United States Patent

McCoy

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[45] May 16, 1972

[54] BLAST-ACTUATED VALVE-CLOSURE SYSTEM

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[73] Assignee: **Bell Telephone Laboratories, Incorporated**, Murray Hill, Berkeley Heights, N.J.

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[21] Appl. No.: **40,527**

[52] **U.S. Cl.** **98/119**

[51] **Int. Cl.** **F23l 13/08**

[58] **Field of Search** 98/119, 85

[56] **References Cited**

UNITED STATES PATENTS

3,420,155	1/1969	Slater	98/119
3,459,114	8/1969	Baclini	98/119

Primary Examiner—Edward J. Michael

Attorney—R. J. Guenther and William L. Keefauver

[57] **ABSTRACT**

A blast-actuated valve-closure system for closing an opening in response to the overpressure of a blast. The system comprises a plurality of louvers disposed across the opening in a normally open position. The louvers are fastened by cranks to a rod which is adapted to be moved by a rotatable actuating crank driven by a torsion spring. Normally, rotation of the actuating crank is blocked by two spring-loaded rollers interposed in a detent therein. A rotatable triggering crank is responsive to the impingement of a blast pressure wave on the louvers for unblocking the actuating crank which then effects movement of the rod for tilting the louvers to their closed position. A rotatable resetting crank is provided for restoring the actuating crank and the rod to their initial positions thereby moving the louvers to their open position. In addition, the actuating crank may alternatively be unblocked by electromechanical means which has its energization controlled either electrically by sensing devices or manually by an attendant.

32 Claims, 16 Drawing Figures

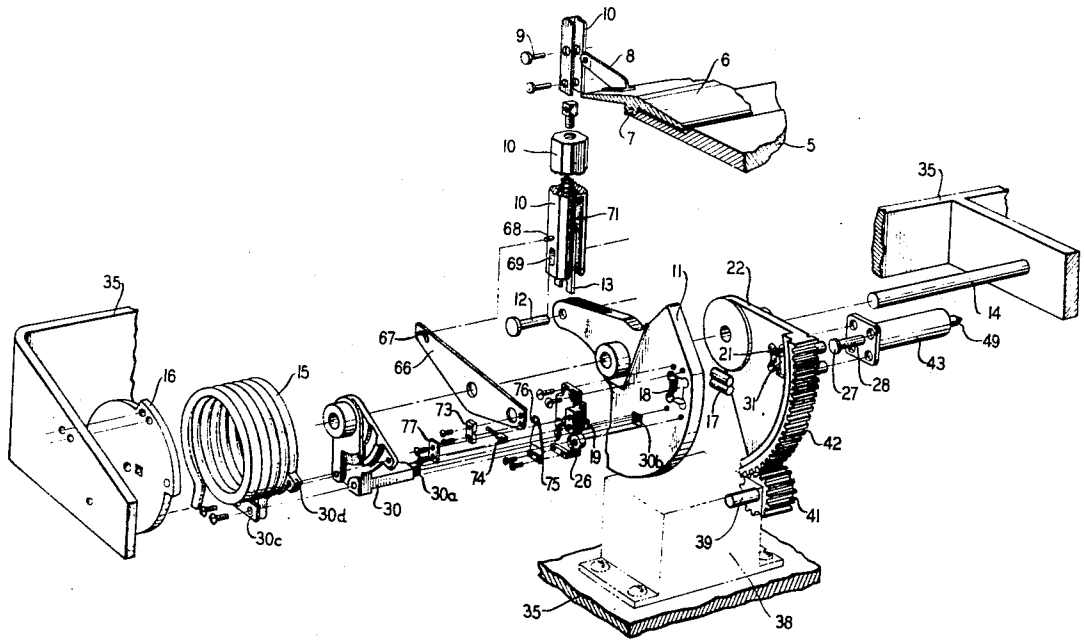


FIG. 1

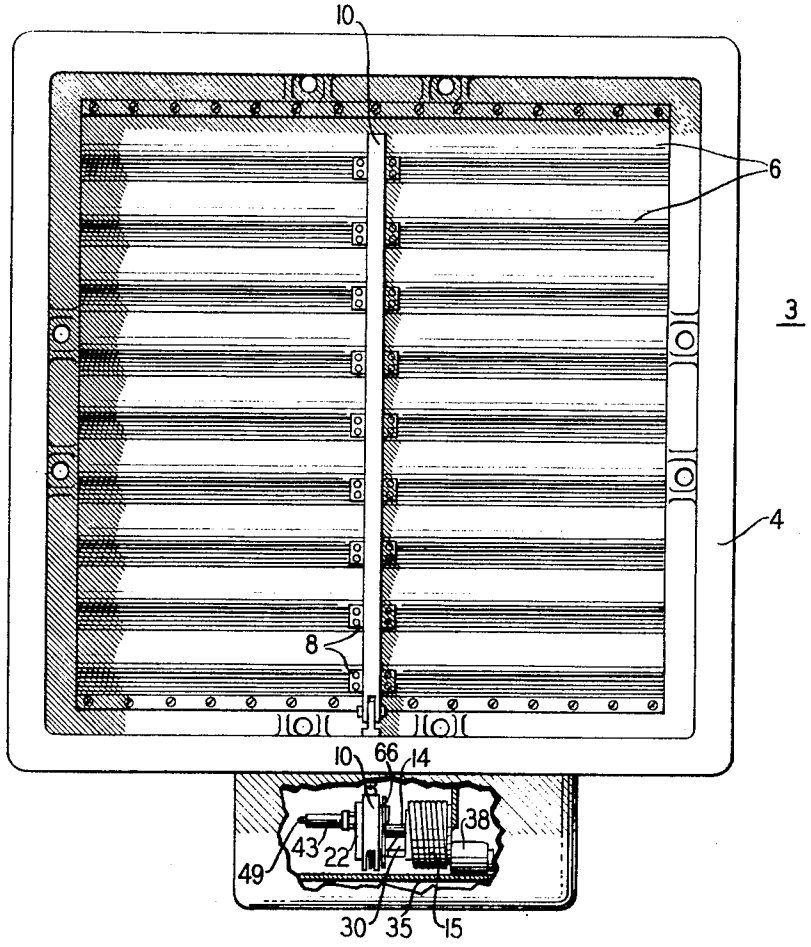
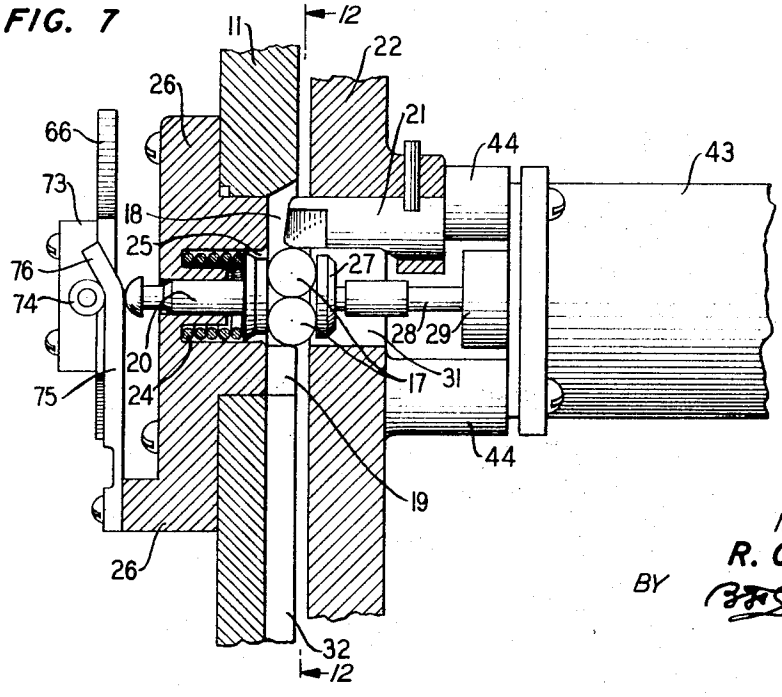


FIG. 7



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FIG. 9

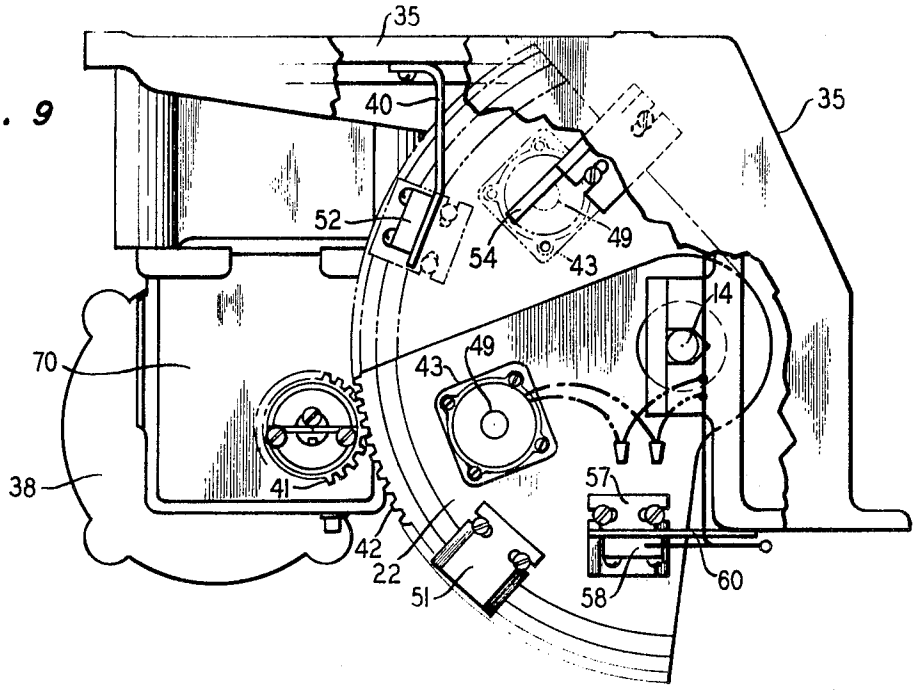
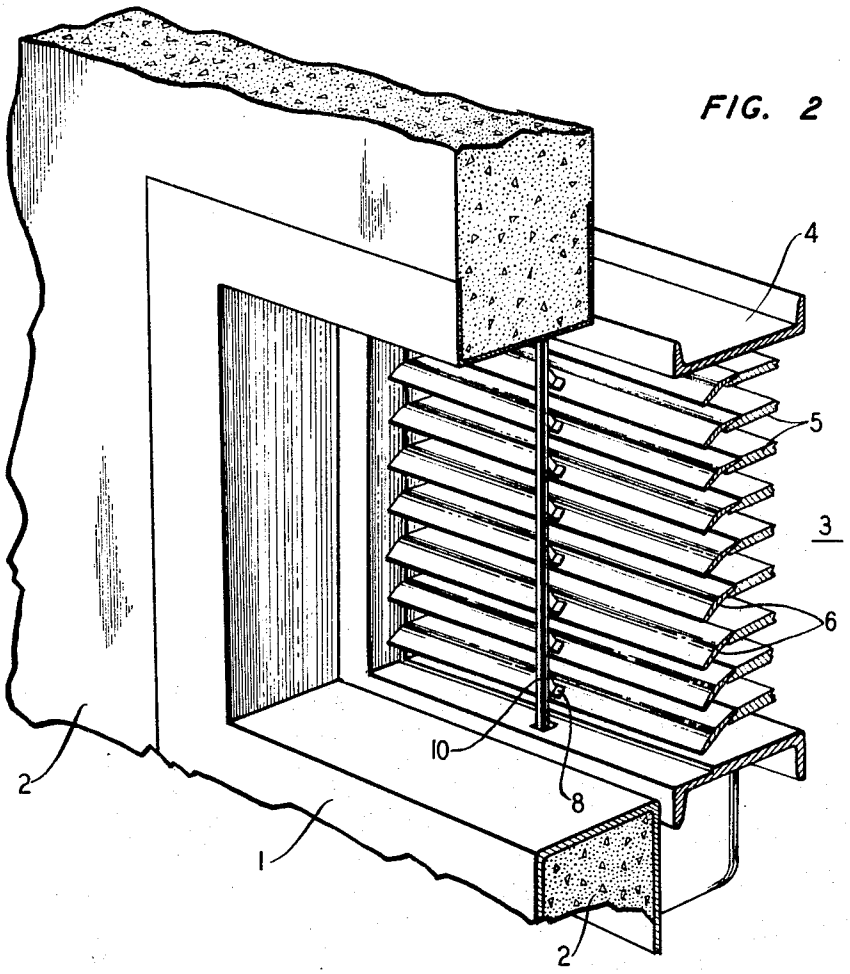


