July 9, 1957 J. W. CHRISTY ET AL 2,799,016

TWO-NOTE SOLENOID OPERATED CHIME MECHANISM

Filed Oct. 6, 1954 2 Sheets-Sheet 1

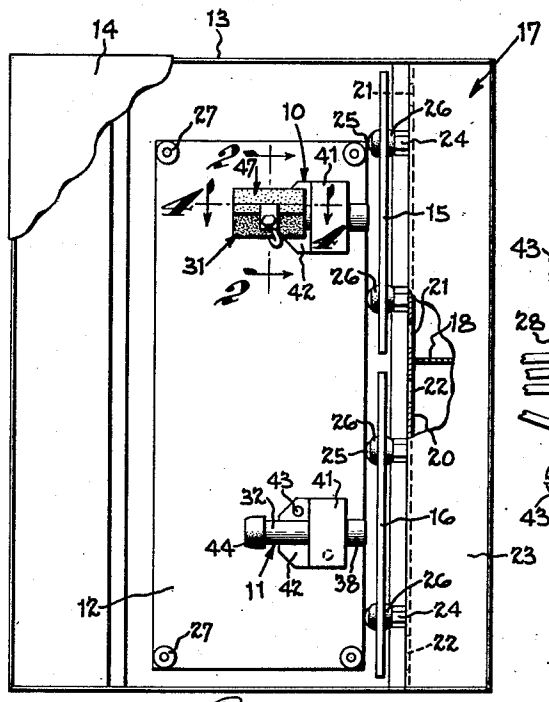


Fig. 1

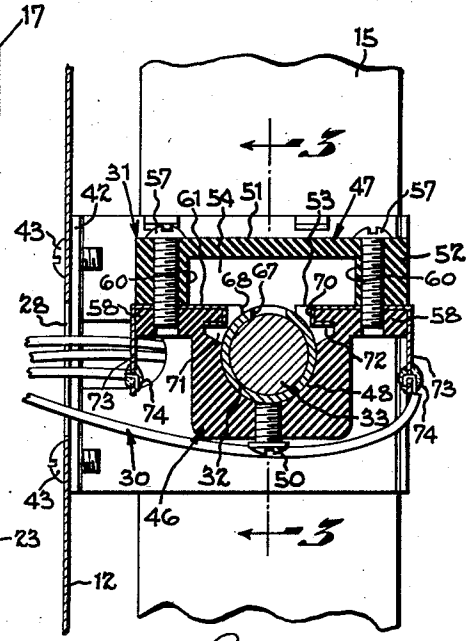


Fig. 2

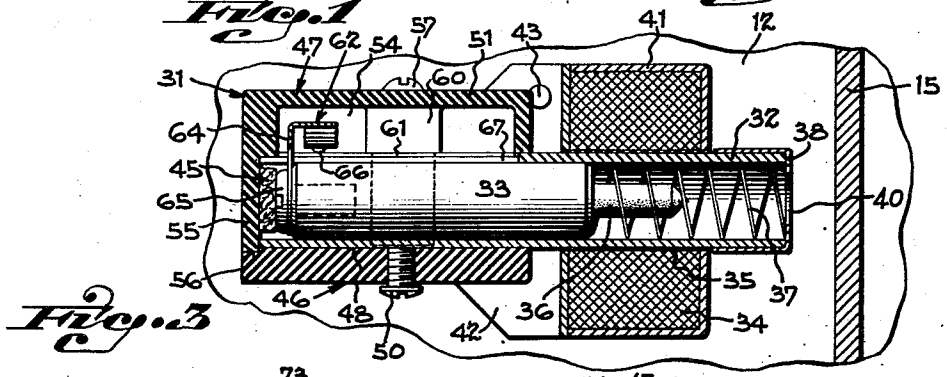


Fig. 3

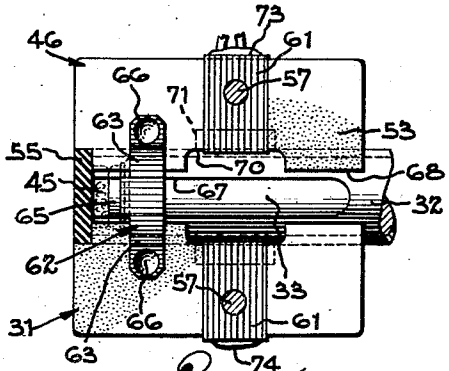


Fig. 4

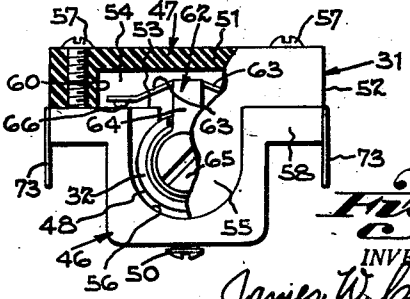


Fig. 5

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TWO-NOTE SOLENOID OPERATED CHIME MECHANISM

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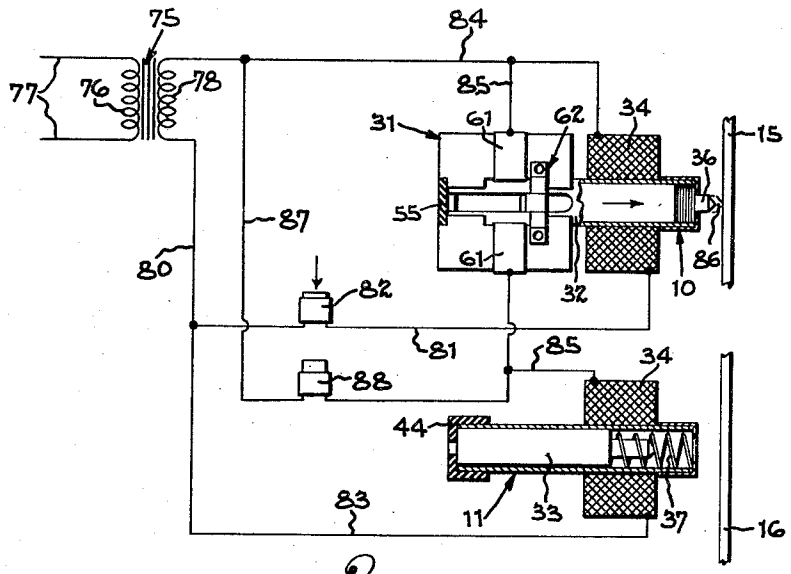


Fig. 6

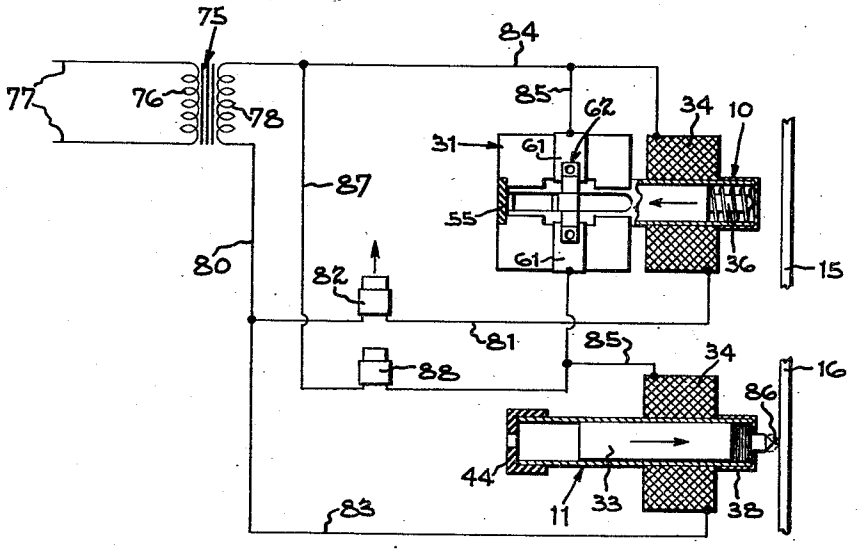


Fig. 7

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TWO-NOTE SOLENOID OPERATED CHIME MECHANISM

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Application October 6, 1954, Serial No. 460,554

8 Claims. (Cl. 340—392)

The invention relates to solenoid operated door chimes and is directed particularly to a solenoid mechanism utilizing two solenoids to create a two-note signal and utilizing one of the solenoids to create a single-note signal.

A chime providing a single and two-note signal of this character, but utilizing a different principle of operation, is disclosed in the prior patent of Lowell M. Alexander et al., No. 2,659,074, issued to the present assignee. The chime signal disclosed in the prior patent comprises a pair of tone bars and a double acting solenoid plunger actuated by a pair of solenoid coils arranged in tandem, the coils being of different magnetic strength. The plunger is biased by a pair of springs, each having different resistance to deflection, the stronger spring causing the plunger to strike both tone bars when the stronger solenoid coil is activated, the weaker spring causing the plunger to strike one tone bar when the weaker solenoid coil is activated.

