Dec. 13, 1949 C. THUMIM 2,491,400

BOMB RELEASE RACK

Filed Feb. 14, 1945 6 Sheets-Sheet 1

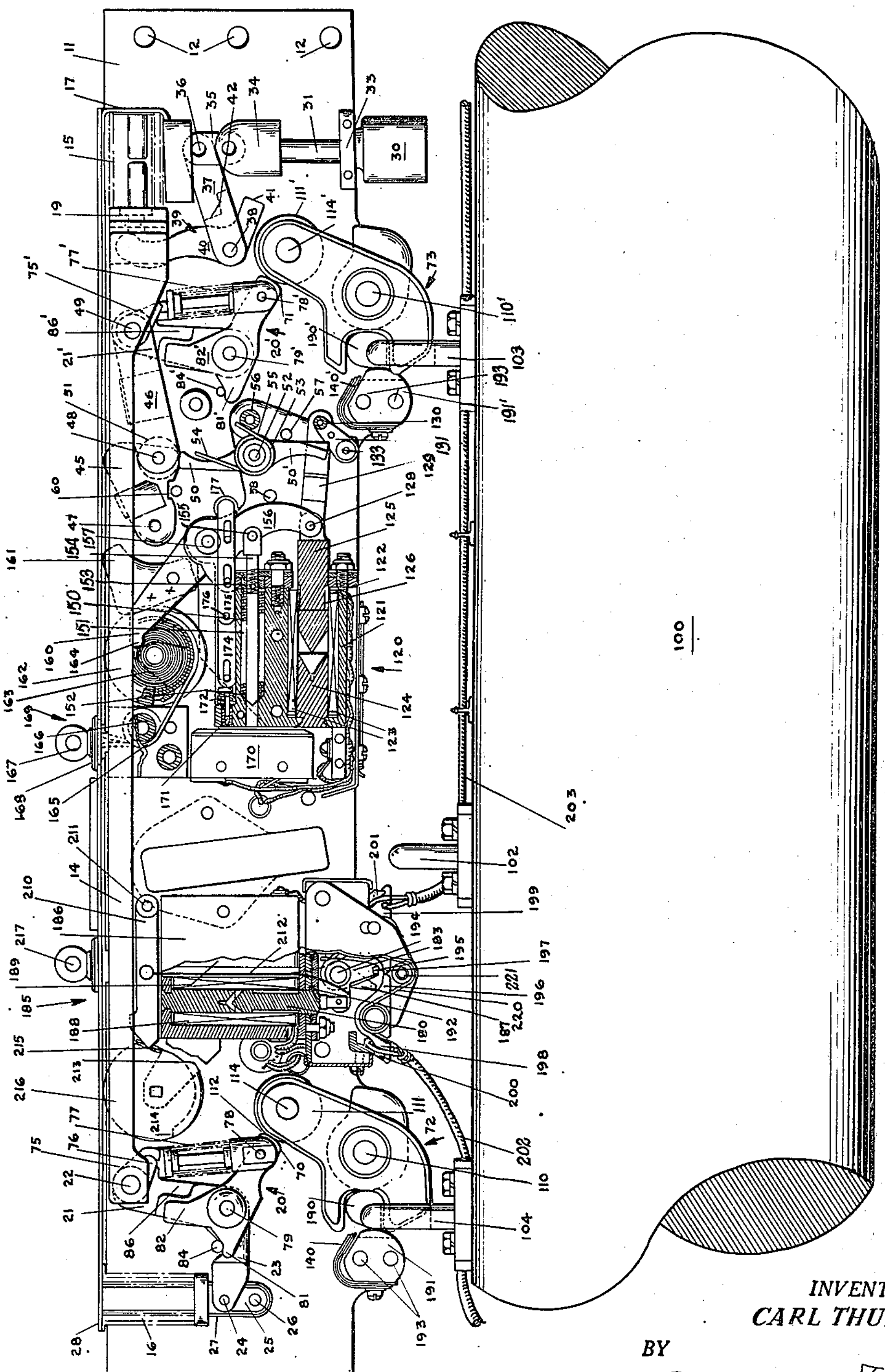

Fig-1

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Dec. 13, 1949 C. THUMIM 2,491,400

BOMB RELEASE RACK

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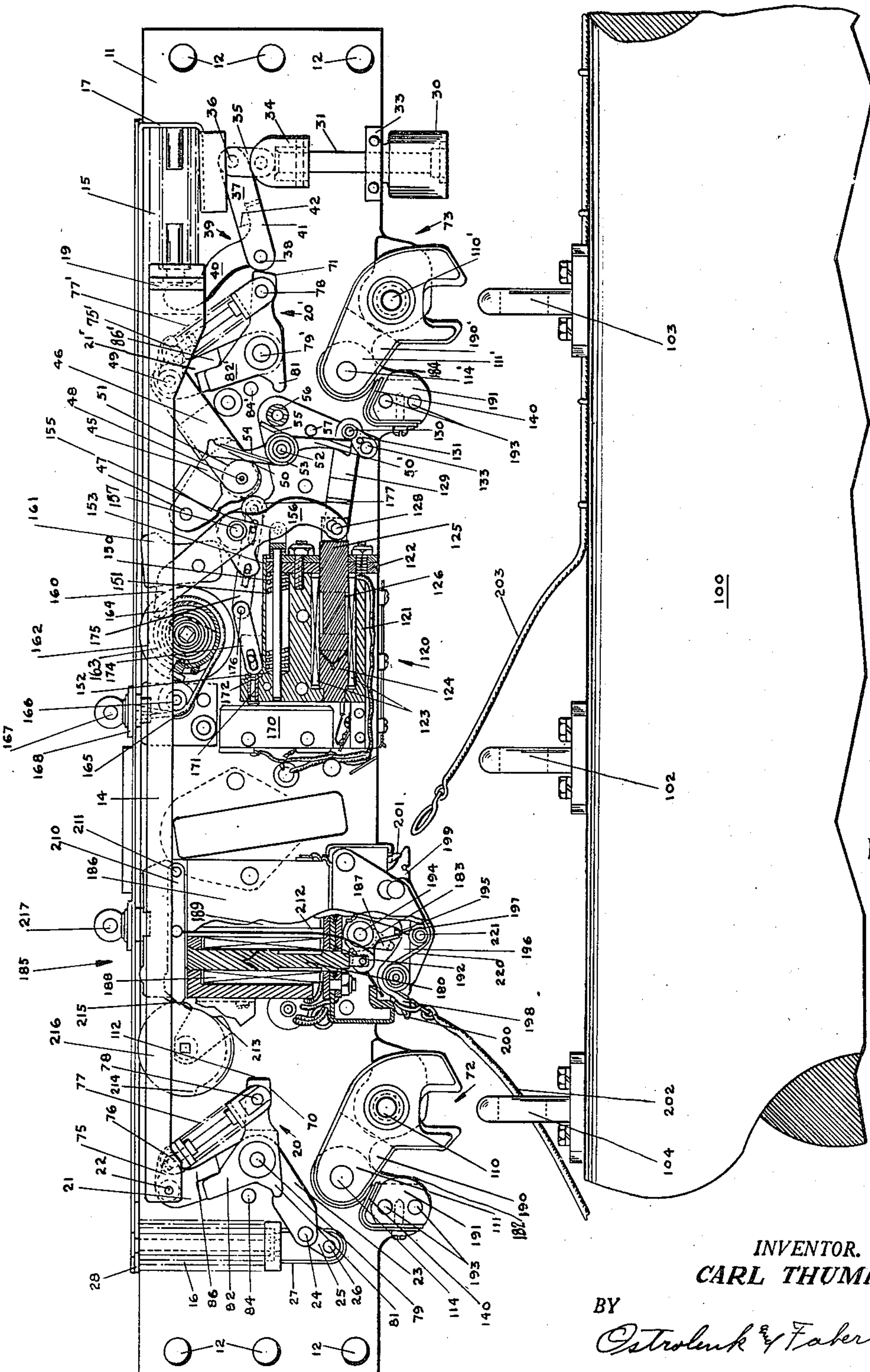