FIG. 2



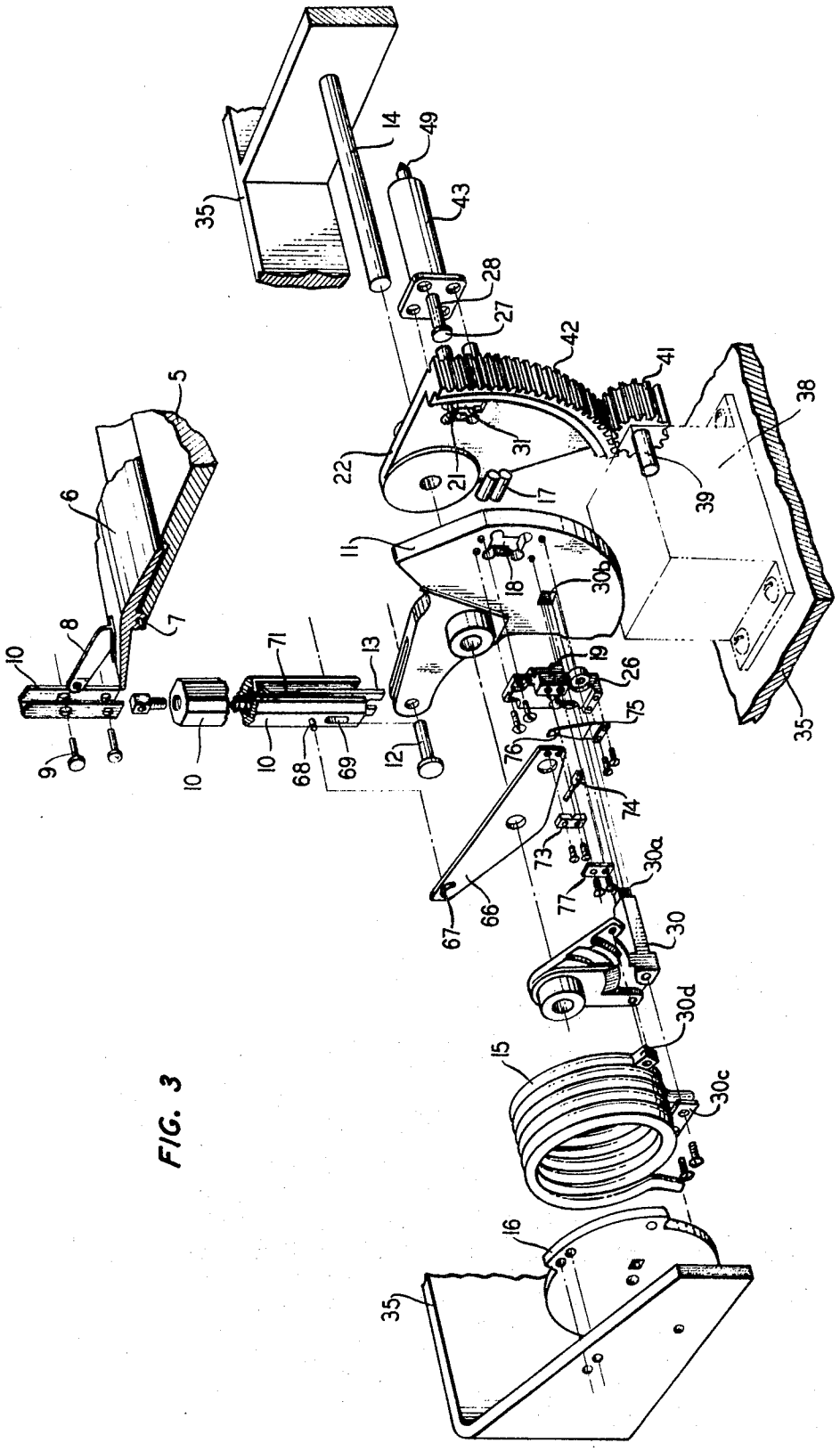

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FIG. 3

FIG. 6

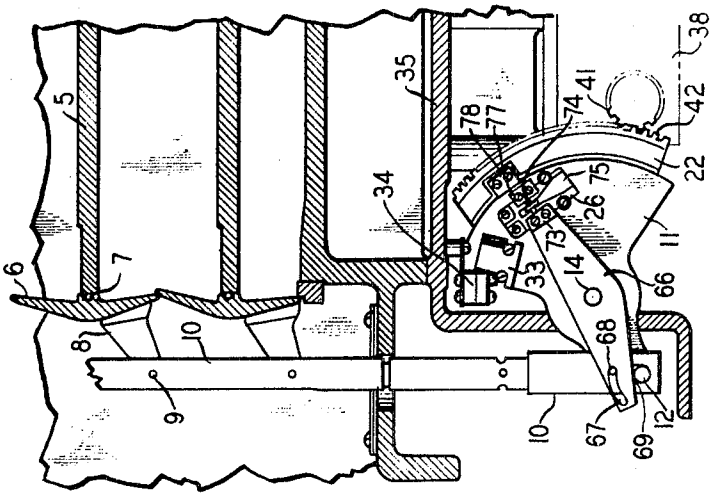


FIG. 5

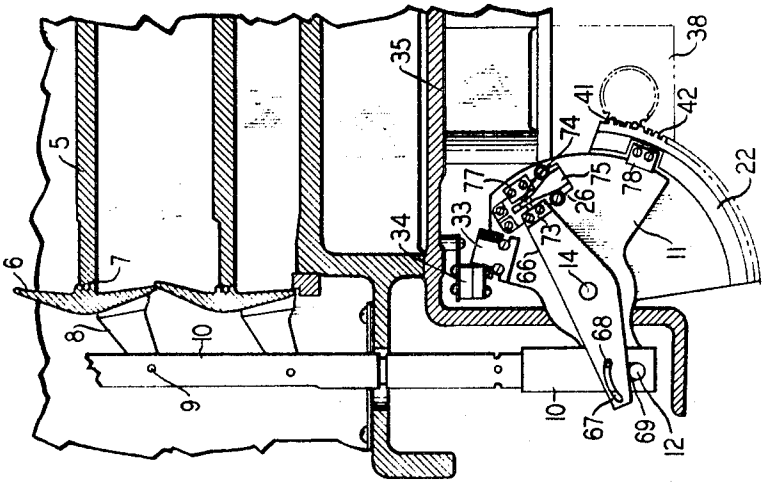


FIG. 4

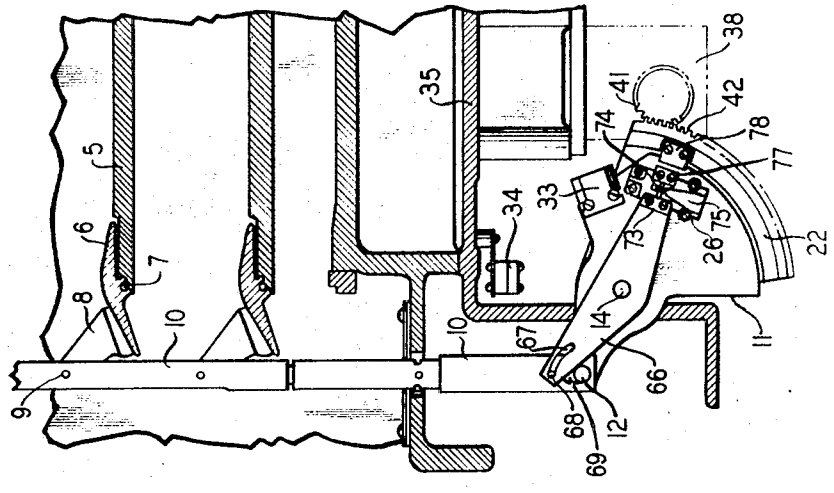


FIG. 8

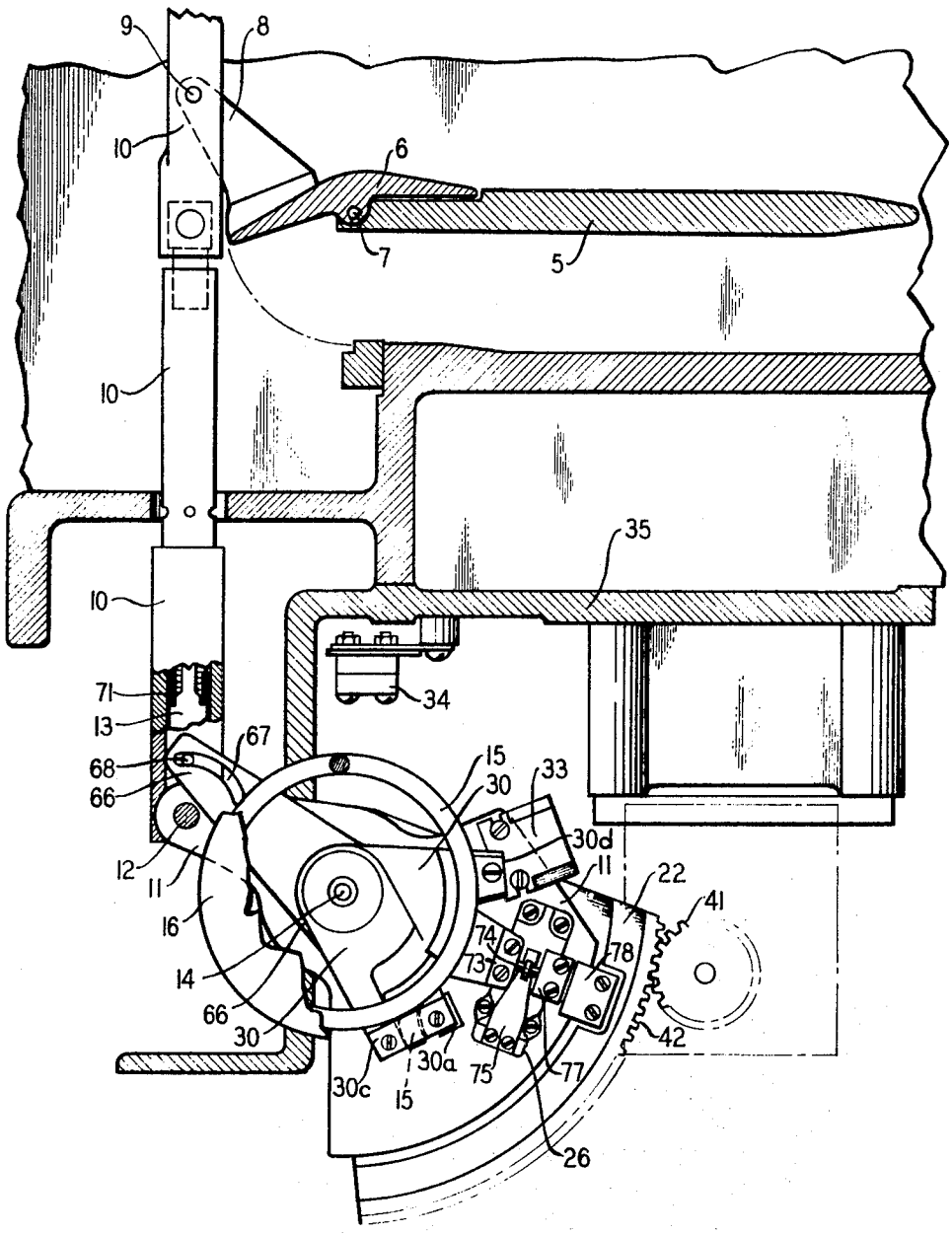

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FIG. 10

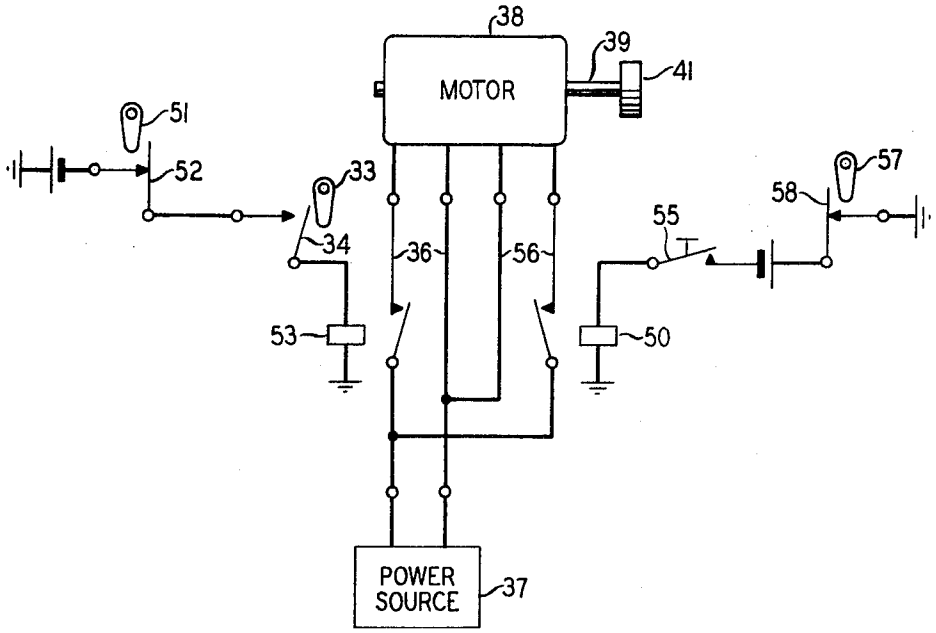
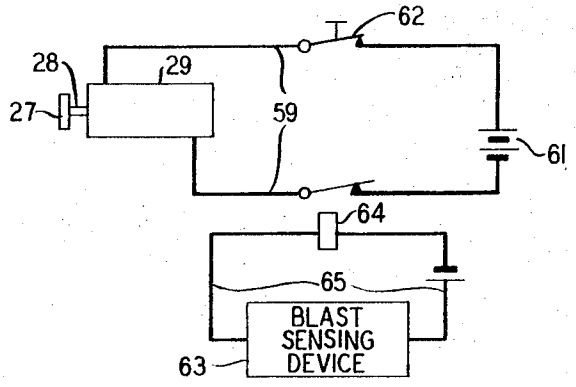

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MOTOR
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POWER SOURCE
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FIG. 11


