June 13, 1944. F. J. HOOVEN 2,351,336

BOMB RELEASE SYSTEM

Filed Sept. 25, 1941

Fig. 2

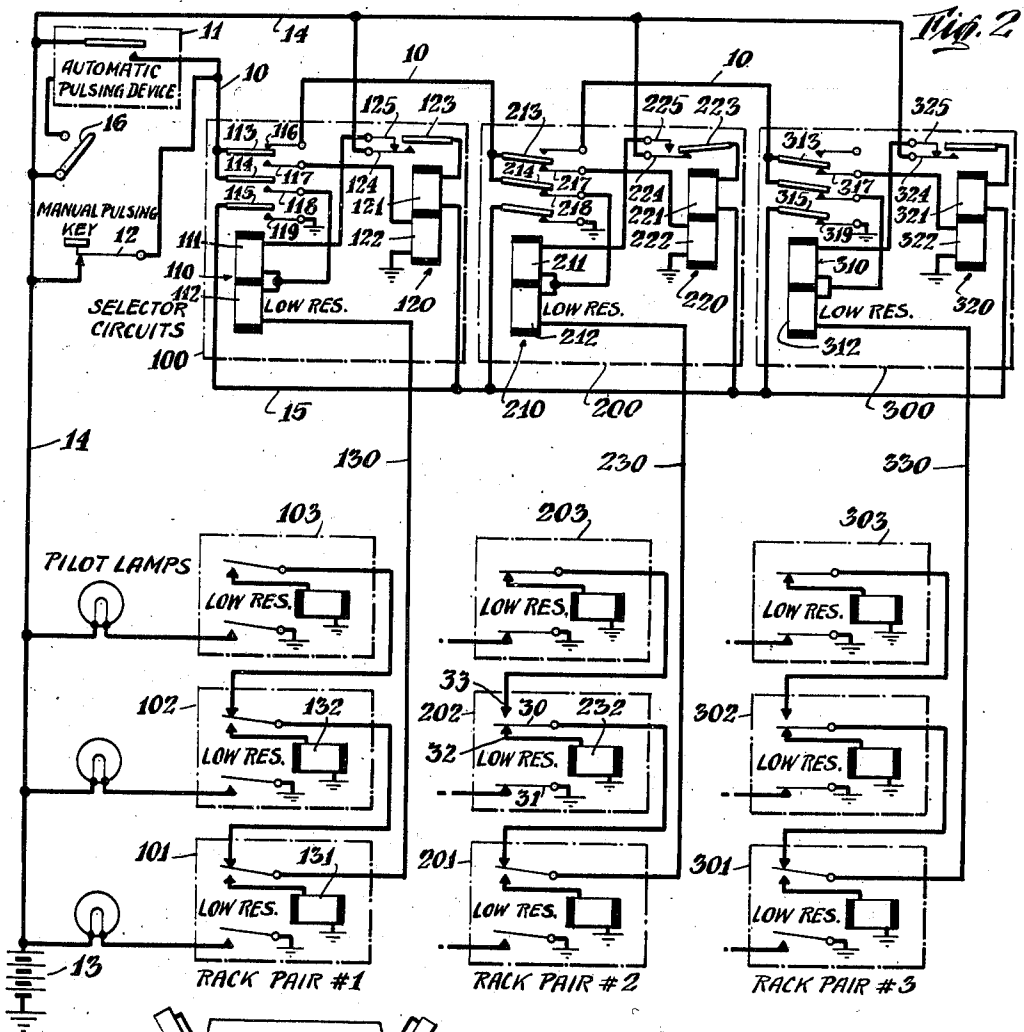


Fig. 1

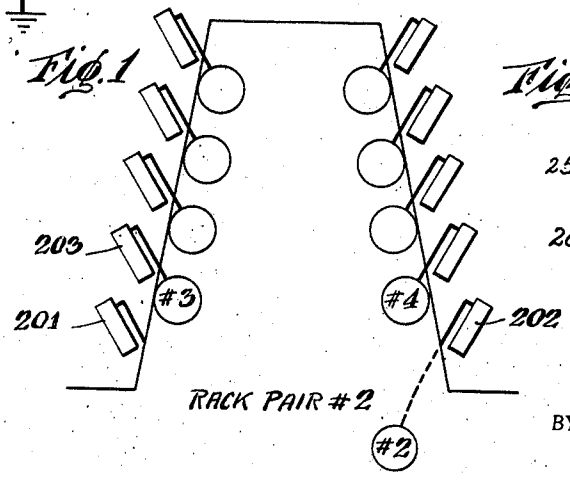
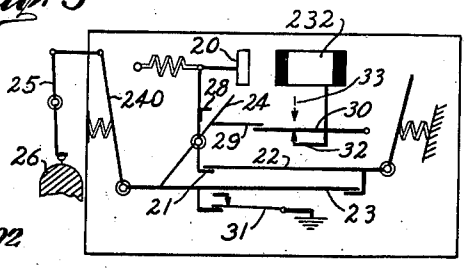


Fig. 3



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BOMB RELEASE SYSTEM

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2 Claims. (Cl. 89—1.5)

This invention relates to electric bomb release systems.

An object of the invention is to improve electrical systems for the release of bombs from aircraft and the like.

Other objects of the invention will be apparent from the following description and accompanying drawing taken in connection with the appended claims.

The invention comprises the features of construction, combination of elements, arrangement of parts, and methods of manufacture and operation referred to above or which will be brought out and exemplified in the disclosure hereinafter set forth, including the illustrations in the drawing.

In the drawing:

Figure 1 is a diagram illustrating an arrangement of bombs in an airplane; and

Figure 2 is a circuit diagram of an electric bomb release system embodying features of the present invention.

Figure 3 is a simplified diagram of the mechanical working parts of a bomb release mechanism.

In bombardment airplanes the bombs are hung in racks, one bomb above the other. The racks are usually arranged in pairs facing each other in a bomb bay as shown in Figure 1. A common arrangement is for each rack to contain 5 bombs when fully loaded so that each pair of racks contains 10 bombs. Figure 1 shows a rack pair capable of carrying 10 bombs but, in the condition illustrated, having one of the bombs already released and the second bomb in the process of being released. A bombing airplane ordinarily carries a number of such rack pairs, a common arrangement consisting of 4 pairs of racks in each airplane.

For a given rack pair the racks are usually mounted so that their rails slope inward and upward toward each other with the bombs on each rack facing those on the opposite rack as shown in Figure 1 where bomb #3 is opposite bomb #4 and so forth.

