

May 17, 1955

H. L. LEACH
MUSICAL INSTRUMENT

2,708,337

Filed Nov. 1, 1950

4 Sheets-Sheet 1

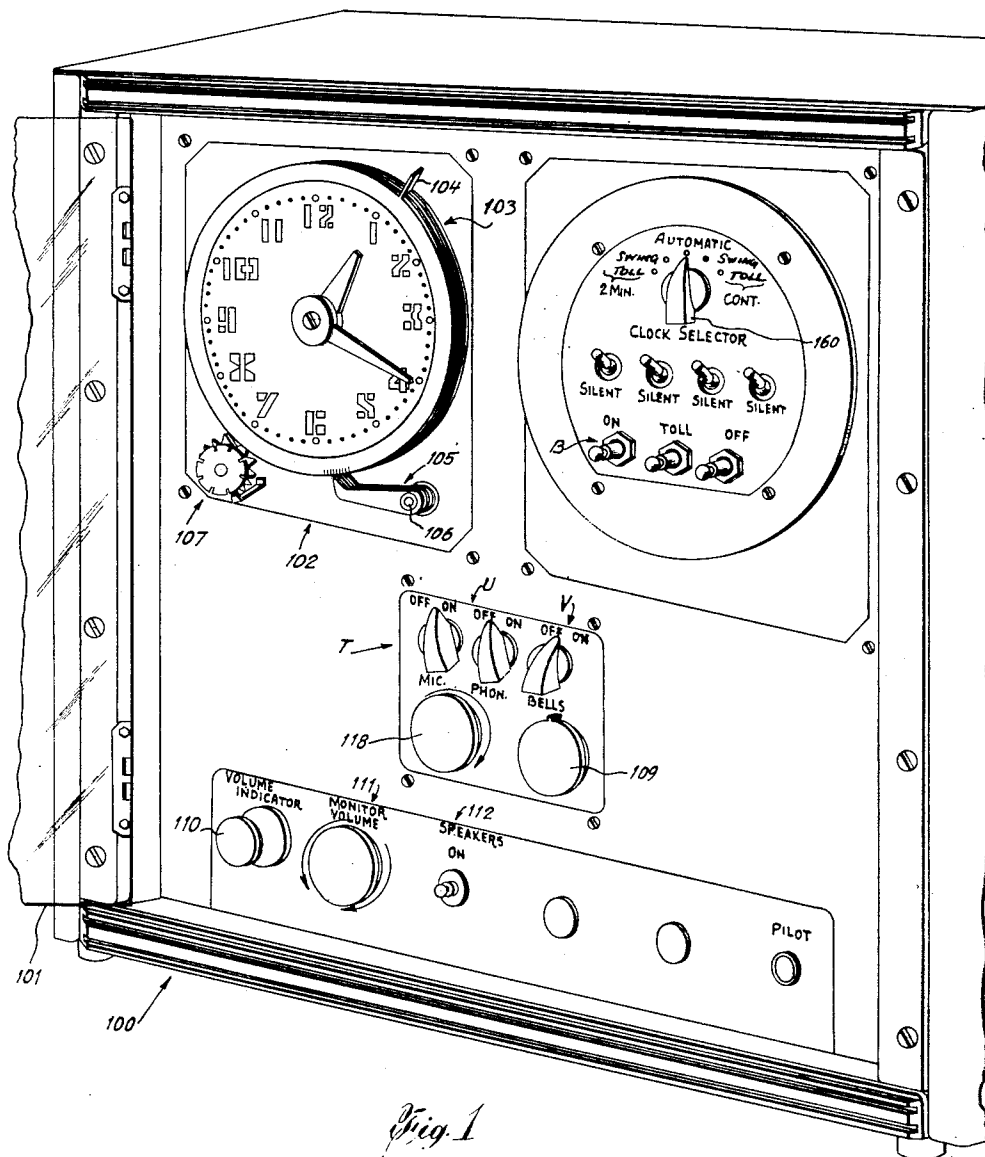


Fig. 1

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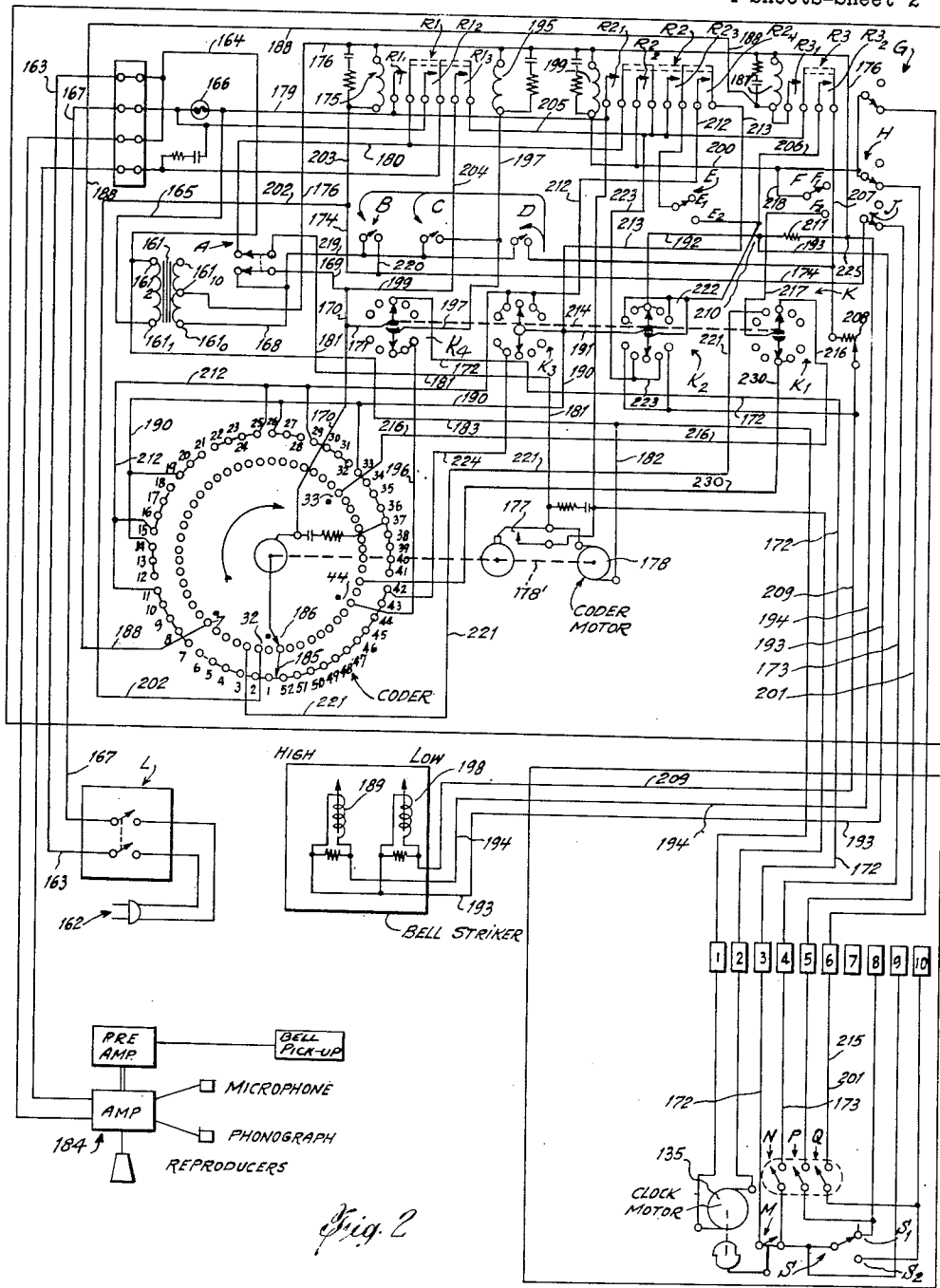


