Oct. 3, 1950 L. C. KING 2,524,320

ELECTROMAGNETIC BELL STRIKER

Filed Sept. 27, 1947

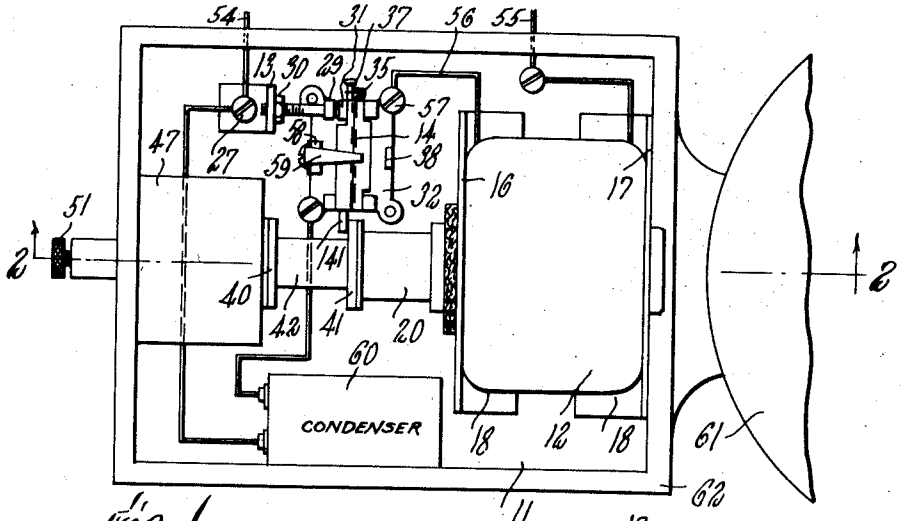

Fig. 1.

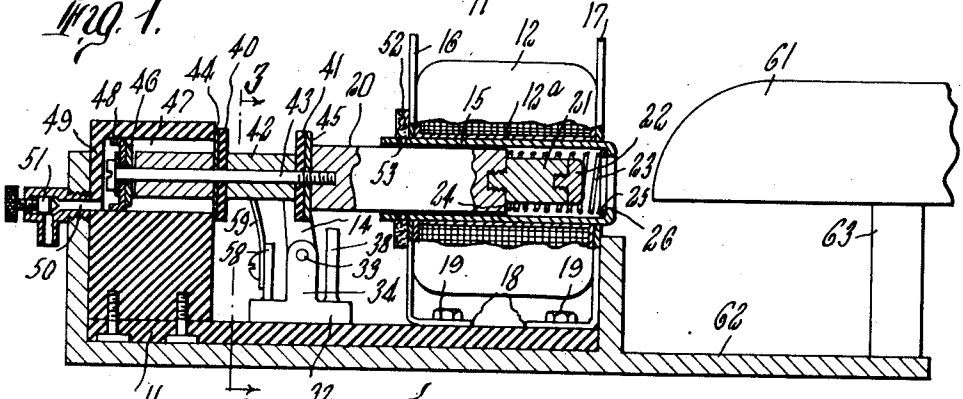

Fig. 2.

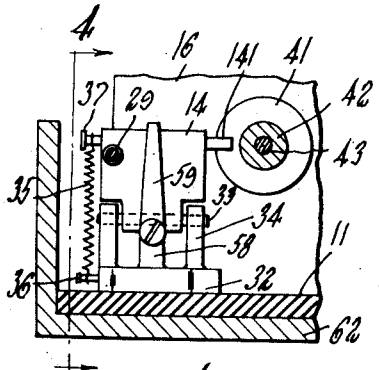

Fig. 3.

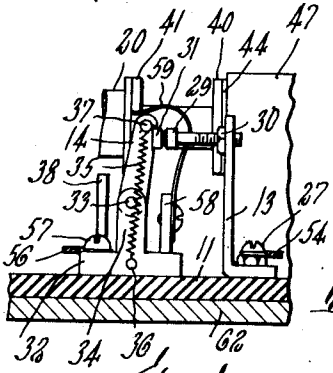

Fig. 4.

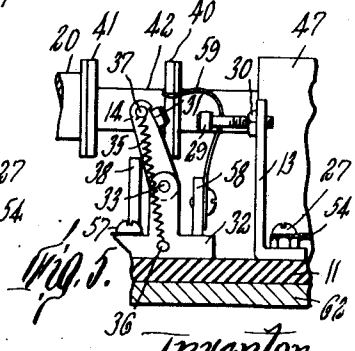

Fig. 5.