Fig - 2

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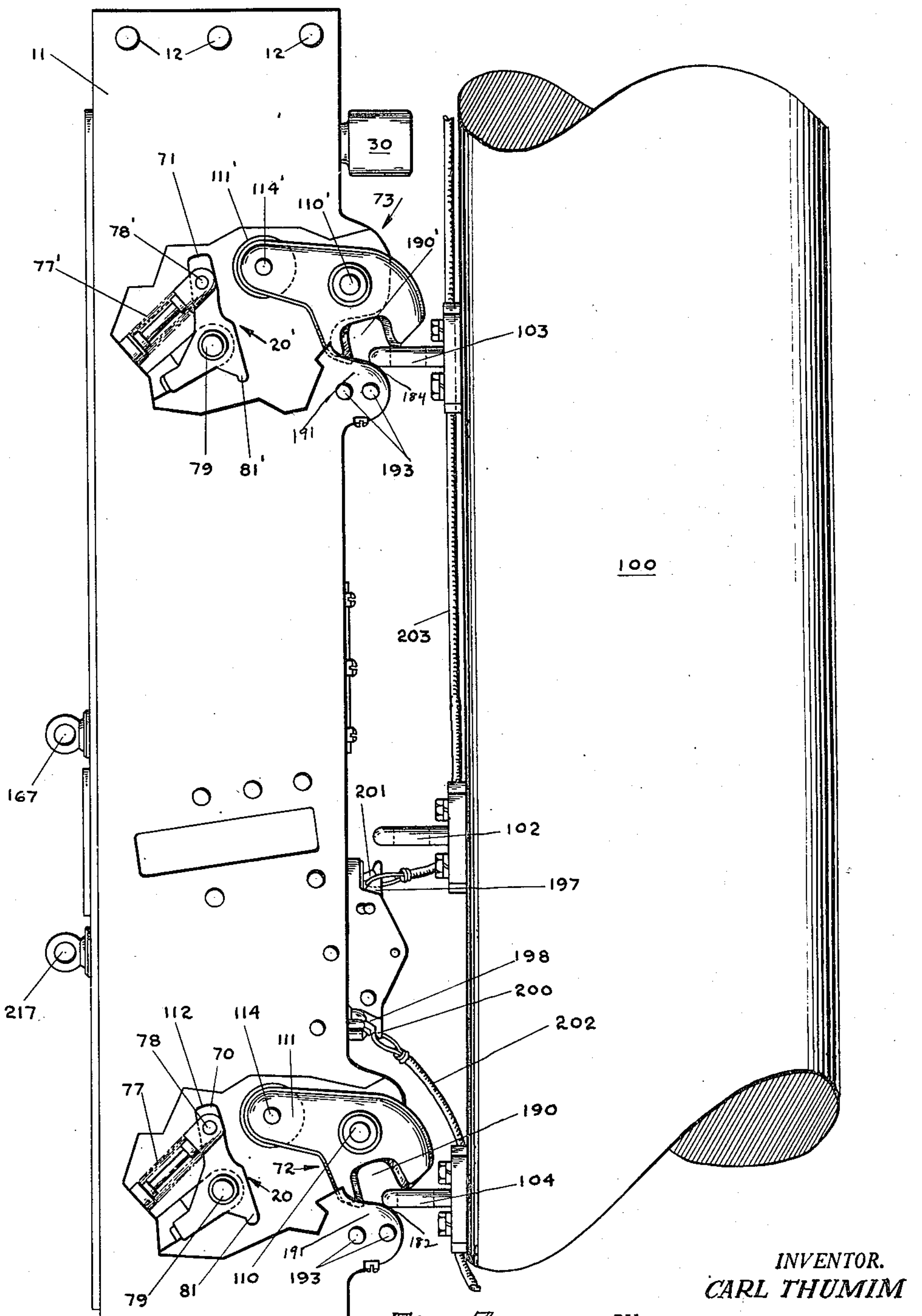

Fig-3

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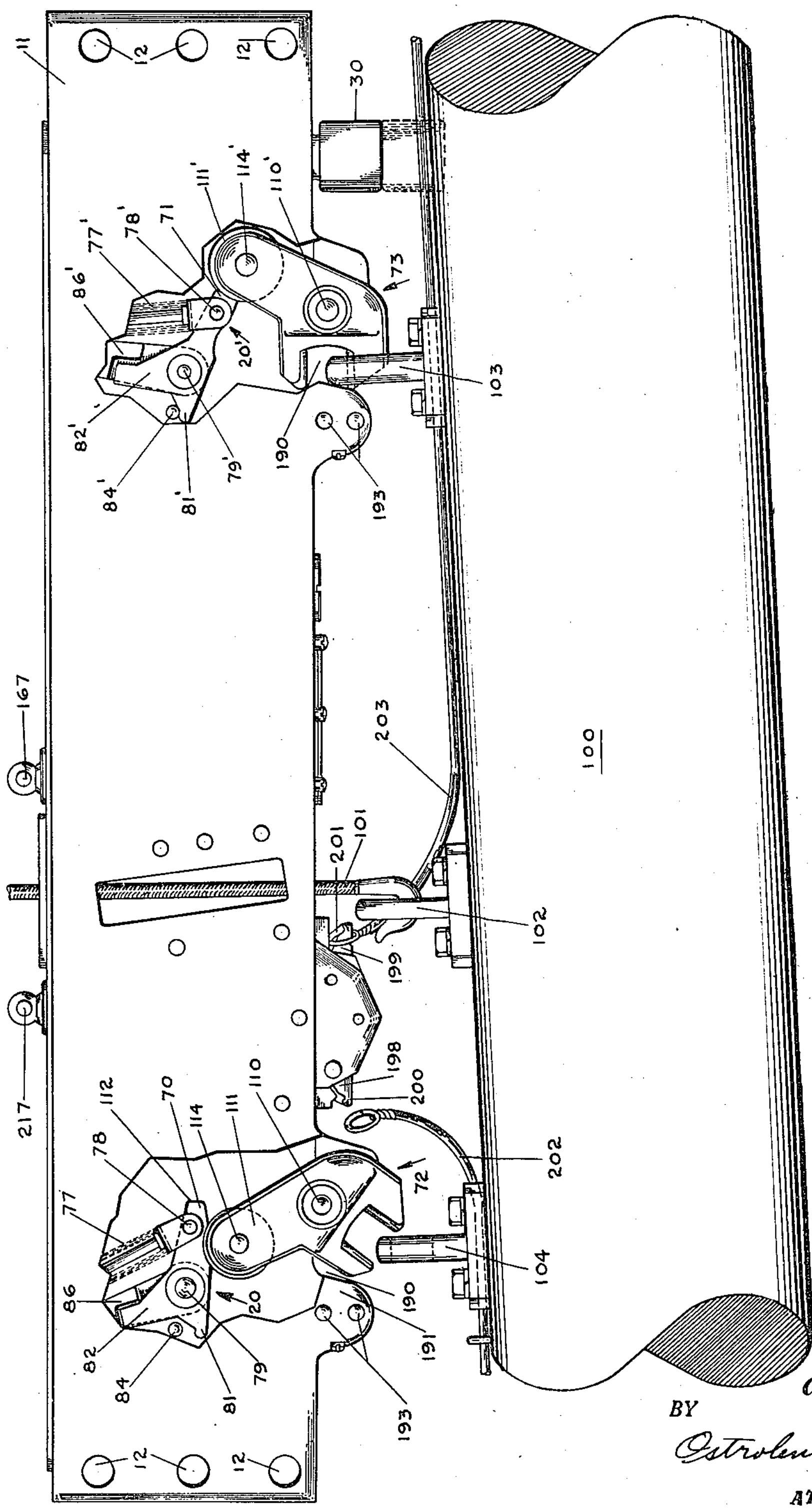