It is essential that the bomb releasing mechanism be so arranged that the bombs be released in order starting at the bottom of one rack and alternating between the two racks of the rack pair in ascending order to avoid any risk of one bomb falling upon another bomb still held in the rack. It is also essential that if any bomb should fail to drop, all bombs above it in the same rack pair shall be prevented from dropping in order to avoid any risk of a bomb becoming caught in the bomb bay of the aircraft after it has been released and armed.

In my copending application Serial No. 381,218 filed March 1, 1941, (Patent No. 2,332,795) I have described a bomb release mechanism, one of which is associated with each bomb in the rack. Upon receipt of an electric impulse by such a release mechanism in the cocked condition it operates to release its associated bomb and then to transfer the control circuit with which it is connected to the release mechanism for the next succeeding bomb in the rack pair. By the use of this mechanism it is apparent that should any one of the mechanisms fail to operate, the circuit will not be transferred, and hence, the remaining bombs cannot be dropped upon the unreleased bomb. The bomb release mechanisms are shown in Figure 1 designated by numerals **201**, **202**, etc.

Figure 3 illustrates the mechanical operation of such a bomb release mechanism. As shown in this figure the mechanism comprises magnet **232**, and an armature **20** controlled thereby. Armature **20** controls a latch **21** which holds a lever **22** in cocked position. Lever **22**, which may also control the arming of the bomb, holds bomb release lever **23** in cocked position. Bomb release lever **23** has an arm **240** thereon which controls a latch arm **25** of a bomb shackle to release bomb **26** when lever **23** becomes unlatched. A contact holding arm **24** is held by lever **23** in position to press contact spring **30** against contact **32**. Upon release of lever **23** the arm **24** is engaged by projection **28** on latch lever **21** as long as armature **20** is pulled toward electromagnet **232**. After armature **20** is released, arm **24** is permitted to rotate in a counter-clockwise direction thereby allowing projection **29** thereon to release contact spring **30** and permit it to move into contact with contact **33**. Release of lever **23** also releases contact spring **31**, opening the pilot lamp circuit associated with the device.

