Oct. 15, 1935. E. WANNER 2,017,554

COUNTERPOISED TILTING DOOR PARTICULARLY FOR MOTOR CAR GARAGES

Filed Sept. 14, 1933 2 Sheets-Sheet 1

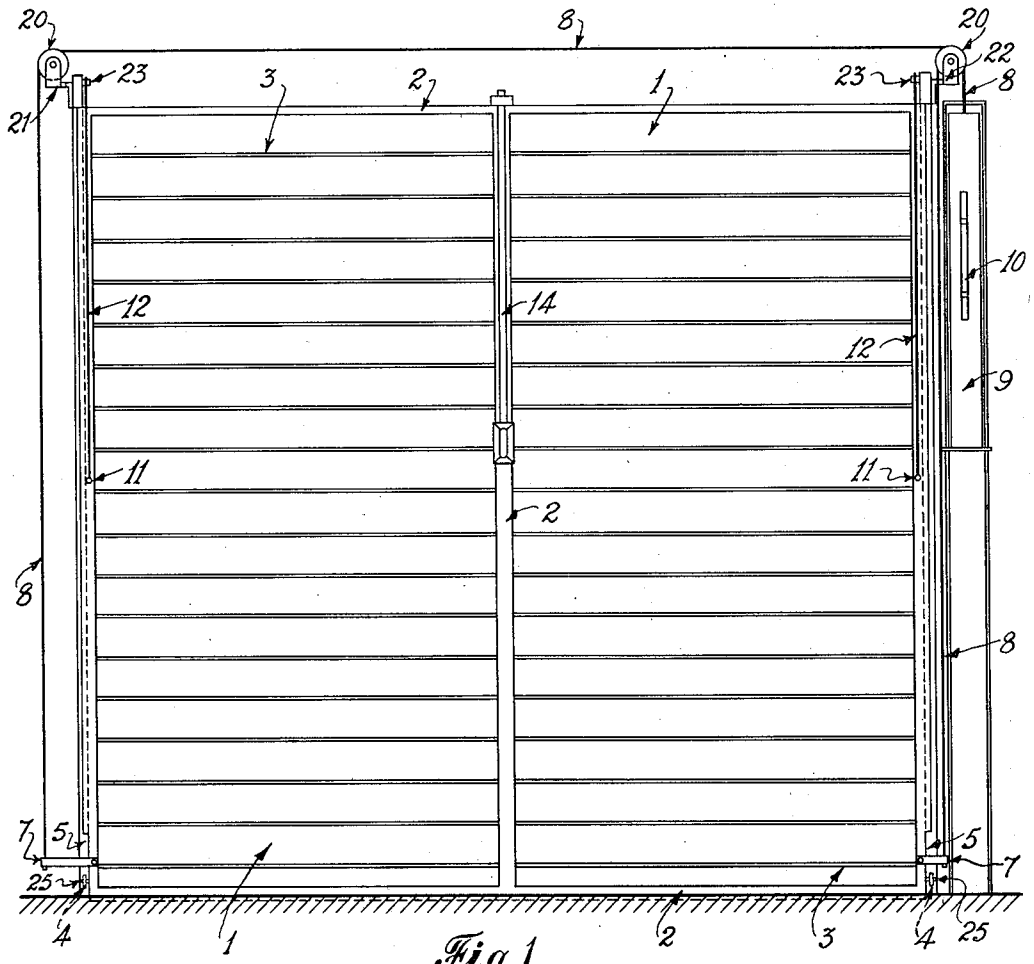

Fig. 1.

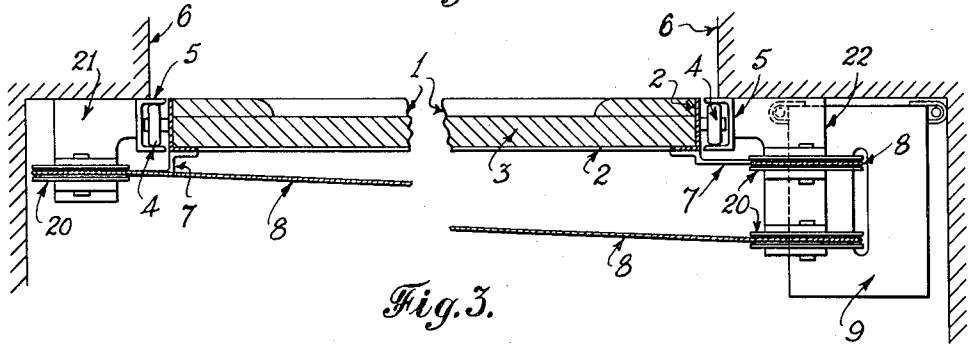

Fig. 3.