Fig. 4

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BOMB RELEASE RACK

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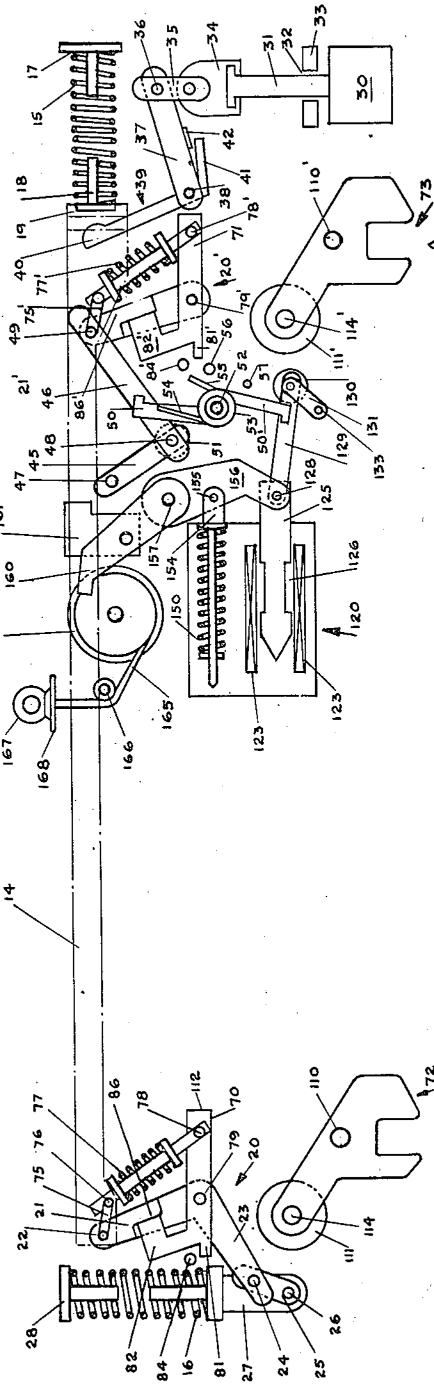

Fig-5

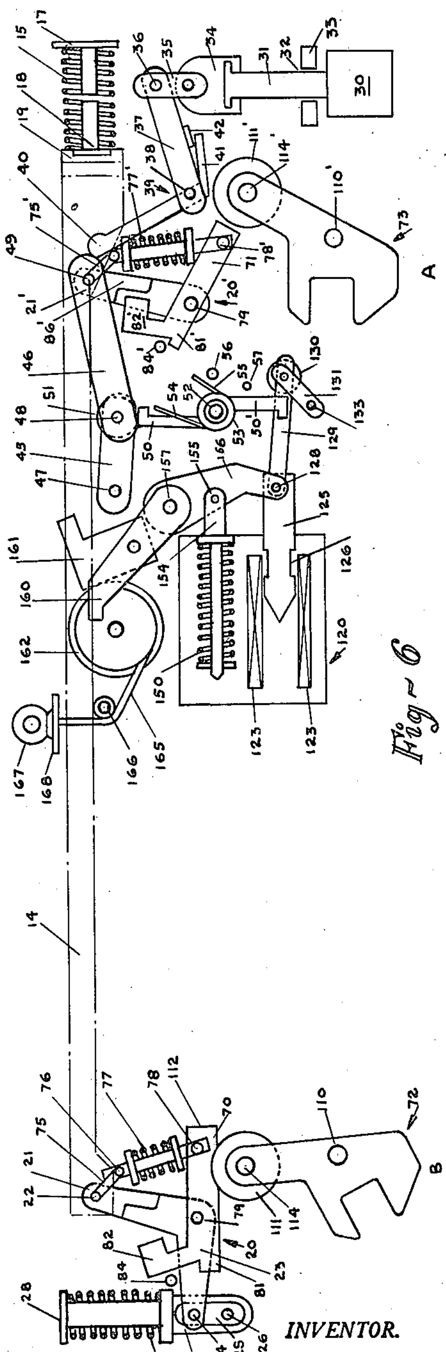

Fig-6

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BOMB RELEASE RACK

Filed Feb. 14, 1945 6 Sheets-Sheet 6

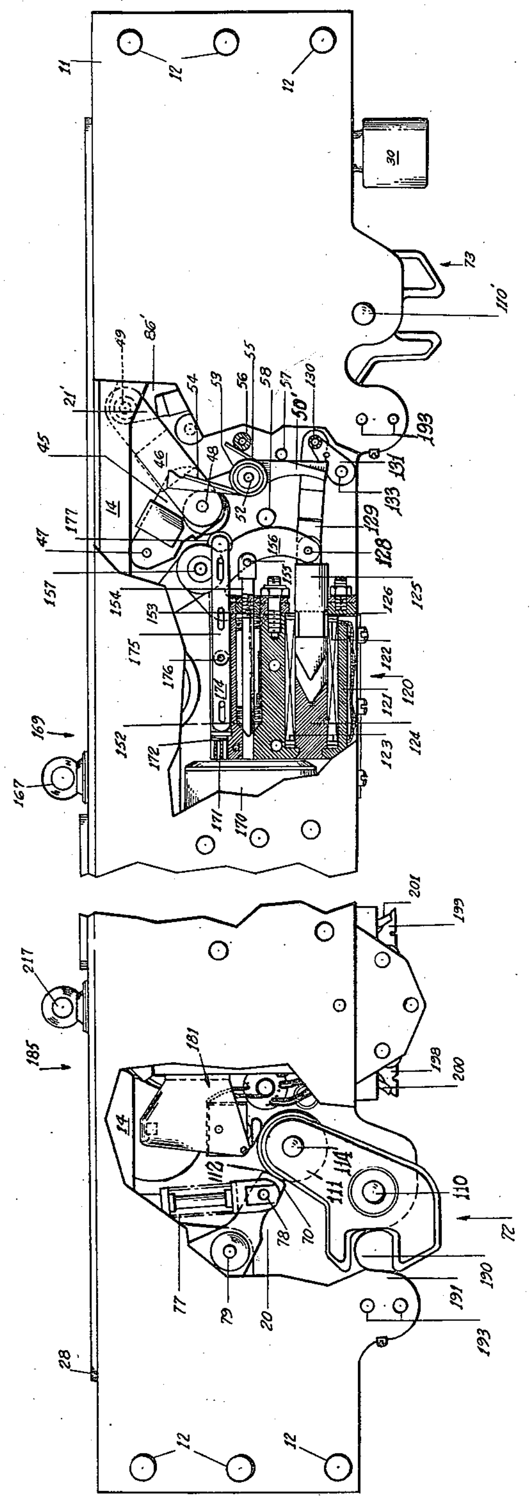

Fig-7

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Patented Dec. 13, 1949 2,491,400

UNITED STATES PATENT OFFICE

2,491,400

BOMB RELEASE RACK

Carl Thumim, Yeadon, Pa., assignor to I. T. E. Circuit Breaker Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Application February 14, 1945, Serial No. 577,831

2 Claims. (Cl. 89—1.5)

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My invention relates to bomb release racks, and more particularly to a bomb release rack so designed that it will ensure an accurate, positive and immediate release of the bomb when the bomb release mechanism is operated.

In the design of bomb release racks, it is essential that the release be such that it will function properly for both horizontal bombing and vertical dive bombing, and the mechanism must be operative under all circumstances and conditions. Further, all of the mechanism must be designed to be confined within the prescribed dimensional limits as determined by the spacing of the hooks on the bombs, the area available within or on the airplane and the predetermined aerodynamic stability of the plane itself. Furthermore, the bomb release rack must be so designed that it is unaffected by extreme variations in temperature, extreme variations in the speed and direction of the airplane, extreme and momentary variations in load owing to rapid turns either during the bombing run itself or during evasive action; and dirt and icing conditions.

Heretofore, bomb release racks have required that the weight of the bomb operate the release latches themselves. This often led to false operation or, what was much worse, failure to operate instantaneously at the instant of release.

