April 30, 1946. J. O. YORK ET AL 2,399,530

BOMB SELECTOR

Filed Jan. 4, 1941 2 Sheets-Sheet 1

Fig. 1.

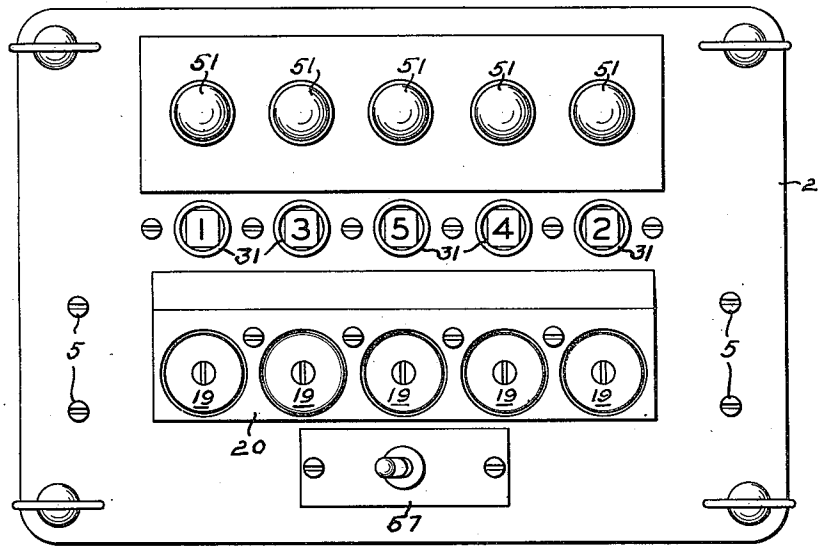


Fig. 2.

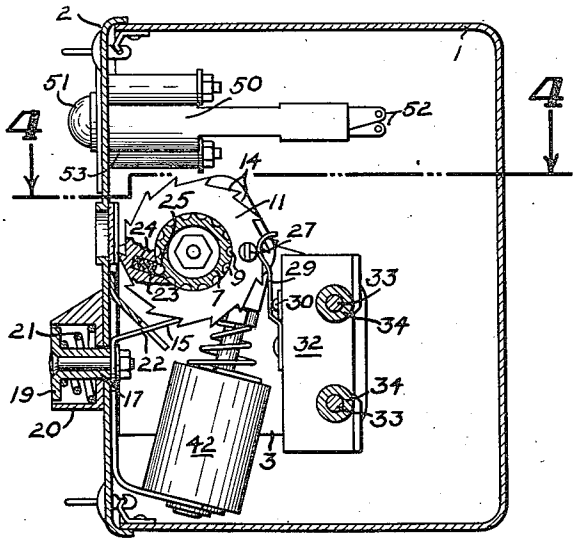
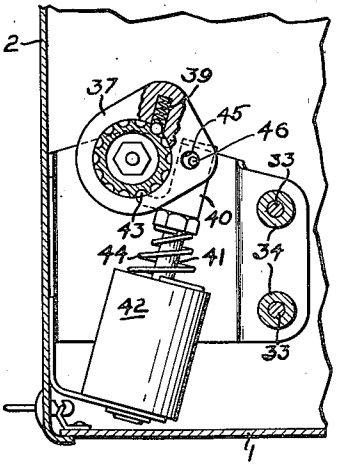


Fig. 3.



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Fig. 4.