In bombing, it is often desirable to release bombs in rapid succession, sometimes as fast as twenty bombs per second. An automatic pulsing circuit or device may be used to provide a rapid series of timed electric impulses for this purpose. One such circuit is shown and described in Bradford B. Holmes Patent 2,080,273 issued May 11, 1937. It has been found, however, that if several bombs are released in rapid succession from a single rack pair the bombs strike one another as they are released. This causes them to wobble during their fall and spoils the aim of the bombardier. It is desirable, therefore, that one bomb be dropped from each rack pair in rotation. This

not only prevents bombs released in rapid succession from striking each other but improves the balance of the airplane since at any time the number of bombs is approximately equal in all the rack pairs. If an interlocking circuit were to be wired with succeeding bomb release mechanisms connected in this order, however, great lengths of wire would be required running back and forth between the bomb release mechanisms in the different rack pairs. This would not only require extensive wiring but would cause so great a drop in electric current supplied to the last release in the order due to the resistance of the wiring that it would be quite impractical. Another serious drawback of such a system is that, if a wire be broken or severed by gunfire, or if any station should fail to release its bomb, all subsequent stations would become inoperative and it would be impossible to release further bombs in an armed condition.

The automatic bomb release system of the present invention avoids the above difficulties and provides an effective system for release of bombs in the desired order. The system of the present invention also makes possible the continued release of bombs should any station become disabled due to wire breakage or failure of the releasing mechanism. The invention also automatically disassociates the circuit for a given rack pair from the controlling circuit after its functions have been performed. With this circuit it is possible to release bombs in rapid succession as long as bombs remain in any of the racks to be released and without breaks in the rapid succession of bomb releases even if one or more of the rack pairs is fully unloaded or becomes disabled. The bomb release system is illustrated in Figure 2, the circuits for three rack pairs being shown and the release mechanisms for three bombs in each rack pair being illustrated. It is understood that further rack pairs and additional bombs in each rack pair may be provided and will operate in a similar manner.

In general, the system shown in Figure 2 comprises a number of bomb release mechanisms in each rack pair, for instance, mechanisms **101**, **102** and **103** in rack pair #1, mechanisms **201**, **202** and **203** in rack pair #2, etc. Associated with each rack pair is a selector circuit comprising two double wound relays. Thus, selector circuit **100** is connected to the bomb release mechanisms of rack pair #1 by conductor **130**; selector circuit **200** to mechanisms in rack pair #2 by conductor **230**, etc. The selector circuit serves to connect the bomb release mechanisms of its associated rack pair with a pulsing circuit **10** supplied with electric current pulses by an automatic pulsing device **11** rendered operative by switch **16** or by a normally open manual pulsing key **12** at the will of the bombardier. Each pulse sent over circuit **10** effects the release of a bomb. Electric energy for the pulsing circuit and for operation of the relays in the selector circuits is supplied by battery **13** over conductor **14**. The negative terminal of the battery is grounded to the structure of the airplane.

Since the circuits associated with each rack pair are identical, it will be sufficient to describe those associated with rack pair #1. Selector circuit **100** includes a double wound circuit preparing relay **110** having high resistance winding **111** and a low resistance winding **112** thereon for controlling three movable contacts, **113**, **114** and **115**. These contacts engage stationary front contacts **117**, **118** and **119** respectively when the relay is energized and movable contact **113** engages a back contact **116** when the relay is de-energized. A double wound disconnect relay **120** is also part of selector circuit **100**, this relay having two high resistance windings **121** and **122** and controlling a movable contact **123** which engages a stationary front contact **124** when the relay is energized. Contact **124** normally engages another contact **125** but is disengaged therefrom when the relay is operated, and after contacts **123** and **124** have engaged.

Movable contacts **113** and **114** of relay **110** are both connected to the first section of pulsing circuit **10**. Relay contact **116** is connected to the second section of circuit **10** to extend the circuit to contacts **213** and **214** of relay **210** in selector circuit **200** when relay **110** is in the released position. Contacts **117** and **118** connect the pulsing circuit to relay winding **122** and the common terminal of relay windings **111** and **112** when relay **110** is in the operated position. Contact **115** engages contact **119** to connect ground to a common ground circuit **15** as long as relay **110** is energized.