My invention contemplates essentially that the bomb be supported by two freely rotatable hooks engaging the holding rings on the bomb itself; and that the hooks be maintained in engaged position by a quick acting latch mechanism which is instantaneously responsive to the action of the operator; and further, that the latch mechanism be positively operated by direct means rather than by the weight of the bomb.

My invention further contemplates that the individual hooks be separately latched. The latch members may be moved to latching position simultaneously by a tie-link, while the hook members may independently be moved to engagement with the latch members to facilitate the loading of the bomb. My invention, however, contemplates that the latch members and the hooks be simultaneously released. For this purpose the elements controlling the latches are tied together by the single tie-link. Energy for quick opening of the latches is supplied by a pair of compression springs at each end of the tie-link, which springs are compressed when the latches are in latching position and which bias the tie-link and the latching members to open position.

The operation of the compression springs to

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move the latching members to open position is resisted by a third latching element comprising a toggle which is extended when the tie-link is moved to the position where the latches are engaged; a latch member supports the center pin of this toggle in the fully latched position. Operation of the bomb release mechanism removes the supporting latch from the center pin of the toggle and permits the compression springs to operate the tie-link to in turn operate the hook latches to release the hooks. The operation of the compression springs is direct and immediate and occurs instantaneously on movement of the supporting latch out of supporting position.

The hook latching elements are located at either end of the tie-link so that the provision of compression springs at either end of the tie-link provides a direct and immediate means for acting on the hook latches to free the hook at each end.

My device is so designed that it has a minimum of essential moving parts. These parts comprise the tie-link supporting toggle and its latch and hook latch release toggles at each end of the tie-link and the hooks themselves. This relatively small number of moving parts makes possible the utilization of exceedingly strong members within the confined space which is provided and enables the provision of a factor of safety as high as 5 or even better.

My invention further contemplates a simplified release mechanism and a simplified arming mechanism all contained within the bomb release rack itself.

My invention further contemplates a simplified manual bomb release and manual arming means, the mechanism for which is entirely contained within the bomb release rack itself.

A primary object of my invention, therefore, is the provision of a novel quick acting bomb release rack useful for horizontal bombing as well as vertical dive bombing.

Another object of my invention is the arrangement of a bomb release rack in such manner that individual hook latches are supported in latching position by a third latch, the operation of which results in simultaneous release of the hook latches.

Another object of my invention is the arrangement of a bomb release rack wherein force multiplying toggle members are utilized to provide a positive retaining force on the bomb hooks far exceeding any contemplated force which may be exerted thereon, and where, nevertheless, on operation of the bomb release rack, the bomb will be instantaneously released irrespective of the position of the plane.

A further object of my invention is the arrangement of a bomb release rack in such a manner that it will be unaffected by extreme variations in temperature or by dirt and ice conditions or by extreme variations in load owing to extreme changes in speed or direction of the airplane.

Another object of my invention is the provision of simplified manual release and manual arming mechanism associated with the automatic mechanism of the bomb release rack.

These and many other objects of my invention will become apparent in the following description and drawings in which

Figure 1 is a longitudinal view of my novel bomb release rack partly in section showing a bomb held thereby.

Figure 2 is a view corresponding to that of Figure 1 showing the release position of my bomb release rack.

Figure 3 is a view similar to that of Figures 1 and 2 showing the conditions of the bomb release rack in the vertical dive bombing position just after tripping of the release members and just before the bomb has been completely released.

Figure 4 is a view corresponding to that of Figures 1 and 2 showing however the loading position of my novel bomb release rack.

Figure 5 is a schematic view corresponding exactly to that of Figure 2 and showing the release position of the bomb release rack.

Figure 6 is a schematic view corresponding to that of Figures 1 and 4 showing the loading and bomb retaining position of my bomb release rack.

Figure 7 is a view corresponding to that of Figure 2 showing however the utilization of indicating means to signal possible failure to operate effectively.

Referring now to Figures 1 and 2, my novel device is mounted between a pair of opposite side plates 11 which may be interconnected, cross-braced and secured to the airplane in any suitable manner as, for instance, by bolts or other securement devices passing through openings 12.

The bomb rack comprises a principal tie-link 14 which extends between the compression springs 15 and 16. Compression spring 15 bears against the cross piece 17 of the bomb rack at one end and at the other end drives an abutting element 18 against the cross piece 19 of the tie-link 14. Compression spring 15 accordingly tends to drive the tie-link 14 toward the left with respect to Figures 1 and 2.

The tie-link 14 at the other end is connected to compression spring 16 through the bell crank lever 20. One end 21 of the bell crank lever 20 is pivotally connected at the pivot 22 to the left hand end of the tie link 14. The other end 23 of the bell crank lever 20 is pivotally connected at 24 to the link 25 which in turn is connected at 26 to the link 27. Link 27 is biased downwardly by the compression spring 16, one end of which bears against a cross piece 28 at the top of the bomb rack and the other end of which bears against the end of link 27.

The downward bias on link 27 transmitted through the link 25 biases the end 23 of bell crank lever 20 downwardly; this motion is translated into movement toward the left of end 21 of bell crank lever 20 thus biasing the tie-link 14 toward the left. Accordingly compression springs 15 and 16 have simultaneous and similar action on the tie-link 14.

The tie-link 14 may be moved from the position shown in Figure 2 to the position shown in Figure 1 by rotation of the knob 30 of screw 31 which passes through the tapped opening 32 in the cross piece 33 of the bomb rack. Screw 31 is connected to the element 34 and has rotational movement with respect thereto but is locked against longitudinal movement with respect to element 34. Element 34 is connected by the link 35 to the end 36 of link 37. The opposite end of link 37 is mounted on a stationary pivot 38.

Bell crank lever 39 is rotatably mounted on the stationary pivot 38. One end 40 of the bell crank lever 39 may be brought to bear against the inner (left hand) surface of the cross piece 19 of tie-link 14. The opposite end 41 of the bell crank lever 39 extends beneath a lug 42 on the line 37.

It will now be obvious that rotation of the knob 30 in a direction to cause the screw 31 to move downwardly with respect to the cross piece 33 will draw the connecting element 34 and link 35 downwardly. This will cause the link 37 to rotate in a clockwise direction round the pivot 38. Lug 42 of link 37 accordingly will bear downwardly on the end 41 of bell crank lever 39 thus causing bell crank lever 39 to rotate in a clockwise direction and moving the end 40 of the bell crank lever 39 toward the right. This will result in movement of the cross piece 19 and hence of the tie-link 14 toward the right to compress the spring 15 directly. The movement of the tie-link 14 will also result in rotation of bell crank lever 20 in a clockwise direction to raise the link 27 and compress the spring 16.

The knob 30 is rotated to move the screw 31 downwardly until the tie-link 14 is locked in position against the bias of compression springs 15 and 16. This lock is obtained by means of the toggle mechanism comprising links 45 and 46. Link 45 is pivoted at one end on the stationary pivot 47 carried between the side pieces of the bomb rack. The opposite end of link 45 is connected by the center pin 48 to the end of link 46. The outer end of link 46 is connected at the pivot 49 to the tie-link 14.

When the mechanism is in the completely released position of Figure 2, the toggle 45—46 is collapsed and the springs 15 and 16 are extended with the tie-link 14 moved over to its left hand position. When the screw 31 has been moved downwardly to perform the operation above described to move the tie-link to the right, the toggle 45—46 is extended to the position shown in Figure 1 and is supported by the latch member 50.

The toggle 45—46 is provided with a roller 51 rotatably mounted on the center pin 48 of the toggle, which roller bears against the left-hand side of the latch member 50 in the collapsed position of Figure 2. When the toggle 45—46 is extended to the locked position of Figure 1, the latch member 50 moves under the roller 51 to support the center pin 48 of the toggle 45—46 and prevents collapse thereof. With the toggle 45—46 locked in the extended position of Figure 1, the tie-link 14 is now supported in the right-hand position of Figure 1 against the bias of the now compressed springs 15 and 16.