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BLAST SENSING DEVICE
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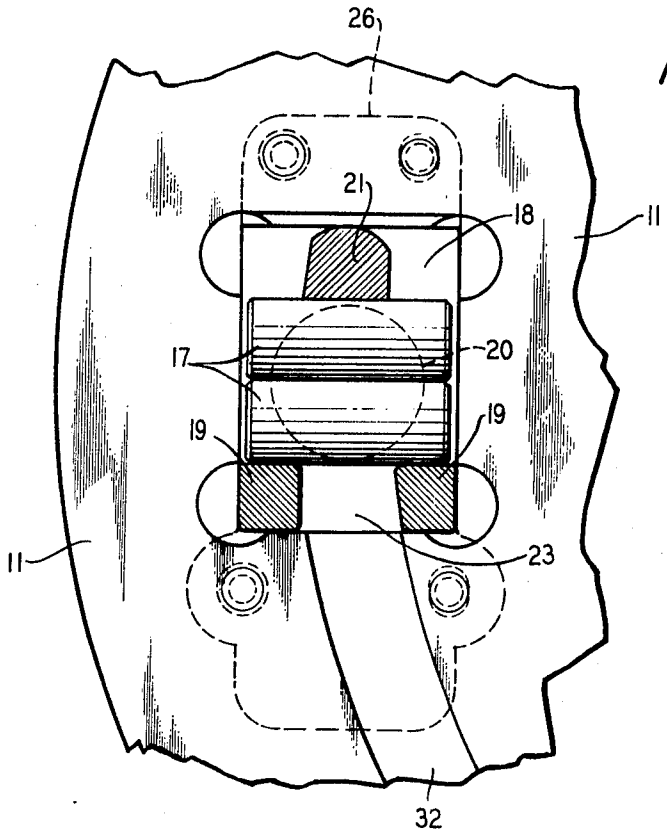


FIG. 12

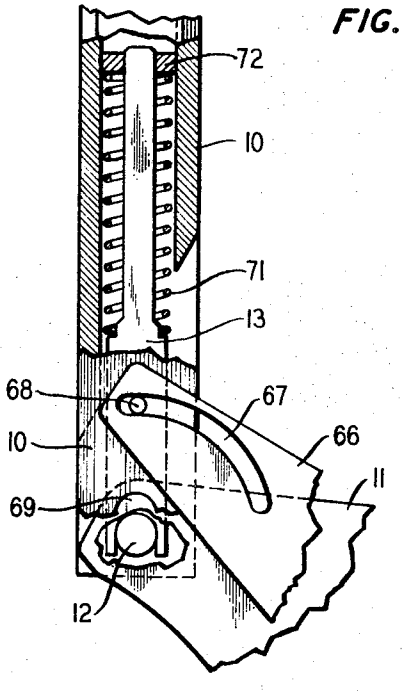


FIG. 16

FIG. 13

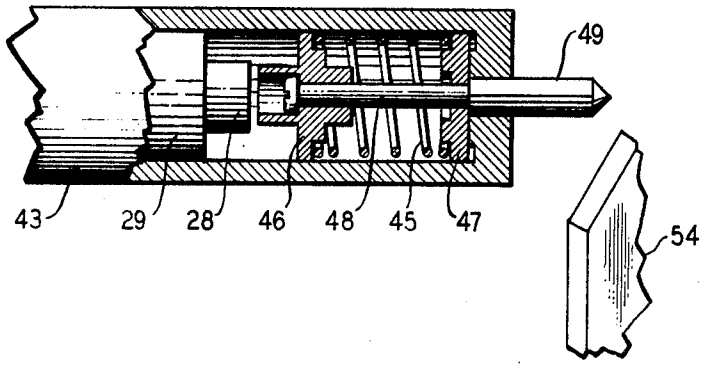


FIG. 14

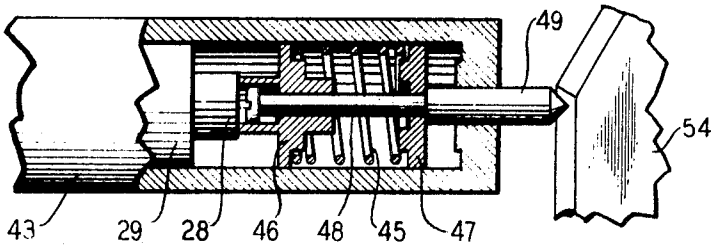
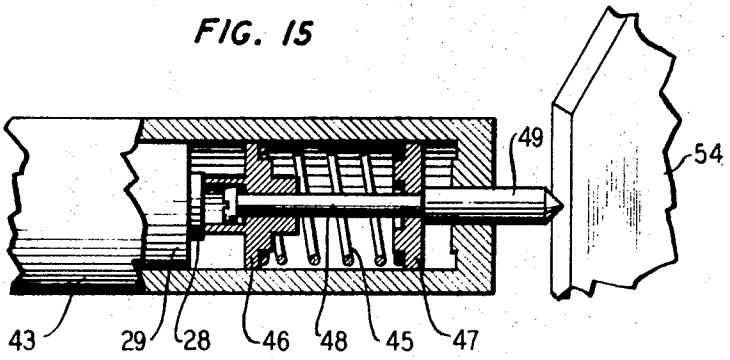


FIG. 15



BLAST-ACTUATED VALVE-CLOSURE SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to valve-closure systems and, more particularly, to an improved valve-closure system that is actuated automatically in response to the over-pressure of a blast.