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Patented Oct. 3, 1950

2,524,320

UNITED STATES PATENT OFFICE

2,524,320

ELECTROMAGNETIC BELL STRIKER

Louis C. King, Quincy, Mass.

Application September 27, 1947, Serial No. 776,548

1 Claim. (Cl. 172—126)

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The present invention relates to the general field of electric bells, but is of special character and is adapted to perform services of which no other electric bells within my knowledge are capable. There is a crying need for warning bells which will make a noise loud enough and penetrating enough to be heard at a far enough distance from unguarded railroad crossings to give a safe warning of approaching trains, and to be sharply heard over the din and racket of large machine shops, shipyards, and other localities where noisy machines are in operation, the hammering and the lifting and dropping of heavy weights are going on, or other conditions exist which tend to distract the attention of persons in the vicinity. For instance, heavy mobile machines, such as gantry cranes which travel on tracks, are employed in shipyards and large shops, and such machines when once started in motion cannot be quickly stopped. People who may be in the way of such a moving machine and do not see it coming are liable to be killed or seriously hurt. The noise in the places where such cranes are used is generally so loud and confused as to smother warning shouts and the sound of any such warning bells or gongs as have heretofore been available on the market.

The purpose of the present invention is to provide an automatic warning bell for the uses above indicated and many other uses, including means for striking the bell with such force as to make a loud and penetrating ringing noise, with repeated blows at intervals sufficiently far apart to permit full amplitude of vibration of the bell and compel the attention of all who are able to hear it. A related object is to provide in combination with the foregoing, convenient and easily operated means for adjusting and varying the frequency rate of the striking means. Further objects are to furnish a rugged, durable apparatus for the purpose set forth capable of long continued effective use under severe conditions of mechanical shock and vibration and when activated by electric current of relatively high voltage.

These objects are accomplished by the apparatus or device described in the following specification and illustrated in the drawings. The invention consists in the novel features and combinations embodied in said device, and in all equivalents thereof and their fundamental principles.

In the drawings,

Fig. 1 is a plan view of an electro-magnetic bell striker embodying this invention;

Fig. 2 is a longitudinal axial section of the striker apparatus taken on line 2—2 of Fig. 1;

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Fig. 3 is a partial cross section taken on line 3—3 of Fig. 2;

Fig. 4 is a side elevation of the parts shown in Fig. 3 and a section taken on line 4—4 of that figure;

Fig. 5 is a view similar to Fig. 4, but showing the circuit breaker in open circuit position and the actuating means therefor in a corresponding position.

Like reference characters designate the same parts wherever they occur in all the figures.

The main parts of the striker apparatus include a base 11 of insulating material, a solenoid coil or winding 12, a stationary holder 13 for one of the terminals or contacts of an electric circuit making and breaking device, and a movable contact carrier or circuit interrupter 14; all suitably mounted on and secured to the base 11.

The coil 12 is wound as a self-contained unit on a spool or sleeve 12a which surrounds a tube 15 made of nonmagnetic material, for instance brass. This tube is supported by plates or brackets 16 and 17 which have feet 18 turned toward one another and secured to the base 11 by screws 19; the tube thus constituting both a support for the coil 12 and a guideway for the solenoid core 20. It protrudes at both ends from the brackets sufficiently to be adequately supported and to serve the purposes later explained. It may be connected to one or both brackets by solder or other means effective to hold it securely against displacement but which permit easy disconnection in case need arises to substitute a new or different coil.

The core 20 is made of iron or mild steel with a free sliding fit in the tube 15. It carries on the end which, for the purposes of this specification, is called the forward end, an extension 21 of nonmagnetic metal which, in turn, carries on its forward end a striker head 22, of hard steel or other material suitable to withstand wear and to cause a loud ringing of a bell against which it may be caused to strike. A helical spring 23 surrounds the core extension 21 and is confined under compression between a shoulder 24 on the core and a washer 25 which lies against an internal shoulder 26 at the forward end of tube 15. Spring 23 is stiff enough and long enough to retract the core as rapidly as permitted by the timing regulator later described, and to such extent that the magnetic core is brought to a position of magnetic unbalance with respect to the coil, when the coil is deenergized. It is not so strong, however, as to prevent the core from being advanced suddenly

and with accelerating speed by magnetic force when the coil is energized.

