Oct. 24, 1939. A. W. FOWLER 2,176,870

CLOCK

Filed Jan. 25, 1937 2 Sheets-Sheet 1

Fig. 1.

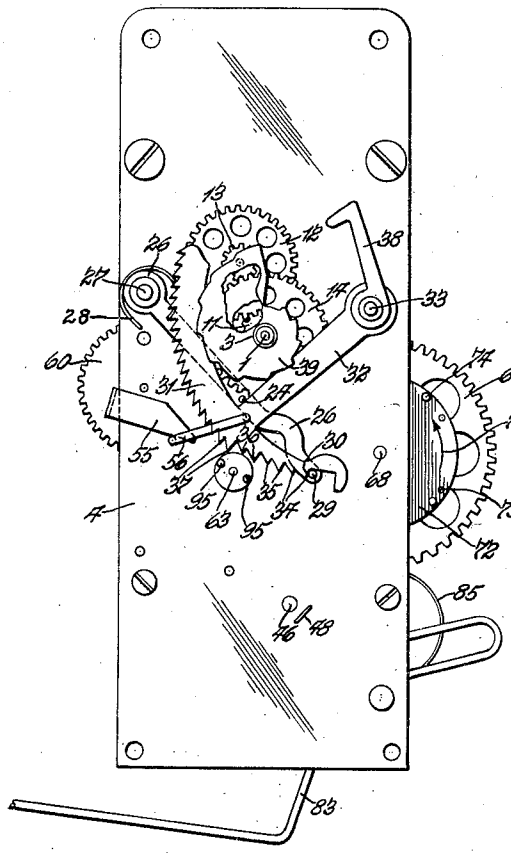


Fig. 2.

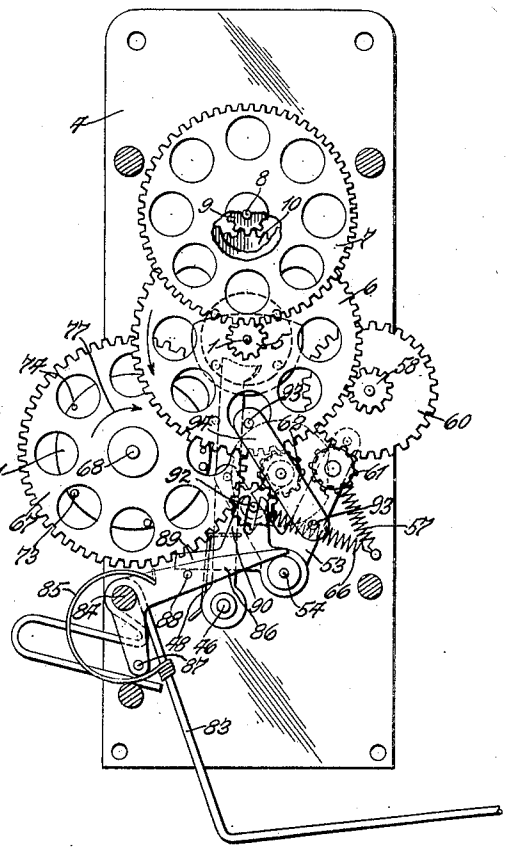


Fig. 3.

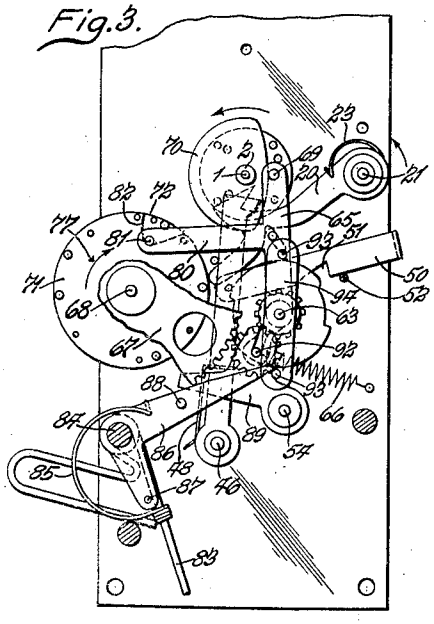
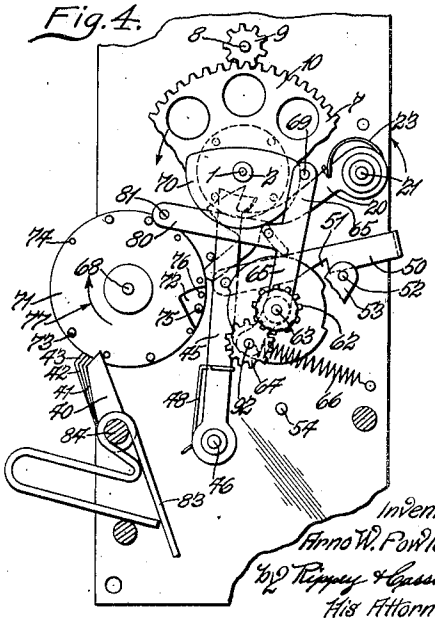


Fig. 4.