Inventor:-
Edmond Wanner.
By his Attorney:- Walter Gunn.

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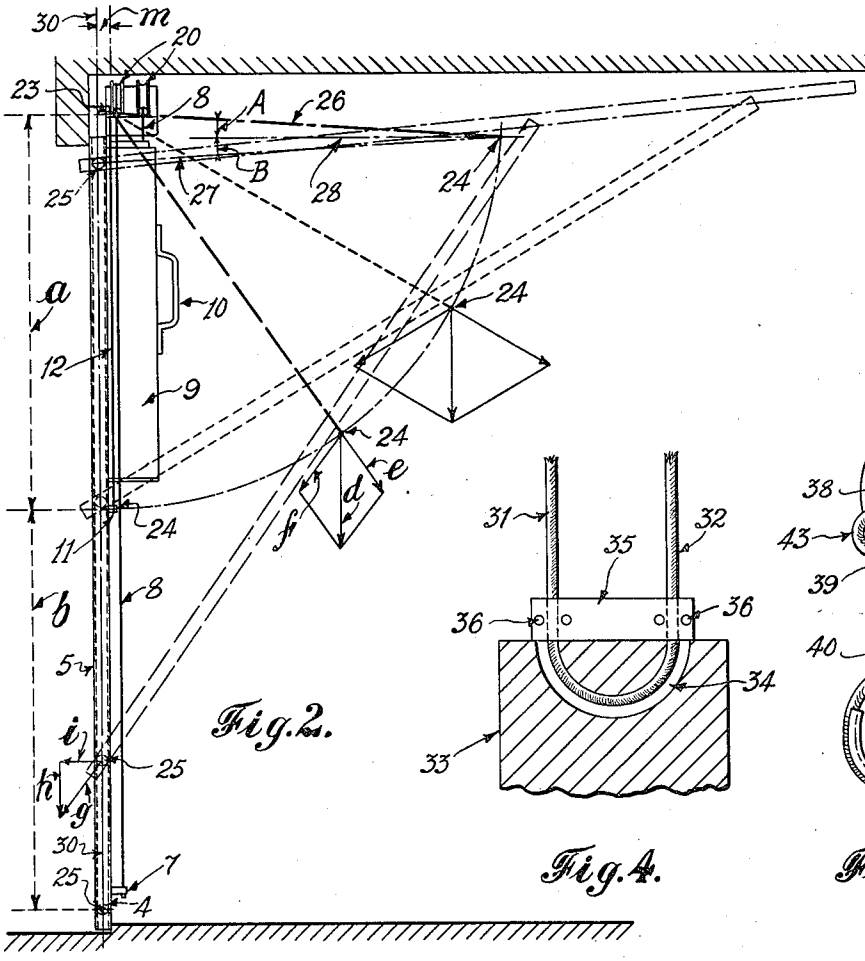

Fig.2.

Fig.4.

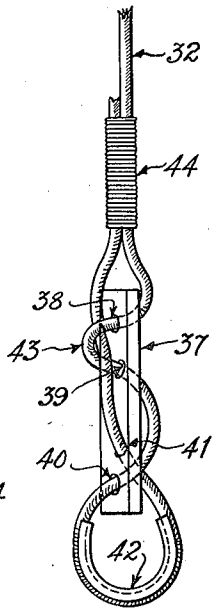

Fig.5.

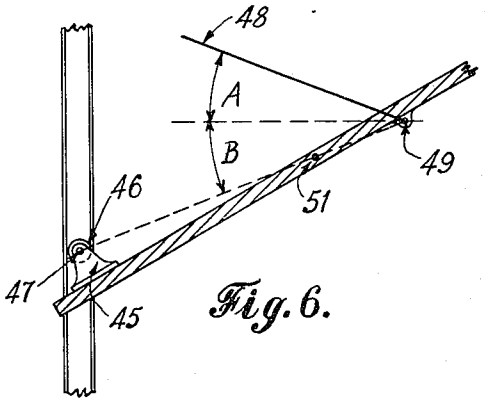

Fig.6.

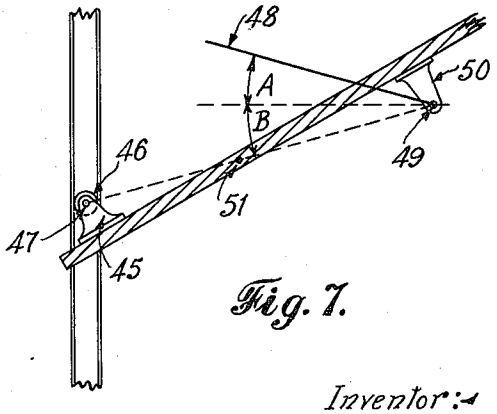

Fig.7.

