Oct. 26, 1943. F. J. HOOVEN 2,332,795

BOMB DROPPER

Filed March 1, 1941 2 Sheets-Sheet 1

Fig. 1

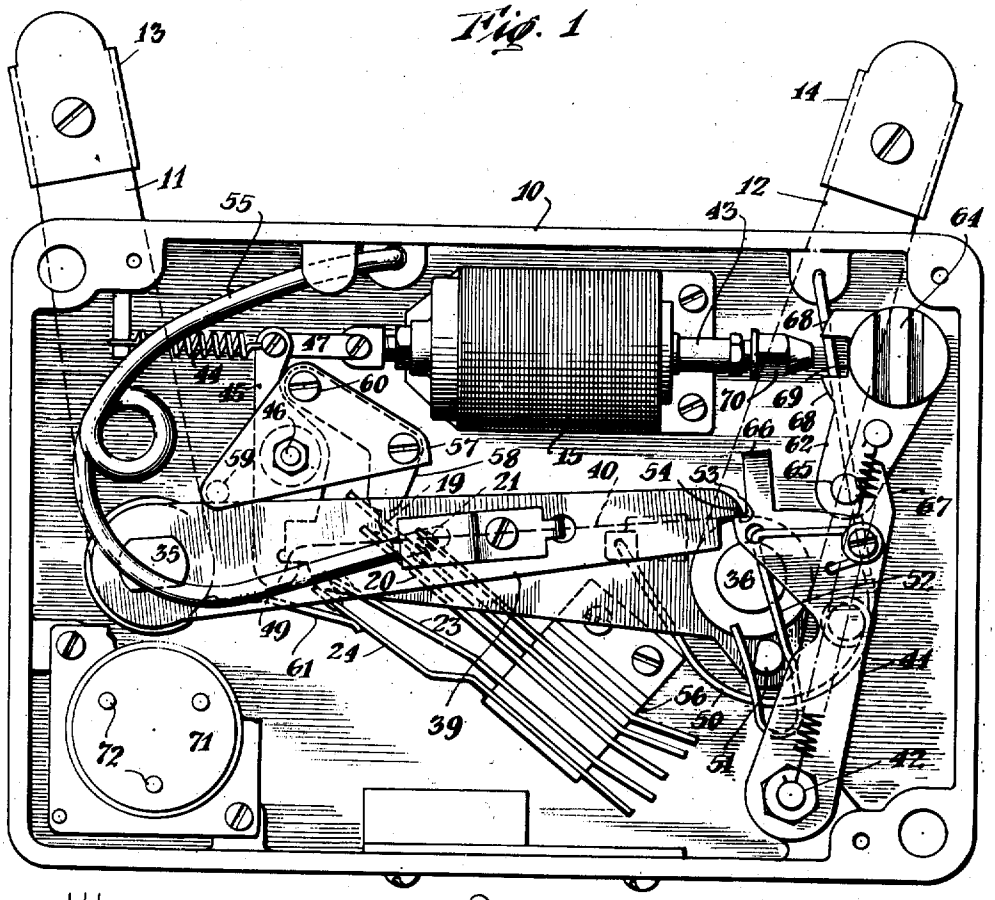
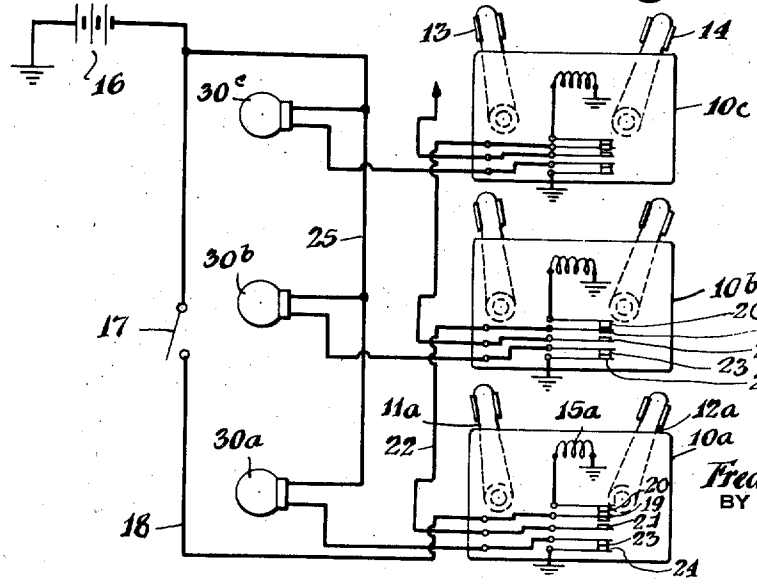