Inventor
Arno W. Fowler
by Pippey & Cassidy
His Attorneys.

Oct. 24, 1939. A. W. FOWLER 2,176,870

CLOCK

Filed Jan. 25, 1937 2 Sheets-Sheet 2

Fig. 5.

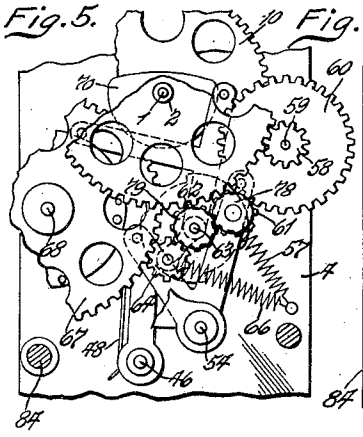


Fig. 6.

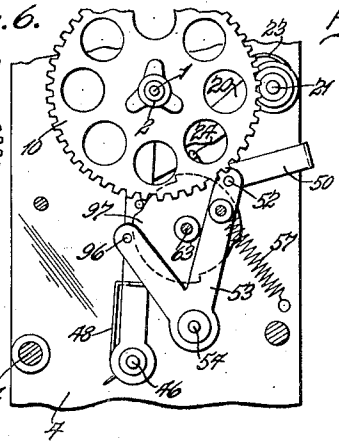


Fig. 7.

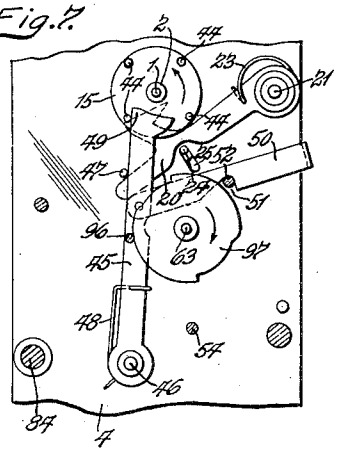


Fig. 8.

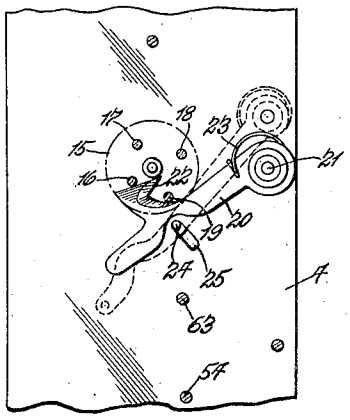


Fig. 9.

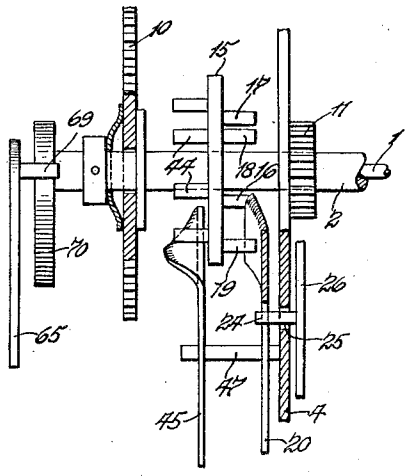


Fig. 10.

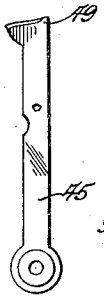


Fig. 13.

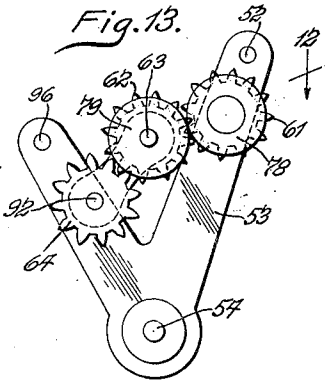


Fig. 11.