Protection against blasts from atomic bombs or other severe explosions may be obtained by constructing a strongly reinforced chamber in a favorable location, such as at a suitable depth under the surface of the earth. A chamber of this type is usually equipped with a ventilating system having a number of ducts extending from the chamber to the surface of the ground. Some of these ducts function as intake ducts for admitting fresh air to the chamber while other of the ducts serve as exhaust ducts for removing stale air from the chamber. Both of these types of ducts are, in general, provided with valve-closure devices for sealing or closing them against overpressure when a blast occurs. This is especially necessary in the event of an atomic explosion in order to exclude radioactive fallout and destructively high blast pressures.

These valve-closure devices can be controlled by various types of sensing systems which are designed to detect the occurrence of a blast. The sensing systems are usually designed to operate the valve-closing devices so that they will be closed before the arrival of an airblast wave. In addition, as a safety precaution against a possible failure of a sensing system, it is desirable that the valve-closing devices be so designed as to become closed automatically when a sudden overpressure impinges upon them.

Heretofore, such automatically operated valve-closing devices have not been fully satisfactory because they have employed large closure members, usually a single closure member for a large valve. Because of the large unit blast pressures over large closure areas, the closure members and, consequently, all associated moving parts, as well as bearings and fixed hardware, must be very massive to withstand the large static and dynamic loads resulting from airblast pressure loading, shock-front interaction, and heavy impact on seating. This heavy construction has been objectionable because it is expensive and its operation is not sufficiently rapid.

SUMMARY OF THE INVENTION

The present invention is designed to overcome the objections discussed above by providing an improved automatically operated valve-closure system which is safer, faster, simpler, cheaper, and more reliable than valve closures of the prior art. The valve-closure system of this invention comprises a plurality of louvers pivoted near their centers and mounted across the opening of a ventilating duct in a normally open position. The louvers are individually fastened by connecting cranks to a common operating rod which is adapted to be moved by a rotatable actuating crank driven by a torsion spring. Normally, the rotation of the actuating crank is blocked by locking means comprising two rollers interposed in a detent formed therein.

A rotatable triggering crank is responsive to the impingement of a blast pressure wave on the louvers for effecting the unblocking of the actuating crank through the removal of the rollers from their interposed positions. Upon being thus unblocked, the actuating crank is rotated by the torsion spring and drives or pulls the operating rod to a position where the associated connecting cranks effect the tilting of the louvers to their closed position thereby closing the opening in the ventilating duct.

A rotatable resetting crank is provided for utilizing the rollers and the detent to restore the actuating crank and the operating rod to their initial positions thereby effecting the return of the louvers to their normally open position.

The unblocking function of the rotatable triggering crank may alternatively be performed by electromechanical triggering means having its energization controlled either manually by an attendant or electrically by a suitable blast-sensing device.

BRIEF DESCRIPTION OF THE DRAWING

The features of this invention are more fully discussed hereinafter in relation to the following detailed description of the drawing in which:

FIG. 1 is a front view of an exemplary embodiment of the valve-closure system of this invention;

FIG. 2 is a perspective view of the valve-closure system mounted across the opening of a duct that is located in a concrete emplacement;

FIG. 3 is an exploded perspective view of the chief operating components of the valve-closure system;

FIG. 4 is a side view, partly in section, of a portion of the valve-closure system with the louver blades in their normally open position and some of the components of the valve-operating equipment in their normally unoperated or idle positions;

FIG. 5 is a side view that is somewhat similar to FIG. 4 but showing the louver blades in their closed position with some of the other components of the valve-operating equipment in their operated or active positions;

FIG. 6 is a side view that is somewhat similar to FIG. 5 but which shows the resetting crank, which is employed in the valve-operating equipment, in its operated or active position;

FIG. 7 is an end view, partly in section, of the locking mechanism and the triggering mechanisms which are used in the valve-operating equipment;

FIG. 8 is a partly sectionalized side view that is somewhat similar to FIG. 4 but which illustrates a number of additional components of the valve-operating equipment;

FIG. 9 is a partly sectionalized side view taken from the opposite direction of that used for FIG. 8 and showing additional components of the valve-operating equipment;

FIG. 10 is a schematic diagram of exemplary circuits utilized for controlling the operation of the motor employed in the valve-operating equipment;

FIG. 11 is a schematic diagram of exemplary circuits used for controlling the energization of the solenoid that is incorporated in the valve-closing equipment;

FIG. 12 is a partly sectionalized side view, taken along the line 12—12 in FIG. 7, of the locking mechanism;

FIG. 13 is a detailed side view, partly in section, of normally unoperated resetting means which is adapted for resetting the locking mechanism after it has been released;

FIG. 14 is a detailed side view that is somewhat similar to FIG. 13 but which shows the resetting means in a partly operated condition;

FIG. 15 is a detailed side view that is somewhat similar to FIG. 14 but which shows the resetting means in a fully operated condition; and

FIG. 16 is a detailed side view, partly in section, of a portion of the operating rod and some of the components of the valve-operating system that are associated with it.

DETAILED DESCRIPTION

An exemplary blast-actuated valve-closure system in accordance with this invention is broadly illustrated in FIG. 1 and FIG. 2. It can be seen in FIG. 2 that the valve-closure system is associated with a ventilating duct 1 extending to an underground chamber which is not shown as it forms no part of the invention. The duct 1 may be either an intake duct or an exhaust duct and is securely held by a concrete emplacement or support 2. The mouth or opening of the duct 1 may have any convenient shape, such as that of a rectangle. A louver valve-closure device 3 is securely mounted in abutting relationship across the opening of the duct 1 as is represented by FIG. 2.

The louver valve-closure device 3 is provided with a heavy rectangular frame 4 having a number of strong cross-ribs 5. The ribs 5 are spaced equidistantly apart and are immovably fastened to the frame 4. Each of the ribs 5 has a louver blade 6 pivotally attached thereto by suitable continuous hinge means 7. Each of the hinge means 7 is disposed near the center of the cross-section of its associated louver blade 6 as is best seen in

FIG. 3 and FIG. 8. The louver blades 6 are parallelly disposed and, when closed, form covering means for the opening of the duct 1. Each of the blades 6 has a tapered chevron-shaped cross-section, as is best seen in FIG. 8, and is designed to rotate through a stroke of about 70°.

One of the blades 6 is shown in the upper portion of FIG. 8 and it should be noted that the distance between its right edge and the hinge 7 is slightly less than the distance between its left edge and the hinge 7. This hinge eccentricity is provided for the purpose of assisting in developing aerodynamic torque and to insure that blast pressure impinging on the valve 3, after it has been closed, cannot reopen it.

A plurality of connecting cranks 8 are associated with the louver blades 6. Each of the cranks 8 has one end fixedly and immovably attached to a respectively different one of the blades 6 at a point in the middle of the length thereof. The other end of each of the cranks 8 is pivotally attached by appropriate hinge means 9, as is best indicated in FIG. 3, to a hollow operating rod 10 which is adapted to be moved up and down along its longitudinal axis by means described hereinafter.

A portion of one side of the rod 10 is cut away so that the ends of the cranks 8 can enter the cavity formed by the hollow interior of the rod 10 and thus receive the hinge means 9. Theoretically, the operating rod 10 may be constituted by a unitary member. However, as a practical expedient, it is shown in the drawing as being a composite rod which is formed in sections that are joined together by conventional coupling means.

When the operating rod 10 is moved to the limit of its extent of travel in one direction, the connecting cranks 8 effect the rotation of the louver blades 6 to their open position where, as is shown in FIG. 2 and also in FIG. 4, they uncover the opening of the duct 1. Then, when the operating rod 10 is moved to the limit of its extent of travel in the opposite direction, the pivotally-mounted connecting cranks 8 will pull the louver blades 6 into their closed position where, as is shown in FIG. 1 and also in FIG. 5, the blades 6 overlap in flat array thereby covering, or closing, the opening of the duct 1.

It should be noted that the tapered chevron shape of the cross-section of each of the louver blades 6 minimizes air flow losses and assists, in combination with the above described location of the hinge means 7, to produce aerodynamic closing torques.

The construction and configuration of the valve-closure device 3 is especially suited for fast closing action because of its low inertia. This is because the valve-closure device 3, instead of being a large, single device, comprises a number of low-inertia blades 6. For equal closing times, the ratio of the actuating force required for this valve to that required for most of the prior art valves is less than 0.01. This ganged array of balanced blades 6 has the additional advantages of minimizing the energy which must be absorbed when it is rapidly closed, and of spreading the minimized impact energy fairly evenly over the large elastic field of the blades 6.

The louver blades 6 are normally in an open position because the operating rod 10 is normally in its unoperated position shown in FIG. 3 and also in FIG. 4. When it is desired to tilt the louver blades 6 to their closed position, the operating rod 10 must be moved to its operated position shown in FIG. 5. This movement of the operating rod 10 is effected by an actuator crank 11.

THE ACTUATOR CRANK

As is shown in FIG. 3, one end of the actuator crank 11 is bifurcated or divided into two branches. The ends of these branches are pierced for receiving therein an instrumentality, constituted by a coupling pin 12, which extends through the walls of the hollow operating rod 10. A blade 13, having a shouldered end, is vertically disposed inside the cavity formed by the hollow interior of the rod 10. As is shown in FIG. 16, the blade 13 has its shouldered end in engagement with that portion of the coupling pin 12 which extends between the branches of the bifurcated end of the actuator crank 11. The function performed by this blade 13 is explained hereinafter.