Fig. 2




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Filed March 1, 1941 2 Sheets-Sheet 2

Fig. 4

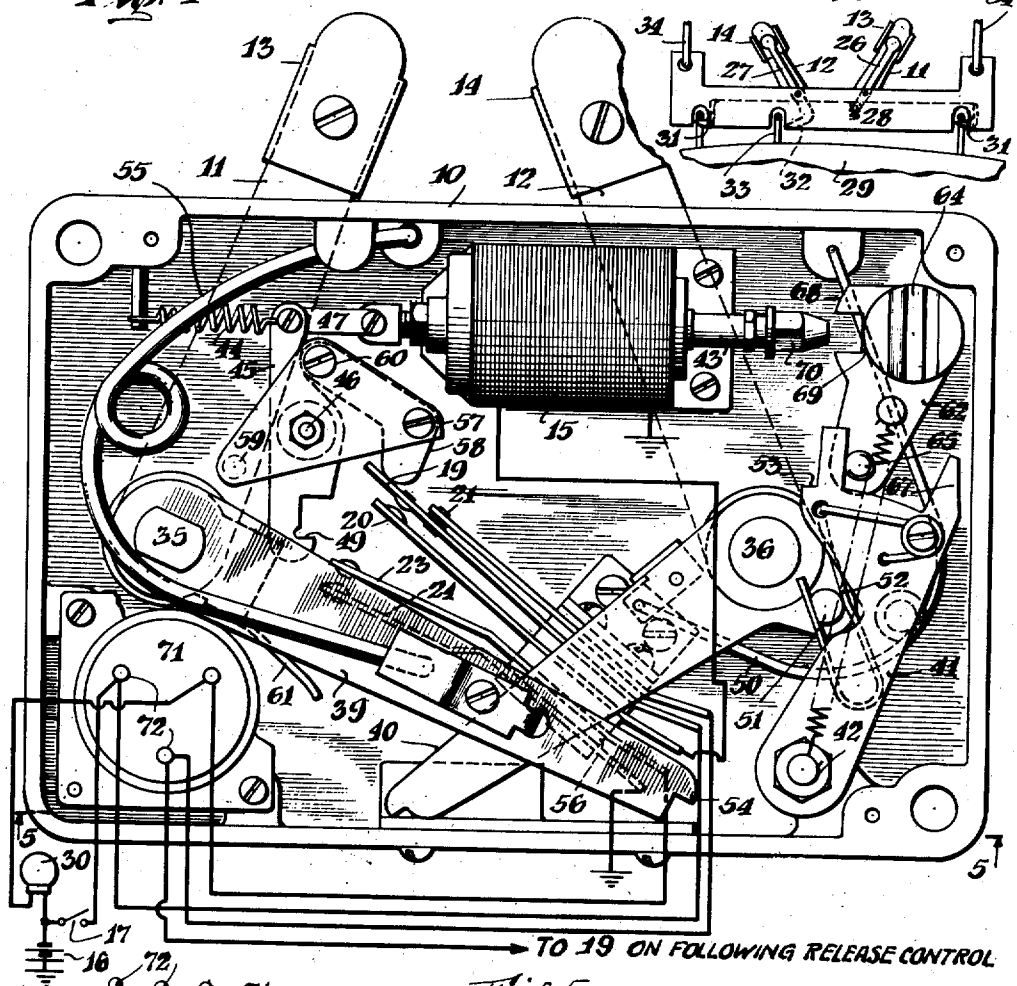
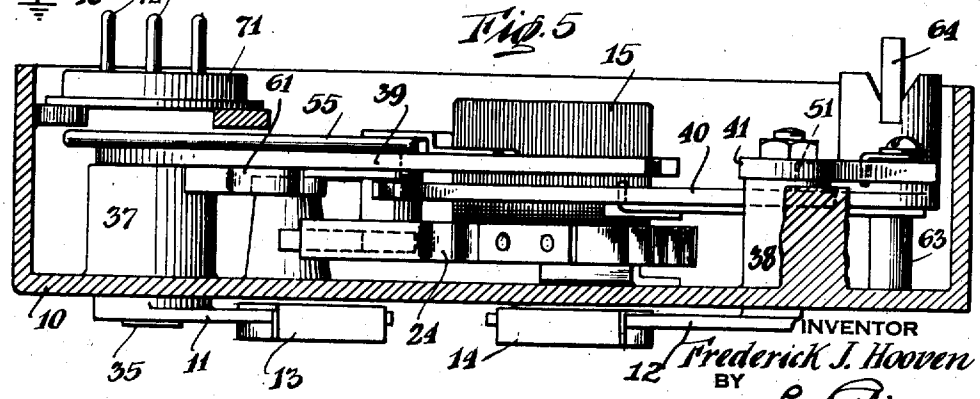