Movable contact **123** of disconnect relay **120** cooperates with stationary contact **124** to provide a lock-up circuit for relay **120** from battery conductor **14** through winding **121** to common ground circuit **15**. Circuit **15** has ground thereon as long as any of the relays **110**, **210** and **310** are operated. Contacts **124** and **125**, when closed, provide a holding circuit for relay **110** from battery conductor **14** through the contacts and through windings **111** and **112** of relay **110** and via conductor **130** to ground through the solenoid of the first cocked release mechanism. As shown in Figure 2, release mechanisms **101**, **102** and **103** are all uncocked and hence no ground is found in any of these mechanisms for holding relay **110** operative.

The system of Figure 2 will be further understood from the following description of its operation:

In the condition illustrated in Figure 2, rack pair #1 is shown with all three bombs having been released. In rack pair #2 the bomb associated with release mechanism **201** has been released and the mechanism **202** is just in the process of releasing its associated bomb. In rack pair #3 the bomb associated with mechanism **301** has been released and the remaining two bombs are still held by their associated cocked release mechanisms **302** and **303**.

Since mechanisms **101**, **102** and **103** are all uncocked, circuit **130**, which is connected to them in series, finds no ground. Hence, although battery from conductor **14** is connected to winding **111** the relay circuit receives no current and the relay remains de-energized. Contacts **113**, **116** therefore extend the pulsing circuit **10** to contacts **213** and **214** of circuit preparing relay **210** in selector circuit **200**. Since there is ground on circuit **230** in release mechanism **202**, relay **210** has been in the operated position. Hence, when the first pulse is received by selector circuit **200** over pulsing circuit **10**, the pulse reaches relay winding **222** through contacts **213**, **217** thus operating disconnect relay **220** as shown. The pulse also reaches the common terminal of windings **211** and **212** through contacts **214**, **218** and finds a low resistance path to ground through low resistance winding **212** and solenoid **232** of release mechanism **202**. The current through this circuit holds circuit preparing relay **210** operated and actuates solenoid **232** to release its associated

bomb and prepare the mechanism 202 to transfer the control circuit to mechanism 203 at the completion of the pulse.

Disconnect relay 220, which has been operated by the current pulse through winding 222 is locked-up by current from battery conductor 14 to ground conductor 15 through the relay contacts and winding 221. Since contacts 224, 225 are thereby opened, the holding circuit through winding 211 is broken and, hence, relay 210 will be released at the completion of the pulse (when key 12 is manually released) thereby transferring control to selector circuit 300. The next pulse received will therefore go through selector circuit 300 to bomb release mechanism 302.

It will be noted that relay 310 is held operated by holding current through contacts 324, 325 awaiting connection of selector circuit 300 to the pulsing circuit. Relay 320 on the other hand is not operated at this time but will be operated immediately upon receipt of a pulse since winding 322 is ready to receive a current pulse through closed contacts 313, 317.

When a pulse is received through selector circuit 300 resulting in the discharge of a bomb by release mechanism 302 relay 310 will release at the completion of the pulse thus opening its contacts 315, 319 and thereby removing ground from common ground conductor 15. Since relays 110 and 210 have at that time already become released, ground conductor 15 is thereby deprived of ground at all points and hence the holding circuit for relays 220 and 320 is destroyed and these relays will release. Immediately upon release of these relays energizing circuits will be provided for any of relays 110, 210 and 310 which have unreleased bombs in their associated racks since battery from conductor 14 is connected to these relay windings and ground will be found through the solenoid in the next cocked release mechanism. Since rack pair #1 is already completely unloaded no ground is found through conductor 130 and hence relay 110 does not operate. However, conductors 230 and 330 will now be connected to ground through the solenoid in release mechanisms 203 and 303 and hence relays 210 and 310 will operate. Relay 210 prepares the circuit for release of a bomb by mechanism 203. It also disconnects selector circuit 300 from the pulsing circuit.