Fig. 2

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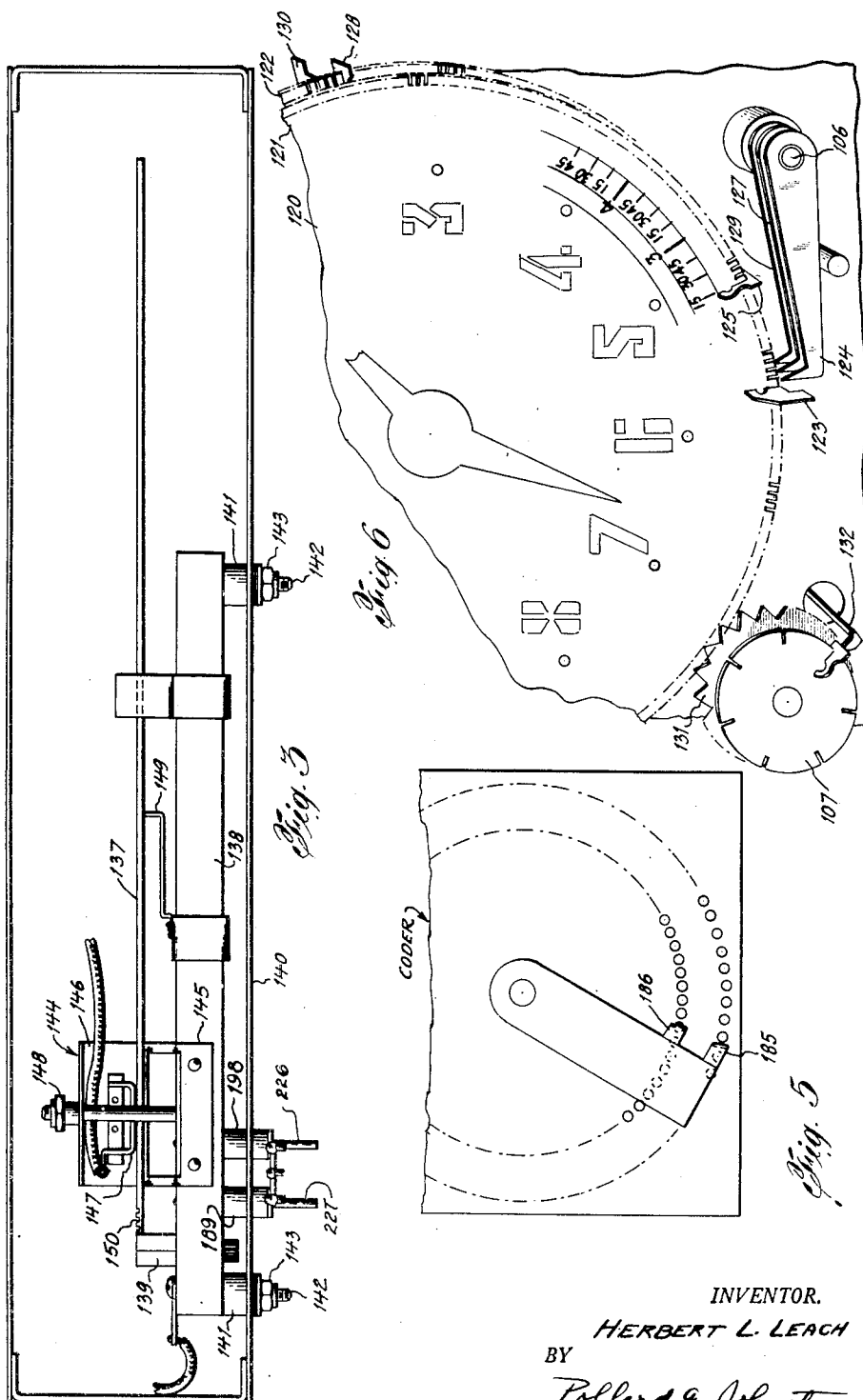
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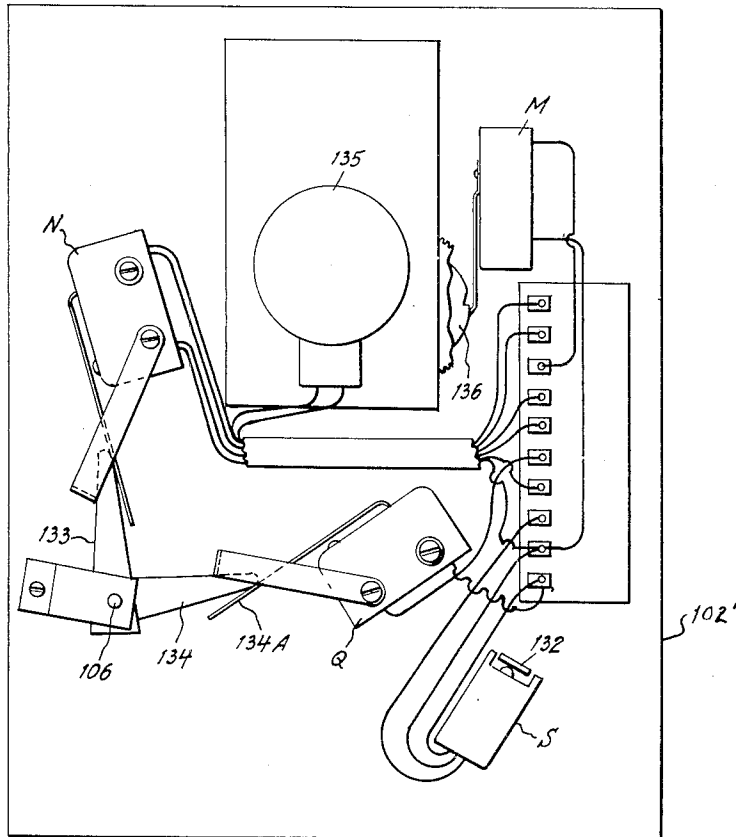
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Fig. 4