The latch member 50 is pivotally mounted on the stationary pivot 52 and is biased toward latching position by the coil spring 53, one end 54 of which bears against the right-hand side of the latch member 50 and the other end 55 of which bears against stop 56 on the frame of the rack. The latch member is accurately positioned in the supporting position shown in Figure 1 by the stop 57 which limits counterclockwise rotation thereof under the influence of the coil spring 53 so that, as shown in Figure 1, the latch member will automatically be positioned to engage the undersurface of roller 51 when the toggle 45—46 is extended.

Since the tie-link 14 is now supported in the latched position of Figure 1 by the toggle 45—46 and the latch 50, the bell crank lever 39 and the longitudinal screw 31 associated therewith are no longer necessary to support the tie-link 14 in position, accordingly the screw 31 may be rotated back to the position shown in Figure 1.

When the screw 31 is rotated upwardly now by rotation of the knob 30, the end 36 of link 37 rises upwardly thus moving the lug 42 of the link upwardly away from the end 41 of the bell crank lever 39, and the bell crank lever 39, by reason of the fact that the end 40 thereof is heavier than the end 41, may rotate freely counterclockwise away from the cross piece 19 of the tie-link 14. Now, as shown in Figure 1, the only thing that maintains the tie-link 14 in position against compression of springs 15 and 16 is the latch 50 bearing against the roller 51 on the center pin 48 of the extended toggle 45—46.

Should the roller 51 of toggle 45—46 for any reason not be engaged, then the pressure of the springs 15 and 16 to force the cross piece 19 of link 14 against the end 40 of bell crank lever 39 will be felt by the operator as he rotates the knob to raise the screw 31 and that will be an immediate indication to him that the tie-link 14 has not been locked in position by its toggle and latch. As a further indication, an opening 60 (Fig. 1) may be provided in the side frame member 11 of the bomb rack, which opening will be cleared only when the toggle 45—46 is in the extended latched position; and the operator will not be able to see the side of the link 45 through the opening 60 when the toggle is fully extended. Now on moving the screw 31 upwardly by rotating the knob 30 in the proper direction, the operator will receive further indication that the latches are engaged if the opening 60 remains clear. If the opening 60 is however blocked by the link 45, that will be an immediate indication to the operator that the latch has not been engaged.

In appropriate cases, and where desired, a safety pin may be passed through opposite aligned openings 60 in the side frame members of the bomb release rack to prevent any collapse of the toggle 45—46 owing to any cause. The pin through the aligned openings 60 may be left in position until just before the plane takes off; or in the event that the plane is used simply to transport bombs, the pin may be left in position while the plane is in flight.

Use of the safety pin through the openings 60 completely de-activates the bomb release rack and makes it impossible to release bombs for any cause; and accordingly it will be used only on extreme, rare and unusual occasions—such, for instance, as ensuring that the bomb release rack will be completely de-activated while planes are on the flight deck of an aircraft carrier or under other circumstances where the accidental operation of a bomb release rack must be positively defeated.

When the tie-link 14 is moved from the position of Figure 2 to the position shown in Figure 1, the latch members 70 and 71, which engage respectively the bomb hooks 72 and 73, are moved to latching position. With respect to the latch member 70: the movement of tie-link 14, to the right, moves the pivot 22 to the right and accordingly moves retaining link 75 connected at one end to the pivot 22, to the right. Retaining link 75 at its opposite end 76, is connected to the compression spring link 77, the opposite end of which is at 78 connected to the latch 70. Accordingly movement, to the right, of the retaining link 75 tends to move the spring link 77 to the right; since, however, the latch member 70 is pivotally mounted on the pivot 79, the spring link 77 is forced to move downwardly and to the right on movement of the retaining link 75 to the right. Consequently, this operation rotates the latch member 70 from the position shown in Figure 2 to the position shown in Figure 1.

The latch member 70 has a pair of extensions 81 and 82 on the opposite side of the pin 79 from the latch portion. The extension 81 engages the stop member 84, as shown in Figure 1, when the latch 70 has reached the exact latching position. Any further movement of the tie-link 14 toward the right after the latch 70 has been stopped in the exact latching position is taken up by compression of the spring link 77. The extension 82 of the latch member 70 is arranged so that it is in the path of movement of the abutment 86 on the link 21. When the bomb release rack is tripped and the end of link 21 is moved rapidly toward the left, as hereinafter described, the abutment 86 will strike extension 82 of the latch 70 and impinge a hammer blow on the latch 70 in a counterclockwise direction to move it from the position of Figure 1 to the position of Figure 2.

The latch member 71 operates in exactly the same manner as does the latch 70. The link 21′ is pivotally mounted at one end on the pivot 49 and at the other end is pivotally mounted on the stationary pivot 79′. Pivot 49 on the tie-link 14 is connected by the retaining link 75′ to the spring link 77′, which in turn is pivotally connected at 78′ to the latch 71. Accordingly, retaining link 75′ and spring link 77′ act in the same manner as do links 75 and 77 above described.

The latch member 71 is provided with an extension 81′ which bears against the stop 84′ to predetermine the exact latching position of the latch 71.

Link 21′ is provided with an abutment 86′ which strikes a hammer blow on the extension 82′ of the latch 71 during the opening operation again as previously described in connection with the link 70.

In the operation of my device, when the tie-link 14 is moved from the position of Figure 2 to the position of Figure 1, then the latch members 70 and 71 are moved from the position of Figure 2 to the position of Figure 1 while the bomb hooks 72 and 73 nevertheless remain in the position of Figure 2.

The bomb 100 cannot be mounted on the bomb rack until the knob 30 has been moved upwardly by rotation of screw 31 to move it upwardly. This, as above described, provides a test of the proper locking of the latches.

It is now necessary to engage the hooks 72 and 73 with the latches 70 and 71 respectively in order that the bomb may be loaded. Accordingly, the bomb is lifted up toward the bomb rack, as shown in Figure 4, by a cable and hook 101 engaging the loading ring 102 of the bomb. As the winch is operated to raise the bomb, the rings 104 and 103 are brought up into juxtaposition with the hooks 72 and 73 respectively.

With the latches in the charged position, as shown in Figure 5, but with the hooks 72 and 73 disengaged and remaining in the position of Figure 2, the bomb, of course, cannot be held. However, when the hooks 72 and 73 are moved to the full locked position of Figure 1, the bomb cannot be moved out of the holding position because of the great force required to release the hooks 72 and 73.

Accordingly, my device, particularly by the use of the spring links 77 and 77', provides for a means of manipulating the hooks 72 and 73 between the full open position of Figure 2 up to almost the full locked position of Figure 4 even though the latch members 70 and 71 and the main latch 50 are engaged.

Referring now to hook 72 of Figure 4, it will be seen that this hook may be rotated readily about its pivot 110 from the position shown in Figure 2 to the position shown for hook 72 in Figure 4, and through that position to the full latch position shown for hook 73 in Figure 4. As the hook 72 is rotated about its pivot 110, the latching roller 111 thereof bears upwardly against the undersurface of the latch 70 and causes the latch 70 to rotate counterclockwise about its pivot 79 compressing the spring 77 until the latch roller engaging surface 112 of the latch 70 bears against the surface of the roller 111. Further rotation of the hook 72 in a clockwise direction causes the roller 111 to move further to the right with respect to the latch engaging surface 112 of the latch 70 until the latch engaging surface 112 is tangential with the surface of roller 111—that is, until the hook is in the latched position of hook 73 shown in Figure 4, where any movement of the hook counterclockwise is blocked by the latch engaging surface 112.

