the structural requirements of the existing doors are not generally compatible with the most economical methods of fabrication or with the most decorative aspects of door design. In other words, the design of an existing overhead door is dictated primarily by strength requirements rather than economy of maintenance and decorative appearance. In order to provide a particular door decor, for example in harmonizing a door with an adjacent building, it has ordinarily been necessary either to construct the door specially or to attach a separate decorative panel which is not subject to stress. As a result, the door cost is generally high and the decorative design of the door is generally a compromise consistent with the structural requirements of the door.

It is therefore the general object of the present invention to provide an improved overhead door which eliminates or alleviates the aforementioned shortcomings and disadvantages of prior art doors.

An object of the invention is the provision of an improved overhead door wherein the torsional and bending loads imposed on the door are carried, not by the door panel, but substantially entirely by a single, relatively light weight load-carrying member or torque shaft, which extends between and is anchored at its ends to the door hinges, whereby the door panel may be of simplified, relatively light weight construction.

An object of this invention is to provide an improved overhead door structure which may economically be externally configured to match the external finish of an adjacent building structure.

An object of the invention is the provision of an improved overhead door which substantially minimizes or eliminates safety hazards inherent in conventional overhead doors.

A further object of the invention is to provide an improved overhead door which requires only relatively light counter balance springs which are economical, easier to install and easier to adjust than the counter balance springs of conventional existing overhead doors.

Another object of the invention is to provide an improved overhead door which is substantially easier to

open and close than the existing overhead doors and which may be raised and lowered from any point along the door without excessive twisting and/or bending of the door.

Another object of the invention is to provide an improved overhead door wherein the main load-carrying member or torque shaft resists both torsional and bending moments on the door, whereby tie rods and other forms of reinforcement required in the existing overhead doors may be eliminated.

Further objects of the invention are concerned with providing an improved overhead door which is relatively economical to fabricate, simple to install, pleasing in appearance, and otherwise ideally suited to its intended purposes.

Other objects, features and advantages of the present invention will become apparent to those versed in the art from a consideration of the following description, the appended claims and the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a door according to the present invention installed in a door opening;

FIGURE 2 is an enlarged sectional view taken at line 2—2 in FIGURE 1;

FIGURE 3 is an enlarged sectional view taken at line 3—3 in FIGURE 1;

FIGURE 4 is an enlarged sectional view taken at line 4—4 in FIGURE 2;

FIGURE 5 is an enlarged sectional view taken at line 5—5 in FIGURE 1; and

FIGURE 6 is an enlarged perspective view of a torsion bracket assembly embodied in the door construction of FIGURES 1, 2 and 3.

Referring to the drawings, there is illustrated a vertical wall or partition 10 having an access opening 12 therein. Partition 10, for example, may comprise a wall of a garage. Mounted within the opening 12 is an improved overhead door 14 according to this invention. Door 14 comprises a main horizontal load carrying member, or torque shaft 16, a panel 18 supported by the torque shaft, and hinges 20 which are operatively connected between the ends of the torque shaft and the side frame members 22 of the door opening 12. The door hinges 20 support the door 14 in the usual way for combined translation and rotation between its closed position of FIGURE 1, wherein the door panel 18 is vertically disposed within and closes the door opening 12, and its open position (not shown), wherein the door panel occupies a horizontal overhead position adjacent the upper frame member 24 of the door opening. Operatively connected between the door hinges 20 and the side frame members 22 of the door opening are counter balance springs 26 which assist in opening and closing the door.

In the drawings, the main load carrying member or torque shaft 16 is represented by a torque tube. The cross-sectional dimension, or diameter, of this torque tube is determined by the length and weight of the door. Preferably, the torque tube is constructed of stainless steel tubing. As preliminarily discussed, and hereinafter described in greater detail, the torque tube 16 supports substantially all of the torsional or twisting loads and bending loads imposed on the door. However, since the torsional or twisting loads imposed on the door are carried by the torque tube rather than by the door panel 18, the latter may possess a relatively light weight construction, such as that hereinafter described, with the result that the torque tube is not subjected to any appreciable bending load. In other words, as will become evident from the ensuing description, the torque tube acts predominately as a torsion member which serves primarily to carry or support the torsional or twisting loads imposed on the door. For this reason, the beam will be referred to in the ensuing description and claims as a torsion member, torque shaft or torque tube. It is apparent, of course, that while the torsion member is referred to and shown as a hollow shaft or tube, other types of torsion members may be employed.