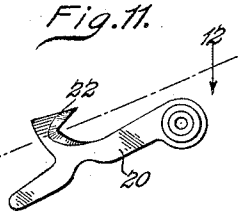
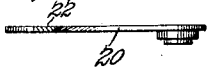


Fig. 12.



Inventor
Arno W. Fowler
by Rippey & Cassidy
His Attorneys.

Patented Oct. 24, 1939

2,176,870

UNITED STATES PATENT OFFICE

2,176,870

CLOCK

Arno W. Fowler, Highland, Ill.

Application January 25, 1937, Serial No. 122,198

6 Claims. (Cl. 58—38)

This invention relates to clocks, and has special reference to novel mechanism for operating a series of chiming devices once at the first quarter-hour and then, with increasing sequence, at the half-hour, at the three-quarters of an hour, and at the hour, respectively.

An object of the invention is to provide in a clock including seconds, minutes and hours spindles, mechanism for positively rotating the seconds spindle, connections driven thereby for operating the minutes spindle, and connections operated by the minutes spindle for operating the hours spindle; in combination, a train of gearing constantly operated by the seconds spindle and another train of gearing to be operated by but out of operative engagement with said first named train of gearing until the proper times arrive for operating the chiming devices, mechanism operated by the minutes spindle for engaging said second gearing with said first named gearing, and mechanism controlled by said spindles and said gearings for operating each of the chiming devices once on the first quarter-hour and then, with an increasing sequence, at the half-hour, at the three-quarters hour, and at the hour, successively.

Another object of the invention is to provide a series of chiming elements with trains of novel operating mechanisms therefor operated by the time mechanism of the clock in order to operate each of the chiming elements once at the first quarter-hour, and then, sequentially, twice at the half-hour, three times at the three-quarters of an hour, and four times at the hour, respectively.

Another object of the invention is to provide, in association with the chiming mechanisms, an hour striking device which will strike the hours successively and independently between the chiming periods and will strike the proper hours after the operation of the chiming devices.

Another object of the invention is to provide an improved chiming mechanism in a clock embodying the novel combination of elements associated and operating in the novel relationship herein disclosed, reference being made to the annexed drawings, in which—

Fig. 1 is a front elevation of the clock mechanism, the hands of the clock and the dial being omitted.

Fig. 2 is a vertical sectional view at the rear of the clock looking toward the front and showing the trains of gearing, a portion of two of the gears being broken away.

Fig. 3 is a vertical sectional view taken forwardly from the sectional view of Fig. 2, showing additional parts of the mechanism for controlling and operating the chiming devices, one of the gears being broken away, leaving only a part thereof shown.

Fig. 4 is a vertical sectional view taken forwardly from the sectional view of Fig. 3, showing one of the chime operating devices after it has moved from its stationary or idle position.

Fig. 5 is a sectional view of a clock showing a portion of the chime operating mechanism, this sectional view being taken slightly rearwardly of the sectional view of Fig. 3.

Fig. 6 is a sectional view similar to Fig. 5, but omitting many of the parts to illustrate additional elements.

Fig. 7 is a sectional view forwardly from the sectional view of Fig. 6 to illustrate the features shown in Fig. 7 that cannot appear in Fig. 6.

Fig. 8 is a sectional view forwardly from the sectional view of Fig. 7 to illustrate the features in Fig. 8 that are not completely illustrated in Fig. 7.

Fig. 9 is a vertical front-to-rear sectional view of a portion of the clock illustrating parts of the chime operating devices.

Fig. 10 is a detached side elevation of one of the controlling elements for the chiming devices which is operated intermittently by the upper rotary tripping element shown in Fig. 7.

Fig. 11 is a detached side elevation of another tripping member operated intermittently by the upper rotary tripping element shown in Fig. 7.

Fig. 12 is a sectional view on the line 12—12 of Fig. 11.

Fig. 13 shows the devices controlling movement of the pinion 61 into mesh with the pinion 62.

The seconds hand spindle 1, the minutes hand spindle 2, and the hour hand spindle 3 are concentric and of different lengths. The seconds spindle 1 is at the center and extends farther to the front than the spindles 2 and 3, the minutes spindle extending farther to the front than the hour spindle 3. The three spindles rotate about the same axis and the hands (not shown) attached to the front end of said spindles cooperate with the same dial. All of these spindles extend forwardly beyond the front frame 4 of the clock.