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MUSICAL INSTRUMENT

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Application November 1, 1950, Serial No. 193,401

9 Claims. (Cl. 58—38)

This invention relates to an apparatus and method for automatically or manually operating bells or other similar devices according to predetermined programs or as desired.

The invention will be described particularly in conjunction with the operation of a liturgical bell arrangement. Often, for church purposes, certain programs of striking bells are desired. For example, the Angelus bell is employed in conjunction with church services, the bell being struck in a predetermined manner using groups of strikes, all of the groups not having the same number of strikes. It also may be desired to have the bell strike in a particular manner at certain times during the day, such as the Mass bell. Sometimes it is desired to have an automatic tolling bell strike wherein the bell is struck or sounded as a series of strikes, the strikes being slow and uniformly repeated. At other times, it may be desired to have a swinging bell effect, or the sound which occurs when a cast or campaniform bell is swung, the clapper remaining under the influence of gravity and striking the edge of the bell as the bell is swung. As the mouth of the bell is swung toward the listener, a higher tone will be heard when the clapper strikes the side of the bell, than is heard when its clapper strikes the other side of the bell with the mouth of the bell away from the listener. This will be referred to as a "swinging" bell strike.

In prior practice, heavy cast or campaniform bells have been required which must be situated in heavy tower structures, often impossible in the small or average church. Also, it has been necessary for someone to manually operate the bells, requiring considerable attention and physical effort. As an example, the bell tone involved can be "G" below middle "C" which would need a 13,000 pound cast bell.

One of the objects of the present invention is to provide an automatic arrangement for striking and producing bell tones according to predetermined programs.

Another object of the invention is to provide an automatic means for operating bells which can be changed or adjusted to give various effects and programs.

Another object of the invention is to provide an arrangement in which the bell tones or strikes can be initiated by manually controlled mechanisms.

Still a further object of the invention is to provide an arrangement whereby a swinging bell strike, a tolling bell strike, or combinations thereof, can be produced.

A still further object of the invention is to provide an arrangement wherein the conventional cast bell can be eliminated.

In one aspect of the invention, a coding switch device or mechanism connectable with switching or relay circuits to choose one of a plurality of programs for operating suitable mechanisms can be connected with a program selecting means, such as clock means, the program selecting means being capable of choosing and setting up or connecting the switching or relay circuits in various combinations to produce the desired program and also activating the coding device.

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In a preferred aspect, a program clock can be arranged to operate a coder switch controlling the striking mechanism for a bell tone producing apparatus, the bell tone producing apparatus preferably being one including electronic devices for producing the bell tone, although the impulses can be used otherwise for other purposes. The clock can be made so as to operate the coder switch for controlling the bell tone devices in different manners or programs according to the days of the week. Various switches can be provided, as will be explained in detail hereafter, to cause automatic operation of the bell, or to permit manual operation of the bell. The manual operations can be for predetermined periods of time, or can continue until manually stopped.

In a still further aspect of the invention, a striker mechanism is provided for a vibrator, producing either a single bell note or tone, tolling bell notes, or swinging bell notes.

These and other objects, advantages, and features of the invention will become apparent from the following description and drawings which are merely exemplary.

In the drawings:

Fig. 1 is a perspective front view of the control cabinet.

Fig. 2 is a wiring diagram of one form of the invention.

Fig. 3 is an enlarged view of one form of vibrator and striker means which can be used in conjunction with the invention.

Fig. 4 is an enlarged rear view of the clock showing certain details of the mechanism.

Fig. 5 is an enlarged fragmentary rear view of the coder, showing some of the structural details thereof.

Fig. 6 is an enlarged fragmentary view of the clock and program discs with related apparatus.

The invention will be described in conjunction with a bell tone producing apparatus but it is to be understood that it, or portions thereof, can be employed for controlling or operating other mechanisms or apparatus to be operated according to desired programs and in response to electrical pulses.

Merely by way of example, the apparatus can be designed and arranged for bell tone apparatus as described hereafter to perform the following functions:

1. An automatic Angelus bell operating automatically at pre-set times each day of the week, the usual sequence of 3-3-3-9 strikes being used. The last nine strikes can be as a tolling bell or as a swinging bell.

2. An automatic swinging bell, such as a Mass bell, striking automatically for a predetermined duration at selected times. The time of striking can be the same for one group of days and can be changed for another group of days. For example, the Sunday times can be different than the times of striking on other days of the week.

3. The operation as described for the automatic swinging bell in 2 can be made to function as a tolling bell.

4. A semi-automatic tolling bell or a semi-automatic tolling bell operating for a predetermined duration, such being started by manually manipulating a switch, the shut-off being automatic at the end of the period for the predetermined period.

5. A continuous tolling bell or swinging bell, the operation being started and stopped by manipulation of a manual switch or switches. In the case of the swinging bell operation, the first few strokes may be as a tolling bell simulating the commencing of operation of a big bell before it has complete swinging movement.

6. A manually controlled tolling bell strike operated by manipulation of a push button.

The instrument is shown generally in Fig. 1 wherein a cabinet 100 can be employed to house the various mechanisms including the bell tone producing apparatus or parts thereof. The cabinet may have a transparent door 101 of plastic or similar material to cover the various switches and clock mechanism, opening of said door

giving access to the control switches and clock, said door being provided with suitable lock means to prevent tampering with the settings, yet permitting the positions of the switches to be seen. Clock 102 may have a plurality of program discs generally shown at 103 thereon, the discs having adjustable operating keys, one being shown at 104, the discs and keys being described in detail hereafter. A plurality of program time levers 105 are pivoted at 106 and are suitably contacted by the various operating keys or pins on the discs, the program time levers in turn operating switches on the rear of the clock panel 102' (Fig. 4).