Secured to each end of the torque tube 16 is a torsion bracket assembly 28. Each bracket assembly 28 comprises a mounting bracket 30 proper having a pair of spaced parallel mounting plates 32 which straddle the adjacent ends of the torque tube 16. These bracket mounting plates are secured to the torque tube in any convenient way. In the drawings, for example, the bracket plates are spot welded to the torque tube. Each mounting bracket 30 includes a channel shaped member 33 outboard of the end of the torque tube with coplanar flanges or shoulders 34 along opposite sides of its channel midsection. Each channel member 33 is constructed of relatively heavy gauge steel and extends a distance below the torque tube 16, when the door 14 is closed, as may be best observed in FIGURES 1 and 6. At the outer end of each channel member 33 is an arm 40 which extends normal to the respective channel, in a plane normal to the axis of a torque tube. Each arm 40 seats against and is secured to the flanges 34 of its respective channel member. The two bracket assemblies 28 are similarly angularly oriented about the axis of the torque tube 16, whereby the channel members 33 are disposed in a common plane containing the axis of the torque tube and the bracket arms 40 are disposed in a common plane parallel to and laterally offset from the axis of the torque tube. Extending through the outer end of each arm 40 is a bore 42.

The torque tube 16 may comprise one continuous length of tubing having its ends secured directly to the torsion bracket assemblies 28. According to the preferred practice of the invention, however, the torque tube 16 comprises a main torsional load carrying section 16*a* whose length is somewhat shorter than the overall length of the door panel 18 and tubular end sections 16*b* which telescope over and are secured to the ends of the main load carrying section 16*a*, as best shown in FIGURE 3. The torsion bracket assemblies 28 are secured to these end sections of the torque tube.

Fitting over the channel member 33 of each torsion bracket assembly 28 is a relatively long channel-shaped door panel frame member 44 which is coextensive with the end edges of the door panel 18. Each frame member 44 is secured to the adjacent channel member 33, as by spot welds 46. Extending lengthwise of the frame members 44 are outwardly opening channels 48 to contain seals or weather strips 50 for sealing the door 14 to the side frame members 22 of the door opening 12 when the door 14 occupies its closed position of FIGURE 1. The outer or forward longitudinal edge of each panel frame member 44 is turned inwardly to form a flange 52.

The door panel 18 is secured at intervals to the torque tube 16 by means of rivets or bolts 54. The end edges of the door panel fit underneath the inwardly directed flanges 52 of the panel frame members 44 and may be secured, if desired, to the flanges.

As hereinafter mentioned, one distinct and highly important advantage of the present improved overhead door construction resides in the fact that since the door panel 18 is not required to sustain any appreciable twisting or bending load, its design and construction may be predicated primarily on cost and decorative considerations rather than structural strength considerations. In other words, the door panel may be constructed to afford the completed door 14 with the desired decorative appearance. In the drawings, for example, the door panel 18 is shown to comprise a corrugated aluminum sheet, the corrugations 56 of which extend inwardly toward and seat against the torque tube 16. The door panel fasteners 54 extend through the inner end walls of these corrugations and are thus obscured. A corrugated door panel of this type is particularly pleasing in appearance and is highly favored by a wide majority of prospective door purchasers. Other panel configurations may be employed, of course.

A distinct and highly important advantage of the present improved overhead door construction resides in the fact that the door panel 18 may possess a relatively light

weight construction, whereby the overall weight of the completed door is reduced to an absolute minimum. The illustrated door panel **18**, for example, may be constructed of light gauge aluminum sheet material. In this regard, attention is directed to the fact that the corrugations **56** in the panel not only provide the panel with a pleasing decorative appearance, but in addition these corrugations reinforce the panels, thereby permitting the latter to be constructed of light gauge material.