Fig. 3



Fig. 5



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2,332,795

## BOMB DROPPER

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Application March 1, 1941, Serial No. 381,218

7 Claims. (Cl. 89—1.5)

This invention relates to bomb dropping mechanisms and more particularly to mechanisms for dropping bombs from aircraft under control of electrical means.

An object of the invention is to improve bomb dropping mechanisms.

Another object is to improve the means whereby bomb shackles may be actuated in rapid succession by electrical means in order to drop bombs individually or in groups of a predetermined number at spaced time intervals.

A further object is to improve the means for releasing bombs from aircraft in either armed or safe condition.

Another object is to reduce the weight and cost of bomb release mechanisms.

A further object is to improve the safety of operation of bomb dropping systems and mechanisms.

A still further object is to provide a removable bomb dropping actuating mechanism.

Other objects of the invention will be apparent from the following description and accompanying drawings 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 drawings.

In the drawings:

Figure 1 is a side view of a bomb dropping actuator mechanism embodying features of the present invention, with the cover removed to show the mechanism in cocked position;

Figure 2 is a circuit diagram illustrating preferred circuit connections for a tier of bomb release control mechanisms;

Figure 3 is a fragmentary diagram showing the normal operating connection between the actuated arms of the bomb release control mechanism and a bomb shackle from which a bomb is supported;

Figure 4 is a side view of the bomb release control mechanism in released position; and

Figure 5 is a section on the line 5—5 of Figure 4.

One means of supporting bombs in aircraft so that they may be dropped at will is known as a "bomb shackle." This carries a pair of hooks from which a bomb is suspended together with trigger means for releasing the hooks when desired. The trigger means is controlled by an arm projecting from the top of the bomb shackle. A second arm projecting from the top of the bomb shackle controls a hook for engaging the arming wire of a bomb so that the bomb may be dropped in either the "armed" or "unarmed" condition. The shackle is ordinarily attached to the bomb before loading it into the aircraft and the bomb is then hoisted into position by means of the shackle, the shackle then being hung on snaffle hooks. The bombs are ordinarily supported in the aircraft in tiers in which several bombs are supported one above the other from individual bomb shackles.

Heretofore the arming arm and releasing arm of the bomb shackles have been controlled mechanically by the bombardier by a system of levers which engage the shackle arms. In some cases electromagnetic means has been used wherein the shackle arms were controlled by strong solenoids.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring to the drawings, Figure 1 shows a bomb dropping control mechanism in a box 10 having a pair of external levers 11 and 12 provided with channel-shaped ends 13 and 14 respectively for engaging releasing arm and arming arm respectively of a bomb shackle carrying a bomb. Control box 10 contains a system of power multiplying levers associated with levers 11 and 12 and adapted to actuate said levers under control of an electrically operated solenoid 15 as will be described more in detail later. Control box 10 also contains a system of electric contacts under control of the solenoid and the levers for transferring the control of the electric control circuit to a succeeding bomb dropping control mechanism after a given mechanism has operated. The electric contacts also control the circuits for tell-tale lamps located in the bombardier's compartment to indicate the condition of the bomb dropping mechanisms.

Before going into the detailed description of the mechanism it may be interesting to refer to Figure 2 which shows the preferred control circuits for a tier of said box mechanisms 10*a*, 10*b*, 10*c*, etc. controlling a tier of three or more

bombs. In this circuit energy is supplied from a battery 16 for actuating the bomb dropping control mechanisms under control of a normally-open switch 17 in the bombardier's compartment. The actuating circuit for controlling the release of a bomb by mechanism 10a, for example, extends from battery 16 through switch 17 controlled by the bombardier, conductor 18, closed contacts 19, 20 within box 10a and solenoid 15a to ground. Thus when the bombardier actuates switch 17 closing the circuit solenoid 15a operates its armature to throw levers 11a and 12a thereby releasing the associated bomb in the armed condition. Actuation of the mechanism to release the bomb results in a transfer of contact 19 out of engagement with contact 20 and into engagement with contact 21 thereby connecting the energizing circuit through conductor 22 to the next higher control box 10b of the tier. This transfer does not occur, however, until solenoid 15a releases due to an opening of the contacts of switch 17 and hence only one bomb is released for each actuation of switch 17.