The seconds spindle 1 extends rearwardly through the rear frame of the clock and is rotated in a clockwise direction (Fig. 1) by an appropriately mounted and connected motor (not shown). A pinion 5 is rigid with the spindle 1 and with a gear 6, so that the pinion 5 and the

gear 6 are rotated by the spindle 1. The pinion 5 meshes with a gear 7 attached to a rotary shaft 8 having rigid therewith a pinion 9 (Fig. 2) which meshes permanently with a gear 10 mounted on the spindle 2. The ratio of this gearing is such that the seconds spindle 1 is rotated a complete revolution during each minute and the spindle 2 is rotated only the distance of one minute with respect to the dial during each complete revolution of the spindle 1.

The spindle 2 has attached thereto a pinion 11 (Fig. 1) which rotates the spindle 3 through a chain of reduction gearing comprising a gear 12 meshing with the pinion 11 and attached to and rotating a pinion 13 meshing with a gear 14 attached to the spindle 3. The ratio of this speed reduction gearing is such that the spindle 3 is turned the distance of one hour with respect to the clock dial for each complete revolution of the spindle 2.

A plate 15 (Figs. 7, 8 and 9) is attached to the spindle 2 and has projecting from one side four pins 16, 17, 18 and 19. These pins are different radial distances from the axis of the spindle 2, being of gradually increasing distances from said axis from the pin 16, which is closest to the axis, to the pin 19, which is farthest from the axis. These pins control, in cooperation with other elements yet to be described, the operation of the chiming devices for the quarter-hour, the half-hour, the three-quarters of an hour, and the hour, respectively. A lever 20 mounted on a pivot 21 is formed with a cam 22 against which the pins 16, 17, 18 and 19 operate successively. A spring 23 actuates the lever 20 to hold the pointed cam 22 in engagement with the respective pins 16, 17, 18 and 19. As shown in Fig. 8, which is looking from the rear toward the front of the clock, the series of pins 16, 17, 18 and 19 are rotated in a counter-clockwise direction and will successively move the lever 20 downwardly until the respective pins pass beyond the sharp point of the cam 22 and release the lever so that the spring 23 can move the lever upwardly again into contact with the next pin for operation thereby. When the lever 20 is moved downwardly by the respective pins, it engages and pushes downwardly a pin 24 which projects through a slot 25 formed in the front frame plate 4. The pin 24 is supported by and projects rearwardly from a lever 26 mounted on a pivot 27 supported at the front of the frame plate 4 and actuated upwardly by a spring 28. When the lever 26 is pushed downwardly by the lever 20, a pin 29 on the free end of said lever is disengaged from a tooth 30 formed on a rack sector 31 supported by an arm 32 mounted on a pivot 33. The rack sector 31 is formed with a pair of teeth 34 corresponding to the pin 16; with a pair of teeth 35 on a longer radius from the axis of the pivot 33 than the teeth 34 for the pin 17; with a pair of teeth 36 on a longer radius than the teeth 35 for the pin 18; and with a pair of teeth 37 on a still longer radius than the teeth 36 for the pin 19.

Therefore, the element 15 with the pins 16, 17, 18 and 19 supported and operated thereby constitute a device or means for releasing the pin 29 from the shoulder 30. When the pin 16 releases the pin 29 from the shoulder 30, the rack 31 will drop until the first or lowest tooth 35 engages the pin 29 to support the rack. When the pin 17 disengages the pin 29 from the shoulder 30, the rack 31 will drop until the lowest tooth 36 engages the pin 29. When the pin 18 operates to disengage the pin 29 from the shoulder 30, the rack 31 will drop until the first or lowest tooth 37 engages the pin 29 to stop further movement of the rack. When the pin 19 operates to disengage the pin 29 from the shoulder 30, the rack 31 will drop until the arm 38 engages the snail element 39 rigidly attached to the hour spindle 3. The said arm 38 is rigid with the rack arm 32. As shown, the snail element is formed with twelve peripheral steps or segments corresponding to the hours, and at different radial distances from the axis of the spindle 3. The snail element is familiar in clocks.

Downward movement of the rack 31 by action of the pin 16 as described conditions the chiming mechanism for operation of the selected chiming elements at the first quarter-hour; downward movement of said rack 31 by action of the pin 17 as described conditions the chiming mechanism for operation of the selected chiming elements at the half-hour, preferably twice the number of operations at the quarter-hour; downward movement of said rack 31 by action of the pin 18 as described conditions the chiming mechanism for operation of the selected chiming elements at the three-quarter hour as often as desired; and downward movement of said rack 31 by action of the pin 19 as described conditions the chiming mechanism for operation of the selected chiming elements any desired number of times at the hour.