A calendar disc 107 is used to select the desired program for the day or days involved, for example, to change from a weekday setting to a Sunday setting.

A suitable volume control arrangement 108 can be provided for controlling the volume of the loud speakers employed in the tower or elsewhere. Control knob 109 can be used for the purpose of controlling the tone by adjusting conventional filter and tone control circuits in the amplifiers. For example, the treble or the bass can be emphasized as desired, thus varying the bell tone from deep sonority to a high brilliance.

The amplifiers and associated loud speakers in the tower, or elsewhere, can be employed for other purposes in addition to producing bell tones. Switch T can be used to connect a microphone input to the amplifier circuit and switch U can be used to connect a phonograph or record player input to the amplifier. Switch V can be used to connect the bell tone arrangement with the amplifier circuit, this being turned on when it is desired to employ the bell tone producing apparatus described herein. A volume indicator arrangement 110 can be used to give an indication of the volume or maximum volume being delivered or to be delivered to the loud speakers. The volume of the monitor speaker, if used, is controlled by knob 111, and switch 112 can be used to turn the tower speakers "on" or "off," this latter switch normally being in "on" position.

Clock and program discs

The clock (Fig. 6) may be of the conventional synchronous type having a dial 120 and a pair of discs 121, 122, disc 121 being the front program disc upon which can be set up the keys or pins for a weekday program of operation and also the Angelus program. The rear program disc 122 can have the Sunday program thereon and also can carry the calendar disc operating pin. It is to be understood that the disc can be used in various manners by setting the pins appropriately and connecting circuits to be controlled as needed.

The front program disc 121 has offset pins 123 which are selectively placed in slots in the disc so as to contact the Angelus time lever 124 only at the desired time. The disc, as illustrated, is arranged to have the slots placed at five minute intervals. "Offset" in referring to the pins means that the operating portion of the pin is offset or spaced from the plane of the dial or the other row of pins on the dial. Thus, an offset pin in the disc can be used to operate a switch lever other than the one operable by a straight pin in the same disc. Straight pins 125 are placed in the front disc and arranged to operate the weekday time lever 127. Straight pins 128 can be placed in appropriate slots in the rear program disc 122 for operating program time lever 129 for Sunday operation.

In addition to the straight pins in the rear disc, an offset pin 130 can be provided for the purpose of contacting the toothed star wheel arrangement 131 for operating the calendar disc 107. The toothed star wheel may have a spring or suitable yieldable detent (not shown) for yieldably holding the calendar disc. The calendar disc 107 is cooperable with a calendar time lever 132 for the purpose which will be described hereafter.

The two program discs are geared to the clock in such

a manner that they will make one revolution for every two complete revolutions of the clock. In other words, the program discs represent a 24 hour time period for one revolution; whereas the clock hands represent a 12 hour time period for one revolution.

The program time levers are mounted on conventional concentrically arranged shafts so that they operate independent of each other and move appropriate levers at the rear of the clock panel for controlling switches.

Lever 133 (Fig. 4), operated by program time lever 124, cooperates with switch N to operate the same. There is a lever (not shown) aligned with and behind lever 133 which is operated by program time lever 127 for controlling switch P (not shown) located behind switch N. The Sunday program time lever 129 operates lever 134 to control switch Q. Lever 134 oscillates lever 134A which in turn operates switch Q. The switches N, P and Q may be of a snap acting variety such as ones sold under the trademark "Micro-switch."

The synchronous clock motor is illustrated at 135 (Figs. 2 and 4), said clock motor being suitably connected to the A. C. power source.

A 15 second, or similar period, pulse switch M is operable by means of cam 136 (Fig. 4) driven by clock motor 135, said switch furnishing a short pulse every five minutes in a predetermined relationship with the closing of one of the program time levers by pins on the program discs. The calendar switch S is operated by the calendar time lever 132 to shift operation of the apparatus from one program disc to the other.

As can be seen from Fig. 6, the program time levers 124, 127, and 129 have sloping faces which are contacted by the various pins. The program time levers are arranged to operate their respective switches $2\frac{1}{2}$ to $4\frac{1}{2}$ minutes before the time indicated by the notch into which the pins are inserted in the program discs. The 15 second pulse switch M is closed about $\frac{1}{2}$ minute before the indicated time on the disc so that a short pulse is available to a selected relay coil about $\frac{1}{2}$ minute before the desired time of striking or operation. As previously mentioned, the switches can be arranged to be operated each 5 minute period by suitably adjusting the pins in the slots in the program discs.

The calendar time lever switch S is arranged to be operated by the calendar time lever 132 so as to shift the blade of switch S between calendar time lever switch contacts S₁ and S₂. This will change from weekday to Sunday operation or from the front program disc program to the rear program disc program. The calendar time lever 132 is operated by pins placed at suitable points on the calendar disc. Thus, a pin placed in the calendar disc 107 causes the switch S to move to contact S₂ from its normal position on contact S₁.

The Angelus circuit in the particular arrangement involved operates on weekdays and Sundays and thus it is not necessary to include it in the calendar change circuit.

Bell vibrator and strikers

A preferred form of bell vibrator and strikers is illustrated in Fig. 3. It is to be understood, however, that other types of devices may be employed for use in conjunction with the amplifier circuits and the loud speakers to produce electrically the bell tone or tones involved. The terms "Characteristic tone" or "Note" are used to mean the whole sound identifying the note to the listener. "Fundamental tone" is employed to mean the lowest vibration present in the vibrator. When a rod is struck by a striker, the rod will vibrate in a particular pattern, depending to some extent upon the point of contact of the striker with the rod, and a person listening to the note produced will select a characteristic tone by which he identifies the pattern. In the case of a fixed-free rod, the characteristic tone is a synthesized tone and is not actually present in the rod vibrations but is formed by a combination of the fourth and fifth partials of the rod. The

term "partial" refers to a single tone or vibration. The hum tone is the lowest tone heard in the bell and it is normally a sixth below the characteristic tone in an English type bell tone. In the case of the swinging bell, the high tone striker is arranged to strike the rod in such a manner as to emphasize the higher harmonics of the bell. The low tone striker is placed so as to place an emphasis on the hum tone of the bell tone.

Preferably, the tone generator has a fixed-free rod 137 fastened to a supporting block 138 of a relatively small size compared with supporting blocks previously used. The fixed-free vibrator 137 may take various forms but is illustrated as a flat strip of a suitable metal, the vibrator being made the correct length to produce the desired characteristic tone. The vibrator is fastened to a post 139 which is securely held in an acoustically integral relationship with supporting block 138. Post 139 may have a suitable transverse slot cut therein to snugly receive the end of the fixed-free vibrator 137. The edges of said slot can be peened inwardly or else joined with the vibrator surface so that there is an acoustically integral joint. The inner surface of the post 139 at its point of contact with the supporting block is relieved so that the annular surface around the outer edge thereof will firmly contact the surface of the block 138.