Extending across the top and bottom of the door **14** are channel-shaped panel frame members **58** which are similar in cross-section to and secured at their ends to the side frame members **44**. These upper and lower frame members have inturned longitudinal side flanges which fit over and are secured to the upper and lower edges of the door panel **18**. It is apparent, therefore, that the door panel **18** is peripherally framed and supported against bending and twisting, as well as against rotation about the torque tube **16**, by the side frame members **44** and the top and bottom frame members **58**. The forces exerted on the door frame members **44**, **58** by the door panel **18** are relatively small, because of the light weight construction of the panel, and, in addition, act along direction lines parallel to the channel webs of these frame members. Since the members possess maximum bending strength in this direction, they are uniquely arranged to support the door panel **18** against bending and twisting. Moreover, as will be explained shortly, the forces which are exerted on the door during opening and closing also act on the door frame members **44**, **58** in directions parallel to the channel webs, whereby the members are uniquely arranged to withstand such opening and closing forces without bending.

Door hinge assemblies **20** are generally conventional and each comprises a link **60** which is pivotally secured at one end to the outer perforated end of the arm **40** of the adjacent torsion bracket assembly **28**. Each link **60** is pivotally secured at its opposite end to a bracket plate **62** which is rigidly anchored to the adjacent side frame member **22** of the door opening **12**. The two bracket plates **62** are located at the same elevation and are disposed a distance above the torsion bracket assembly arms **40** when the door **14** occupies its closed position of FIGURE 1. In this closed position of the door, the hinge links **60** are generally vertical. Each hinge assembly **20** further includes a lever **64** which is pivotally secured at one end to the flange **34** of the adjacent bracket assembly **28**. Each lever **64** is pivotally secured, at a point **68** intermediate its ends, to the adjacent bracket plate **62**. The pivotal connection **68** between each lever **64** and its respective bracket plate **62** is located above and to the rear of the pivotal connection **70** between the upper end of the adjacent hinge link **60** and the respective bracket plate **62**. Accordingly, when the door **14** occupies its closed position of FIGURE 1, each hinge lever **64** extends upwardly and rearwardly at an acute angle to the door panel **18** and to a position above the adjacent bracket plate **62**. Counter balance springs **26** are secured at one end to the upper or outer ends of the hinge levers **64** and at their opposite ends to the lower ends of the side frame members **22** of the door opening **12**.

Since the door hinge assemblies **20** are conventional, their operation will be understood by those skilled in the art, and, accordingly, such operation need not be treated in detail here. Sufficed to say, that when the door **14** is raised and lowered, the hinge links **60** and hinge levers **64** pivot about their respective pivotal attachments to the supporting brackets **62** in such manner that the door **14** moves or rotates between its closed position in FIGURE 1, wherein the door panel **18** is vertically disposed within and closes the door opening **12**, and an open position (not shown), wherein the door panel occupies a horizontal overhead position adjacent the upper frame member **24** of the door opening. During this opening and closing movement of the door, the latter undergoes a compound motion involving angular or rotational motion of the door about a horizontal axis displaced rearwardly from the plane of the door and a simultaneous translational motion. It is apparent that the counter balance springs **26** act through the hinge levers **64** to exert a combined moment or force on the door in the direction of its open position. These springs are initially adjusted so that when the door occupies its closed position, the combined force exerted by the springs on the door is only slightly less than that required to raise the door from its closed position.

It is obvious that because of the light weight construction of the present improved overhead door, the counter balance springs **26** are required to possess only a relatively low spring rate. These springs, therefore, are less costly, and are easier to install and adjust, than the counter balance springs of conventional overhead doors. Moreover, since only relatively light weight springs are required in the present door construction, the springs are less likely to break, particularly when the door remains in its closed position for an extended period of time. Also, the forces imposed by the springs, and by the weight of the door itself, on the hinge assemblies **20**, and particularly on the supporting brackets **62** of the assemblies, are minimized. Accordingly, there is little if any tendency for the hinge assemblies to loosen, or the hinge brackets **62** to pull away from their respective supporting frame members **22**, over a period of time, as is prone to occur in the existing overhead door constructions.