A primary object of the present invention has been to provide an arrangement of two separate solenoids and related tone bars, one of the solenoids electrically interconnected with the other, the two arranged to strike their tone bars automatically in sequence by magnetic action for the two-note signal, as distinguished from spring action, thereby to create a signal of equal intensity and to provide more dependable operation.

According to the present invention, one solenoid, which is termed the "primary solenoid," is connected to a two-note push button. The other, or "secondary solenoid" is energized by a switch carried by the primary solenoid, such that the secondary solenoid is energized in response to the reciprocation of the primary solenoid plunger. By virtue of the solenoid actuated switch, the primary solenoid strikes its tone bar when the push button is depressed, while the secondary solenoid remains idle. When the button is released and the primary solenoid deenergized, then the solenoid responsive switch energizes or excites the secondary solenoid momentarily, causing it to strike its tone bar and thus sound the second note. In other words, the chime sounds one note when the button is depressed and sounds a second note when the button is released. The single note signal is sounded by a single note push button which is connected directly to the secondary solenoid, such that the primary solenoid remains idle when the single note button is depressed.

Another object of the invention has been to provide a simple, solenoid actuated switch which allows the secondary solenoid to remain idle during the power stroke of the primary solenoid and to actuate the secondary plunger only during the slower return stroke of the primary plunger. This action is critical to the striking of two individual notes as the two-note push button is depressed and released. In other words, if the secondary plunger were activated during the power stroke as well as the return stroke of the primary plunger, then both notes would be sounded when the button is depressed and a single note would be sounded when the button is released.

The solenoid actuated switch consists essentially of a pair of stationary contacts carried in a housing which is mounted upon the primary solenoid. A sliding bridge contact, which is attached to the primary plunger, wipes across the stationary contacts when the plunger executes its power and return strokes. During the return stroke, the primary plunger is actuated by a spring which drives the plunger at substantially lower velocity than power stroke velocity. During the power stroke, due to the high velocity of motion, the wiping action of the bridge creates an electrical impulse which is too short in duration to activate the secondary plunger. However, during the return stroke at lower velocity under spring action, the electrical impulse is of sufficient duration to activate the secondary plunger and thereby to sound the second note.

Essentially, the actuation of the secondary plunger depends upon a balanced relationship of the time factor (duration of electrical impulse), the electrical current value and the mass or inertia of the secondary plunger. In other words, with a given current value and a given plunger mass, the stationary contact strips must have a width sufficient to provide the required time factor during the return stroke of the primary plunger and less than the required time factor during the power stroke. In addition to the physical lag due to mass, the actuation of the secondary plunger is further retarded by the magnetic lag or build-up of the magnetic field of the secondary solenoid. Thus, even though an impulse is sent to the secondary coil during the power stroke, its duration is insufficient to overcome the magnetic lag and inertia factors.

The various features and advantages of the present invention will be more fully apparent to those skilled in the art from the following detailed description in conjunction with the drawings.

In the drawings:

Figure 1 is a general front view of a chime assembly embodying the present invention.

Figure 2 is an enlarged sectional view taken on line 2—2 of Figure 1, detailing the construction of the switch housing of the primary chime solenoid.

Figure 3 is a sectional view taken on line 3—3 of Figure 2, further illustrating the primary solenoid and its switch housing.

Figure 4 is a sectional view taken on line 4—4 of Figure 1, further illustrating the arrangement of the switch contacts of the primary solenoid.

Figure 5 is a fragmentary end view of the primary solenoid, further illustrating the switch housing.

Figure 6 is a diagram of the electrical circuit showing the action of the primary solenoid and its switch contacts when the two-note push button is depressed.

Figure 7 is a diagrammatic view similar to Figure 6, showing the circuit completed to the secondary solenoid when the push button is released.

General arrangement

Described generally with reference to Figure 1, the two-note chime assembly comprises a primary chime solenoid indicated generally at **10** and a secondary solenoid indicated at **11**, both solenoids being secured upon a mounting panel **12**. The several components of the chime assembly are enclosed within a housing **13** formed of sheet metal, the cover **14** of the housing being broken away to illustrate the general arrangement of the parts. It will be understood that the structure shown in the drawings has been selected to illustrate a typical embodiment of the invention and that the same principles are intended to be utilized with various other arrangements of tone bars and resonator tubes.