Thus, when the bomb is loaded, as previously pointed out, the bomb 100 is hoisted up to a point where it is adjacent to the hooks 72 and 73 and the rings 104 and 103 are positioned immediately beneath the hooks 72—73 respectively. Hooks 72 and 73 are individually rotated clockwise around their pivots 110 until a definite detent action is felt, at which time the hooks are almost closed with sufficient room left for entry of the rings 104 or 103. This detent action is felt when the lower edge of the latch surface of latch 70 passes a line on the surface of the roller 111 extended through the pivot 110 and the pivot 114 of roller 111 (Figure 4) The bomb rings 104 and 103 are then positioned in the slots of the hooks 72 and 73; and further lifting of the bomb 100 by the winch attached to cable 101 will now force the hooks further upwardly, rotating the hooks further in a clockwise direction and causing the hooks to move from the previously mentioned detent position to the full latched position of hook 73 in Figure 4 or to the completely latched position of Figure 1.

From Figure 4 it will be seen that the hooks may be latched independently of each other—that is, the bomb 100 may be raised and the ring 103 completely secured by the hook 73 before the hook 72 is positioned for engagement with the ring 104.

By this means therefore, the bomb may be readily and automatically loaded and the hooks

automatically locked by the latch members merely by raising the bomb 100 and appropriately positioning the rings 104 and 103 with respect to the hooks 72 and 73 respectively.

Here again an additional safety feature is obvious. Unless the principal latching toggle 45—46 and the latch 50 are engaged, the latches 70 and 71 are in disengaged position and the hooks 72 and 73 are entirely loose in any position thereof; they cannot support the bomb at all and no resistance whatever is offered to their movement. This is a further indication as to the latch condition of the bomb release rack.

After the bomb is loaded in the position of Figure 1, a further test of the condition of the hooks is obtained by loosening the winch cable 101 slightly. If the latches are unset for any reason, the bomb will fall out of the hooks since the hooks will engage the bomb only when the latches are fully set. If the bomb stays in the hooks, then the winch cable 101 may be released from the loading ring 102.

Thus summarizing, there are four ways at least in which the bomb release rack may be tested for its latched position before the bomb is finally secured in the rack. First, on rotation of knob 39 upwardly, the operator will be able to feel, simply on rotation of this knob, whether or not the spring 15 is pressing against the end 40 of bell crank lever 39. Second, the aligned holes 60 in opposite sides of the rack frame will be cleared only when the toggle 45—46 is fully extended to its latched position. Third, the hooks 72 and 73 may be rotated freely around their pivots 110 and 110' between the full open and full closed position if the latches are not engaged; if the latches are engaged, then, as shown in connection with hook 72 of Figure 4, manual rotation of the hook is resisted by the latch member. Fourth, when the bomb is in loaded position, a slight release of the winch cable 101 will serve as a final test for the latches.

Immediately subsequent to loading or even after latching and before loading, a safety pin as previously described may be passed through opposite openings 60. Removal of this safety pin prior to take-off of the plane serves as a final test for the latched position. It is obvious, of course, that a cable or other device may be attached to the safety pin so that the safety pin may even be removed during flight.

The release of the bomb from the hooks 72, 73 is accomplished by the release mechanism generally indicated at 120. The release mechanism comprises a suitable housing 121, preferably a soft iron casting bored at 122 to provide a housing for solenoid coil 123. A soft iron rod 124 is mounted in the housing in the interior of the coil 123 to provide an appropriate magnetic path cooperating with the solenoid plunger 125. Plunger 125 is provided with an annular recess at 126 to provide a space for dirt and ice particles so that they will not jam or freeze the solenoid mechanism.

Energization of solenoid coil 123 by closing of the appropriate circuit will cause an attraction of the plunger 125 to close the gap and move from the Figure 1 position to the Figure 2 position.

Plunger 125 is connected by the pin 128 to the link 129 which carries a latch engaging roller 130 at its opposite end. Link 129 is controlled in its movement by the guide link 131, one end of which is pivoted on the same pivot as the latch engaging roller 130, and the opposite end of which is pivoted on the stationary pivot 133.

Operation of plunger 125 to the left (with respect to Figure 1) by energization of the solenoid coil 123 will cause the roller 130 to strike a hammer blow against the lower end 50' of the latch 50. This will cause latch 50 to rotate clockwise and move out from under the roller 51. The toggle 45—46 will no longer be supported and will accordingly collapse owing to the bias of the compression springs 15 and 16 (compression spring 15 pushing on the tie-link 14 and compression spring 16 pulling on the tie-link 14, both operating in the same direction).

As the tie-link 14 now moves towards the left under the influence of the springs 15 and 16, the links 21 and 21' are driven toward the left. The abutments 86 and 86' respectively of the links 21 and 21' will now strike smartly against extensions 82 and 82' of the latches 70 and 71 respectively. The hammer blow on these latches 70 and 71 will cause them to move smartly from the latched position of Figure 1 to the release position of Figure 2, thus releasing their engagement with the rollers 111 and 111' of the hooks 72 and 73. There will now be no resistance at all offered to counterclockwise rotation of the hooks 72 and 73 about their respective pivots 110 and 110'. Accordingly, the load of the bomb will promptly rotate the hooks 72 and 73 about their pivots 110 and 110' and the bomb will be released as shown in Figure 2.

Spring stop members 140 and 140' are provided to absorb the shock of rapid rotation of the hooks 72 and 73, respectively, and are struck by rollers 111 and 111' of the hooks on completion of the release of the bomb as shown in Figure 2.

It will be noted that during the release operation, the pressure of the springs 15 and 16 is not alone relied on, but rather the device is so arranged that the kinetic energy of a hammer blow is obtained. Thus, the latch release roller 130 is not initially, in the position of Figure 1, in engagement with the end 50' of the latch 50 but rather is substantially spaced therefrom. As the plunger 125 is attracted within the solenoid, substantial kinetic energy is stored up and the roller 130 is arranged to strike the end 50' of the latch immediately before the completion of the movement of the solenoid plunger 125 when it is moving at its greatest speed, and thus to strike the latch end 50' a sharp hammer blow. This hammer blow exerts a force on the latch member which is a compound of the attractive force of the solenoid coil 123 plus the kinetic energy of movement of the armature 125.

Similarly, the release of the latch members 70 and 71 for each of the hooks 72 and 73 is achieved by a hammer blow in which the force of the springs 15 and 16 is compounded with the kinetic energy of movement of the tie-link 14 and the associated elements.

Thus, in the latched position of Figure 1, the abutments 86 and 86' are spaced from the extensions 82 and 82' of the latches 70 and 71. These abutments 86 and 86' do not strike the extensions 82 and 82' until the tie-link 14 has moved for some portion of its full distance. At this time, the springs are sufficiently far from the end of their stroke to exert maximum energy while the kinetic energy of movement of the tie-link 14 is additively used to move the latches sharply out of engagement. Accordingly, the operation of the release mechanism is positive and direct.

While the compression springs 15 and 16 are

sufficient to ensure a full opening operation, the spacing of the elements to utilize a series of hammer blows to operate the latches ensures a multiplication of force which will positively open the latches irrespective of the weight of the bomb.

In order further to ensure release of the hooks 72 and 73, the rollers 111 and 111' are mounted in needle bearings having a minimum co-efficient of friction to ensure that the latches 70 and 71 may move freely with respect to the rollers when they are struck the hammer blow as above set forth.

Thus, it is obvious from all of the foregoing that the latches are positively tripped by mechanical means irrespective of the weight of the bomb and that the bomb weight plays no part in tripping the latches. After the latches are tripped, the bomb need merely rotate members 72 and 73 on their needle bearings as it falls out. Since these members are so balanced that they tend to assume the position of Figure 2, the bomb need perform no work even to rotate them.

On de-energization of the solenoid coil 123, the apparatus is so designed that the release mechanism will re-set itself to the original position of Figure 1 in preparation for a re-setting of the latches. This re-setting operation of the release mechanism is accomplished by compression spring 150 mounted in a recess 151 of the housing 121 of the solenoid and bearing at one end against the base 152 of the recess 151 and at the opposite end bearing against nut 153 on the rod 154. Rod 154 is pivotally connected at 155 to the link 156 which is rotatably mounted at 157 on a stationary pivot secured to the rack. Link 156 at its lower end is pivotally connected to the pivot 128 between the solenoid plunger 125 and link 129. Accordingly compression spring 150 which biases the link 156 in a counterclockwise direction biases the pin 128 toward the right and tends to drive the solenoid plunger 125 toward the right or toward the non-tripped position of the solenoid shown in Figure 1. Link 156 is prevented from rotating too far to the right by the stop 58. Accordingly, immediately on de-energization of the coil 123 of the solenoid, plunger 125 is moved back to its non-tripped position.