Prior to actuation of mechanism 10a to release its bomb, contacts 23, 24 within the box are also closed thereby completing an energizing circuit for tell-tale lamp 30a in the bombardier's compartment, the circuit extending from battery 16 through conductor 25, lamp 30a, contacts 23, 24 to ground. Similar energizing circuits are normally closed for the tell-tale lamps 30b and 30c associated with control boxes 10b and 10c respectively. Upon the release of a bomb by control mechanism 10a contacts 23, 24 are opened thereby extinguishing lamp 30a and indicating to the bombardier that the bomb has been released from that position.

Figure 3 illustrates the relationship between the release control levers 11 and 12 of the bomb release control box mechanism and release arm and arming arm 26 and 27 respectively of a bomb shackle 28 supporting a bomb 29 by hooks 31. Hooks 31 are controlled by bomb release arm 26 under control of lever 11. Arming arm 27 of the bomb shackle, under control of lever 12, controls a projection 32 adapted to pull out arming wire 33 of the bomb when arming arm 27 has been actuated before the bomb is dropped. This results in the bomb being dropped in armed condition. Should arming lever 27 remain unactuated as illustrated in Figure 3 the bomb would be dropped in unarmed condition. Shackle 28 is supported from snaffle hooks 34 in the aircraft.

Referring now to the mechanical details of the bomb release control box 10 and its associated mechanism illustrated in Figure 1 in cocked position and in Figures 4 and 5 in released position the box 10 may comprise a die casting of light metal to which a removable cover (not shown) may be attached. Bomb release lever 11 and arming lever 12 are secured respectively to shafts 35 and 36 pivoted in integrally cast bearings 37 and 38, Figure 5, respectively in the wall of box 10. Inside the box a latch lever 39 is secured to shaft 35 and a latch lever 40 to a shaft 36. A sear 41 is pivoted on a bolt 42 so as to swing in and out of latching engagement with latch arm 39.

Solenoid 15 is mounted horizontally near the top of the box as shown in the figures and has an axially sliding armature 43 normally held by coil tension spring 44 in unactuated position. Armature 43 controls a latch lever 45, pivoted on a bolt 46, through a link connection 47.

Latch levers 39, 40, 41, and 45 comprise a system of power multiplying levers whereby the relatively weak pull of solenoid 15 may be utilized to control levers 11 and 12 which must be actuated with the strong force necessary to perform their required functions. When the device is in cocked position as shown in Figure 1 arming lever 12 is at the right-hand end of its travel and hence its associated latch lever 40 within box 10 is raised to a position where its latching end 48 is latched with the hook 49 on the end of solenoid-control lever 45. A safety pin type spring 50 having one end attached to box 10 and the other end to lever 40 urges lever 40 downward against the restraint of hook 49.

Lever 40 carries an eccentric pin and sear 41 has attached to it a "hairpin" loop spring 52 doubled around pin 51. This places sear 41 under control of lever 40 through the resilient connection furnished by spring 52 and hence when lever 40 is latched up as described, sear 41 is drawn to the left, as shown in Figure 1, by pin 51. This brings latching edge 53 of sear 41 within the path of travel of latch lever 39 so that when lever 39 is raised to the cocked position its latching end 54 rests on latching edge 53 thereby holding lever 39 in latched position. Strong safety pin type spring 55 attached at one end to box 10 and at the other end to latch lever 39 urges lever 39 downward against the restraint of latching edge 53.

Contact springs 19, 20, 21, 23, and 24 which control the circuit for solenoid 15 and for the tell-tale lamp 30 are clamped in a stack assembly 56 within box 10. A switch actuating arm 57 of insulating material such as laminated Bakelite is also pivoted on bolt 46 which supports solenoid operated lever 45. Arm 57 carries a projection 58 which engages the free end of contact spring 19. Spring 19 is braced to normally engage adjacent contact spring 21 for connecting the control circuit to the succeeding bomb dropping mechanism. Arm 57 carries a pin 59 which is engaged by latch arm 39 when it is raised to cocked position thereby rotating arm 57 in a clockwise direction (as shown in Figure 1) to press contact spring 19 into contact with spring 20 thereby connecting solenoid 15 to the control circuit. Bakelite arm 57 also carries a pin 60 which is engaged by solenoid controlled lever 45 when the solenoid pulls up its armature so that spring 19 is also held in contact with spring 20 whenever solenoid 15 is actuated.