Inventor:-
Edmond Wanner.
By his Attorney:- Walter Gunn.

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2,017,554

COUNTER-POISED TILTING DOOR, PARTICULARLY FOR MOTOR-CAR GARAGES

Edmond Wanner, Geneva, Switzerland

Application September 14, 1933, Serial No. 689,359
In Great Britain October 4, 1932

4 Claims. (Cl. 20—19)

This invention relates to a counter-poised tilting door particularly for motor car garages and more particularly of the kind in which the upper portion of the door is guided by one or more pivoted arms while the lower portion is guided by vertical guide rails so that the door has a combined rising and tilting movement, during which it is counter-balanced by means of a cable or cables attached to the door adjacent to the vertically guided portion and arranged vertically over pulleys and connected to a counterbalance weight or weights of constant effective mass and having a free vertical movement.

Hitherto in such doors the support required to be provided by the counterweight to maintain a balance varied considerably with the position of the door in its tilting movements for opening and closing, and various indirect acting and gearing devices, such as a fusee cable gear, have been provided to give a coresponding progressive variation of pull by the counterweight to maintain balance thereby in all positions.

The object of the invention is an improved construction of tilting door of the kind referred to so as to overcome the above difficulties and is based upon an appreciation of certain necessary relative geometrical proportions of the parts of the door so that a direct acting (i. e. not variably geared) counterweight or counterweights may substantially balance the door in all its positions.

According to the invention the counter-poised tilting door of the kind referred to is characterized in that the door is balanced by at least one direct-acting counterweight, the guiding arms being proportioned and arranged so that in direction, the tension in the arms and the thrust in the door are maintained at substantially equal and opposite angles to the horizontal in all positions of the door and especially as the latter approaches the horizontal or raised position.

According to a further feature of the invention, the counter-poised tilting door of the kind referred to is characterized in that the door is suspended so that the axes of the points of suspension are close to the median plane of the door.

In the accompanying drawings:—

Fig. 1 is an elevation from the interior of the garage of one example of tilting door in accordance with the invention.

Fig. 2 is a side view and

Fig. 3 a horizontal section on a larger scale of the same door.

Figs. 4 and 5 are detail views, the first showing a way of fixing the cable to the counterweight and the second a way of fixing the cable to the door.

Figs. 6 and 7 show modified forms of the invention.

As shown in Figs. 1 to 3 the panel 1 of the door is made of a metallic frame 2 with panelling 3 in wood for example. It is furnished at its lower end with two lateral rollers 4 running in rectilinear vertical guides 5 composed of U-irons positioned in front of the two sides of the opening 6. The frame 2 of the door bears, in the interior of the garage besides the guide rollers 4, two connecting irons 7 to which the ends of two metallic cables 8 are fixed. The cables 8 go over different pulleys so as to rise vertically from the connecting irons 7 and are brought together and joined to the single counter-weight 9 which is to counter-balance the weight of the door. This counterweight is furnished with a handle 10.

The metallic supports 21, 22 of the pulleys 20 are attached rigidly to the guides 5.

The frame 2 of the panel 1 is also furnished towards the centre of its lateral sides, and therefore approximately in the line of the centre of gravity of the door, with short brackets 11 to which are pivoted, on an axis 24, the extremities of the two arms 12, their upper extremities being pivoted at axes 23 in brackets placed above the guides 5; the axes 23, in view of the convenience of the construction, are not to be found in the median vertical plane 30 of the guides 5 which contains the turning axis 25 of panel 1 on the rollers 4, but are to be found at a relatively short horizontal distance m to the right of (i. e. behind) this plane.

Further, by construction, if one calls m the horizontal distance separating the fixed turning axis of the arm from the vertical plane 30 passing through the door's turning axis on the guide members, at the maximum opening position of the latter, a the distance between the geometrical turning axes 23, 24 of the arms, and b the distance between the axes 24 and 25, then, in order that the arms and the door may make substantially equal angles with the horizontal, particularly in its uppermost portions, the following formulæ must be satisfied:

$$a=\frac{a+b-m}{2}$$

$$b=\frac{a+b+m}{2}$$

Both these formulæ could be written as $a=b-m$ or $b=a+m$, but the formulæ first given are preferred because the dimensions $(a+b)$ and m are

in practice directly ascertainable and therefore calculation for *a* or *b* is simplified.