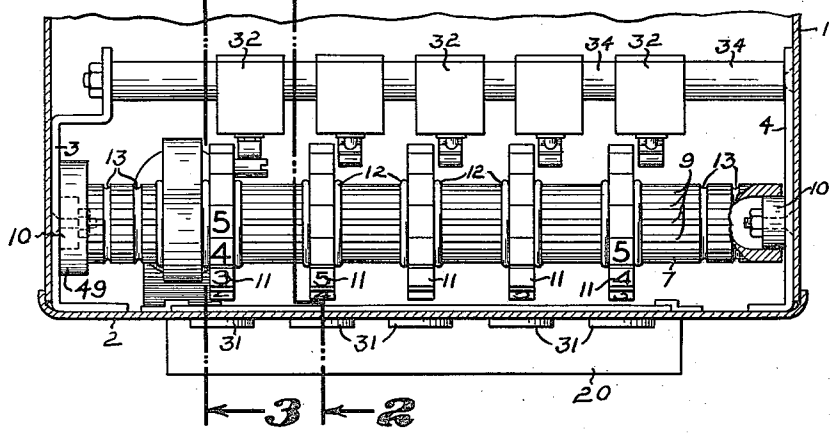
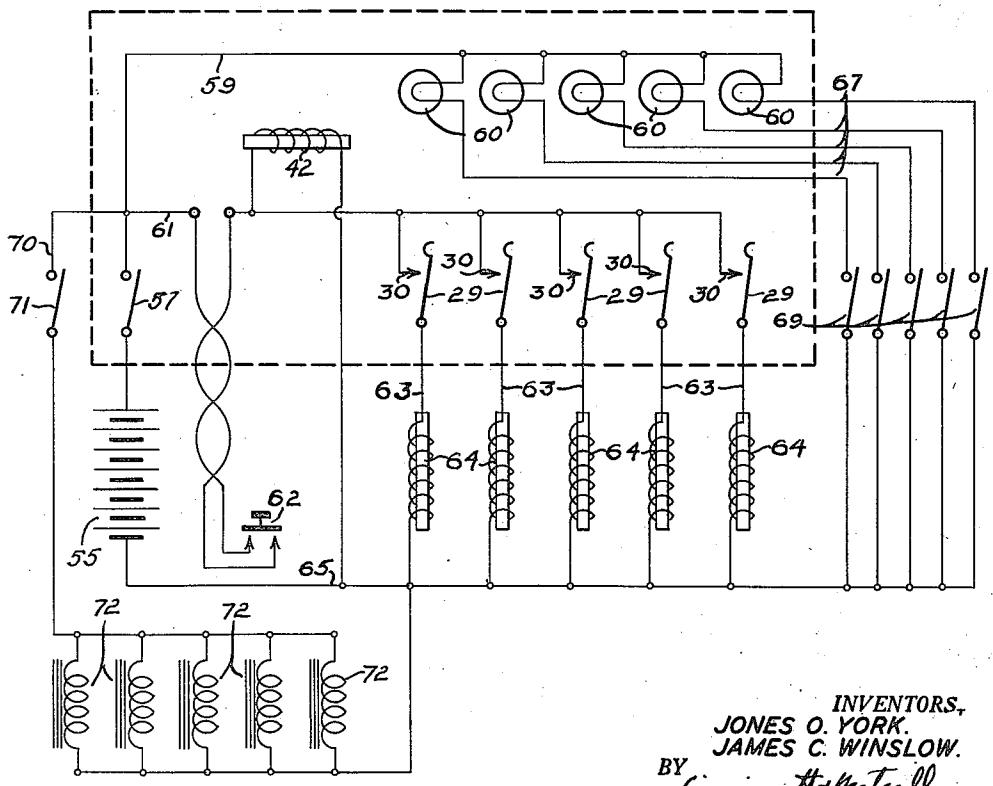


Fig. 5.



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UNITED STATES PATENT OFFICE

2,399,530

BOMB SELECTOR

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Application January 4, 1941, Serial No. 373,069

5 Claims. (Cl. 89—1.5)

This invention relates to circuit selector mechanisms, and particularly to such mechanisms as adapted for the operation of electrically controlled bomb racks. Its broad purpose is to provide a mechanism whereby the dropping of bombs from aircraft may be controlled by a single trigger switch, and whereby the order or sequence in which such bombs are dropped may be pre-set, and the bombs released singly or in groups in such order by successive operations of the trigger switch. Subsidiary to this primary object of the invention are the provision of means for speedily and positively pre-setting the release sequence or of changing such setting and of means for indicating which bombs have been released, which will be the next to be released, and the weight or character of the bombs in the various racks, should these differ; and the provision of an exceedingly light, smooth working, and positive ratchet mechanism for effecting the step-by-step motion necessary for the aforementioned objects.

Other objects of this invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but we do not limit ourselves to the embodiment of the invention herein described, as various forms may be adopted within the scope of the claims.

Considered broadly, the mechanism of the invention comprises a frame or housing wherein is journaled a shaft upon which, in turn, are journaled a plurality of index wheels corresponding in number to the various bomb racks to be controlled. Means are provided for rotating each of these wheels step-by-step upon the shaft to any of a predetermined number of positions thereon as indicated by indexing upon the wheels, and movable with each of the wheels is means for closing an electrical circuit when the wheel is in a predetermined position. Electromagnetic means are provided for rotating shaft and index wheels together in step-by-step fashion, and the electromagnetic means is connected in series with a trigger switch and the group of said circuit-closing means connected in parallel, so that the step-by-step mechanism for rotating the shaft and wheels will be operated by the trigger switch when any one or more of the circuit-closing means is closed. Each of the circuit-closing means is, in practice, connected in series with the operative circuit for one bomb rack, and hence successive operations of the trigger switch will release those bombs whose racks are connected to the circuit-closing means which are, for the moment, closed, and upon opening the trigger switch the next rack or racks in sequence will be connected for operation upon the next operation of the trigger switch.