The stationary contact holder 13 is a rigid bracket of electrically conductive metal, such as brass or steel, having a foot portion which is secured to the base 11 by a screw 27, and an upright portion which supports a contact piece or circuit terminal 29. This terminal has a screw threaded shank which passes through an internally threaded hole in the upstanding part of the holder 13, whereby it may be rotated to adjust its contact extremity forward or back. A lock nut 30 or, if desired, a pair of lock nuts, is applied to the threaded shank to secure the terminal in its various adjusted positions.

The circuit interrupter 14 carries a contact or terminal 31 arranged to cooperate with the contact 29. It is a plate or bar of electrically conductive metal, to which the terminal 31 is secured conductively, mounted on a base block 32 of electrically conductive material which is secured to the base 11; connection being made between the interrupter and base block by a pivot pin 33 passing through the lower end of the interrupter and through posts 34 which rise from the block and embrace the lower end of the interrupter.

The pivot 33 is at a substantial height above the base 11, whereby the linear movement imposed on the interrupter 14 causes it to swing through a wide angle. A helical tension spring 35 is connected to the base block by a pin 36 at a substantial distance below the pivot, and to the interrupter 14 by a pin 37 at a substantial distance above the pivot. The interrupter is so located that when its contact piece 31 bears against contact piece 29, the spring is at the same side of the pivot 33 as contact 29 and exerts force tending to hold the movable contact in circuit closing position. But the interrupter 14 is free to move away from the contact 29 far enough to bring the spring to the opposite side of the pivot, its movement in that direction being limited by any suitable stop means, here illustratively indicated as a post 38 rising from the base block 32 beside the interrupter to a height above pivot 33. The position established by this stop is shown in Fig. 5. Thus spring 35 is adapted to hold the movable member of the circuit closer against accidental displacement when in the open circuit position, and to bring it rapidly into circuit closing position when it has been moved past the dead center from the position shown in Fig. 5.

For thus moving the interrupter 14 past the dead point in either direction, shifter members 40 and 41 and an intermediate spacer 42, all of insulating material, are connected with the solenoid core 20 by a rod 43 which passes through them and is secured to the rear end of the core in alinement therewith. These shifter members are conveniently made as disks, which may be reinforced by metal disks 44 and 45, respectively, at their outer faces. They are located so as to embrace a projection 141 on the side of the upper end portion of the interrupter 14 and to engage and move the interrupter when the core is moved endwise. They are spaced apart and located with respect to the limits of movement of the core and to the location of the interrupter so that the shifter 40 will engage the interrupter and shift it from the circuit closing position to slightly beyond its dead point with respect to the pull of spring 35 just before the core reaches the end of its forward movement, that is, its position when its striker head 22 hits the bell. The other shifter member 41 is located to engage the interrupter 14 during the spring-retracted movement of the core and to bring the interrupter past its dead point when the core reaches its prescribed limit of rearward movement. Thus the core, in its back and forth movements, causes the circuit of the solenoid to be alternately made and broken.

The effectiveness of my striker mechanism for achieving its intended purpose depends principally on two main features. One is the winding of the solenoid to exert a powerful magnetic pull when energized. The other is an adjusting means by which the striking frequency of the core may be regulated and made sufficiently slow to afford appreciable intervals between successive strokes. The regulator in the embodiment here shown comprises a piston 46 carried by the solenoid core on the remote end of rod 43 in rearward extension from the shifter member 40, and contained in a cylinder 47. Such cylinder may be formed in a block of non-conductive material secured to the base 11, and such block may be disposed with a portion in the path of the disk 44 located to serve as a stop for establishing the rearward limit of movement of the core.

Piston 46 includes a flexible cup washer, the rim 48 of which faces rearwardly (with respect to the striking movement of the core) toward the head wall 49 of the cylinder. A vent passage 50 leads from the head end of the cylinder and is controlled by a needle valve 51 so as to regulate the effective area of the passage. The opposite end of the cylinder is open to the atmosphere so as to admit air freely to the cylinder space back of the cup washer when the core is magnetically impelled. Thus the piston makes no appreciable resistance to the outward or striking movements of the core, but it prevents escape of air from the open end of the cylinder when the core is retracted, and so retards the speed of retracting movements thereof to the speed of escape of air through the restricted channel past the valve 51. By adjustment of the valve, any desired striking frequency, less than the maximum possible, can be obtained.

The cup washer 48 is, in effect, a valve which permits substantially free passage of air, or passage with very little resistance, into the space between the piston and closed end of the cylinder when the piston is moving outwardly, but confines the air in such space when the piston is moving toward the cylinder head. Other valve means having the same essential function and effect are within the range of equivalents of this phase of the invention.