The supporting block 138 preferably is mounted in such a manner as to isolate the acoustic system, including the block and rod, from the main frame 140 or other supporting means. This may be accomplished by means of rubber bushings 141 located between the block and frame 140. Stud 142 can be screw threadedly engaged in block 138, nuts 143 being carried thereby contacting the outer faces of the bushings 141 or washers placed between said faces and nuts. The bushings 141 may have suitable annular grooves at their point of engagement with frame 140. Frame 140 may take the form of a metal box having a suitable cover (not shown).

A condenser type microphone electrical pick-up arrangement is illustrated generally at 144 comprising a frame 145 carried by the supporting block 138. The frame has a pair of legs joining the top extension 146 thereof resiliently with the portion 145 carried on supporting block 138. The collector plate or electrode 147 is mounted on the upper portion of the pick-up arrangement. Adjusting nut 148 can be operated so as to change the relative position of the collector plate and rod 137.

The collector plate 147 can be suitably connected to a source of polarizing voltage and to the preamplifier circuit. It is to be understood that other types of pick-ups or mechanical-electrical transducers can be employed, for example, magnetic devices.

A spring stabilizer 149 can be mounted on a slidable clip, said clip being adjustably movable along the supporting block 138. The clip and spring preferably are mounted in such a manner as to be in acoustically integral relationship with the vibrating system.

The low tone striker is shown at 226 (Fig. 3) and the high tone striker at 227. The striker solenoid coils are indicated at 198 and 189 respectively.

Rod 137 preferably is grooved near the base at 150, the deviation of the partials falling into a more exact relationship as a result of the grooving. Other details of the vibrating members can be found in Patent No. 2,582,411, issued January 15, 1952.

Automatic Angelus strike

Bell selector knob 160 (Fig. 1) of switch K (Fig. 2) is set in its central or automatic position. This arranges the blades of the various elements of the switch in the central positions illustrated in Fig. 2. The switch may take the form of a conventional arrangement having a plurality of wafers with contacts thereon. In elements or wafers K₁, K₂, and K₄, there are opposed switch contact members which are electrically separated from each

other. In section K₃, the opposed switch members are connected together.

Control transformer 161 is energized from a source of alternating current connected to plug 162 through the main safety switch L, line 163, line 164 to terminal 161₂ of transformer 161. The other side 161₁ of the primary of the transformer 161 is connected through line 165, fuse 166 and line 167 to the safety switch L.

Assuming that an offset key on the front program disc has closed Angelus program switch N and that the 15 second pulse switch M has closed just before an operation, the solenoid coil 175 of relay R1 will be energized as follows: terminal 161₀ of the secondary of transformer 161 will be connected through line 168, closed main-silent switch A, line 169 and 170, upper blade of switch K₄, line 172, closed 15 second pulse switch M, closed Angelus circuit switch N, line 173, closed Angelus-silent switch J, line 174, lead 203, "on" relay coil 175 of relay R1, line 176, back to terminal 161₀ of the secondary of control transformer 161. Relay R1 is of the type which, when operated by the "on" coil, latches itself in the "on" position, so that the contacts thereof are closed and remain closed until the "off" coil is energized.

The circuit energized by contacts R1₁ is in parallel with the cam operated contacts 177 on the coder motor shaft 178' which will start the coder switch or device motor 178 in operation. The coder motor is energized through line 179, from power source 167, closed switch contacts R1₁, line 180, closed switch A, line 181 to the coder motor 178. The other side of coder motor 178 is connected by line 182, line 183, line 164 with line 163 leading to safety switch L. Switch contacts R1₂ close and turn on the amplifier 184. Switch contacts R1₃ are not used in conjunction with the Angelus strike. A summary of the circuits affected by this relay and other relays will be given at a later point. The coder switch or coder mechanism is indicated in Fig. 2 by the word "coder."

As can be seen in Fig. 5, the coder motor contacts are arranged so that the inner contact finger 186 is 1/3 on an inner contact when the outer contact finger 185 has left the same or corresponding outer contact. At this time, the cam contacts 177 are open, but close after the outer contact finger 185 has passed outer contact 2 and stay closed until the outer contact finger 184 passes contact 52.

When the inner contact finger 186 reaches inner contact 7, a pulse will be delivered to relay coil 187 of relay R3 from terminal 161₀ of control transformer 161, line 168, closed switch A, line 169, line 170, finger 186, inner contact 7, line 188, relay coil 187, line 176, and to the other terminal 161₀ of the control transformer. Closing of contacts R3₁ of relay R3 will close a holding circuit for relay R3 through contacts R1₃ of relay R1.

Contacts R3₂ are inactive in this operation, they being involved in the low tone striker operation which does not function in the automatic Angelus operation being described, wherein only a tolling bell tone is used.

When the outer contact finger 185 reaches outer contact 12 of the coder, a circuit is closed to the high tone striker coil 189 from terminal 161₀, line 168, closed switch A, line 169, line 170, outer contact finger 185, outer contact 12, line 190, junction 214, line 191, upper blade of switch K₂, line 192, common line 193, high tone striker coil 189, line 194, junction 225, line 176, and to the other terminal 161₀ of transformer 161. When the outer finger 185 drops between the contacts 12 and 13, the high tone striker is released in readiness for the next strike.

There will be three more pulses as the outer finger passes over outer contacts 19, 20, and 21, and then three more as it passes over contacts 26, 27, 28. Thereafter there will be nine strikes as the outer finger passes over contacts 33 to 41 inclusive. There will be larger intervals between outer contacts 14 and 19, between outer

contacts 21 and 26, and between outer contacts 28 and 33, then between adjacent contacts. Thus, the bell will strike in the sequence 3-3-3-9 and will be struck as a tolling bell because the low tone strikes are not energized.

Inner contact 44 will deliver a pulse to the "off" coil 195 of relay R1, such being delivered from inner contact 44, line 196, lower blade of switch K4, line 197, to coil 195, and thence through line 176 to the control transformer. Relay R1 will be opened thereby so as to shut off the amplifier and power therefrom to the coder.

Opening of contacts R11 will open the circuit to the coder motor 178 but the coder motor will continue to run because contacts 177 are closed in parallel with contacts R11. The coder motor continues to run until the outer finger is between contacts 52 and 1 at which time the cam opens contacts 177 which will stop the motor.