The plate 15 has projecting therefrom four equally spaced pins 44 on the side opposite from the pins 16, 17, etc. (Figs. 7 and 9). A lever 45 is mounted on a pivot 46 and is actuated in one direction and against a pin 47 by a spring 48. The upper end 49 of the lever 45 is in the path of movement of the pins 44 so that, as the minutes spindle 2 rotates, one of the pins 44 will engage and move the lever 45 each quarter-hour. At the proper times, the respective pins 44 escape from the end 49 of the lever 45, whereupon the spring 48 quickly moves said lever 45 toward its starting position. An arm 50 is pivotally supported by the lever 45 and has in its underside a notch 51 adapted to be engaged with and disengaged from a pin 52 projecting from a support 53 mounted for swinging movements on a rod 54. The arm 50 is provided with a rebent end portion 55 extending laterally in front of the plate 4 in position to be engaged by a finger 56 rigid with the rack 31. When the rack 31 is in its unoperated position with the pin 29 engaging the shoulder 30, the finger 56 supports the arm 50, 55 so that the notch 51 is above and out of engagement with the pin 52. When the rack 31 is moved downwardly as described, the finger 56 moves downwardly with said rack and permits the arm 50 to drop, so that the notch 51 will receive and engage the pin 52 when the lever 45 is moved forwardly by any one of the pins 44. Then, while the notch 51 is in engagement with the pin 52, and after the pin 44 releases the lever 45, the spring 48 moves said lever 45 toward its starting position, and this movement of said lever 45 causes the arm 50 to swing the support 53 in opposition to a spring 57.

The gear 6 which is attached to the seconds spindle 1 is in permanent mesh with a pinion 58 (Figs. 2 and 5) attached to a spindle 59. A gear 60 is also attached to and rotated by the spindle 59 and is in permanent mesh with a pinion 61 rotatively carried by the swinging support 53. When the support 53 is moved by the arm 50 as described, the pinion 61 is moved into mesh with a pinion 62. The movement of the pinion 61 by operation of the swinging support 53 by the arm 50 is from the position shown in Fig. 2 to the position shown in Fig. 5. When the arm 50 is disen-

gaged from the pin 52, the spring 57 immediately moves the support 53 and thereby the pinion 61 from the position shown in Fig. 5 to the position shown in Fig. 2, in which latter position the pinion 61 is out of mesh with the pinion 62.

The pinion 62 is attached to a rotary spindle 63 and is in permanent mesh with a pinion 64. The pinions 62 and 64 are rotatively carried by a swinging support 65 pivoted on the spindle 63. A spring 66 connected with the support 65 moves said support to the position shown in Fig. 3, but said support is operative to move the pinion 64 into and out of mesh with a gear 67 attached to a rotary shaft 68. The support 65 has a pin 69 projecting across a cam 70 attached to and rotated by the minutes spindle 2 so that said cam will operate the swinging support 65 to move the pinion 64 into mesh with the gear 67 and thereby rotate said gear 67 when, and only when, the pinion 61 is in mesh with the pinion 62.

From the foregoing, it is apparent that the plate 15, which is mounted on and operated by the minutes spindle 2, performs the function of conditioning for operation the operating mechanism for the chiming devices, and also functions to operate the lever 45 which controls the mechanism for rotating the spindle 68. This spindle 68 is an essential part of the operating mechanism for the chiming devices 40, 41, 42 and 43. The spindle 68, which is rotated by the gear 67 as described, has attached thereto a pair of discs 71 and 72. An annular series of pins 73 project from one side of the disc 71 and an annular series of pins 74 project from the opposite side of the disc 71. An annular series of pins 75 corresponding to the pins 73 project from one side of the disc 72 and an annular series of pins 76 corresponding to the pins 74 project from the opposite side of said disc 72. Each series of pins is in staggered relationship with respect to every other series of pins, which is to say that no series of pins is in alinement with any other series of pins, because said pins are relatively circumferentially spaced. The disc 71 extends between the chiming device parts 40 and 41 while the disc 72 extends between the chiming device parts 42 and 43. Therefore, when the spindle 68 is rotated in the direction of the arrow 77 (Figs. 3 and 4), the pins 73 will operate the chiming device 40 intermittently, the pins 74 will operate the chiming device 41 intermittently, the pins 75 will operate the chiming device 42 intermittently, and the pins 76 will operate the chiming device 43 intermittently, and no two chiming devices will be operated at the same time.