A manual trip mechanism is provided at 169 which comprises essentially a pair of arms 160 extending upwardly from link 156 on the upper side of its pivot 157. The arms 160 carrry between them the weight 161 which is rigidly connected thereto by the pin 158 and the spot welding 159. The weight 161 serves as a counter-balance to that portion of the link 156 that is below the pivot 157. This balancing prevents involuntary operation due to sudden changes in motion of the plane.

The cam following surfaces 164 of the arms 160 are arranged for engagement with the cam roller 162 which is spring biased by the coil spring 163 (preferably of flat beryllium copper) to the non-trip position shown in Figure 1.

A cable 165 is wound around a portion of the cam roller 162 and is led around guide roller 166 through the top of the bomb release rack to the manual release ring 167 which is held in position by a suitable stop 168. Pulling manual release ring 167 upwardly will pull up the cable 165 to rotate the cam roller 162 clockwise and bring the raised surface thereof against the cam follower 164 to force the cam follower 164 and the arms 160 toward the right and therefore to cause the entire link 160—156 to rotate in a clockwise direction around its pivot 157. This will, through the pivot 128, draw the link 129 toward the left with respect to Figure 1, thus pulling the tripping element 130 against the extension 50′ of the latch 50 and trip the device open as above set forth.

Suitable control means may be provided as required. Thus, for instance, a transfer switch 170 may be provided, so designed that it will be operated by the link mechanism 174—175 in the following manner. When the control solenoid plunger 125 is actuated and link 156 is moved to the left with respect to Figure 1, the links 174—175 will break upwardly at their pivot 176. Collapse of the toggle 45—46 due to tripping action places the roller 48 in the position shown in Figure 2. When the solenoid plunger 125 is released and the lever 156 returns to its normal position, thereby straightening out the toggle 174—175, the right hand end of which is prevented from moving by the appearance of roller 48 in the space once occupied by the roller 177, the left hand end of the linkage 179 moves forward to actuate the switch plunger 171. This double position of the end 179, of the toggle 174—175, is provided for by the elongated holes 178.

Since the links 174—175 are straightened out only after the solenoid plunger 125 and the link 156 are moved to the right, due to the de-energization of the solenoid 123, it becomes obvious that the transfer switch cannot be actuated until after the bomb has been released, the toggle mechanism 45—46 collapsed and the solenoid 123 de-energized.

Other indicating devices may be provided as required. Thus, for instance, an appropriate switch operator or plunger may be provided at 181 (Figure 7) to indicate that the hook 72 is in the full latched position. This will continuously indicate to the bombardier the condition of the bomb rack and will provide him with an indication of the release of the bomb. Preferably the switch 181 should close the circuit to a light on the instrument panel so that there will always be a constant positive indication of the fact that the bomb is in the rack, and the extinguishment of the light will indicate the release of the bomb.

Should the bomb release rack, when tripped, jam for any reason as shown at the left hand end of Figure 7, then switch 181 will provide an immediate indication of this fact.

It will be noted that the surfaces 182—184 (Figure 2) of the recesses 190—190′ respectively are disposed at an angle of 15 degrees from the vertical. These surfaces 182—184 cooperate with the bombing hooks 72—73 respectively to form the above mentioned recesses within which the bomb loading rings 103—104 are captured. Inasmuch as the surfaces 182—184 will bear the entire weight of the bomb in the almost vertical dive bombing position, shown in Figure 3, it is desirable to provide the 15° slant since at this angle the bomb will be sure to overcome any friction regardless of the bombing angle of the plane and the release of the bomb will be ensured, regardless also of the bombing angle of the bomb rack at the time of discharge.

The abutments 191—191′ are provided to give additional rigidity to the sides 11 of the bomb rack and also provide a broad smooth surface on which the bomb loading rings 103—104 slide. The abutments 191—191′ are suitably secured between the side frame members by the cross bolts 193 and provide a support for the bomb hook shock-absorbing springs 140.

As will be obvious from a comparison of Figures 1 and 3, my bomb rack will operate effectively to release the bomb in any position from the steepest possible climbing angle to a vertical diving position.

One of the primary problems which occurs in equipment, such as bomb release racks mounted on the outside of airplanes, is the protection of the equipment against dirt and ice. It will be noted here that essentially two types of enclosure are used. Where possible, as in the case of the solenoid release mechanism, the plunger and other members contained in the housing 121 are completely enclosed with an appropriate recess 126 provided in the plunger 125 to provide a space for any dirt or ice which may get in and thus cause the jamming of the parts. When it is not possible to enclose the parts completely, then the parts are left entirely in the open to permit the dirt to drop out or be blown away.

Accordingly, the materials used must themselves be inherently self-protecting with respect to corrosion, dirt and other influences to which plane parts are subjected. Thus, the materials are chosen to give the least possible galvanic action. To accomplish this wherever possible, all working parts are made of stainless steel. The various pins, for example, are of heat-treatable non-galling type #416 rustless iron, as defined in the "Steel Products Manual—Stainless and Heat-resisting Steels—Section 24," July 1947 issue of the American Iron and Steel Institute, 350 Fifth Avenue, New York 1, N. Y., and the latches are made of type #440-F as defined in the "Steel Products Manual—Stainless and Heat-resisting Steels—Section 24," July 1947 issue of the American Iron and Steel Institute, 350 Fifth Avenue, New York 1, N. Y., which can be hardened to 60 Rockwell C. The bearings throughout have one element of homogeneous and the other coacting element of heterogeneous structure, so as to provide for boundary lubrication. Where loads require it, aluminum bronze bushings are used, this being the only place where galvanic action may occur. However, when covered with any low temperature lubricant, the effects of this action would be at a minimum. Where very light loads are encountered, as in the arming linkage (hereinafter described) plastic bushings are used.

A careful analysis of all the linkages with an allowance of an extreme coefficient of friction of 25% will show that the parts are sufficiently strong and the leverages sufficiently large to ensure maximum safety in operation. That is, for a positive release of the bomb to hold the size of the operating mechanism to reasonable proportions, it is necessary to use needle bearing rollers at 111, 111′ to bear against the concentric latch surfaces. The use of ordinary rollers with a frictional coefficient of .25 would require more force and a coil larger than the space available to limit the temperature rise. While the cofficient of friction of a needle bearing is below 1%, the design of the device herein disclosed was based on a value of 5% giving the factor of safety of 5 at the latch itself. In all cases, the bomb load on the hooks was calculated on the basis of 5G, and this multiplied by an inherent factor of safety of 5 at the latch results in a force 25 times that required to disengage the bomb-retaining latch under static conditions. In other words, once the latches are locked in position, the factor of safety is 25.

To reduce the effects of seizure, sticking and friction, all parts were pivoted wherever possible, and rectilinear motion was avoided. Therefore, the only points where rectilinear motions occur are in the solenoid plunger and compression springs.

It will be evident that the design herein disclosed was so contrived that dimensional accuracy is not too important and has only a minor effect on the operation. Essentially, this is achieved by the utilization of the spring links 77 and 77′ cooperating with the stops 84 to position the latch members 70 and 70′. The width of the latch roller engaging face 112 of each of the latch members provides for a margin of safety even after substantial wear has occurred. This is particularly so since the roller 111 by reason of its angular position with respect to the pivot 110 must first move upwardly further into engagement with the latching surface 112 before it can move downwardly out of engagement. Accordingly, misalignments in assembly and changes in dimension due to wear or replacement of parts should, within reasonable limits, have no substantial effect in the operation of the device. For example, scaling the device on a basis of 14″ between the bomb loading rings 103 and 104, surfaces 112 of the latches 70 must be moved a full ⅛″ before tripping occurs. Misalignment of the latch parts to a large fraction of this amount will not affect operation.