Several advantages of the present improved overhead door construction have been discussed hereinbefore. There remain to be discussed the two primary advantages of the door construction, to wit its lessening of the safety hazard inherent in overhead doors of all types and the unique arrangement of the door which eliminates the imposition of twisting and bending loads on the door panel **18**, whereby the door panel may possess a simple light weight construction which gives rise to the other advantages of the door. With regard to safety, it is apparent that the present improved door, because of its reduced weight, inherently presents a substantially less serious safety hazard than the existing overhead doors. A typical conventional overhead door, for example, may weigh on the order of 230 pounds. A door of the same size but constructed in accordance with this invention, on the other hand, would weigh on the order of 54 pounds. Lessening of the safety hazard presented by the present overhead door is due not only to the reduction in the weight of the door itself but also to the fact that this reduction in weight results in a corresponding reduction in the strain placed on the door hinges, directly by the weight of the door and by the counter balance springs **26**. Accordingly, the possibility of failure of the door hinges, counter balance springs, or other parts of the door is substantially reduced. The substantially reduced stress in the counter balance springs and their reduced size, in comparison with those of conventional doors, greatly reduce the hazards of personal injury and property damage resulting from spring breakage. Moreover, because of its light weight construction, there is substantially no tendency for the door to slam to its closed position in such a way as to injure a person standing in the path of the door.

We prceed now to a primary advantage of the present improved overhead door construction, whereby the advantages hereinbefore discussed are obtained. Assuming that the door is opened and closed by grasping the lower edge of the door at a point midway between its ends, the forces required to open and close the door are transmitted in each direction along the lower panel frame member **58** to the side frame members **44**, and then through the latter members directed to the torque tube **16** and the hinge assemblies **20**. This raising and lowering force is not transmitted through the door panel **18**. Rather, the door panel reacts on the panel frame mem-

bers 44, 58 which are uniquely arranged, as already discussed, to resist bending under the action of the forces imposed thereon both by the door panel and by a person opening and closing the door.

Assuming that the door is raised and lowered by grasping the lower edge of the door adjacent one end of the door, the door is subjected to a twisting or torsional load which tends to twist one end of the door relative to the other end of the door. In contrast to the existing overhead doors, however, when the door according to the invention is opened and closed from one end in this manner, the force or torque exerted on the door is transmitted, predominately, from its point of application, through the adjacent side frame member 44, to the torque tube 16, and then through the latter to the side frame member 44 at the opposite end of the door. Here again, none of the torsional or twisting load on the door is transmitted through the door panel 18. According to the present invention, the torque tube 16 is proportioned to transmit, without appreciable twisting, the torsional or twisting load imposed on the door when the latter is raised and lowered from one end, as just described.

It is apparent that when the door occupies its overhead open position, the door panel 18 exerts a bending moment or load on the torque tube 16. However, because of the fact that the door panel 18 is permitted to have the light weight construction discussed above, the magnitude of this bending load is so small as to be negligible. Accordingly, there is no need to reinforce the present overhead door with cross braces or tie rods, as required in conventional overhead doors, the torque tube 16 functions primarily as a torque transmitting member for transmitting torsional loads from one end of the door to the opposite end of the door.

Those versed in the art will appreciate that the present invention achieves the object and realizes the advantages hereinbefore mentioned.

Although a specific embodiment of the present invention has been illustrated and described herein, it will be understood that the same is merely exemplary of presently preferred embodiments capable of attaining the objects and advantages hereinbefore mentioned, and that the invention is not limited thereto; variations will be readily apparent to those versed in the art, and the invention is entitled to the broadest interpretation within the terms of the appended claims.

The inventor claims:

1. An overhead door structure comprising a door panel having opposite ends and upper and lower edges, a single torsionally rigid generally tubular torque transmitting member connected with the door panel and extending lengthwise of said panel intermediate said edges thereof, hinge means operatively connected with the respective ends of said torque transmitting member for mounting said door in a door frame for movement between open and closed positions, means torsionally attached to said torque transmitting member and adapted to receive a force of sufficient magnitude to open and close the door and being proportioned to resist bending to transmit said force to said torque transmitting member without substantial deflection of said force receiving means.