The actuator crank 11 is normally in its idle position, shown in FIG. 3 and also in FIG. 4, wherein it holds the operating rod 10 in its unoperated position. This causes the operating rod 10 to hold the covering means, comprising the louver blades 6, in its open position. The actuator crank 11 is rotatably mounted on a pivot rod 14 and is adapted to be rotated to its active position, shown in FIG. 5, in response to a driving force exerted by a coiled torsion spring 15 which is best seen in FIG. 3.

This torsion spring 15 has one end fixedly connected by any suitable means, such as a clamp, to an anchor plate 16 which, as is indicated by broken lines in FIG. 3, is fastened to a portion of the valve-operating equipment frame 35 by any convenient means, such as bolts. The other end of the torsion spring 15 is fixedly attached to a driving thimble 30 by appropriate clamping means 30*c* and 30*d*. The driving thimble 30 is rotatably mounted on the pivot rod 14, as is indicated by a broken line in FIG. 3. The bottom part of the driving thimble 30 has a protruding portion with a squared end 30*a* which is adapted to be received within a hole 30*b* in the actuator crank 11 and is securely retained therein by axial confinement for the purpose of applying a driving torque to the actuator crank 11.

In this exemplary embodiment of the invention, the torsion spring 15 is normally wound so as to be torsionally stressed. It is designed to exert a starting torque of approximately 900 inch-pounds which can be used for rotating the actuator crank 11 so that its bifurcated end will move downward to its active position, shown in FIG. 5, thereby moving the operating rod 10 downward to its operated position. This movement of the operating rod 10 will cause the covering means, comprising the louver blades 6, to move to its closed position wherein the opening of the duct 1 will be closed.

THE LOCKING MEANS

However, the driving force of the torsion spring 15 and the rotation of the actuator crank 11 are normally blocked by locking means. The locking means have a first position for normally holding, or locking, the actuator crank 11 in its idle position. In addition, the locking means have a second position adapted for unblocking or releasing the actuator crank 11. The locking means comprise two locking, or trip, rollers 17 normally interposed one above the other in a composite detent.

Specifically, this composite detent comprises a hole or cavity 18 formed in the actuator crank 11. The cavity 18 contains two spaced pins or double fingers 19 which are attached to the actuator crank 11 by means described hereinafter and which are so disposed as to support the lower one of the rollers 17 as is shown in FIG. 7. The detent further comprises a third pin or holding finger 21 attached to a resetting crank 22. This resetting crank 22, which is normally stationary, is rotatably mounted on the pivot rod 14 in a position adjacent to one side of the actuator crank 11 for a purpose that is explained hereinafter.

The third finger 21 is adapted to protrude from the resetting crank 22 in such a manner as to bear on the upper one of the trip rollers 17 as is shown in FIG. 7. Thus, the holding finger 21 and the locking rollers 17 function to prevent the double fingers 19 and their associated portion of the actuator crank 11 from moving upward. It should be noted that the position of the holding finger 21 is above a space 23 which, as is shown in FIG. 12, is formed between the two pin or finger elements of the double fingers 19. This space 23 is made at least equal to the width of the holding finger 21 and is sufficiently large to allow the holding finger 21 to pass therethrough when the locking rollers 17 are removed from their interposed position and the double fingers 19 are moved upward by the actuator crank 11 in the manner described hereinafter.

THE TRIGGER MEANS

Trigger means are provided for moving the locking rollers **17** from their interposed position to their second position for effecting the release of the actuator crank **11** from its idle position. The trigger means comprise a trigger spring **24** coiled around a trigger plunger **20**. As is best seen in FIG. **7**, both the spring **24** and the plunger **20** are disposed in a cavity **25** formed in a block **26** which is securely fastened to one side of the actuator crank **11**. One end of the plunger **20** extends through a hole in the block **26** for a purpose that is described hereinafter. One end of the trigger spring **24** rests against a portion of the block **26** and its other end bears against the enlarged head of the plunger **20** for pressing it against one side of the rollers **17**. Normally, the trigger spring **24** is compressed so that it exerts pressure against the rollers **17**.

The force exerted by the spring **24** and the plunger **20** against one side of the rollers **17** is normally ineffective to move them because the other side of the rollers **17** abuts against a disk **27** which is fastened to one end of a plunger **28** in a solenoid **29**. The solenoid **29** is normally energized and, consequently, pushes its plunger **28** and the disk **27** toward the left in FIG. **7** with sufficient force for holding the rollers **17** firmly against the head of the trigger plunger **20** thereby overcoming the force exerted by the trigger spring **24**. The vertical alignment of the rollers **17** is maintained by the fact that the disk **27** also causes the ends of the rollers to press against the interior face of the block **26**.

It should be noted that a portion of the resetting crank **22** is recessed for forming a cavity **31** in the area around the disk **27**. This cavity **31** is of sufficient size to receive therein the rollers **17** but they are normally prevented from entering it by the presence of the disk **27** which is held therein at this time by the force exerted by the solenoid **29**.

CLOSING THE LOUVER BLADES

When it is desired to move the louver blades **6** to their closed position for closing the opening of the duct **1**, the restraining or blocking force presented by the solenoid **29** must be overcome. This can be accomplished by several different methods which are explained hereinafter. In response to using any one of these methods, the plunger **28** and the disk **27** are forced to move toward the right in FIG. **7** thereby vacating the left portion of the cavity **31**. This permits the trigger spring **24** and the trigger plunger **20** to push the locking rollers **17** into the cavity **31** thereby unblocking or releasing the double fingers **19**. Accordingly, the double fingers **19** and their associated portion of the actuator crank **11** are now free to be rotated or moved upward in response to the driving force exerted by the torsion spring **15** which is normally wound so as to be torsionally stressed.

It should be noted that this portion of the actuator crank **11** has an arcuate groove or trough **32** formed therein as is best seen in FIG. **12**. This groove **32** is of sufficient size to accommodate or to receive therein the end portion of the holding finger **21**. The reason for this is that the holding finger **21** is attached to the resetting crank **22** which remains stationary during the upward rotation of this portion of the actuator crank **11**. Accordingly, when this portion of the actuator crank **11** is rotated upward, the groove **32** and the space **23** between the double fingers **19** travel past the protruding portion of the holding finger **21** and thus enable the actuator crank **11** to rotate freely without, at this time, being blocked by the holding finger **21**.

When the double fingers **19** and their associated portion of the actuator crank **11** rotate upward, the other, or bifurcated, portion of the actuator crank **11** rotates downward to its active position, as is represented in FIG. **5**. As was stated above, since this end of the actuator crank **11** is joined by the coupling pin **12** to the operating rod **10**, this rotation of the actuator crank **11** causes the operating rod **10** to be pulled down to its operated position thereby tilting the louver blades **6** to their closed position, as is shown in FIG. **5**, and thus closing the opening of the duct **1**.

The resulting abutment of the edges of the louver blades **6** against each other restrains the operating rod **10** from further downward movement and this, in turn, prevents further rotation of the actuator crank **11**.

It should be noted that the operation of the actuator crank **11** and the operation of the torsion spring **15** are entirely rotary. This rotary operation produces the following advantages: it minimizes inertia of the parts, simplifies the constructional details, minimizes the number and complexity of the bearings, and also minimizes the effects of friction.

STARTING THE UPWARD ROTATION OF THE RESETTING CRANK

At a point in time near the end of the abovementioned rotation of the actuator crank **11**, a cam **33**, which is attached to one side of the actuator crank **11**, moves into engagement, as is represented in FIG. **5**, with a normally open control switch **34** which is fastened to the frame **35** of the valve-closure equipment. The engagement of the cam **33** with the control switch **34** closes the switch **34** and thereby closes an obvious circuit, shown in FIG. **10**, for energizing a relay **53**.

In response to being energized, the relay **53** operates its armature and thereby effects the closure of a forward power supply circuit **36** for applying electric energy from a suitable source **37** of electric power for operating a conventional reversible electric gear motor **38** in a forward direction. This gear motor **38** has a shaft **39** on which a pinion gear **41** is mounted in meshing engagement with gear teeth **42** formed in an edge of the resetting crank **22**. Accordingly, the motor **38** is now energized in a forward direction so as to cause its pinion gear **41** to drive the gear teeth **42** in a direction such that the resetting crank **22** will be rotated upward in the same direction as that in which the actuator crank **11** was rotated when it effected the closure of the louver blades **6**.

THE TRIGGER RESETTING MECHANISM

Attention should now be directed to the trigger resetting mechanism which is associated with the solenoid **29**. As is shown in FIG. **7**, the solenoid **29** is enclosed within a container **43** which is securely fastened by means of screws driven into a plurality of studs **44** formed on one side of the resetting crank **22**. Thus, when the resetting crank **22** is rotated, it carries the container **43** and the solenoid **29** with it. The trigger resetting mechanism is positioned within the container **43** and is located adjacent to the right end of the solenoid **29**.

The trigger resetting mechanism, as is shown in FIG. **13**, includes a collapsible spring-loaded linking-mechanism comprising a compressed spring **45** disposed between a left washer **46** and a right washer **47** which are adapted to slide back and forth within the container **43**. The left washer **46** has an axially extending bushing on each of its sides. The right bushing on the left washer **46** is designed to function as a sliding bearing for assisting in stabilizing the left washer **46** by preventing it from tilting. The left bushing on the left washer **46** has a central bore for receiving therein the head of a retaining shouldered screw **48** which normally abuts against the left washer **46**.

The screw **48** extends through the spring **45** and also through a hole in the right washer **47**. The point of the screw **48** is driven into the base of a control button **49** which abuts against the right washer **47**. This control button **49** is slidably positioned in a hole in the end of the container **43**. Due to the pressure exerted by the spring **45** against the right washer **47**, the conically-shaped external end of the control button **49** normally protrudes outside the container **43** to the extent shown in FIG. **13**.

STOPPING THE UPWARD ROTATION OF THE RESETTING CRANK

When the resetting crank **22** approaches the limit of its rotation, control means must be utilized to effect its stopping at the proper point. These control means include a cam **51** which, as is shown in FIG. **9**, is mounted on the resetting crank **22** near the toothed edge thereof. The control means also include a normally closed limit switch **52** which is mounted on a bracket **40** that is attached to the frame of the valve-closure equipment.