According to the present disclosure, the primary and

secondary chime solenoids are mounted adjacent the two tone bars **15** and **16** to strike the tone bars upon being energized. The tone bars are mounted along one side of a resonator tube **17** which is provided with an intermediate wall **18** dividing the tube into two resonator sections. The side wall **20** of the resonator tube includes openings **21** and **22** at opposite end portions providing communication between the tone bars and related resonator sections. The tone bars and resonator sections, by virtue of their respective lengths, are pitched musically to produce two distinctive notes when sounded individually and to produce a harmonious two-note chord effect when sounded in sequence. When the two-note button is depressed, both solenoids are energized in sequence to strike both tone bars and when the single-note button is depressed, the secondary solenoid is energized to strike its tone bar.

In the present structure, the resonator tube **17** is square in cross section and is constructed as a part of the housing **13**, the tube being formed of sheet metal bent to form the side wall **20** and a front wall **23**, the remaining two sides preferably being provided by the back wall and side wall of housing **13**. The tone bars **15** and **16** are mounted upon the side wall **20** by spacers **24**, the tone bars being supported by rivets **25** passing through the spacers. The tone bars are cushioned by means of the rubber grommets **26** interposed between the tone bars and rivets.

The mounting panel **12** which supports the two chime solenoids is detachably mounted within the housing **13** by means of knurled nuts **27** threaded on studs projecting from the bottom of the housing. The panel preferably is spaced outwardly from the bottom of the housing by means of spacers (not shown) to accommodate the electrical wiring which interconnects the two solenoids with one another and with the push buttons and transformer, as explained later. As best shown in Figure 2, the panel **12** is provided with an opening **28** behind each solenoid, such that the wiring, which is indicated generally at **30**, may pass from the solenoids and through the panel. The wiring includes the usual sleeving or covering for insulating purposes.

Solenoid structure

The two solenoids **10** and **11** are of identical construction except that the primary solenoid **10** is provided with a switch housing indicated generally at **31** including switch contacts for energizing the secondary solenoid **11**. Described in detail with reference to Figure 3, each solenoid includes a solenoid tube **32** formed of brass or similar non-magnetic material, with a solenoid plunger **33** formed preferably of cold rolled steel, slidably sustained within the tube. The forward end of the plunger extends partially within the solenoid coil **34** which is wound upon the end portion of the solenoid tube. A sleeve formed of electrical insulating material **35** is interposed between the coil and the tube.

The solenoid plunger includes a stem **36** formed of a non-magnetic material which is pressed into a hole drilled axially into the end of the stem. The plunger is maintained in the retracted position shown in Figure 3 by a compression spring **37** having one end seated against the plunger and having its opposite end seated against a spring retainer cap **38** which is pressed upon the end of the solenoid tube. The retainer cap is provided with an opening **40** to provide clearance for the stem **36**. When the coil **34** is energized, the plunger is propelled sharply to the right, causing spring **37** to be compressed and causing the end of the stem to strike the tone bar as shown in Figure 6.

A coil housing **41**, formed of sheet metal encloses the coil **34**. The coil housing is suitably bent to provide a base **42** which is secured to the panel **12** by means of screws **43** (Figure 2) which pass through the panel into threaded engagement with the base. The coil housing securely embraces the coil and tube and thus provides a secure mounting for the solenoid unit.

The structure so far described applies both to the primary solenoid **10** and the secondary solenoid **11**. However, it will be noted that solenoid **11** includes a rubber cap **44** at its rearward end, which as shown in Figure 6, provides a stop for the solenoid plunger in its deenergized rearward position. The primary solenoid **10** also includes a stop **45** for the same purpose. In this case, the stop is in the form of a pad of sponge rubber mounted within the switch housing **31** and stopping the plunger in a similar retracted position.

The switch housing **31** is formed from an electrical insulating material such as plastic and comprises a base indicated generally at **46** and a cover indicated generally at **47**. The base includes a bore **48** which fits snugly about the solenoid tube **32**, the base being locked in position on the tube by a set screw **50** threaded through the base and engaging the tube. The cover **47** comprises a top wall **51** and a continuous side wall **52** completely enclosing the upper surface **53** of the base. It provides a dust proof chamber indicated at **54** completely enclosing the switch contacts which energize the secondary solenoid as explained later.

As best shown in Figure 5, the side wall **52** includes a lug **55** which depends downwardly and interfits a recess **56** formed in the rearward end of the base. Lug **55** provides a closure for the bore **48** of the base, the cushion stop **45** for the plunger being mounted upon the lug as shown in Figure 3. The cover is secured upon the base by the two screws **57—57** passing through the cover at opposite sides and threaded into the flanges **58—58** formed along opposite sides of the base. The side wall **52** includes enlarged bosses **60** formed upon its internal surface enclosing the shanks of the screws.