Thus, for this operation, a pulse to relay R1 will latch it in closed position so as to energize the amplifier and so as to start the coder motor. At appropriate times thereafter, the outer contact finger will deliver striker coil operation pulses to the high tone striker coil. At the completion of the Angelus call, a pulse will be delivered by an inner contact to the relay R1 so as to open it.

Weekday automatic swinging bell

When it is desired that the bell strike program controlled by the straight pins of the front program disc be a swinging bell strike, switch E is moved from contact E1 to contact E2, the bell selector switch K still being in its central or automatic position as seen in Fig. 2.

As the 15 second pulse is delivered by switch M after the weekday program switch P has been closed by a program disc pin, relay coil 199 of relay R2 will be energized. This energization may be traced from terminal 1610, line 176, coil 199, line 200, closed "Weekday-silent" switch H, line 200, closed "Weekday-silent" switch H, switch P, contact S1 of calendar switch S, pulse switch M, line 172, upper blade of switch K4, line 171, line 170, switch A, line 168, and terminal 1610. Switch contacts R21 are in parallel with contacts R11 of relay R1 so that the coder motor 178 will be started.

As the inner contact finger 186 reaches inner contact 2, a pulse will be furnished coil 175 of relay R1 through line 202, line 203, to coil 175, thereby closing relay R1. Closing of contacts R13 will furnish a holding circuit for relay coil 199 of relay R2 through previously closed contacts R22 of relay R2. This can be traced through switch A, line 199, line 204, contacts R13, line 205, closed contacts R22, line 200, to coil 199.

As inner contact 7 of the coder is reached, a pulse is delivered to relay coil 187 of relay R3 as described for the Angelus operation. Closing of contacts R31 completes a holding circuit for coil 187 of relay R3 through closed contacts R13 of relay R1.

A circuit now has been set up connecting terminal 1610 with the low tone striker coil 198. This can be traced from 1610, line 168, switch A, line 169, line 199, line 204, closed contacts R13, line 205, closed contacts R23, contact E2 of switch E, line 206, closed contacts R32, line 207, rheostat 208, line 209, low tone coil 198, common line 193, to junction 210.

From junction 210, there is a network having parallel branches to the control transformer, one branch going through resistance 211 (e. g. ohms), line 176, to terminal 1610; the other branch going through the high tone striker coil 189 through line 193, striker coil 189, line 194 to junction 225, and through line 176 to terminal 1610. Another branch extends in the opposite direction from junction 210 toward the other terminal of the transformer through the coder contacts to terminal 1610, this branch in effect being in parallel with the branch from junction 210 to terminal 1610 leading through the low tone coil 198. Thus, when the coder contacts are open, the low tone coil will be energized to operate its striker

but the voltage differential will be such through the high tone coil that it will not operate until a coder control closes to short out the low tone striker coil.

All of the outer contacts except 1 through 6 and 42 through 52 are used. This is accomplished by closed switch R24. Outer contacts 7 to 11, 15 to 18, 22 to 25, and 29 to 32 are connected through line 212 with closed contacts R24 and then through line 213 to junction 214. The other groups of active contacts also are connected to junction 214 through line 190 as previously described. As the outer finger 185 reaches active outer contact 7, a circuit is closed to the high tone striker coil which in effect shorts the low tone striker coil and provides sufficient voltage to the high tone coil to operate its striker. As the contact finger leaves a contact, sufficient voltage again is established through the low tone striker coil 198 to cause the low tone striker to function. Thus, there will be a series of high and low tones produced simulating a swinging bell until outer contact 41 is passed.

When inner contact 44 is reached, the "off" coil of relay R1 will be energized so as to open all of the relays but the coder motor continues running until the outer finger passes contact 52 and the cam opens contacts 177.

Summarizing, relay R2 is closed so as to start the coder. The coder will furnish a pulse to relay R1 closing it and also a pulse to R3 to close it. Relay R3 provides a circuit including the low tone striker coil and relay R2 includes a circuit connecting all of the active outer contacts so as to furnish a swinging bell from outer contact 7 to outer contact 41.

Sunday automatic swinging bell

Calendar disc 107 can be arranged so that one of the pins thereof will operate calendar time lever 132 on Sunday which will move the blade of calendar switch S from contact S1 to S2. This connects the Sunday switch Q into the circuit through lead 215, switch G to lead 200. Upon closure of switch Q and the pulse switch M, the bells will function as automatic swinging bells in the same manner as that described for the weekday swinging bell strike, the difference being that the initiating pulse is delivered by the Sunday program disc 122.

Sunday and weekday automatic tolling bell

In order to have the bell function as a tolling bell instead of a swinging bell, bell switch E is moved so that its blade is on contact E1 instead of E2. This will interrupt the circuit from the low tone striker coil 198 to transformer terminal 1610 so that the low tone striker will not function. Thus, only the high tone striker will be operated upon each closure of the various contacts with the outer contact finger 185 as described for the automatic swinging bell arrangement.

Swinging bell in portion of Angelus strike

Sometimes it is desirable to have the last 9 strikes of the Angelus operation function as a swinging bell rather than a tolling bell. Such can be accomplished by changing Angelus switch F from contact F1 to F2. The Angelus operation is as described previously until the last group of 9 strikes starts. Prior thereto, relay R1 and R3 were closed and held in closed position but relay R2 had not been closed.

In the previously described operation, the last strike normally starts as a tolling bell when outer contact 33 is reached. With Angelus switch F changed as described, the circuit is shifted when the inner finger 186 reaches inner contact 33 so as to provide a swinging bell for the remainder of the striking time. This is provided by a pulse from the control transformer through the inner finger 186, inner contact 33, line 216, the upper blade of switch K1, line 217, switch contact F2, closed switch F, line 218, line 200, and relay coil 199 of relay R2. This closes relay R2 and places the low tone striker in the circuit in a manner similar to the previously de-

scribed weekday automatic operation. At the beginning of the Angelus, only relays R1 and R3 were closed, whereas in the weekday swinging operation all three relays were closed. As the contacts 33 to 41 are passed over by the outer finger 185 the high tone striker will be operated as the finger makes contact with said contacts, and as it passes between the contacts, the low tone striker will become effective in the manner described for the automatic swinging operation.