While the toothed edge of the resetting crank **22** is rotating upward, it moves the cam **51** upward to its position shown in dotted lines in FIG. **9**. This upward position of the cam **51** causes the cam **51** to engage and open the normally closed limit switch **52**. As can be understood from inspection of FIG. **10**, the opening of the switch **52** effects the deenergization of the relay **53** which consequently releases its armature and thereby effects the opening of the power supply circuit **36** of the motor **38**. This stops the motor **38** and thus terminates the upward rotation of the resetting crank **22**.

PINNING THE ACTUATOR CRANK TO THE RESETTING CRANK

Slightly before the motor **38** is stopped, the solenoid container **43**, which is being carried along with the rotating resetting crank **22**, is moved upward to its position shown in dotted lines in FIG. **9**. This upward position of the solenoid housing **43** causes the conical end of its control button **49** to come into engagement with a stationary cam **54** that is fastened to the frame **35** of the valve-closure equipment.

The resulting engagement of the control button **49** with the cam **54** causes the protruding portion of the control button **49** to be pushed toward the solenoid **29** as is shown in FIG. **14**. Normally, as is shown in FIG. **13**, the control button **49**, which can now be understood as constituting a cam-operable instrumentality, abuts against the right washer **47** which is inside the solenoid container **43**. In moving inward, the control button **49** pushes the washer **47** toward the left, as is shown in FIG. **14**, thereby further compressing the spring **45**, as is also represented in FIG. **14**. The inward motion of the control button **49** causes the head of the screw **48** to move toward the left inside the left bushing on the left washer **46**.

The compressional force thus produced in the spring **45** tends to push the left bushing on the left washer **46** toward the left in FIG. **14** so as to increase its pressure against the plunger **28** of the solenoid **29**. This increased pressure tends to push the plunger **28** and its disk **27** toward the left in FIG. **14** but such movement of the plunger **28** is blocked at this time because the rollers **17** are held within the cavity **31** by the presence of the adjacent side of the actuator crank **11**. Accordingly, this pressure is maintained without producing any useful result until the rotation of the resetting crank **22** is nearly terminated.

Just before the rotation of the resetting crank **22** is terminated, the rollers **17** in the cavity **31** will be carried into alignment with the cavity **18** in the actuator crank **11**. Now, the pressure exerted by the spring **45**, which is being transmitted by the left washer **46** through the plunger **28** and the disk **27** to the rollers **17**, becomes effective to force the rollers **17** out of the cavity **31** in the resetting crank **22** and into the cavity **18** in the actuator crank **11**. This permits the plunger **28** and the disk **27** to move to their positions shown in FIG. **7**. Also, the left washer **46** now moves to its position shown in FIG. **15**.

It should be noted that the trigger spring **24** and the plunger **20** oppose the entry of the rollers **17** into the cavity **18**. However, since the pressure exerted by the spring **45** is designed to be greater than that exerted by the spring **24**, the rollers **17** will enter the cavity **18** at this time and will assume their previously described interposed position between the double fingers **19** on the actuator crank **11** and the holding finger **21** on the resetting crank **22**. This serves to pin the actuator crank **11** to the resetting crank **22**. The trigger resetting action is now terminated with the above-mentioned opening of the motor energizing circuit **36**. The valve-closure system now remains in this closed and reset condition.

OPENING THE LOUVER BLADES

When it is desired to open the louver blades **6**, a conventional manual control switch **55**, which is normally open as is shown in FIG. **10**, is manually operated for closing an obvious circuit for energizing a relay **50**. Upon being energized, relay **50** operates its armature to close a suitable reverse energizing circuit **56** for connecting the power supply source **37** to the motor **38** in such a manner as to cause the motor **38** to operate in the reverse direction from that previously described. Accordingly, the pinion gear **41** will now be rotated in a direction opposite to that described above and will consequently drive the gear teeth **42**, which are on the edge of the resetting crank **22**, in such a manner as to cause the resetting crank **22** to rotate in a direction which is the opposite of its previously described rotation.

The reverse rotation of the resetting crank **22** will be accompanied by corresponding reverse rotation of the actuator crank **11** due to the fact that they are pinned together by the double fingers **19**, the rollers **17**, and the holding finger **21** as was explained above. The reverse rotation of the actuator crank **11** carries the cam **33** out of engagement with the switch **34** which thereupon reopens. Immediately thereafter, the reverse movement of the resetting crank **22** carries the cam **51** out of engagement with the limit switch **52** which, consequently, becomes closed.

During the reverse rotation of the actuator crank **11**, the torsion spring **15**, which has one end fixedly connected to the actuator crank **11** as was described above, will be wound so as to return to its original fully energized state or condition of being under full torsional stress. Also, at this time, the coupling pin **12**, which couples the actuator crank **11** to the operating rod **10**, will force the operating rod **10** to move upward. This upward movement of the operating rod **10** will cause the connecting cranks **8**, which couple the operating rod **10** to the louver blades **6**, to force the louver blades **6** to return to their open position.

STOPPING THE DOWNWARD ROTATION OF THE RESETTING CRANK

The reverse movement of the above-mentioned parts continues until it is terminated in response to a cam **57** moving into engagement with a limit switch **58** to effect its operation. The cam **57** is shown in FIG. **9** to be attached to one side of the resetting crank **22** at a point near the previously described cam **51**. The limit switch **58** is mounted on a bracket **60** that is attached to the frame **35** of the valve-closing equipment.

FIG. **9** shows the cam **57** in engagement with the limit switch **58**. However, the portion of the resetting crank **22**, that is shown in solid lines in FIG. **9**, represents the idle position of the resetting crank **22** as is illustrated in FIG. **4**. It should be noted that, prior to the occurrence of the reverse movement of the resetting crank **22**, this portion of the resetting crank **22** had been rotated upward to its active position as is illustrated in FIG. **6**. This active position of the resetting crank **22** is represented with broken lines in FIG. **9**. The rotation of the resetting crank **22** to its active position causes the cam **57** to be rotated upward out of engagement with the limit switch **58**. This permits the limit switch **58** to become closed as is represented in FIG. **10**.

When the resetting crank **22** is now rotated to return to its idle position, the cam **57** is carried into engagement with the limit switch **58** as is illustrated in FIG. **9**. This action operates and opens the limit switch **58** thereby opening the energizing circuit of the relay **50**. This causes the relay **50** to release its armature thus opening the reverse power supply circuit **56** of the motor **38**. Accordingly, the reverse rotational movements of the resetting crank **22** and the actuator crank **11** are now

terminated. The manually operable switch **55**, which has been maintained closed during this movement of the resetting crank **22**, can now be moved to its open position that is shown in FIG. **10**. It should be noted that the terminating function of the cam **57** is so designed that the above mentioned reverse movements are not terminated until the louver blades **6** are fully restored to their normally open position.

LOCKING THE RESETTING CRANK

It should be noted that, when the motor **38** is not energized, the pinion gear **41** is held stationary due to the fact that it is coupled to the motor **38** by a conventional worm gear reduction drive mechanism **70** that is represented in FIG. **9**. The reduction gear mechanism **70**, which is of a type well known to those skilled in the art, is so designed that it does not allow the pinion gear **41** to rotate unless the motor **38** is energized. Accordingly, since the pinion gear **41** is normally locked in a stationary position by the reduction gear mechanism **70**, the pinion gear **41** functions, in turn, through its engagement with the gear teeth **42** on the rim of the resetting crank **22**, to hold or lock the resetting crank **22** in a normally stationary position.

As a result, due to the above-mentioned pinning action between the actuator crank **11** and the resetting crank **22**, the actuator crank **11** is normally prevented from rotating. Therefore, this locked, or stationary, condition of the actuator crank **11** imposes a restriction upon the movement of the operating rod **10** during the time that the rollers **17** are in their interposed position. This pinned and stationary condition of the actuator crank **11** renders the torque exerted by the torsion spring **15** ineffective to rotate the actuator crank **11** at this time.

UNLOCKING THE LOCKING MEANS

It was stated above, in describing the procedure that should be followed in tilting the louver blades **6** to their closed position, that the operating rod **10** cannot be moved to its operated position until the locking means, which comprise the rollers **17**, has released the actuator crank **11** for rotation thereof. It was also explained above that the rollers **17** are normally held in their locking position by pressure exerted by the normally energized solenoid **29**. It was further stated above that the blocking force presented by the solenoid **29** can be overcome by several different methods. These methods will now be described.

UNLOCKING BY MANUAL MEANS

The simplest method is to open manually a normally closed circuit **59** which is adapted to energize the solenoid **29**. This energizing circuit **59**, which is illustrated in FIG. **11**, serves to connect a suitable source **61** of electric energy to the winding of the solenoid **29**. A manually operable switch **62**, which is normally closed, is connected in series with the energizing circuit **59** so that, by manually opening the switch **62**, the energizing circuit **59** will be opened and the solenoid **29** will become deenergized.

Accordingly, the plunger **28** of the solenoid **29** will now cease its normal opposition to the force exerted by the trigger spring **24** and the trigger plunger **20**. Therefore, the trigger plunger **20** will now move toward the right in FIG. **7** thus pushing the rollers **17** into the cavity **31** in the resetting crank **22** and thereby releasing the actuator crank **11** for rotation in response to the driving force exerted by the torsion spring **15**. The louver blades **6** will now be moved to their closed position in the manner described above. The solenoid **29** can be subsequently reenergized by manually closing the switch **62** either during or after the above described upward rotation of the resetting crank **22**.

UNLOCKING WITH A BLAST-SENSING DEVICE

A second method is to employ a suitable conventional blast-sensing device **63**, such as a remotely located blast-pressure detector or a gamma detector, which, as is well known to those skilled in the art, will produce an electric output in response to the occurrence of a blast. The electric output from the blast-sensing device **63** is adapted to open an obvious circuit **65** which is normally closed for energizing a relay **64**, as is shown in FIG. **11**. The opening of the circuit **65** causes the normal energized relay **64** to become deenergized. Accordingly, the relay **64** will now release its normally operated armature thereby opening the energizing circuit **59** of the solenoid **29**. This deenergization of the solenoid **29** effects the release of the rollers **17** in the same manner as that described above and for accomplishing the same results, i.e., rotation of the actuator crank **11** and the consequent closure of the louver blades **6**.

After the effects of the blast have subsided, the electric output from the blast-sensing device **63** is discontinued thereby effecting the reclosing of the energizing circuit **65** with the consequent reenergization of the relay **64**. This subsequent reenergization of the relay **64** will cause it to operate its armature thereby reclosing the energizing circuit **59** to effect the reenergization of the solenoid **29**. This restores the system to the condition required for reopening the louver blades **6**.