Lever 39 also carries a small insulated arm 61 on its lower edge. When lever 39 is cocked arm 61 presses contact spring 24 into contact with spring 23 thereby closing the circuit for tell-tale lamp 30. When lever 39 is released springs 23 and 24 separate and extinguish the lamp.

The box 10 is preferably made readily removable from the aircraft to which it may be attached by bolts or other suitable securing means. The circuit connections for the solenoid and contact springs are made through a plug 71 having a series of contact prongs 72 corresponding to the individual circuit conductors. The aircraft is provided with a corresponding receptacle into which plug 71 fits to complete the circuit of Figure 2.

Assuming the mechanism to be in cocked position as shown in Figure 1 the armed release of the bomb is effected as follows, reference also being made to the other figures of the drawings. Upon closure of switch 17 (Figure 2) by the bombardier energizing current is supplied to solenoid 15 from battery 16 through closed contacts 19, 20,

The solenoid armature 43 is pulled up thereby rotating latch lever 45 in a clockwise direction to unlatch lever 46. Lever 46 is rapidly moved downward by spring 50 and arming lever 12, connected to it, is thereby moved to armed position. As seen in Figure 3 lever 12 thus moves arm 27 of the bomb shackle so as to introduce hook 32 under the arming wire 33 to pull out wire 33 and arm the bomb 29 when it falls.

When the lever 46 is dropped under control of spring 50 it also moves sear 41 to the right (as seen in Figure 1) by means of hairpin spring link 52. This moves shoulder 53 from under the latch end 54 of arm 39 allowing arm 39 to be rapidly moved downward under the force of heavy spring 55. Bomb dropping control arm 11, connected to the same shaft as lever 39, is thereby moved to bomb dropping position. This moves arm 26 on the bomb shackle (Figure 3) to cause hooks 31 to release and drop bomb 29.

When lever 39 is latched up it engages pin 59 on Bakelite arm 57 to hold projection 58 of arm 57 against spring 18 and thereby hold contacts 19 and 20 together as already mentioned. When solenoid 15 pulls up its armature thus rotating latch lever 45 in a clockwise direction, lever 45 engages pin 60 on Bakelite arm 57 thus holding contacts 19, 20 closed. After lever 39 has dropped to unlatched position (Figure 4) lever 45 holds contacts 19, 20 together as long as the solenoid armature is pulled up, thus preserving the energizing circuit for the solenoid. When switch 17 in the bombardier's compartment is again opened, however, to de-energize the solenoid circuit and release the solenoid armature, Bakelite arm 57 is allowed to rotate counter-clockwise and permit contact spring 19 to spring away from contact 20 and into contact with contact 21. This opens the circuit for solenoid 15 and closes a circuit through to the solenoid of the next higher control box of the tier as explained in connection with Figure 2. Release of arm 39 likewise results in the opening of contacts 23, 24 thereby extinguishing the associated pilot lamp 30.

It is necessary that means be provided for dropping the bombs in unarmed condition should the aircraft return to its base without having used its full load of bombs since it is dangerous to land the aircraft with bombs remaining in the rack. For this purpose a disarming arm 62 is provided pivoted on a bolt 63 in box 10. Arm 62 has attached to it a tongue 64 projecting out of box 10 where it is engaged, when the box is mounted in the aircraft, by a receptacle in the aircraft having a mechanical means connected to the bombardier' compartment for rotating tongue 64 in a clockwise or counter-clockwise direction. Arm 62 carries a pin 65 near its end, the pin being positioned in the space between a pair of fingers 66 and 67 projecting from the free end of sear 41. This permits freedom of motion of sear 41 into and out of latching position without interference from pin 65.

If arm 62 is rotated 20 degrees or so in a clockwise direction (as seen in Figure 1) pin 65 is brought into abutment with finger 66 on sear 41 thereby preventing sear 41 from releasing lever 39 and hence positively preventing the bomb from being dropped. This is "safe" position. Should cam 62 be rotated in a counter-clockwise direction (as seen in Figure 1) pin 65 will engage finger 67 thereby moving sear 41 out of latching position and allowing lever 39 to drop resulting in the unarmed release of the bomb.