Swinging bell two minute duration

Sometimes it is desirable to have a swinging bell operation for a limited period. In order to accomplish this, the bell selector knob K (Fig. 1) is turned counterclockwise one step so that the top blades will be on the first contact to the left of the central contact. This means that the various top switch blades of switch K (Fig. 2) have been moved one step to the left. Switch B (Figs. 1 and 2) or the "on" push button is momentarily depressed. After a warmup period, the unit will sound a swinging bell automatically for about two minutes according to the speed of the coder motor, and then will shut off automatically.

Closing of switch B will provide a circuit from the control transformer through line 163, line 219, closed switch B, line 220, line 174, line 203, R1 relay coil 175, line 176, to the other terminal of the control transformer.

Energization of the relay will close contacts R1₁ to start the coder motor 178 and to start the amplifier in operation by closing of contacts R1₂. Number 3 inner contact of the coder will send a pulse through line 221 to the turned upper switch blade of K₁ (not shown turned), line 217, switch contact F₂, Angelus switch F, if in position 2, line 218, to relay coil 199 closing relay R2. When the inner finger 186 reaches inner contact 7, relay R3 then will be closed, so that all three relays will be closed, similar to that described for the weekday automatic circuit, thus providing a swinging bell arrangement until the coder outer finger 185 passes outer contact 41.

In the event that Angelus switch F is in number 1 position, or where the blade is on contact F₁, the lower switch blade of K₂ will connect terminal 161₀ of the control transformer with rheostat 208. This connection can be traced from rheostat 208, closed contacts R3₂, line 206, line 222, the lower switch blade of K₂, line 223, line 205, closed switch R1₃, line 204, line 199, line 169, switch A, to terminal 161₀.

The coder will continue a swinging bell operation until outer contact 41 is passed and the speed of the coder may be set or designed, for example, so that the bell will swing for two minutes. Of course, the speed of the coder could be changed to provide other limited durations of operation.

Tolling bell two minute duration

When it is desired to have the bell function as a tolling bell for a limited period, for example, two minutes, the bell selector switch knob K is turned counterclockwise so that it is one step further than the one just described for the swinging bell. The "on" button B is depressed momentarily in a manner similar to that described for a two minute swinging bell operation, relay R1 being closed thereby so that contacts R1₁ start the coder motor and contacts R1₂ turn on the amplifier. When inner contact 7 is reached, a pulse is delivered to relay R3 which closes it and causes it to hold because relay R1 is closed. Closed contacts R3₂ will close the circuit between outer contacts 7 through 41 to the low tone striker coil 198 in the manner previously described for the automatic swinging bell arrangement. When the outer contact finger 185 hits contact 7, the control transformer terminal 161₀ is connected to the low tone striker coil inasmuch as terminal 161₀ is connected through parallel resistance 211 and high tone striker coil

189 to the common bell lead 193 and thence to 161₁₀. Thus, the low tone striker will hit the bell each time the outer contact finger 185 reaches one of the contacts 7 through 41. In this instance, the high tone striker will not operate because the voltage across it is too low. Inner contact 44 will energize the "off" coil of the closed and locked relay R1. The coder will stop when the cam contacts open which will complete the cycle. All of the contacts 7 through 41 are connected together because of the position of the upper blades of bell selector switch elements K₂ and K₃.

Swinging bell continuous duration

When it is desired to have the system operate continuously as a swinging bell, the selector knob K is moved clockwise one step from its central or automatic position, the various blades of switch K assuming a corresponding position. By this movement, inner contact 44 is disconnected at K₄ from the "off" coil 195 of relay R1. It is otherwise connected similar to that described for the swinging bell two minute duration. Also, contacts 42 to 52 and 1 to 6, normally inactive, are connected through lead 224, the lower blade of K₃, line 191 with the bell strikers. In this way, every contact on the coder is employed to energize the bell striker appropriately. In this particular instance, the bell will operate as a tolling bell until contact 7 is reached, at which time relay R3 is energized so as to complete the connection to the two strikers as in the swinging bell operation. This is similar to a large cast bell where sufficient momentum is not reached to cause the clapper to hit both sides during the first few strokes. The operation will continue until the main switch A is opened so as to disconnect terminal 161₀ from the striker circuit. Then, the "off" button C is depressed which will furnish energy to relay "off" coil 195 and thus open relay R1 to disconnect the amplifier circuit. The coder continues to run until contacts 177 are opened by the cam.

Tolling bell continuous duration

In this instance, the bell selector knob K is turned clockwise to its farthest position in the clockwise direction. Closing of the "on" button B will start the arrangement in operation similar to the tolling bell two minute duration as just described, with the exception that the inner contact 44 is disconnected similar to the swinging bell continuous operation. Outer contacts 42 through 52 and 1 through 6 are connected to the bell striker circuit through the lower blade of switch K₃. The operation is discontinued in the same manner as for the swinging bell.

Manual toll push button operation

When it is desired to toll the bell manually, switch A is opened and the push button B is momentarily depressed. As a result thereof terminal 161₀ is disconnected from the coder wiper arm and also the alternating current power line is disconnected from coder motor 178. By operation of button B, the system is turned on inasmuch as relay R1 is closed. Thereafter, by pressing the manual toll button D, terminal 161₀ is connected to the low tone bell striker 198 through rheostat 208. As a result, thereof, the low tone striker is operated each time the manual button is passed.

Relay functioning

The relays function generally as follows:

Relay R1 (mechanically latched on)—

Contacts R1₁—start coder.

Contacts R1₂—start amplifier.

Contacts R1₃—when closed, furnishes holding circuit for R2.

Relay R2—

Contacts R2₁—also start coder.

Contacts R2₂—holding circuit for relay R2.

Contacts R2₃—bell striker circuit.

Contacts R2₄—can connect two groups of contacts so that contacts 7 to 41 are all connected together.
Relay R3—

Contacts R3₁—holding circuit for relay R3.
Contacts R3₂—bell striker, low tone.

By utilizing any of the inner contacts, the coder also can be used to operate other accessory equipment by a common pulse. As an example, it may be used to activate an automatic strike of a different type than described hitherto and at the same time block out any strikes normally programmed. This can be accomplished by using a pulse from one of the inner contacts to activate relay means (not shown) to break the circuit to line 194 and at the same time start the accessory control operating. The lower switch blade of K₁ can be connected to the accessory control so that a pulse from inner contact 42 through line 230 will stop operation.

The invention provides a means for automatically or manually operating a bell tone producing apparatus. It is to be understood that various details of construction can be varied without departing from the spirit of the invention except as defined in the appended claims.