UNLOCKING WITH AERODYNAMIC TORQUE

A third method is to utilize the aerodynamic torque which is generated at the louver blades **6** and which is applied by them to the operating rod **10** when a sudden over-pressure impinges upon the valve-closure system. This is accomplished by employing an aerodynamically operated trigger crank **66** which is positioned adjacent to the actuator crank **11** and which is rotatably mounted on the same pivot rod **14** as is indicated in FIG. **3**. The left end of this aerodynamic crank **66** extends to the operating rod **10** and has an arcuate slot **67** formed therein as is best seen in FIG. **16**. A pin **68**, which is attached to the operating rod **10**, as is best shown in FIG. **3**, protrudes through the slot **67**. Thus, the pin **68** and the operating rod **10** serve to couple the aerodynamic crank **66** to the plurality of louver blades **6**.

When a blast occurs, its overpressure impinges on the louver blades **6** and, because of their cross-sectional shape, applies a downward torque to them and they, in turn, translate this into a downward force upon the operating rod **10**. The rod **10** accordingly moves downward carrying with it the pin **68** and thereby forcing the associated end of the aerodynamic crank **66** to rotate downward about the pivot rod **14**. When the downward torque exerted by the louver blades **6** is sufficiently great, as is explained hereafter, it will initiate the movement of the aerodynamic crank **66** from its idle or unrotated position, shown in FIG. **4**, to its active or rotated position. Thus, the overpressure of the blast effects the rotation of the aerodynamic crank **66** about the pivot rod **14**.

It should be noted that, when the actuator crank **11** is released for rotation by either of the two methods previously described above, it pulls the operating rod **10** downward in the manner explained above. This, in turn, causes the pin **68** to move downward thereby forcing the aerodynamic crank **66** to rotate in the manner described immediately above. However, since the actuator crank **11** is also rotating, the accompanying rotation of the aerodynamic crank **66** performs no useful function at this time. Whenever the actuator crank **11** has been rotated to effect the closing of the louver blades **6**, the arcuate slot **67** will have been moved toward the left, as is shown in FIG. **5**, so that at any point during subsequent reopening of the louver blades **6**, the aerodynamic crank **66** can respond to a blast pressure wave and can reclose the louver blades **6** if they are partly opened.

THE BIASING MEANS FOR THE OPERATING ROD

Since, in spite of the normally locked condition of the actuator crank **11**, the operating rod **10** must move downward to a certain extent in order to initiate rotation of the aerodynamic trigger crank **66**, a limited degree of freedom of movement is provided for the operating rod **10** by mounting the actuator coupling pin **12** in two slots **69** formed in opposite sides of the hollow operating rod **10**. Due to the fact that, at this time, the actuator coupling pin **12** is held stationary, the operating rod **10** can move up and down within the limits imposed by the lengths of the slots **69**.

Normally, the operating rod **10** is pushed upward, to the upper limit permitted by the slots **69**, by means of a coiled biasing spring **71**. This biasing spring **71** is under compression and is coiled around the blade **13** which, as was previously described, is vertically disposed inside the rod **10** with its shouldered end in engagement with the coupling pin **12**, as is represented in FIG. **16**.

The lower end of the biasing spring **71** abuts against the top edge of the shouldered portion of the blade **13**, and the upper end of the spring **71** pushes upward against the bottom of a small block **72** which is securely fastened inside the cavity formed by the hollow interior of the rod **10**. This block **72** has a central slot formed therein for receiving the upper end of the blade **13**. Accordingly, when the rod **10** moves downward and further compresses the spring **71**, the slot in the block **72** will slide downward around the upper portion of the blade **13**.

Normally, since the spring **71** is under compression, it pushes against the block **72** and thus forces the operating rod **10** upward to the furthest extent permitted by the slots **69**. As a result, the bottoms of the slots **69** normally abut against the coupling pin **12**. Also, the position of the pin **68** is normally toward the left end of the arcuate slot **67** in the aerodynamic crank **66** as is shown in FIG. **16** and also in FIG. **4**. It can therefore be understood that the downward force exerted by the louver blades **6** upon the operating rod **10**, as a result of the overpressure of a blast, will not be effective to move the rod **10** downward unless it is greater than the opposing force exerted by the biasing spring **71**.

When the overpressure of a blast causes the downward force exerted by the louver blades **6** to exceed the biasing force of the spring **71**, the operating rod **10** will be forced downward so that the top edges of the slots **69** will approach the top edge of the coupling pin **12**. This action further compresses the spring **71** by forcing the block **72** downward over the blade **13**. The downward movement of the operating rod **10** forces the adjacent, or left, end portion of the aerodynamic trigger crank **66** to rotate downward correspondingly and thereby causes the other, or right, end portion of the aerodynamic crank **66** to rotate upward as was explained above.

As is indicated in FIG. **3**, a small block **73** is adapted to be securely fastened to the right end portion of the aerodynamic trigger crank **66**. This block **73** functions as a clamp for holding a shaft on which a trigger roller **74** is rotatably mounted. As is represented in FIG. **8**, the trigger roller **74** protrudes beyond the right edge of the block **73**. Thus, the trigger roller **74** is mounted to rotate in a plane which is tangent to the end of the actuator crank **66**.

Another small block **77** is located near the first block **73**. As is indicated by the broken lines in FIG. **3**, this block **77** is adapted to be fixedly fastened to the block **26** which is designed to be attached to the actuator crank **11**. The block **77** is mounted in such a manner as to overlap the right edge of the aerodynamic trigger crank **66** without normally applying any binding force to it. The purpose of this block **77** is to provide a stabilizing support for limiting the extent of any deflection or motion of the aerodynamic crank **66** outside of its desired plane of rotation.

A somewhat similar block **78** is fixedly secured to the resetting crank **22** near the toothed edge thereof as is best seen in FIG. **8**. A portion of the block **78** overlaps the right edge of the actuator crank **11** but does not normally apply any binding force to it. This block **78** functions to restrict the motion of the actuator crank **11** to its desired plane by stabilizing, or limiting, the extent of any deflection therefrom which might tend to be caused by axial forces produced by the tripping of the locking rollers **17**.

THE AERODYNAMIC TRIGGER MEANS

As is shown in FIG. **7** and also in FIG. **8**, the block **26**, which is attached to the actuator crank **11**, has one end of an instrumentality, constituted by a spring-hinged lever-cam **75**, fixedly secured thereto in the manner indicated in FIG. **3**. The unattached end of this lever-cam **75** is tilted outward in a direction leading toward the aerodynamic trigger crank **66** for forming a ramp **76** as is best seen in FIG. **7**. This instrumentality, or lever-cam, **75** is designed to bear against the roller **74** with a frictional engagement. As is best shown in FIG. **7**, the trigger roller **74** normally engages that portion of the lever-cam **75** which is opposite that end of the trigger plunger **20** which is normally protruding through a hole in the block **26**. The lever cam **75** is positioned close to the protruding end of the trigger plunger **20** and may touch it lightly. It should be noted that, when the trigger roller **74** is in the position shown in FIG. **7**, neither it nor the lever-cam **75** apply any significant pressure to the protruding end of the trigger plunger **20**.

When the right end portion of the aerodynamic trigger crank **66** is rotated upward, as was described above, it carries with it the trigger roller **74**. In thus moving upward, the frictional engagement between the lever-cam **75** and the roller **74** produces rotation of the roller **74**. The upward movement also causes the trigger roller **74** to move against the outwardly extending ramp **76** of the lever-cam **75**.

Since the lever-cam **75** is spring-hinged, the movement, or rotation, of the trigger roller **74** upward along the ramp **76** will force the lever-cam **75** to move toward the face of the block **26** on the actuator crank **11**. At the same time, the intermediate portion of the lever-cam **75** will be forced to move toward the block **26** and will consequently press against the protruding end of the trigger plunger **20**. This pressure is transmitted to the enlarged head of the trigger plunger **20** which, in turn, applies pressure to the left side of the locking rollers **17**.

When this pressure applied to the left side of the rollers **17**, combined with the pressure exerted by spring **24**, is greater than the opposing pressure applied to the other side of the rollers **17** by the operated disk **27** and plunger **28** of the solenoid **29**, the disk **27** and the plunger **28** will be forced toward the right in FIG. **7**. Accordingly, the locking rollers **17** will now be pushed into the cavity **31** which is formed in one side of the resetting crank **22**. This action unlocks the actuator crank **11** and allows it to be rotated by the driving force exerted by the torsion spring **15** in the manner described above and thereby effects the tilting of the louver blades **6** and the closing of the opening in the duct **1**. Thus, the trigger roller **74** constitutes rotatable initiating means which, through its rotation, effects the rotation of the actuating means formed by the actuator crank **11**. Also, the aerodynamic crank **66** constitutes rotatable control means which, through its rotation, effects the rotation of the initiating means constituted by the trigger roller **74**.

What is claimed is:

1. A blast-actuated valve-closure system adapted for closing an opening in response to the overpressure of a blast,

said system comprising movable covering means having a closed position for covering said opening and an open position for uncovering said opening,

said covering means having a surface adapted for receiving the force of a blast pressure wave,

rotatable actuating means adapted for effecting through its rotation the movement of said covering means from said open position to said closed position,

rotatable initiating means adapted for effecting by its rotation the initiation of the rotation of said actuating means,

and rotatable control means adapted for effecting through its rotation the rotation of said initiating means,

said control means being further adapted to be rotated in response to the impingement of a blast pressure wave on said covering means.

2. A blast-actuated valve-closure system in accordance with claim 1 and further comprising locking means having a first position adapted for blocking rotation of said actuating means,

said locking means having a second position adapted for unblocking rotation of said actuating means,

said rotatable initiating means including a roller adapted for effecting through its rotation the placing of said locking means in its second position and for thereby effecting the initiation of the rotation of said actuating means,

and said rotatable control means having means adapted for carrying said initiating means during rotation of said control means and for thereby effecting rotation of said roller.

3. A blast-actuated valve-closure system in accordance with claim 2 and further comprising an instrumentality attached to said actuating means and adapted to bear against said roller with a frictional engagement adapted for producing rotation of said roller in response to the carrying of said roller by said control means during its rotation.

4. A blast-actuated valve-closure system in accordance with claim 3 wherein said instrumentality is constituted by a spring-hinged lever-cam having a tilted portion for forming a ramp,

said ramp being adapted for sloping in a direction away from said locking means.