For the purposes of energizing the secondary solenoid **11** in response to the operation of the primary solenoid **10**, the switch housing is provided with a pair of stationary contact strips **61—61** which are closed momentarily by a sliding bridge contact indicated generally at **62**. The bridge contact is generally T-shaped as viewed in Figure 5, comprising a cross head **63** having a shank portion **64** depending downwardly and attached to the end of the plunger by a screw **65**. The bridge contact is formed of thin springy sheet metal, such as Phosphor bronze, and the outer ends of the cross head include spherical contact dents **66—66**, which slide upon the top surface **53** of the base. The cross head urges the dents **66** under light spring pressure against the surface **53** and provides a sliding electrical contact bridging the stationary contact strips **61** in passing across them.

To provide clearance from the shank **64** of the bridge contact, the solenoid tube **32** is provided with an elongated slot **67** and the base **46** includes a matching slot **68** communicating with its bore, such that the shank **64** is free to traverse the two slots as the solenoid plunger is reciprocated.

The stationary contact strips **61**, which are also formed of thin Phosphor bronze, are let into the surface **53** of the base, such that the two surfaces are flush. This allows the dents of the cross head to slide smoothly across the contact strips. As shown in Figures 2 and 4, the slot **68** of the base is notched out as at **70** on opposite sides intermediate the length of the slot. A cavity **71** (Figure 2) is formed beneath each notch and the inner ends of the contact strips **61** are clinched over as at **72** within the cavities **71**. This anchors the inner ends of the strips to the base. The screws **57** of the cover pass through the contact strips (Figure 4) and the cover seats upon the strips and securely clamps them in position. Each contact strip is provided with a depending portion **73** which serves as an electrical terminal for the wires which are soldered thereto as indicated at **74**. The soldered wires complete the electrical circuit to the secondary solenoid as described below.

Electrical circuit and operation

As shown in Figures 6 and 7, the chime circuit is energized by a transformer 75 having a primary winding 76 energized by the service lines 77. One side of the secondary winding 78 is connected by way of line 80 to a branch line 81 and through a push button switch 82 to one side of the coil 34 of the primary solenoid 10. Line 80 is also connected by way of branch line 83 with the coil 34 of the secondary solenoid 11. The circuit is completed to the coil of the primary solenoid 10 by way of line 84, such that the solenoid is energized when the push button 82 is depressed.

The circuit to the secondary solenoid is completed from line 84 by way of branch line 85 and through the contacts 61 and 62 of the primary solenoid. It will be seen in Figure 4, that when the primary solenoid plunger is in retracted position against its stop, the bridge contact 62 resides at the left hand side of the stationary contact strips 61, such that the circuit normally is open. When the primary solenoid is energized by operation of push button 82, the plunger 33 moves rapidly toward the right as indicated by the arrow in Figure 6.

According to the present invention, the plunger of the secondary solenoid remains idle as the primary plunger moves toward the right to strike its tone bar. During the power stroke of the primary plunger, the bridge contact wipes across the stationary contacts before the plunger strikes the tone bar; however, the velocity of the plunger during the power stroke under the magnetic field of its coil is so high that the circuit is closed only momentarily. This sends an electrical impulse to the secondary coil but the momentary excitation of the coil is not effective to actuate the secondary plunger. This is due to two factors, the mass of the plunger which causes it to resist sudden acceleration and the lag in the build-up of the magnetic field of the secondary solenoid.

In order to actuate the secondary plunger, the electrical impulse must be of sufficient duration to overcome the effect of plunger inertia and magnetic lag. Therefore, the width of the contact strips 61 is related to the velocity of movement of the sliding bridge to provide the brief, ineffective impulse during the power stroke and to provide an impulse during the return stroke which is of sufficient duration to overcome the magnetic lag and the inertia of the secondary plunger and to actuate it for its full stroke.

The response of the secondary solenoid to the operation of the primary solenoid thus depends upon a balanced relationship between the inertia or mass of the secondary plunger, the time factor (contact width) and the electrical current value. The present structure is intended to be energized by a standard 16 volt chime transformer and the above factors are related to that current value. It will be apparent that the same principles can be applied to an apparatus utilizing a different current value by properly balancing the several factors.

During its movement toward the right as shown in Figure 6, the primary plunger compresses its spring 37, and near the end of its stroke, the tip of stem 36 impinges against the tone bar 15 as indicated in broken lines. After striking the bar, the plunger retracts slightly to the position shown in full lines, providing the air gap indicated at 86 between the stem and tone bar. The plunger remains in this position so long as the push button is held in depressed position keeping the coil energized. It will be noted in Figure 6, that after striking the tone bar, the plunger position causes the sliding bridge contact to reside slightly to the right of the stationary contact strips, with the circuit to the secondary solenoid open.