There are preferably also provided pilot lights for each rack connected to be lighted when the rack is loaded, and to direct a beam of light against the corresponding index wheel, thus indicating at a glance which racks are still loaded and which will be the next to be released.

The nature of the invention can best be understood by the following description, taken in connection with the accompanying drawings, wherein:

Fig. 1 is a front elevation of a preferred embodiment of the selector of our invention.

Fig. 2 is a transverse section through said selector, the plane of section being indicated by the line 2—2 of Fig. 4.

Fig. 3 is a fragmentary sectional view showing the step-by-step operating mechanism, the plane of section being indicated by the line 3—3 of Fig. 4.

Fig. 4 is a horizontal sectional view, projected in planes indicated by the line 4—4 of Fig. 2.

Fig. 5 is a circuit diagram indicating the connections of the selector to a plurality of bomb racks such as are illustrated and described in our copending application, Serial No. 373,068, filed January 4, 1941 (Patent No. 2,374,066, granted April 17, 1945).

The operative mechanism of the selector of our invention is enclosed within a rectangular housing or frame 1, preferably made of "dural" or other light alloy, and closed by a front cover plate or panel 2. We prefer to mount the entire mechanism on the cover plate, supporting it from a pair of brackets 3 and 4, rigidly secured to the cover plate, as by the screws 5.

Journaled on the bracket is a horizontal shaft 7, preferably formed of light alloy tubing and provided with a plurality of flutes 9 of circular cross section. The bearings on which the shaft turns are preferably anti-friction ball bearings 10 of the type readily available on the market and are rigidly secured to the brackets 3 and 4 respectively.

Mounted on the shaft 7 are a plurality of index wheels 11. These wheels are mounted to journal on the shaft, being retained in place longitudinally thereof by snap rings 12 which engage semi-toroidal grooves similar to the grooves 13. Thus, although the particular selector shown in the accompanying figure is designed for handling five bomb racks only, the shaft as shown in Fig. 4 would accommodate two extra index wheels journaled thereon between the two sets of grooves 13, and in practice the selectors are made to handle as many racks or as few as are provided by the specific design of the bombing plane wherein the selector is installed.

We prefer to construct the index wheels 12 of transparent plastic. Each of the wheels is provided with ratchet teeth 14 corresponding in number to the number of flutes on the shaft 7. These ratchet teeth are engaged by a spring pawl 15, mounted on the stem 17 of a push button 19

which is mounted in a block 20 preferably of white or light colored plastic, secured to the face of the cover plate 2. The push button and pawl are normally held in retracted position by a compression spring 21. The pawl 15 extends through a slot in an angled metal guide plate 22, which prevents push button and pawl from rotating out of engagement with the index wheel ratchet, and the stroke of the push button is limited so as to advance the index wheel with respect to the shaft, step-by-step, one tooth at a time.

Relative rotation between index plate and shaft in the opposite direction is prevented by a ball ratchet mounted within the wheel. This ratchet is set in a hole 23, directed inwardly toward the shaft at an angle intermediate between the radial direction and tangency with the shaft. A compression spring 24 fitted within this hole presses a ball 25 against the shaft and into the flutes, the radii of the ball and flutes being substantially the same.

This arrangement gives an extremely smooth and positive ratchet. As will be seen from the showing in Fig. 2, when the index wheel is rotated in a counterclockwise direction with respect to the shaft, the force exerted by the flute against the ball is directed practically axially of the hole 23 against the compression spring, and the ball accordingly retreats into the hole and permits the index plate to rotate. When relative rotation in the opposite direction is attempted, however, the side of the flute operating against the ball tends to force it nearly perpendicularly against the wall of the hole in which it rests, so that no compressive force is exerted thereby against the spring 24. The ball is in nearly pure shear, completely preventing relative rotation in this direction. Operation of the push button 19, therefore, advances the ball ratchet from flute to flute of the shaft, but accidental rotation in the opposite direction, due to the retraction of the pawl 15, is positively prevented by the ball ratchet.