5. A blast-actuated valve-closure system in accordance with claim 1 wherein said covering means comprise a plurality of parallelly disposed louver blades,

and further comprising coupling means for coupling said plurality of louver blades to a portion of said control means,

said coupling means including an operating rod,

a plurality of connecting means each having one end attached to the middle of a respectively different one of said louver blades and having another end attached to said operating rod,

said control means having means defining an arcuate slot formed in said portion thereof,

and a pin attached to said operating rod and disposed in said slot,

the position of said pin in said slot being adapted to be changed in response to rotation of said control means.

6. A blast-actuated valve-closure system in accordance with claim 5 wherein said operating rod includes means defining a cavity formed therein,

and further comprising an instrumentality extending through said rod and into said cavity,

a block fixedly fastened inside said cavity,

biasing means for normally forcing said pin to move toward one end of said slot,

said biasing means including a blade having a shouldered end,

said blade being slidably disposed within said cavity with said shouldered end in engagement with said instrumentality,

and spring means encircling said blade for pressing in one direction against said shouldered end of said blade and for pressing in an opposite direction against said block.

7. A blast-actuated valve-closure system in accordance with claim 1 and further comprising a shaft,

and means for mounting both said actuating means and said control means on said shaft for rotation thereabout.

8. A blast-actuated valve-closure system in accordance with claim 1 wherein said actuating means has an unrotated position in which it normally rests and a rotated position to which it moves in response to its rotation,

and further comprising rotatable resetting means adapted for returning said actuating means from its rotated position to its unrotated position.

9. A blast-actuated valve-closure system in accordance with claim 8 and further comprising a shaft,

and means for mounting said actuating means and said control means and said resetting means on said shaft for rotation thereabout.

10. A blast-actuated valve-closure system adapted for closing an opening in response to the overpressure of a blast,

said system comprising movable covering means having a closed position for covering said opening and an open position for uncovering said opening,

said covering means having a surface adapted for receiving the force of a blast pressure wave,

rotatable actuating means adapted for effecting through its rotation the movement of said covering means from said open position to said closed position,

and rotatable control means adapted for effecting through its rotation the consequent rotation of said actuating means,

said control means being further adapted to be rotated in response to the impingement of a blast pressure wave on said covering means.

11. A blast-actuated valve-closure system in accordance with claim 1 and further comprising rotatable initiating means adapted for effecting through its rotation the initiation of the rotation of said actuating means,

said initiating means having its rotation effected in response to the rotation of said control means.

12. A blast-actuated valve-closure system adapted for closing an opening in response to the overpressure of a blast,

said system comprising movable covering means having a closed position for covering said opening and an open position for uncovering said opening,

said covering means having a surface adapted for receiving the force of a blast pressure wave,

rotatable actuating means adapted for effecting through its rotation the movement of said covering means from said open position to said closed position,

control means for effecting the initiation of the rotation of said actuating means from an idle position to an active position,

and resetting means for returning said actuating means from said active position to said idle position.

13. A blast-actuated valve-closure system in accordance with claim 12 and further comprising locking means having a first position adapted for holding said actuating means in its idle position,

said locking means having a second position adapted for releasing said actuating means from its idle position for movement to its operated position,

said locking means including a composite detent having two holding means,

one of said holding means being fixedly attached to said resetting means,

and the other of said holding means being secured to said actuating means.

14. A blast-actuated valve-closure system in accordance with claim 13 wherein one of said holding means includes a holding finger and the other of said holding means includes a double finger having two finger elements spaced apart by a distance at least equal to the width of said holding finger.

15. A blast-actuated valve-closure system in accordance with claim 14 wherein said holding means that is fixedly attached to said resetting means is constituted by said holding finger,

said holding finger having an end portion,

and further comprising means defining an arcuate groove in said actuating means for receiving therein said end portion of said holding finger.

16. A valve-closure system in accordance with claim 12 wherein said actuating means include means defining a cavity therein and wherein said resetting means include means defining a cavity therein,

and further comprising locking means adapted for locking said actuating means in its idle position,

said locking means including a first portion and a second portion,

said first portion being fixedly disposed in said cavity in said actuating means,

and said second portion being fixedly disposed in said cavity in said resetting means.

17. A valve-closure system in accordance with claim 16 wherein one of said portions of said locking means includes a single holding pin,

and wherein the other of said portions of said locking means includes a double holding pin having two pin elements spaced apart by a distance at least equal to the diameter of said single holding pin.

18. A valve-closure system in accordance with claim 16 and further comprising roller means normally having a position interposed between said first and second portions of said locking means,

and first pushing means positioned in a first one of said cavities and adapted for pushing said roller means into a second one of said cavities for effecting the unlocking of said actuating means.

19. A valve-closure system in accordance with claim 18 and further comprising second pushing means positioned in said second one of said cavities and adapted for pushing said roller means out of said second one of said cavities after having been pushed therein by said first pushing means.

20. A valve-closure system in accordance with claim 19 and further comprising activating means for effecting movement of said second pushing means,

said activating means including spring means,

and a cam-operable instrumentality adapted for compressing said spring means for effecting movement of said second pushing means.

21. A valve-closure system in accordance with claim 16 and further comprising roller means normally having a position interposed between said first and second portions of said locking means,

first pushing means positioned in a first one of said cavities and adapted for exerting pushing force against said roller means in a direction toward the second one of said cavities,

second pushing means positioned in said second one of said cavities and adapted for exerting pushing force against said roller means in a direction toward said first one of said cavities.

22. A valve-closure system in accordance with claim 21 and further comprising trigger means for effecting the movement of said roller means out of said interposed position,

said trigger means including means for causing the pushing force exerted by one of said pushing means to become relatively stronger than the pushing force of the other of said pushing means.

23. A system for alternatively covering and uncovering an opening,

said system comprising covering means having a closed position for covering said opening and an open position for uncovering said opening,

operating means adapted for moving said covering means alternatively from one of said positions to the other of said positions,

said operating means having an unoperated position for holding said covering means in its open position and an operated position for holding said covering means in its closed position,

actuating means adapted for moving said operating means from its unoperated position to its operated position,

said actuating means having an idle position for holding said operating means in its unoperated position and an active position for holding said operating means in its operated position,

locking means having a first position adapted for holding said actuating means in its idle position,

said locking means having a second position adapted for releasing said actuating means from its idle position,

trigger means adapted for moving said locking means from its first position to its second position for effecting the release of said actuating means from its idle position,

rotatable driving means responsive to said release of said actuating means for driving said actuating means to its active position whereby said operating means is moved to its operated position thereby moving said covering means to its closed position,

and resetting means adapted for returning said actuating means from its active position to its idle position.

24. A system in accordance with claim 23 wherein said rotatable driving means includes torsion means,

and further comprising coupling means for coupling said torsion means to said actuating means,

said torsion means being normally in a wound condition and in a state of torsional stress,

and said torsion means being adapted to assume an at least partly unwound condition in response to driving said actuating means to its active position.

25. A system in accordance with claim 24 wherein said resetting means has an unoperated position and alternatively has an operated position,

said resetting means being normally in its unoperated position when said actuating means is in its idle position,

and gear means adapted for producing a driving action for placing said resetting means in its operated position in response to the movement of said actuating means to its active position.

26. A system in accordance with claim 25 and further comprising control means for reversing the driving action of said gear means for effecting the return of said resetting means from its operated position to its unoperated position,

said actuating means being adapted to be returned from its active position to its idle position in response to the movement of said resetting means from its operated position to its unoperated position,

and said torsion spring being adapted to resume its wound condition and return to its state of being torsionally stressed in response to the movement of said resetting means from its operated position to its unoperated position.

27. A system for alternatively covering and uncovering an opening,

said system comprising covering means including a plurality of parallelly disposed louver blades having a closed position for covering said opening and an open position for uncovering said opening,

an operating rod having means for connecting it individually to each of said louver blades for alternatively moving them from one of said positions to the other of said positions,

said operating rod having an unoperated position for holding said louver blades in their open position and an operated position for holding them in their closed position,

a rotatable actuating crank adapted for moving said operating rod from one of its positions to the other of its positions,

said crank having two end portions,

a pivot rod for rotatably supporting said actuating crank at a point intermediate said end portions,

said actuating crank having an idle position for holding said operating rod in its unoperated position and an active position for holding said operating rod in its operated position,

and connecting means for connecting one end portion of said rotatable actuating crank to said operating rod for effecting movement thereof.

28. A system in accordance with claim 27 and further comprising torsion driving means adapted for imparting rotary motion to one of said end portions of said actuating crank for effecting rotation of said actuating crank from its idle position to its active position,

said connecting means being responsive to said rotation of said actuating crank for effecting movement of said operating rod from its unoperated position to its operated position and for thereby moving said louver blades from their open position to their closed position,

and a rotatable resetting crank rotatably mounted on said pivot rod in a position adjacent to one side of said actuator crank,

said resetting crank being adapted for effecting the return movement of said actuating crank from its active position to its idle position and for thereby effecting the return of said operating rod to its unoperated position and the consequent return of said louver blades to their open position.

29. A system in accordance with claim **28** and further comprising gear means adapted for normally holding said resetting crank in a stationary condition,

and locking means adapted for normally holding said actuator crank in a stationary condition thereby overcoming the driving influence of said torsion driving means,

said locking means including means for normally pinning said actuator crank to said resetting crank.

30. A system in accordance with claim **29** and further comprising trigger means for effecting the unpinning of said actuator crank from said resetting crank,

said torsion driving means being responsive to said unpinning of said actuator crank for effecting the rotation of said actuator crank to its active position and for thereby effecting the movement of said operating rod to its operated position with the consequent movement of said louver blades to their closed position.

31. A system in accordance with claim **30** and further comprising operating means adapted for operating said gear means for rotating said resetting crank in the same direction as that in which said actuator crank was rotated,

and means for limiting the extent of said rotation of said resetting crank to the same extent as that in which said actuator crank was rotated from its idle position to its active position,

and said locking means including means adapted for repinning said actuator crank while in its active position to said rotated resetting crank.

32. A system in accordance with claim **31** and further comprising reversing means adapted for reversing the operation of said gear means for effecting the rotation of said resetting crank in a direction opposite to that of its previous rotation,

and means for limiting the extent of said reverse rotation of said resetting crank to the same extent as that of its previous rotation,

said reverse rotation of said resetting crank being adapted to effect the return of said repinned actuator crank to its idle position.

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