In choosing favorable mechanical advantages, long wheelbases were utilized where possible, and, as above described, latches which did not depend on hair-trigger action were utilized. Accordingly, the necessity for extreme accuracy was avoided.

In the operation of the device, as previously described, since the bomb weight is not used to open the release mechanism, the manner in which the bomb weight is applied has no effect on the release action. Therefore the smoothness of the hook surface is immaterial and any indentation due to softness or brinelling as a result of vibration has no effect on the operation.

The springs 15 and 16 required to trip the bomb produce about 25 times the amount of energy necessary to overcome the friction at the rollers 111 caused by the weight of the bomb. In order to hold the spring, the force of the spring is first reduced by means of the toggle 45—46 set considerably below the friction dead center to avoid failure due to the action of friction. This toggle is prevented from collapse by the dead center roller latch 50 which in turn can be released by the action of the solenoid release mechanism. It should be noted that the force on the latch 50 comes from the coil spring 53 and therefore is constant and is entirely independent of the weight of the bomb or the position of the rack.

Another feature of the design is that two release springs 15 and 16 are used, one at each of the opposite latch positions 70 and 71, so that the long link 14 connecting the two release mechanisms is under little stress during the release operation. The link 14 is used, first to ensure that the springs 15 and 16 will be charged simultaneously, and secondly as a tie so that both mechanisms work together.

As previously pointed out, the solenoid operates through a linkage which strikes the release latch with a hammer blow to ensure positive action, although the design is such that enough force is available for operation with a slow push. The lost motion thus made available however, permits the solenoid plunger and its linkage to vibrate with a considerable amplitude without resulting in release.

Ths spring 53 on latch 50 is calculated to produce a minimum frequency of 80 cycles per second while the reelase mechanism is balanced by the weight 161 sufficient to withstand 20G in the direction of braking of the plane without resulting in release.

Accordingly all necessary safety factors have been considered, and my novel device is therefore so arranged that it will not trip unless the solenoid coil 123 is energized or the manual pull ring 167 is pulled, while nevertheless the bomb release mechanism will be instantaneous and positive in operation on energization of the solenoid coil 123 or on pulling of the manual pull ring 167.

In Figures 5 and 6, I have shown the operation of my novel bomb release mechanism schematically. The Figure 5 schematic position is exactly like that of Figure 2; while the Figure 6 position shows the parts after they have been moved to the position of Figure 4 in which the latches are all in the proper bomb retaining position of Figure 1, but in which the hook members have not yet been fully moved to bomb retaining position.

These schematic illustrations illustrate the simplicity of my novel bomb release rack, the minimum of working parts involved, and the fact that the release mechanism is completely independent of the bomb itself for its operation.

My novel bomb rack mechanism includes an arming mechanism indicated generally at 185 mounted in the housing 186 carried between the side frame members of the bomb release rack. The housing includes a space for the nose arming solenoid coil 188 and the tail arming solenoid coil 189. Solenoid plunger 180 is provided to co-act with the solenoid coil 188, and a similar solenoid plunger is provided to co-act with the solenoid coil 189. The solenoid plungers in the arming mechanism have the same form as the solenoid plunger 125 of the release mechanism, having an appropriate recess to provide for the collection of dirt and ice without jamming the solenoid plunger against movement.

Oil impregnated felt washers 192 are provided around the solenoid plungers to prevent, as much as possible, the collection of dirt inside the housing.

The solenoid plungers for the nose and tail of the arming mechanism are connected to the blocking levers 183—187 which are pivotally mounted at 194 and have blocking surfaces 195—195′. These blocking surfaces 195—195′ when properly actuated cooperate with the ends 196—197 of the hooks 198—199 respectively to lock the hooks and prevent the arming cables 202—203 from slipping free from the hooks 200—201 respectively.

When the solenoid 188 is energized and its plunger 180 is moved upwardly, it will cause the blocking lever 183 to rotate in a clockwise direction and prevent the hook 198 from rotating about its pivot by blocking the end 196. This action will cause the arming cable 202 to remain captured within the hook 198 and thus arm the nose of the bomb when it is released. In order to arm the tail mechanism of the bomb the solenoid 189 is energized and its plunger will cause the blocking element 187 to rotate in a counterclockwise direction and prevent the hook 199 from rotating about its pivot by blocking the end 197. This action effects a positive lock for the hook 199, prevents the arming cable 203 from slipping free, and thereby arms the tail of the bomb.

It is obvious from the above description that should it be desirable to arm both the nose and tail of the bomb at the same time that both the solenoids 188—189 must be energized. Conversely it follows that should it be necessary to release the bomb in a friendly area, neither solenoid should be energized so that the arming cables may pull free from their respective hooks, the bomb dropping as a dud.

The manual arming mechanism is comprised of two levers 210—210′ mounted on opposite sides of the arming mechanism. These levers are pivotally mounted at 211 and connected by the wires 212—212′ to the blocking elements 183—187 respectively. Raising the lever 210 tightens the wire 212 and thereby rotates the blocking lever 183 in a clockwise direction to lock the hook 198 as described in the solenoid operation. Lever 210′ and wire 212′ will similarly rotate the blocking lever 187 to prevent the hook 199 from opening. The lever 210 has a cam following surface 215 which engages the cam roller 216, which cam roller has substantially the same form and operation as the cam roller 162 of the release mechanism 120 and is connected by an appropriate cable to the manual arming ring 217.

Rotation of the cam roller 216 will cause the cam face 213 to raise the lever 210 and actuate the blocking mechanism 183 as above described, further rotation of the cam roller 216 causing the cam surface 214 to raise the lever 210′ (on the opposite side of the arming mechanism, not shown) and actuating the blocking lever 187, manually arming both the nose and tail of the bomb.

An examination of the device will show that the maximum space is available for the arming mechanism coil so as to provide the largest amount of copper for the coil and the largest radiation area.

The iron magnet frame of the housing consists of a single rectangular block with cavities machined in it for the solenoid coils. It fits snugly between the side walls of the rack to which it is bolted and pinned in any suitable manner. This gives the best transfer of heat and increases rigidity of the rack during loading.

To maintain the efficiency of the solenoids during their life, everything in connection with the moving parts, including the pole piece, armature, coil springs, and linkage, are made of stainless steel of the proper grades. This eliminates the possibility of galvanic action, corrosion and the deterioration or flaking of plated finishes which would have to be used with soft iron.

In the foregoing I have described my invention only in connection with preferred specific embodiments thereof and the operation of the elements of my invention in connection with the specific descriptions thereof. Since many variations and modifications of my invention should now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein set forth but only by the appended claims.

I claim:

1. In a bomb release rack, a plurality of freely rotatable members for engaging the holding rings of a bomb, each of said members having a pivotally mounted roller, latch mechanism for controlling said members, each of said latch mechanisms being pivotally mounted and in tangential engagement with its associated roller, the pivots of each roller and its associated latch mechanism being in a straight line through said tangential engagement, positively operating means for operating said latch mechanism to free said rotatable members from said latch mechanism, said rotatable members thereupon being freely rotated independent of the bomb to a position at which the members do not engage the holding rings of the bomb.

2. In a bomb release rack, a plurality of freely rotatable members for engaging the holding rings of a bomb, each of said members having a pivotally mounted roller, latch mechanism for controlling said members including toggle mechanism normally held in locked position, each of said latch mechanisms being pivotally mounted and in tangential engagement with its associated roller, the pivots of each roller and its associated latch mechanism being in a straight line through said tangential engagement, means for releasing said toggle, positively operating means comprising a spring member for operating said latch mechanism to free said rotatable members from said latch mechanism when said toggle is released, said rotatable members thereupon being freely rotated independent of the bomb to a position at which the members do not engage the holding rings of the bomb.

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