The core 20 has a sliding fit in the tube 15, as previously noted. It is lubricated by the disk or pad 52 which surrounds the rear end of tube 15, protruding from bracket 16, and is saturated with oil. Holes 53 in that part of the tube that is surrounded by the disk 52 permit flow of oil between the rubbing surfaces of the core and tube.

The electric circuit for this apparatus comprises a line wire 54 connected with the contact terminal 29 by the screw 27, which serves as a binding post, and a line wire 55 connected with one terminal of the solenoid winding. The other terminal of this winding is connected with the block 32 by a conductor 56 and binding screw 57. A conductive post 58 rises from block 32 at the opposite side of interrupter 14 from the stop post 38 and supports a spring strip 59 of conductive metal, which extends upwardly and is curved over so that its extremity is brought in rubbing contact with the upper end of the interrupter 14 when the latter is in and near the position where

the contact 31 bears on contact 29. A condenser 60 is connected across the circuit breaker terminals to suppress the arc which tends to form when the movable contact is withdrawn from the fixed contact.

The apparatus thus described is mounted, together with a bell 61, on a frame or supporting structure 62 of any suitable character. The bell is supported by a post 63 with a portion of its rim in the path of the striker head 22 at a distance from the solenoid short of the possible limit of forward movement of the striker, and preferably as nearly as possible to the point reached by the striker head when the core has attained its maximum velocity. The bell here shown is of the gong type, but obviously any other type of bell may be used.

The striker mechanism is set in operation by closing a switch in the main circuit. The coil 12 is thereby energized, which causes the core 20 to move forward with a rapid acceleration. When it has nearly attained its maximum velocity, but before it has struck the bell, the shifter collar 40 engages the interrupter 14 and suddenly withdraws the contact 31 from contact 29. Continuing movement of the core before striking the bell propels the interrupter beyond its dead center position, so that it is held by its spring 35 away from the stationary contact until return of the core. During return movement, which is retarded by the piston 46, and when the core has nearly reached its limit of return movement, the interrupter is moved by the shifter 41 rearwardly past its dead point, and spring 35 then causes it to close the circuit until the next forward stroke has progressed to the point previously described.

In addition to the features previously described, it should be noted that the base block 32 for the circuit interrupter, and the holder 13 for the stationary contact, are located on the insulating base 11 with spaces of substantial width between them and between each of them and the nearer supporting standard (16) of the solenoid. This disposition of these electrically conductive members affords ample insulation between parts which are at different electrical potentials and between which the difference of potential may at times be very great. For instance, when the current is shut off from the solenoid coil, the magnetism subsides instantly, and the contracting lines of magnetic force cut the windings of the coil and generate a high counter electromotive force which is impressed on the bracket 16. Still greater inductive reactances are developed from operation of the electrical equipment of machines, such as cranes, on which the bell may be installed. The separation between this bracket and parts of the circuit interrupter prevents jumping of current from the bracket to the circuit controller under difference of potential of as much as 1800 volts.

Apparatus made in accordance with the foregoing disclosure has proved to be singularly effective in giving warning in situations such as those mentioned in the introductory part of this specification. It delivers powerful impacts to the bell at intervals frequent enough to afford an insistent warning, but separated sufficiently to enable the bell to ring with full resonance. By way of illustration I may say that a desirable frequency of striking is two or three strokes per second, and these frequencies are well within the limits of the speed regulating device. Slower frequencies than these may be obtained if desired.

This application is a continuation-in-part of my application Serial No. 572,113, filed January 10, 1945, entitled Electro-Magnetic Bell Striker, now abandoned.

What I claim is:

A bell striker mechanism comprising a supporting structure, a solenoid mounted thereon, a core movable through the solenoid, a spring acting on said core normally holding it in a position of magnetic unbalance with respect to the solenoid and with one end projecting therefrom, a piston carried by the said projecting end of the core, a cylinder in which said piston is contained for axial movement, having a closed end remote from the solenoid and a valve controlled vent opening into the space adjacent to said closed end, the piston having a valve portion disposed to permit flow past it of air into the space between it and the closed end of the cylinder when moving away from such closed end and to prevent escape of air when the piston moves toward the closed end, a make and break device in circuit with the solenoid winding, means carried by the core for causing said device to complete the circuit when the core is projected by its spring, and to break the circuit when the core is shifted by magnetic flux, and a strike extension on the opposite end of the core from the piston arranged to be projected from the solenoid when said core is advanced by the magnetic effect of the energized solenoid.

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