What is claimed is:

1. In a swinging bell playing apparatus for producing one tone emphasizing high partials and another tone emphasizing low partials, the combination including a single vibrator, an electrical pick-up adjacent said vibrator, an amplifier and loud speaker connected to said pick-up, a pair of spaced strikers alternately operable to strike said vibrator, each of said strikers having a solenoid for operating the same, a source of energy, means connecting said solenoids in series with said source of energy, a shunt across the first of said solenoids, and a circuit having switch means for closing said circuit from a point between said solenoids and the lead from the source of energy to the second of said solenoids, said switch means when closed shorting said second solenoid and causing energization of said first mentioned solenoid to operate its striker, the second solenoid operating its striker when said switch means is open.

2. In a bell tone apparatus, the combination including a bell tone producing means having high and low tone strikers, a coding device having contacts connectable with said strikers for producing bell tones, means initiating operation of said coding device and connecting only one of said strikers thereto for producing single strokes, and means operable after a predetermined number of strikes connecting both of said strikers to said coding device contacts so as to operate the strikers alternately and produce swinging bell tones.

3. In a bell tone apparatus, the combination including a bell tone producing means having high and low tone strikers, a coding device having contacts connectable with said strikers for producing bell tones, means initiating operation of said coding device and connecting only one of said strikers thereto for producing single strokes, means operable after a predetermined number of strikes connecting both of said strikers to said coding device contacts so as to operate the strikers alternately and produce swinging bell tones, and manual means for stopping operation of said coding device.

4. In a bell tone producing apparatus, the combination including a vibrator, a pair of strikers for said vibrator to produce high and low tones respectively, an electrical pick-up and amplifier means for said vibrator, a first and second relay means, a coder mechanism having a plurality of sequentially arranged contacts connectable in two groupings to said strikers, a clock mechanism having a plurality of sets of program switch operating means, one for an Angelus strike and one for a Mass bell strike, means connecting said Angelus strike switch operating means to the first relay and closing the same to activate the coder mechanism, the amplifier, and to connect one group of contacts to a striker means for producing a plurality of groups of strikes, and means connecting the

Mass bell operating switch means closing the second relay to activate the coder mechanism, amplifier, and to connect both groups of contacts together to produce a continuous bell strike for a limited period.

5. In a bell tone producing apparatus, the combination including a vibrator, a pair of strikers for said vibrator to produce high and low tones respectively, an electrical pick-up and amplifier means for said vibrator, a first, second and third relay means, a coder mechanism having a plurality of sequentially arranged contacts connectable in two groupings to said strikers, a clock mechanism having a plurality of sets of program switch operating means, one for an Angelus strike and one for a Mass bell strike, means connecting said Angelus strike switch operating means to the first relay and closing the same to activate the coder mechanism, the amplifier, and to connect one group of contacts to a striker means for producing a plurality of groups of strikes, means connecting the Mass bell operating switch means closing the second relay to activate the coder mechanism, amplifier, and to connect both groups of contacts together to produce a continuous bell strike for a limited period, means selectively including said third relay in the striker operating circuit, and means connecting both of said striker means in the coder mechanism operating circuit upon including said third relay in the circuit to produce swinging bell tones.

6. In a bell tone producing apparatus, the combination including a vibrator, a pair of strikers for said vibrator to produce high and low tones respectively, an electrical pick-up and amplifier means for said vibrator, a first, second and third relay means, a coder mechanism having a plurality of sequentially arranged contacts connectable in two groups of contacts to said strikers, a clock mechanism having a plurality of sets of program switch operating means, one for an Angelus strike, and one for a Mass bell strike, means connecting said Angelus strike switch operating means to the first relay and closing the same to activate the coder mechanism, the amplifier, and to connect one group of contacts to a striker means for producing a plurality of groups of strikes, means connecting the Mass bell operating switch means and closing the second relay to activate the coder mechanism, amplifier, and to connect both groups of contacts together to produce a continuous bell strike for a limited period, means selectively including said third relay in the striker operating circuit, means connecting both of said striker means in the coder mechanism operating circuit upon including said third relay in the striker operating circuit to produce swinging bell tones, and calendar switch means operable by said clock mechanism selecting different programs of Mass bell operation depending upon the day.

7. In a bell tone apparatus the combination including an electronic bell tone producing means having a vibrator, an electric pick-up therefor, amplifying means, and loud speaker means, striker means for said vibrator producing a first tone emphasizing the high partials in said vibrator and a second tone emphasizing lower partials in said vibrator, a coding device having contacts connectable with said striker means for alternately producing said first tone and said second tone with a predetermined interval between said tones, means initiating operation of said coding device and connecting said striker means thereto for producing single strikes, and means operable after a predetermined number of strikes connecting said striker means to said coding device contacts to operate the striker means to produce alternate high and low tones of a swinging bell.

8. In an electronic bell playing apparatus arrangement for playing any one of a plurality of programs, the combination including an electronic bell tone producing apparatus, a coder switch mechanism connectable with said bell tone producing apparatus for producing any one of said programs, said mechanism having a plurality of switching circuits connected thereto settable for playing any one of a plurality of different bell tone programs in

accordance with their settings, and coder mechanism activating means connected with said coder mechanism starting said coder mechanism and automatically choosing and setting said switch circuits to produce the particular program.

9. In an electronic bell playing apparatus arrangement for playing any one of a plurality of programs, the combination including an electronic bell tone producing apparatus, a coder switch mechanism operable to produce one program per revolution and connectable with said bell tone producing apparatus for producing any one of said programs, said mechanism having a plurality of switching circuits connected thereto settable for playing any one of a plurality of different bell tone programs in accordance with their settings, and coder mechanism activating means connected with said coder mechanism starting said coder mechanism and automatically choosing and setting said switch circuits to produce the particular program.

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References Cited in the file of this patent

UNITED STATES PATENTS

1,096,778	Clement	May 12, 1914
1,958,053	Little	May 8, 1934
1,983,236	Little	Dec. 4, 1934
2,000,327	Hansen	May 7, 1935
2,043,673	Obergfell et al.	June 9, 1936
2,133,911	Alexander	Oct. 18, 1938
2,224,085	Norton	Dec. 3, 1940
2,299,591	Rex	Oct. 20, 1942
2,334,467	Zenner	Nov. 16, 1943
2,401,199	Talbot	May 28, 1946
2,413,062	Miessner	Dec. 24, 1946
2,417,037	Zuckerman	Mar. 4, 1947
2,505,119	Jacke	Apr. 25, 1950
2,548,710	Dodd	Apr. 10, 1951
2,563,250	Lacks	Aug. 7, 1951
2,641,897	Maas	June 16, 1953