When the lever 45 and the train of connections therefrom are operated to move the pinion 61 into mesh with the pinion 62, a relatively large hub 78 engages a relatively large collar 79 rigid on the spindle 63 to limit and stop movement of the support 53 and the connections therefrom to the lever 45. This contact of the hub 78 with the collar 79 does not occur until the pinion 61 is in proper mesh with the pinion 62.

An arm 80 projecting from the support 65 supports a pin 81 which extends across the disc 71 and, at the end of each hour, engages in a notch 82 in said disc. The cam 70 has a definite relationship to the hands of the clock so that, when the minute hand points to "12" on the clock dial at the end of each hour period, the lowest side of the cam 70 is, as shown in Fig. 3, in engagement with the pin 69. During the next quarter-hour, the cam 70 turns from the position shown in Fig. 3 almost to the position shown in Fig. 4 and thereby disengages the pin 81 from the notch 82 simultaneously with the meshing of the pinion 61 with the pinion 62. Thereupon the chimes are operated in the desired sequence to chime the quarter-hour and, immediately after the completion of the chiming of the quarter-hour, the pinion 61 is moved out of engagement with the pinion 62 and rotation of the discs 71 and 72 is stopped. The cam 70 then rotates approximately ninety degrees to the half-hour, the pinion 61 is moved into mesh with the pinion 62, and the chimes are again operated. Upon the completion of the half-hour chiming, the pinion 61 is again moved out of mesh with the pinion 62 and rotation of the discs 71 and 72 is stopped. The cam 70 continues to rotate to the three-quarter hour point, where the chiming operation is repeated for the three-quarter hour. Continued rotation of the cam 70 brings the low point thereof into contact with the pin 69, the chimes are operated on the hour and, immediately upon completion of the chiming operation, the pin 81 drops into the notch 82 and the pinion 64 is moved out of mesh with the gear 67.

At this time, when the pin 81 drops into the notch 82, the pinion 64 is moved out of engagement with the gear 67; so that the gear 67 will not be rotated irrespective of whether the pinion 64 is rotated or not. Simultaneously with the engagement of the pin 81 within the notch 82, the pinion 64 is moved out of mesh with the gear 67 by action of the spring 66 and the arm 50 is moved upwardly out of engagement with the pin 52 by the movement of the rack 31 to its unoperated position in which the shoulder 30 is engaged with the pin 29. The pinion 61 is disengaged from the pinion 62 after each chiming operation; which is to say that the pinion 61 is disengaged from the pinion 62 after the quarter-hour chiming, after the half-hour chiming, after the three-quarter hour chiming, and after the chiming at the hour. But the pinion 64 is held in engagement with the gear 67 after the quarter-hour chiming through the hour chiming and until the cam 70 moves to the position shown in Fig. 3, in which its low point engages the pin 69 to permit operation of the support 65 by the spring 66 to disengage the pinion 64 from the gear 67 and engage the pin 81 in the notch 82 in order to stop positively rotation of the spindle 68 by the gear 67.

At the hour, after the completion of the chiming the hour is struck by a striker 83 supported on the spindle 84 which also supports the chiming devices 40, etc. (Figs. 2 and 3). The hour striker 83 is connected by a spring 85 with a lever 86 mounted on the same spindle 84 with the striker 83. A pin 87 on one arm of the lever 86 projects behind the striker 83 so that, when the lever 86 is swung upwardly in opposition to the spring 85, said pin 87 will move the striker 83 upwardly.

One arm of the lever 86 has a pin 88 projecting laterally therefrom under the free end of a lever 89 pivoted on the rod 54. The lever 89 is a bell crank lever and has an arm 90 provided with pin and slot connection 91 with a stud 92 that supports or is coaxial with the pinion 64. By reference to Figs. 2 and 3 of the drawings, it is apparent that swinging movement of the pinion 64 into mesh with the gear 67 will push downwardly the free end of the lever 89 against the pin 88 which will swing downwardly the adja-

cent arm of the lever 86 to a position in which the free end of the lever 86 is out of the path of movement of pins 93 on opposite ends of a support 94 attached to and rotated by the spindle 63. Therefore, when the pinion 64 is in mesh with the gear 67, which it is during all chiming operations, the support 94 can rotate with the spindle 63 without operating the lever 86 by the pins 93. But, when the pinion 64 is out of mesh with the gear 67, as shown in Fig. 3, rotation of the support 94 by the spindle 63 will engage the pins 93 successively and alternately with the lever 86 and will operate said lever and thereby the hour striker 83 intermittently and successively as many times as the respective pins 93 engage and operate said lever 86.