Each index wheel carries a stud 27, which in the position shown in Fig. 2, presses against a contact spring 29 and forces it against a contact point 30, thus closing an electrical circuit which will be described in detail later. The purpose of the push button and ratchet arrangement is to determine the positions of the studs 27 on the respective index wheels with respect to the shaft. Each of the wheels carries reference characters inscribed on the long slope or more nearly tangential portion of the ratchet teeth. These reference characters may, of course, be of any kind desired, but the most convenient are arabic numerals, arranged in succession with the lowest numeral of the sequence, i. e., "1," on the tooth opposite the stud 27, so that this numeral is displayed through a window 31 in the cover 2 when the contacts 29 and 30 are closed. The successive numerals are arranged in counter-clockwise order on the faces of the ratchet teeth, so that as the index wheels are rotated by means of the push button 19, or by rotation of the shaft as will later be described, the numerals appear in descending order.

As is indicated in Fig. 4 the index wheels are uniformly spaced along the shaft 7, each with its circuit-closing contacts 29, 30 carried on insulating blocks 32, the latter being mounted on a pair of transverse tie-rods 33 which extend between the brackets 3 and 4, the blocks being separated by spacers 34.

As has already been indicated, means are provided for advancing the shaft and its index wheels together, step-by-step. These means comprise a ratchet block 37 journaled on the shaft similarly to the index wheel, and carrying within it a ball ratchet 38 similar to those of the index wheels but oppositely directed, i. e., so positioned as to carry the shaft with the block if the block is rotated counter-clockwise, and to permit relative rotation when the block is moved in the clockwise direction as shown in Fig. 3. The block is pivotally mounted on a fitting 40, carried on the end of the plunger 41 of an electromagnet or solenoid 42, the plunger being normally held extended by a compression spring 44. The fitting 40 has a projection 43 which is formed and positioned to fit into the flutes 8 when the plunger is extended. An oversize hole 45 in the block 37 engages a pin 46 carried by the fitting 40, thus permitting the small relative lateral motion between the elements 37 and 40 which is necessitated by the arcuate path of the block. Thus excitation of the solenoid rotates the block about the shaft; release of the magnet turns the ratchet block back to its original position, carrying the shaft with it, and the projection or lug 43 serves as a stop to limit the motion of the magnet plunger and also to prevent overriding of the shaft. Clockwise rotation of the shaft is prevented by another ball ratchet, mounted in a block 49 on the bracket 3.

Illumination for the dials is provided by a series of pilot lamps mounted in housings 50, which are of a type purchasable on the open market. They carry colored bull's-eyes 51 on the face of the panel 2, through which the lights are visible, and are provided with terminals 52 for connection to an exciting circuit. Each housing is also provided with a narrow slot 53 from which light is directed downward against the periphery of the index wheels 12, and these wheels being made of transparent material, when viewed from the front of the housing they appear to glow softly with the index characters sharply illuminated.

The connections of the device are shown in Fig. 5, wherein the parts thus far described are illustrated schematically, and are indicated by the same reference characters hitherto used in their description.

A suitable power source, such as a battery 55 connects to a master switch 57, which is preferably mounted on the panel 2 as shown in Fig. 1. Beyond this switch the circuit branches into a common lead 59, to which the pilot lights 60 are connected in parallel, and the operating lead 61 which includes in series the bombardier's trigger switch 62, (preferably mounted on a flexible cord), and a parallel arrangement of the solenoid 42 which advances the shaft and index wheels, and the group of contacts 29, 30.

From each of the contacts 29 a lead 63 connects to the release magnet 64 of one of the bomb racks, and thence to the common return lead 65 to the battery. Similarly, from each of the lamps 60 a lead 67 connects to a pilot switch 69, one of which is incorporated in each of the bomb racks as is disclosed in our copending application above referred to, the other side of which switches also connect to a common return lead 65.

The switch 57 also preferably controls a third circuit, comprising the lead 70 and including a switch 71, which, like the switch 62, is preferably placed in position so that it may be under the immediate control of the bombardier. This switch 71 actuates the entire group of electro-

magnets 72, one of which is mounted on each of the bomb racks and which, when excited, arm the bombs. The bomb release solenoids 64, pilot switches 69, and arming magnets 72 are fully described in our copending application, Serial No. 373,068, above referred to.

In the normal operation of the device, the selector is pre-set at the time the bomber sets forth on its mission with its bomb racks loaded. There is almost always some reason for releasing the bombs in a predetermined order, either because the bombs are of different sizes and the tactical mission of the bomber dictates the use of different sized bombs on different objectives, or else because the trim of the plane may best be maintained by releasing the bombs in a specified order.