When the push button is released, as indicated in Figure 7, the compression spring 37 shifts the primary plunger back toward the left as indicated by the arrow. The compression spring is relatively light and has a capacity of storing less than the energy imparted to the plunger by the coil; consequently, the spring provides a rate of plunger return movement which is considerably slower than the movement imparted to the plunger magnetically by the coil. Thus, the width of the contact strips 61 provides an electrical impulse of sufficient duration to actuate the secondary solenoid during the return movement of the primary plunger.

Referring to Figure 6, it will be noted that the bridge contact resides closely adjacent the stationary contacts so as to close the circuit as soon as the primary plunger begins to retract by operation of its spring. The arrangement therefore takes advantage of the starting inertia of the primary plunger, at which time the velocity is low, to lengthen the duration of the electrical impulse. As the bridge contact wipes across the stationary contacts, the secondary coil builds up to full strength then drops off, causing the secondary plunger to strike its tone bar then to return immediately to its retracted position resting against the rubber cap 44. At about the same time, the primary plunger comes to rest in retracted position against its cushion 45.

From the foregoing it will be observed that the structure takes advantage of the rapid power stroke of the primary plunger and the relatively slow spring actuated stroke to energize the secondary solenoid only on the return stroke of the primary plunger. Thus, the chime signal strikes its first note when the push button is depressed and strikes its second note when the push button is released.

To provide the single-note signal for the second door, a circuit, indicated at 87, is connected from the line 84 of the transformer to the line 85 of the secondary solenoid coil. The second push button, indicated at 88, is inserted in line 87. When the push button 88 is depressed, the circuit is completed to the secondary solenoid, bypassing the contacts of the primary solenoid and causing the signal to sound a single note. The two distinct notes sounded by push button 82 and the single note of push button 88 thus indicated clearly which call is to be answered.

Having described our invention we claim:

1. A solenoid mechanism for a two-note chime signal having tone bars, said solenoid mechanism comprising a primary solenoid having a solenoid tube, a primary plunger slidably sustained in said tube, a solenoid coil on said tube, a compression spring seated in said tube having an end engaged against an end of the plunger, said coil upon being energized shifting the plunger in a power stroke at high velocity and compressing said spring, said compression spring urging the plunger at a lower velocity to a retracted position, said plunger adapted to strike a tone bar during said power stroke, a movable electrical contact connected to said plunger and movable therewith, a stationary contact mounted relative to the movable contact in a position to be engaged by the movable contact upon reciprocation of the primary solenoid plunger, a secondary solenoid including a secondary plunger adapted to be actuated to strike a tone bar when the solenoid is energized, said contacts being electrically connected to the secondary solenoid to energize the same when said contacts are closed, said contacts providing an electrical impulse during the power and retracting strokes of the primary plunger, the impulse during the power stroke being of insufficient duration to actuate the secondary plunger and being of sufficient duration during the retracting stroke thereof to actuate the same, whereby the primary plunger is adapted to sound one tone bar during the power stroke thereof and the secondary plunger is adapted to strike a second tone bar upon the retracting stroke of the primary plunger.

2. A solenoid mechanism for a chime signal having a pair of tone bars, said solenoid mechanism comprising a primary solenoid and a secondary solenoid positioned adjacent the respective tone bars, each of said solenoids having a plunger and a solenoid coil for reciprocating

the plunger in a power stroke toward the adjacent tone bar, the plunger of the primary solenoid having spring means connected thereto normally urging the plunger to a retracted position, said spring means having a capacity to store less than the energy imparted to the plunger by the solenoid coil during the power stroke, the spring means thereby providing a retracting stroke having less than the velocity of the power stroke, a movable contact connected to the plunger of the primary solenoid for movement therewith, a stationary contact mounted relative to said movable contact in a position to be engaged by the movable contact upon reciprocation of the movable contact and plunger during said power and retracting strokes, said contact being electrically connected to the coil of the secondary solenoid for energizing the same, said contacts sending an electrical impulse to said coil in response to reciprocation of the plunger of the primary solenoid in said power and retracting strokes, the velocity of the plunger during said power stroke providing an electrical impulse which is incapable of actuating the plunger of the secondary solenoid and being of sufficiently less velocity during the retracting stroke to provide an electrical impulse capable of actuating the plunger of the secondary solenoid, whereby the plunger of the primary solenoid strikes one tone bar when said solenoid is energized and the plunger of the secondary solenoid strikes the second tone bar when the primary solenoid is deenergized.