When the pinion 64 is moved into mesh with the gear 67, the lever 89 is moved downwardly against the pin 88 and thereby moves the lever 86 downwardly. When the lever 86 is held in its downward position by the lever 89, the end of the lever 86 is out of the path of movement of the pins 93 so that the support 94 can rotate freely without operating the striker 83. Therefore, the striker 83 is held idle during operation of the chiming devices and the chiming devices are idle during operation of the striker in the embodiment of the invention shown. However, the invention is not restricted to the use of a separate striker for the hours.

The spindle 63 projects forwardly through and beyond the plate 4 and supports two pins 95 adapted to engage alternately with the teeth on the rack 31 when said rack is in any of its downward positions and thereby raise the rack step by step a distance of one tooth at a time, the rack sliding along the pin 29, until the rack is raised to the position shown in Fig. 1, in which the pin 29 engages the shoulder 30.

Even after the arm 50 is disengaged from the pin 52, a pin 96 on the support 53 remains in engagement with one of the high points of a cam 97 (Fig. 6) and thereby holds the support 53 approximately in the position to which it had been moved by the arm 50. However, after the cam 97 has turned about one-quarter of a revolution, a low point of the cam is brought opposite the pin 96, whereupon the spring 57 immediately swings the support 53 to its starting or idle position in which the pinion 61 is out of mesh with the pinion 62.

In the foregoing operations of chiming quarter-hours, and then at the hour periods striking the hours after the operation of the chiming elements by operation of the striker 83, said striker 83 is operated at twice the speed of the operation of any of the chiming elements and, at the correct speed of operation, to strike clear notes to signify the hours.

In these operations, the chiming elements are automatically coordinated properly as to time of operation with the hands of the clock because the notch 82 will permit the pin 81 to engage therein only under control of the cam 70, the low point of which has a definite relationship and adjustment with the minutes hand of the clock. I term this an automatic correction of any possible error that may occur during any hour period in reference to the time of operation of the chimes with respect to the position of the minutes hand and therefore with respect to the hour hand and the seconds hand of the clock. This is because the notch 82 has a definite and fixed relationship to the low point of the cam 70 (Fig. 3).

As indicated in Fig. 9 of the drawings, the lever 45 and the cam extension 22 are flared in such a way as to permit the pins 16, 17, 18 and 19, and also to permit the pins 44, to operate against the respective parts 22 and 49 so that the plate 15 attached to the minutes spindle 2 may be rotated in a counter-clockwise direction to set the hands of the clock properly, as may be necessary or desirable when the clock requires reverse operation for resetting purposes.

During operation, the spindle 1 rotates the gearing 5, 7, 9, 10, and thereby the spindle 2 at proper speed ratios. The spindle 2 rotates the plate 15 and thereby the pins 16, etc. to operate the lever 20 and thereby the lever 26 to permit descending operation of the rack 31 predetermined distances according to which of the pins 16, 17, etc. operates the lever 20. Then the lever 45 is operated at proper times by the pins 44 and the pinion 61 is meshed successively with the pinion 62, and the pinion 64 is meshed with the gear 67, whereupon the discs 71 and 72 are operated to operate the chiming devices 40, 41, 42 and 43 in a predetermined and selected order to produce a musical effect. The cam 70, during its rotation against the pin 69, operates the support 65 to raise the pin 81 out of the notch 82 at or immediately before meshing of the pinion 64 with the gear 67 so that the gear 67 and thereby the discs 71 and 72 may rotate freely without resistance by the pin 81. When the pin 81 is raised to or above the periphery of the disc 71 and becomes engaged on the periphery of said disc 71, said pin cannot again enter the notch 82 until said notch 82 has been rotated to position to receive the pin 81, notwithstanding the fact that the high point of the cam adjacent the arrow (Fig. 3) has passed beyond said pin 69. But, when the pin 81 is at the notch 82, said pin will enter said notch, the support 65 will be operated by the spring 66, the pinion 64 will be disengaged from the gear 67 and rotation of the chime operating discs 71 and 72 will be stopped.

When the pinion 61 is moved toward the pinion 62, extent of movement of the pinion 61 will be stopped by the hub 78 engaging against the periphery of the collar 79 effectively to prevent the teeth on the pinion 61 from abutting against the bottoms of the notches between the teeth on the pinion 62 so that the teeth on said pinions are not moved into abutting engagement with the bottoms of the spaces between said teeth. This compensates for any irregularities or tolerances resulting from unequal depths of the spaces between the teeth on the respective pinions and prevents locking of the gearing that might otherwise occur.