The required condition of equal and opposite inclination to the horizontal of the thrust in the door and tension in the arms is given by compliance with such formulæ as shown in Fig. 2 by the dihedral angles A and B between the horizontal plane **28** and the planes **26** and **27** respectively containing the axes **23** and **24** and the axes **24** and **25**.

The door is provided with a bolt **14** adapted to engage with the lintel of the garage for locking the door in the closed position.

In Fig. 2 also the door is shown in two intermediate positions between closed and open, and force diagrams are shown about the axis **24**, in which *d* represents the weight of the door, and by completing the parallelogram of forces, *e* and *f* represent the combined tensions in the two arms **12**, and the thrust in the structure of the door **1** respectively, both in magnitude and direction. Attention is now directed to the force diagram at the axis **25** of the rollers **4** also shown in Fig. 2, where *g*—*f* is drawn as the force which is resolved into a vertical component *h*, representing the combined load in the supporting cables at each side, and the horizontal component *i* representing the outward horizontal thrust on the two vertical guide rails **5**.

As will be evident, while the axis **24** is as close as practicable to the door it may be said to be substantially in the median plane of the door or in the plane containing the axis **25** and the centre of gravity of the door, and therefore the weight distribution of the door at the points **24** and **25** remains substantially constant at all angles of inclination so that *d* is constant and while the angles A and B remain substantially equal, the forces *e* and *f* are equal and, therefore, the vertical component *h* of the force *g* is equal to

$$\frac{d}{2}$$

for all positions. It is also obvious that in practice the axes **24** and **25** may be arranged some distance from the median plane of the door without seriously affecting the balance of the same except as the door approaches the vertical or closed position, so long as such rearrangement is effected in such manner as to maintain the above stated angular equality. If the previously stated geometrical proportions for *a*, *b* and *m* are not provided, then the angular equality, especially at the raised position will not be maintained and the vertical component force *h* may increase or decrease, when the balance of the door cannot obviously be maintained by the direct acting counterweight.

Referring to Fig. 2 shows on the one hand that the greater part of the door remains in all intermediate positions to the right of the left side of the opening **6** outside of which it never projects itself, and on the other hand that the upper end of the panel rises only a little towards the ceiling during its motion; this limits to a relatively small space the supplementary height which it requires in the interior of the garage.

As described, the door is composed of two parts **2**, **3** but the latter are not articulated one on the other, and can have no motion one in relation to the other for the closing or the opening of the door, they thus work as a whole, contrarily to what takes place in some known devices where it is divided into several parts the ones articulated on the others.

The door can be provided with windows, or one or more small doors, which can be closed by turning or sliding parts.

As already stated, it is sufficient where *m* is small that the distances *a*, *b* correspond approximately and not exactly to the values indicated in order that the action required from the counterweight remains approximately invariable.

Means can be provided for adjustment when in position, according to requirements of the length of the arms **12**. The latter can, to this end, be composed for example of two parts placed in line having left and right-handed threads at their opposite ends and being joined by a long nut with corresponding left and right-handed screw threads. The turnbuckle thus provided enables the effective length of the arms **12** to be adjusted.

The device can either be worked by hand or by motor.

If the centre of gravity of the door is not at the point of connection of the arms, the weight of the door is distributed between the two supporting elements, namely the arms and the cable, ascertainable according to the known principles in estimating the weight distribution on the supports of a simple loaded beam. The load to be balanced by the cable will then be a component derived from the weight at the pivot of the arms plus the dead weight at the point of the cable support due to the weight distribution above referred to. So long as the axes **24** and **25** are substantially at the median plane of the door of the line joining them passes through its centre of gravity, the second part of the cable load remains constant and so long as the formulæ as to the relative proportions of *a*, *b* and *m* is also satisfied the other part of the cable load remains constant, the weight at the pivot arms being constant and the component to be supported by the cable being exactly one half thereof. Where the centre of gravity is approximately at the axis **24** then clearly it is less important as regards the point of attachment of the cable relative to the median plane of the door, and vice versa.

In certain cases the door can be arranged to come partly or entirely out of the garage and thus form an awning over the front of the opening **6**.

Accordingly, therefore, as the design of the door provides for it being wholly or partly disposed within the garage when open and also of course according to the construction of the door affecting its weight distribution, the parts can be proportioned and arranged for balance by a simple weight in all positions of the door.

The fixing of the cable will, preferably, be effected in such a manner that should one of the sections of the cable break, the door will not fall as the weight would be taken by the other cable.

A method of fixing for such effect of the two sections of the cable **31** and **32** which are but the two ends of a loop of a cable, is shown in Fig. 4. This figure shows a cross sectional view of the counterweight **33** formed with a circular bore **34** to receive the loop of the cable between the two sections **31** and **32** thereof.