Arm 62 also has a cam surface 68 having a notch 69 therein. With arm 62 in normal position (as shown in Figure 1) notch 69 is directly opposite to plunger 70 on the end of the armature 43 of solenoid 15. Whenever the solenoid operates plunger 70 travels into notch 69. If cam 62 is turned in a clockwise or counter-clockwise direction, however, to place the mechanism in "safe" position, or to effect the unarmed release of the bomb, notch 69 is moved out of register with the end of plunger 70 and cam surface 68 is moved opposite the end of the plunger thereby effectively preventing operation of the solenoid armature should the solenoid become energized. Hence in either position the arming lever is held cocked and the release of a bomb in arm condition is impossible.

The mechanism described provides a means for effecting control of a heavy bomb by a very small solenoid through a series of power multiplying levers. Inasmuch as the bomb shackle arming arm requires only a five pound pressure to effect its actuation as compared with a twenty-five pound pressure required to actuate the releasing arm a much smaller force is required to actuate the latch which holds the arming arm against its five-pound spring than would be required to release the latching of the releasing arm against its twenty-five pound spring. The present invention provides a means for the use of the energy in the five-pound spring to release the latch which holds the twenty-five pound spring, thus saving the weight of a large electromagnet which would otherwise be required for this purpose. In an actual practical embodiment of the invention the necessary mechanism including the housing, associated springs and latches, electrical conductors, wiring and switches weighs only two pounds seven ounces as compared to two pounds twelve ounces for the electromagnet alone used with previous devices for releasing the release arm.

Switch 17 may be a manually controlled switch or one controlled by an automatic timing device capable of producing any desired number of impulses per second such as from 2 to 20 circuit closures per second to thereby effect release of a corresponding number of bombs at closely spaced intervals.

Because of the large solenoids previously required to release the heavily loaded releasing arm latch a relatively long time delay has been required to build up the current sufficiently to actuate the release and another relatively long time has been required for the return spring to return the heavy armature to the open position for the purpose of switching the circuit over to the next bomb release mechanism. This has not only introduced inaccuracies in fire due to the delay between initiation of a bomb dropping cycle and the actual dropping of the bomb but has also made it impossible to drop the bombs in such rapid sequence as is possible with the present invention. With the present invention the time required to complete the cycle of operations has been greatly reduced allowing the speed of release to be increased from the former maximum of 12 to 15 bombs per second up to as many as 30 bombs per second should this become necessary. Another advantage of the small solenoid is the low current requirements, the small solenoid requiring only one and one-half or two amperes at twenty-four volts instead of eleven to fifteen amperes previously required. This enables the use of cheaper and lighter wir-

ing and imposes less severe service upon the battery and the control contacts.

The interlocking control of the spring contacts effected by arm 57 also makes possible a simplification as well as an improvement in performance over devices previously used in which a separate switch has been attached to the releasing arm and to its associated solenoid. The simplification resides in the use of one switch instead of two, while the improvement resides in the fact that if 30 bomb stations are used on one aeroplane the current for the last station to operate must pass through the contacts of the previously operated 29 stations. In the past this has meant 58 pairs of contacts. The present invention reduces this number to 29 pairs.

The operation of the device is also speeded by the arrangement for holding contacts 19, 20 operated. Thus when solenoid 15 operates it is not required to overcome the spring force of contact spring 19 since lever 39 at that time is engaging arm 57. After lever 39 has been released, however, and solenoid 15 releases the spring force of contact spring 19 aids in rapidly moving the solenoid and armature to normal position.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. A bomb dropping control mechanism comprising an electromagnet having an armature, a first latch controlled by said armature, a first lever latched thereby and releasable responsive to operation of said armature, an arming control arm for a bomb secured to said lever, and a first spring urging said first lever and arming control arm to "armed" position against the restraint of said latch, a sear, a second lever latched thereby, a release control arm for said bomb secured to said second lever, and a second spring stronger than said first spring urging said second lever and release control arm to "released" position against the restraint of said sear, and means for releasing said second lever from said sear responsive to the travel of said first lever from latched position.