From the foregoing, it should be apparent that this clock operating and chiming mechanism attains all of the intended objects and functions stated at the beginning of this specification or otherwise attributed thereto through the foregoing description. I am aware that the mechanisms may be varied within the scope of equivalent limits without departure from the nature and principle thereof, and do not restrict myself unnecessarily.

I claim:

1. In a clock including minutes and hours spindles, a seconds spindle, and connections driven thereby for operating the minutes spindle; in combination, a series of chiming devices, a train of gearing constantly operated by one of said spindles, another train of gearing to be operated by said first gearing and normally out of mesh therewith, mechanism operated by one of

said spindles for engaging said first gearing with said second gearing, means for operating said chiming devices, a member holding said means from operation, and an element operated by one of said spindles for releasing said member from said means at predetermined times at each hour.

2. In a clock including minutes and hours spindles, a seconds spindle, and connections driven thereby for operating the minutes spindle; in combination, a series of chiming devices, means for operating said chiming devices, a gear for rotating said means, a train of gearing normally out of mesh with said gear for rotating said gear, another train of gearing constantly operated by one of said spindles and normally out of mesh with said first train of gearing, and mechanisms operated by one of said spindles for engaging said second train of gearing with said first train of gearing and for engaging said first train of gearing with said gear, respectively, to operate said means at predetermined intervals.

3. In a clock including minutes and hours spindles, a seconds spindle, and connections driven thereby for operating the minutes spindle; in combination, a series of chiming devices, means for operating said chiming devices, a gear for operating said means, a train of gearing for rotating said gear, mechanism for holding said train of gearing out of mesh with said gear and for positively preventing operation of said means, a device for operating said mechanism to mesh said gearing with said gear and for releasing said means, another train of gearing constantly operated by one of said spindles and normally out of mesh with said first train of gearing, and devices operated by one of said spindles for meshing said second train of gearing with said first train of gearing and thereby to operate said means.

4. In a clock including minutes and hours spindles, a seconds spindle, and connections driven thereby for operating the minutes spindle; in combination, a series of chiming devices, means for operating said chiming devices, a gear for operating said means, a train of gearing for rotating said gear to operate said means, a support for moving said train of gearing into and out of operative engagement with said gear and for engaging and preventing displacement of said means, a cam operated by one of said spindles for moving said support to engage said train of gearing with said gear and to release said means for operation by said gear, a constantly operating train of gearing, means for supporting and moving said second train of gearing into and out of operative engagement with said first train of gearing, and mechanism operated by one of said spindles for operating said second means to move said second train of gearing into engagement with said first train of gearing.

5. In a clock including minutes and hours spindles, a seconds spindle, and connections driven thereby for operating the minutes spindle; in combination, a series of chiming devices, means for operating said chiming devices, a gear for operating said means, a train of gearing for rotating said gear to operate said means, a support for moving said train of gearing into and out of operative engagement with said gear and for engaging and preventing displacement of said means, a cam operated by one of said spindles for moving said support to engage said train of gearing with said gear and to release said means for operation by said gear, a constantly operating train of gearing, means for supporting and moving said second train of gearing into and out of operative engagement with said first train of gearing, mechanism operated by one of said spindles for operating said second means to move said second train of gearing into engagement with said first train of gearing, and means for operating said support to engage and positively hold said first named means against operation at the end of each hour.

6. In a clock including minutes and hours spindles, a seconds spindle, and connections driven thereby for operating the minutes spindle; in combination, a series of chiming devices, means for operating said chiming devices, a gear for operating said means, a train of gearing for rotating said gear to operate said means, a support for moving said train of gearing into and out of operative engagement with said gear and for engaging and preventing displacement of said means, a cam operated by one of said spindles for moving said support to engage said train of gearing with said gear and to release said means for operation by said gear, a constantly operating train of gearing, means for supporting and moving a part of said second train of gearing into and out of operative engagement with said first train of gearing, mechanism operated by one of said spindles for operating said second means to move said second train of gearing into engagement with said first train of gearing, mechanism operated by said second train of gearing for striking the hours, and means for operating said support to disengage said first train of gearing from said gear and to engage and positively hold said chime operating means against operation at the completion of the striking of each hour.

ARNO W. FOWLER.