If conductor 130 or the circuits within any of the associated bomb release mechanisms be broken or open, either intentionally or by accident, after its associated relay 110 has been energized and before an impulse has been received by selector circuit 100, then the current from battery conductor 14 which ordinarily flows through winding 111 and low resistance winding 112 to ground is broken thus de-energizing relay 110 and transferring the pulsing circuit to selector circuit 200 or the next operative selector circuit and removing circuit 100 from the sequence. The other selector circuits with their associated bomb dropping mechanisms will similarly remove it from the sequence if they become out of order. If conductor 130 is broken there is a possible alternative circuit to ground through winding 111, contacts 114, 118, contacts 113, 117 and winding 122 of relay 120. However the current through this path is insufficient to hold relay 110 operated.

It will be appreciated that a system has been provided as described herein which provides for the dropping of a series of bombs in rapid succession, the bombs being dropped in rotation from the bomb bays of the airplane to prevent too rapid a succession of bombs being dropped from any one rack pair and to preserve even distribution of the remaining bombs.

What is claimed is:

1. A bomb release system comprising a source of current pulses under control of an operator, a series of selector units, a series of bomb release mechanisms associated with each of said units, a control circuit extending from each of said selector units and passing through said series of release mechanisms, each of said mechanisms having contacts in series with said control circuit therein and means for operating said contacts when said device is cocked to break said control circuit leading to succeeding release mechanisms and connect said circuit to a grounded electroresponsive actuating device comprising part of said mechanism, whereby said contacts transfer said control circuit to said succeeding release mechanisms responsive to actuation and release of said electroresponsive device by a current impulse, each of said selector units comprising a circuit preparing relay and a disconnect relay, a pulsing circuit extending from said source of pulses through normally-closed contact pairs of all of said circuit preparing relays in series and having branches connected thereto at parts preceding each of said pairs of contacts, the control circuit individual to each of said selector units extending to its individual branch circuit through a normally-open contact pair of its individual circuit preparing relay, each of said circuit preparing relays thereby breaking the pulsing circuit leading to succeeding relays and connecting said pulsing circuit to its individual control circuit when energized and thereby preparing said control circuit to receive a current impulse from said source, the energizing circuit for each of said circuit preparing relays extending through normally-closed contacts of its associated disconnect relay and the energizing circuit for each of said disconnect relays extending to said pulsing circuit through normally-open contacts of its associated circuit preparing relay, each of said disconnect relays thereby opening the energizing circuit for its associated circuit preparing relay responsive to a current impulse, to thereby disconnect its control circuit from said pulsing circuit and extend the operative portion of said pulsing circuit to succeeding selector units.

2. A bomb release system comprising a source of current pulses under control of an operator, a series of selector units, a series of bomb release mechanisms associated with each of said units, a control circuit extending from each of said selector units and passing through said series of release mechanisms, each of said mechanisms having contacts in series with said control circuit therein and means for operating said contacts when said device is cocked to break said control circuit leading to succeeding release mechanisms and connect said circuit to a grounded electroresponsive actuating device comprising part of said mechansm, whereby said contacts transfer said control circuit to said succeeding release mechanisms responsive to actuation and release of said electroresponsive device by a current impulse, each of said selector units comprising a circuit preparing relay and a disconnect relay, a pulsing circuit extending from said source of pulses through normally-closed contact pairs of all of said circuit preparing relays in series and having branches connected thereto at points preceding each of said pairs of contacts, the control circuit individual to each of said selector

units extending to its individual branch circuit through normally-open contact pair of its individual circuit preparing relay, each of said circuit preparing relays thereby breaking the pulsing circuit leading to succeeding relays and connecting said pulsing circuit to its individual control circuit when energized and thereby preparing said control circuit to receive a current impulse from said source, the energizing circuit for each of said circuit preparing relays extending through normally-closed contacts of its associated disconnect relay and the energizing circuit for each of said disconnect relays extending to said pulsing circuit through normally-open contacts of its associated circuit preparing relay, each of said disconnect relays thereby opening the energizing circuit for its associated circuit preparing relay responsive to a current impulse, to thereby disconnect its control circuit from said pulsing circuit and extend the operative portion of said pulsing circuit to succeeding selector units, lock-up circuits for said disconnect relays, said lock-up circuits being jointly controlled by all of said circuit preparing relays whereby they are opened only by release of all of said circuit preparing relays.

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