2. A door structure according to claim 1, wherein said torque transmitting member comprises a metallic torque tube.

3. A door structure according to claim 1, wherein the torque transmitting member is secured to the panel.

4. An overhead door structure comprising a door panel having opposite ends and upper and lower edges, a torsionally rigid tubular torque transmitting member extending lengthwise of said panel intermediate said edges thereof, a pair of coplanar side frame members torsionally secured to opposite ends, respectively, of said torque transmitting member, upper and lower frame members extending between and secured to normally upper and lower ends, respectively, of said side frame members, means securing said panel to said members, means operatively connected with said opposite ends, respectively, of said torque transmitting member for mounting said door in a door frame for movement between open and closed positions, said lower frame member being adapted to receive at any point therealong an applied force of sufficient magnitude to move said door between open and closed positions, said frame members being proportioned to resist bending to transmit said applied force to said torque transmitting member without substantial deflection of said frame members, and said torque transmitting member being torsionally rigid and proportioned to transmit without appreciable torsional deflection said applied force from one end of said door to the opposite end of said door.

5. A door structure according to claim 4, wherein said frame members comprise channels having webs disposed in planes normal to the plane of said door panel and longitudinal side flanges parallel to said plane.

6. In combination a partition having a door opening therein, an overhead door mounted in said opening including a door panel having normally vertical ends and normally horizontal upper and lower edges, a horizontal torsionally rigid torque transmitting member extending lengthwise of the panel intermediate the edges thereof, a pair of coplanar side frame members torsionally rigidly secured to opposite ends, respectively, of said torque transmitting member, upper and lower frame members rigidly secured to the upper and lower ends, respectively, of said side frame members, and means securing said panel to said members, hinge means operatively connected between opposite ends, respectively, of said torque transmitting member and said partition for mounting said door on said partition for movement between open and closed position relative to said opening, counter balance springs operatively connected between said hinge means and said partition for assisting movement of said door between said positions, said frame members being adapted to receive at any point therealong an applied force of sufficient magnitude to move said door between said open and closed positions and being sufficiently stiff in a direction transverse to the plane of said door panel to transmit said applied force to said torque transmitting member without substantial deflection of the frame members, and said torque transmitting member being proportioned to transmit said applied force from one end of said door to the opposite end of said door without substantial torsional deflection.

7. The combination according to claim 6, wherein said frame members comprise channels having webs disposed in planes normal to the plane of said door panel and longitudinal side flanges disposed in planes parallel to the plane of said door panel, and wherein said torque transmitting member comprises a torque tube.

8. The combination according to claim 6 wherein said hinge means comprise bracket secured to said partition, links pivotally connected between said brackets and said torque transmitting member, and levers pivotally connected between said torque transmitting member and said brackets, and said counter balance springs acting between said levers and said partition.

9. An overhead door structure comprising a door panel having opposite ends and upper and lower edges, a single torsionally rigid generally tubular torque transmitting member connected with the door panel and extending lengthwise of said panel intermediate said edges thereof, hinge means operatively connected with the respective ends of said torque transmitting member for mounting said door in a door frame for movement between open and closed positions, a pair of coplanar side frame members torsionally rigid secured to opposite ends, respectively, of said torque transmitting member and to said ends of said door panel, and adapted to receive a force of sufficient magnitude to open and close the door and being proportioned to resist bending to transmit said

force to said torque transmitting member without substantial deflection of said force receiving means and a lower frame member extending between and secured to the normally lower ends of said side frame members, said lower frame member being adapted to receive said applied force at any point therealong, said torque transmitting member being proportioned to transmit said applied force from one of said side frame members of the door to the opposite one of said side frame members of the door without substantial torsional deflection.

10. A door structure according to claim **9**, wherein said torque transmitting member comprises a metallic torque tube.

References Cited by the Examiner

UNITED STATES PATENTS

2,067,623	1/1937	Smith	20—160
2,603,826	7/1952	Bobisch	20—16 X
2,831,219	4/1958	Nelson	20—16
2,993,572	7/1961	Rich	189—46 X

FOREIGN PATENTS

1,064,023	12/1953	France.

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