A fastening member **35** is secured to the cable immediately above the weight by screws, bolts, or other kinds of fastening members **36** and thus fixes the weight positively in the loop.

It is to be noted that during erection of the door or even afterwards owing to a difference in the length of the sections of the cables, it may

happen that in the course of use, one of the sections of the cable is called upon to work more than the other. To counter-balance the strain supported by both sections it is only necessary to loosen the fastening member 35 so as to allow the loop of the cable to slide in the bore 34, i. e., for the whole to recover its balance, the fastening device being then re-tightened.

Should one of the sections of the cable snap, the door cannot fall seeing that the other section still keeps it in connection with the counterweight. In fact if one supposes that the section 31 broke, the section 32 would still remain attached to the counterweight by the loop formed by the cable in the counterweight and maintained by the fastening member 35. Only the rupture of the two sections of the cable at once or else that of the loop maintained by the fastening member 35 could be dangerous but such a happening is not likely to occur as there should be no wear or movement at the loop.

Fig. 5 shows a simple way of fixing the end of a section of the cable to the door. Let us suppose that it is the end of the section 32 that is to be fixed to the door. For this purpose a metallic plate 37 is provided bored with four holes 38, 39, 40 and 41, through which the cable is threaded in the way shown. The end of the cable is threaded through the first hole 38 then, forming a loop is passed through the second hole 39 and then, forming a second loop, through a third hole 40 passing over the fourth hole 41. After having formed the fastening loop, in which may be provided a cable shoe 42, the cable is passed through the hole 41, then through the loop 43 formed between the holes 38 and 39. The cable thus arranged forms a loop 42 which is absolutely rigid even if the end is left loose but preferably the end will be secured by a binding 44, as shown, if only for the purpose of safe disposal of what might become a dangerous frayed end.

In Figs. 6 and 7 are shown modifications of the invention wherein a bracket 45 is provided for the rollers 46 so that the axis 47 corresponding to the axis 25 is displaced from the plane of the door. The door is supported by an arm 48 pivoted at 49 and as in the previously described example the angular equality for the angles A and B is maintained. By this arrangement the tendency for the partial loss of balance of the door when in its vertical position may be modified. As shown in Fig. 7 a bracket 50 is also provided at the pivot of the arm 48, so that the balance of the door when in its vertical positon may also be thereby modified without substantially interfering with the balance of the door in its horizontal or intermediate positions. These modifications would be particularly useful where the centre of gravity of the door is in the lower half thereof, say at the point 51 on or near the lower boundary line of the angle B.

Obviously the invention while described with reference to garage doors is equally applicable to the construction of windows, partitions, shutters and the like.

In the known arrangement of counter-poised door referred to at the beginning of this specification and wherein a scroll is employed to provide a progressively varying pull from the counterweight, although substantially equal and opposite angularity of the door itself and the arms relative to the horizontal are obtained, these angles must not be confused with the angles A and B as in such known arrangement the formula relative to the dimension a, b and m is not satisfied and consequently the angles equivalent to the angles A and B are not maintained constant, particularly at the upper positions of the door. This difference accounts for the necessity of providing the scroll arrangement for the counterweight mechanism.

What I claim is:—

1. In a counter-poised tilting door of the kind having guide rollers at the lower end of the door engaging vertical guides in the door frame and having supporting arms connected to one face of the door by pivots at points in a horizontal plane, which substantially at all times bi-sects the angle subtended at such connection by the pivots of the other ends of the arms and the axis of the guide rollers, brackets supporting the said guide rollers a substantial distance from the median plane of the door and on the other side thereof relative to the connecting pivots of the supporting arms.

2. In a counter-poised tilting door according to claim 1, brackets for the connecting pivots of the supporting arms which position the pivots a substantial distance from the face of the door.

3. In a counter-poised tilting door of the kind having guide rollers at the lower end of the door engaging vertical guides in the door frame and having supporting arms connected to one face of the door by pivots at points in a horziontal plane, which substantially at all times bi-sects the angle subtended at such connection by the pivots of the other ends of the arms and the axes of the guide rollers, brackets supporting the said guide rollers a substantial distance from the median plane of the door and on the other side thereof relative to the connecting pivots of the supporting arms, and means for adjusting the effective length of the said arms.

4. In a counter-poised tilting door according to claim 1, brackets supporting the guide rollers a substantial distance from the median plane of the door so that the plane in which lie the axes of the guide rollers and of the connecting pivots of the supporting arms is brought closer to the centre of gravity of the door.

EDMOND WANNER.