3. A solenoid mechanism for a chime signal having a pair of tone bars, said solenoid mechanism comprising a primary solenoid and a secondary solenoid positioned adjacent the respective tone bars, each of said solenoids having a plunger and a solenoid coil for reciprocating the plunger in a power stroke at a given velocity toward the adjacent tone bar, the plunger of the primary solenoid having spring means connected thereto normally urging the plunger to a retracted position, said spring means having a capacity to retract the plunger at a velocity less than that imparted to the plunger by the solenoid coil during the power stroke, a movable contact connected to the plunger of the primary solenoid for movement therewith, a pair of spaced stationary contacts mounted relative to said movable contact in a position to be contacted by the movable contact upon reciprocation of the movable contact and plunger in said power and reciprocating strokes, thereby to complete the circuit across the stationary contacts, said stationary contacts electrically connected to the coil of the secondary solenoid for energizing the same, said contacts sending an electrical impulse to said coil in response to reciprocation of the plunger of the primary solenoid in said power and retracting strokes, the width of said stationary contacts being related to the velocity of the primary plunger during said power and retracting strokes to provide an electrical impulse which is too short in duration during said power stroke to actuate the plunger of the secondary solenoid and which is of sufficient duration during the retracting stroke to actuate the plunger of the secondary solenoid, whereby the plunger of the primary solenoid strikes one tone bar when said solenoid is energized and the plunger of the secondary solenoid strikes the second tone bar when the primary solenoid is deenergized.

4. A solenoid mechanism for a chime signal having tone bars, said solenoid mechanism comprising a primary solenoid having a solenoid tube, a plunger slidably sustained in said tube, a compression spring seated in said tube and having an end engaged against the plunger, said solenoid advancing the plunger in a power stroke in one direction at a given velocity and said spring retracting the plunger in the opposite direction at less velocity, the plunger adapted to strike one of said tone bars during said power stroke, a switch housing formed of electrical insulating material mounted on said solenoid tube and having an internal chamber, a stationary contact mounted in said chamber, a movable contact disposed in said chamber in position to engage the stationary contact, connecting means attaching the movable contact to the solenoid plunger for movement therewith, said solenoid tube and housing including a slot communicating with said chamber and providing clearance for the said connecting means, whereby the movable contact reciprocates and wipes across said stationary contact upon reciprocation of the plunger in said power and retracting strokes, and a secondary solenoid having a plunger arranged to strike one of said tone bars, said stationary and movable contacts connected to said secondary solenoid to send an electrical impulse thereto in response to the reciprocations of the movable contact, the impulse sent during the power stroke having a duration insufficient to actuate the plunger of the secondary solenoid, the impulse sent during the retratcing stroke having sufficient duration to actuate the same, whereby the plunger of the primary solenoid strikes one tone bar upon being energized and the plunger of the secondary solenoid strikes a second tone bar when the primary solenoid is deenergized.

5. A solenoid mechanism for a chime signal having tone bars, said solenoid mechanism comprising a primary solenoid having a solenoid tube, a plunger slidably sustained in said tube, a compression spring seated in said tube and having an end engaged against the plunger, said solenoid advancing the plunger in a power stroke in one direction at a given velocity and said spring retracting the plunger in the opposite direction at less velocity, the plunger adapted to strike one of said tone bars during said power stroke, a switch housing formed of electrical insulating material mounted on said solenoid tube and having a flat bearing surface, a pair of spaced contact strips mounted in flush relationship with said flat bearing surface and extending generally at right angles to the solenoid tube, a bridge contact having a cross head slidably engaging the flat surface of the switch housing, the bridge contact having a shank portion connected to said plunger, said solenoid tube and housing including an elongated slot providing clearance for said shank portion, whereby the bridge contact reciprocates and wipes across said spaced stationary contacts upon reciprocation of the plunger in said power and retracting strokes, and a secondary solenoid having a plunger arranged to strike one of said tone bars, said spaced contact strips connected to said secondary solenoid to send an electrical impulse thereto in response to the reciprocations of the bridge contact, the impulse sent during the power stroke having a duration insufficient to actuate the plunger of the secondary solenoid, the impulse sent during the retracting stroke having sufficient duration to actuate the same, whereby the plunger or the primary solenoid strikes one tone bar upon being energized and the plunger of the secondary solenoid strikes a second tone bar when the primary solenoid is deenergized.