2. A bomb dropping control mechanism comprising an electromagnet having an armature, a first latch controlled by said armature, a first lever latched thereby and releasable responsive to operation of said armature, an arming control arm for a bomb secured to said lever, and a first spring urging said first lever and arming control arm to "armed" position against the restraint of said latch, a sear, a second lever latched thereby, a release control arm for said bomb secured to said second lever, and a second spring stronger than said first spring urging said second lever and release control arm to "released" position against the restraint of said sear, and means for releasing said second lever from said sear responsive to the travel of said first lever from latched position, and an independently controlled operating lever for tripping said sear independently of said electromagnet and first lever, thereby to release said bomb in unarmed condition.

3. A bomb dropping control mechanism comprising an electromagnet having an armature, a first latch controlled by said armature, a first lever latched thereby and releasable responsive to operation of said armature, an arming control arm for a bomb secured to said lever, and a first spring urging said first lever and arming control arm to "armed" position against the restraint of said latch, a sear, a second lever latched thereby, a release control arm for said bomb secured to said second lever, and a second spring stronger than said first spring urging said second lever and release control arm to "released" position against the restraint of said sear, and means for releasing said second lever from said sear responsive to the travel of said first lever from ltached position, and an independently controlled lever for locking said sear and electromagnet armature, thereby to prevent arming or release of said bomb.

4. A bomb dropping control mechanism comprising an electromagnet having an armature, a first latch controlled by said armature, a first lever latched thereby and releasable responsive to operation of said armature, an arming control arm for a bomb secured to said lever, and a first spring urging said first lever and arming control arm to "armed" position against the restraint of said latch, a sear, a second lever latched thereby, a release control arm for said bomb secured to said second lever, and a second spring stronger than said first spring urging said second lever and release control arm to "released" position against the restraint of said sear, and means for releasing said second lever from said sear responsive to the travel of said first lever from latched position, and an independently controlled lever having a neutral position, a "safe" position and a "release" position, said lever having shoulders thereon and said sear and electromagnet having cooperating abutments for locking said sear and electromagnet armature when said lever is in "safe" position, thereby to prevent arming or release of said bomb, and said sear having a second abutment engaged by one of the shoulders of said lever for tripping said sear independently of said electromagnet and first lever when said independently controlled lever is moved to "release" position, thereby to release said bomb in unarmed condition.

5. A bomb dropping mechanism comprising an electromagnet having an armature, a first latch controlled by said armature, a first spring-pressed arm latched thereby, a sear, a second spring-pressed arm latched thereby, and means connecting said first spring-pressed arm and said sear to release said sear responsive to the spring-driven travel of said first arm upon release thereof, the spring of said second spring-pressed arm being stronger than the spring of said first arm, an arming lever pivoted to rotate with said first arm for preparing the arming mechanism for a bomb during the spring-driven travel of said first arm from latched position and a release control lever pivoted to rotate with said second arm for effecting the release of a bomb during the spring-driven travel of said second arm from latched position, and mechanical means for tripping said sear while said first arm remains latched, thereby to release said bomb in unarmed condition, said means including a stop movable into the path of said electromagnet armature for positively preventing operation of said armature.

6. A bomb dropping control mechanism comprising an electro-magnet having an armature, a first latch controlled by said armature, a first spring-pressed arm latched thereby, a sear, a second spring-pressed arm latched thereby, and means connecting said first spring-pressed arm and said sear to release said sear responsive to

the spring-driven travel of said first arm upon release thereof, the spring of said second spring-pressed arm being stronger than the spring of said first arm, an arming lever pivoted to rotate with said first arm for preparing the arming mechanism for a bomb during the spring-driven travel of said first arm from latched position and a release control lever pivoted to rotate with said second arm for effecting the release of a bomb during the spring-driven travel of said second arm from latched position.

7. A bomb dropping control mechanism comprising an electromagnet having an armature, a first latch controlled by said armature, a first spring-pressed arm latched thereby, a sear, a second spring-pressed arm latched thereby, and means connecting said first spring-pressed arm and said sear to release said sear responsive to the spring-driven travel of said first arm upon release thereof, the spring of said second spring-pressed arm being stronger than the spring of said first arm, an arming lever pivoted to rotate with said first arm for preparing the arming mechanism for a bomb during the spring-driven travel of said first arm from latched position and a release control lever pivoting to rotate with said second arm for effecting the release of a bomb during the spring-driven travel of said second arm from latched position, and mechanical means for tripping said sear while said first arm remains latched, thereby to release said bomb in unarmed condition.

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