The order of release is determined by operating the push buttons 19 to bring the desired reference characters into view through the windows 31, these characters indicating the order in which the bombs are to be released. Should it be the intent to release all of the bombs at the same time each of the index wheels would be set to display the figure "1." This pre-setting can be done with the switch 57 either open or closed, since none of the bomb-releasing circuits are completed until the bombardier's push button switch 62 is pressed. With the switch 57 closed, however, the pilot lights 60 are visible through their bull's-eyes 51, and the index wheels are illuminated, so that the figures which they carry are readily visible. Fig. 1 shows the selector set up to drop the outer left bomb first, the outer right second, the inner left third, the inner right fourth, and the center fifth and last. In this case only the index wheel corresponding to the outer left-hand rack displays the index character "1," corresponding to the position of the index wheel shown in Fig. 2, with its contacts 29 and 30 closed. Closing the bombardier's switch 62 completes the circuit through the solenoid 42 and bomb release solenoid 64 in series, releasing the bomb, and at the same time rotating the ratchet block 37, which does not, however, rotate the shaft 7. The release of the bomb, however, immediately opens the corresponding switch 69 and extinguishes the corresponding pilot light 60, so that the index wheel and bull's-eye 51 both go dark. On the release of the bombardier's switch the spring 44 returns the solenoid plunger to its original position, and rotates the shaft 7 and all of the index wheels one step counter-clockwise, so that the figures displayed through the four windows which are still illuminated are each decreased by one. In other words, the rack corresponding to the index wheel displaying the figure "1" will always be the next to be discharged. If necessary, of course, the order of discharge may be changed at any time prior to the release of the bombs. At all times, however, the bombardier has displayed immediately in front of him the information as to which racks have been emptied and in what order the remaining racks will be released.

The sloping face of the block 20 in which the push buttons are mounted offers space on which the description of the bombs in the various racks can be penciled, and these descriptions can be correlated at a glance with the order of release.

We claim:

1. Bomb selector apparatus comprising a frame, a rotatable shaft mounted on said frame, ratchet means for causing step-by-step rotation of said shaft, electromagnetic means for operating said ratchet means, a plurality of index wheels rotatably mounted on said shaft, means restraining rotation of said index wheels in one direction relative to said shaft while permitting rotation of said index wheels individually in the opposite direction, means controlled by the rotation of each of said index wheels in the permitted direction for closing a circuit when said respective wheels are in a predetermined position with respect to said frame, ratchet means for individually rotating said index wheels step-by-step on said shaft in said permitted direction, said circuit closing means being connected in a parallel group and said group being connected in parallel with said electromagnetic means, and a master switch in series therewith, all whereby said index wheels may be pre-set to operate said circuit-closing means simultaneously or successively in any order, and excitation of any of said means will advance all of said index wheels and circuit-closing means a single step.

2. Bomb selector apparatus in accordance with claim 1 wherein each of said index wheels is provided with index characters positioned to read successively in decreasing order in accordance with the step-by-step rotation of said shaft, and said circuit-closing means is so positioned with relation to said characters as to close its respective circuit when the character lowest in order of descent is displayed.

3. Bomb selector apparatus in accordance with claim 1 wherein said index wheels are formed of transparent material and with ratchet teeth on the rim thereof, index characters inscribed on the more nearly tangential surfaces of said ratchet teeth, and means for throwing a beam of light against the edges of said wheels to provide illumination for said characters.

4. Bomb selector apparatus comprising a housing, a shaft journaled within said housing and provided with a plurality of equally spaced flutes having cylindrical contours, a plurality of index wheels journaled on said shaft and frictionally rotatable thereon, windows in said housing for viewing said index wheels, a ratchet block also journaled on said shaft, ratchet pawls mounted in holes formed in said index wheels and ratchet block respectively, each of said pawls comprising a spring and a ball of a diameter substantially equal to that of said flutes, and urged against said shaft by said spring, the holes for said pawls being directed inwardly against said shaft at an angle intermediate the radial and the tangential, a switch operating lug on each of said index wheels, a plurality of switches positioned to be closed by said lugs respectively when said index wheels are in a predetermined position with respect to said frame, ratchet means for rotating said index wheels individually on said shaft, electromagnetic means for turning said ratchet block through a predetermined arc about said shaft, and a spring for returning said block to its original position carrying said shaft and index wheels therewith.

5. Bomb selector apparatus in accordance with claim 4 wherein said index wheel rotating means comprises ratchet teeth formed on the periphery of said wheel, a push button mounted on said housing adjacent the window for viewing said wheel, and a pawl carried by said push button and engaging said ratchet teeth.

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