6. A solenoid mechanism for a multiple-note signal having two or more tone elements, said solenoid mechanism comprising a primary solenoid having a solenoid tube, a primary plunger slidably sustained in said tube, a solencid coil on said tube, a compression spring seated in said tube and having an end engaged against the end of the plunger, said solenoid coil upon being energized shifting the plunger in a power stroke at high velocity and compressing said spring, said compression spring urging the plunger at a lower velocity to a retracted position, said plunger striking one of said tone elements during said power stroke, a movable circuit-closing element connected to the plunger of the primary solenoid for movement therewith, a stationary circuit-closing element mounted relative to the movable circuit-closing element in position to be engaged by the said movable element upon reciprocation of the primary solenoid plunger, a secondary solenoid including a secondary plunger, said secondary

plunger striking another of said tone elements upon being energized, said movable and stationary circuit-closing elements being electrically connected to the secondary solenoid and energizing the same when the said elements are engaged, said circuit-closing elements engaging one another and providing an electrical impulse during the retracting stroke of the primary plunger, said impulse having sufficient duration to energize the secondary solenoid during said retracting stroke, whereby the said primary plunger strikes one tone element during the power stroke thereof and the secondary plunger strikes another tone element upon the retracting stroke of the primary plunger.

7. A solenoid mechanism for a two-note chime signal having a pair of tone elements, said solenoid mechanism comprising a primary solenoid having a solenoid tube, a primary plunger slidably sustained in said tube, a primary solenoid coil on said tube, a spring element connected to the primary plunger, said primary solenoid coil upon being energized shifting the plunger in a power stroke at high velocity and activating said spring element, said spring element having a capacity to store less energy than the energy imparted to the plunger by the primary solenoid coil, said spring element urging the plunger at a lower velocity to a retracted position, said plunger striking one of said tone elements during said power stroke, a movable circuit-closing element connected to the plunger of the primary solenoid for movement therewith, a second circuit-closing element mounted relative to the movable circuit-closing element in stationary position relative to the path of travel of the movable circuit-closing element to be engaged by the movable element upon reciprocation of the primary solenoid plunger, a secondary solenoid including a secondary plunger, said secondary plunger striking the second of said pair of tone elements upon being energized, said movable and second circuit-closing elements being electrically connected to the secondary solenoid and energizing the same when the said elements are engaged, said circuit-closing elements engaging one another and providing an electrical impulse during the retracting stroke of the primary plunger, said impulses having sufficient duration to energize the secondary solenoid during said retracting stroke, whereby the said primary plunger strikes one tone element during the power stroke thereof and the secondary plunger strikes the second sound element upon the retracting stroke of the primary plunger.

8. A solenoid mechanism for a two-note chime signal

having a pair of tone elements, said solenoid mechanism comprising a primary solenoid having a solenoid tube, a primary plunger slidably sustained in said tube, a primary solenoid coil on said tube, a spring element connected to the primary plunger, said primary solenoid coil upon being energized shifting the plunger in a power stroke at high velocity and activating said spring element, said spring element having a capacity to store less energy than the energy imparted to the plunger by the primary solenoid coil, said spring element urging the plunger at a lower velocity to a retracted position, said plunger striking one of said tone elements during said power stroke, a switch housing formed of electrical insulating material mounted on the primary solenoid tube and having an internal chamber, a movable circuit-closing element connected to the plunger of the primary solenoid for movement therewith, a stationary circuit-closing element mounted relative to the movable circuit-closing element in the chamber of said switch housing, said stationary circuit-closing element being located in a position to be engaged by the movable circuit-closing element upon reciprocation of the primary solenoid plunger, a secondary solenoid including a secondary plunger, said secondary plunger striking the second of said pair of tone elements upon being energized, said movable and stationary circuit-closing elements being electrically connected to the secondary solenoid and energizing the same when the said elements are engaged, said circuit-closing elements engaging one another and providing an electrical impulse during the retracting stroke of the primary plunger, said impulse having sufficient duration to energize the secondary solenoid during said retracting stroke, whereby the said primary plunger strikes one tone element during the power stroke thereof and the secondary plunger strikes the second sound element upon the retracting stroke of the primary plunger.

References Cited in the file of this patent

UNITED STATES PATENTS

1,098,893	Dinsmoor	June 2, 1914
2,263,051	Rittenhouse	Nov. 18, 1941
2,293,671	Alexander	Aug. 18, 1942
2,307,104	Bossard	Jan. 5, 1943
2,333,448	Seeley	Nov. 2, 1943
2,350,289	Miller	May 30, 1944
2,414,961	Masonet	Jan. 28, 1947