

July 14, 1970

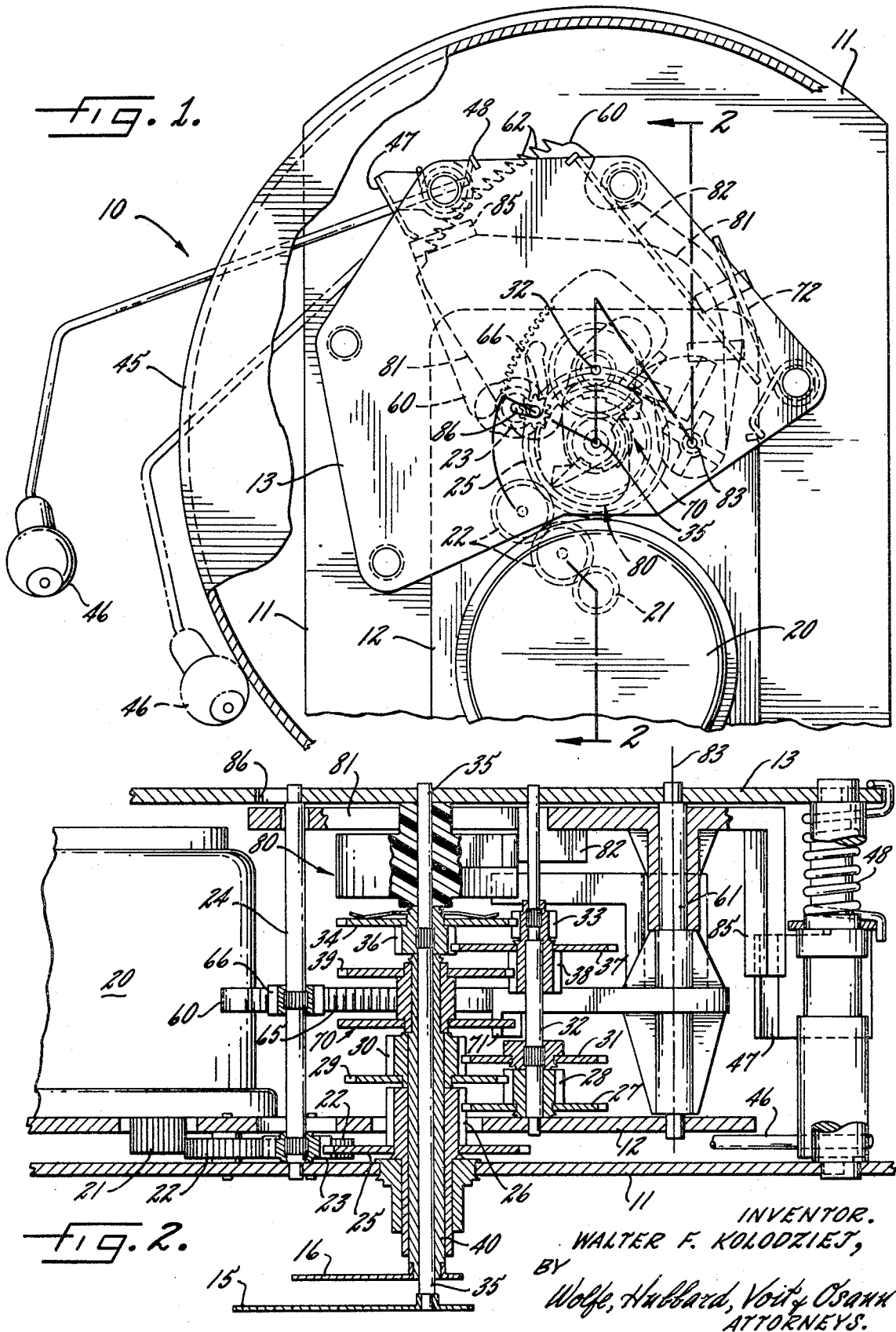
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3,520,126

STRIKER MOVEMENT FOR ELECTRICALLY DRIVEN CLOCK

Filed Oct. 15, 1968

5 Sheets-Sheet 1



July 14, 1970

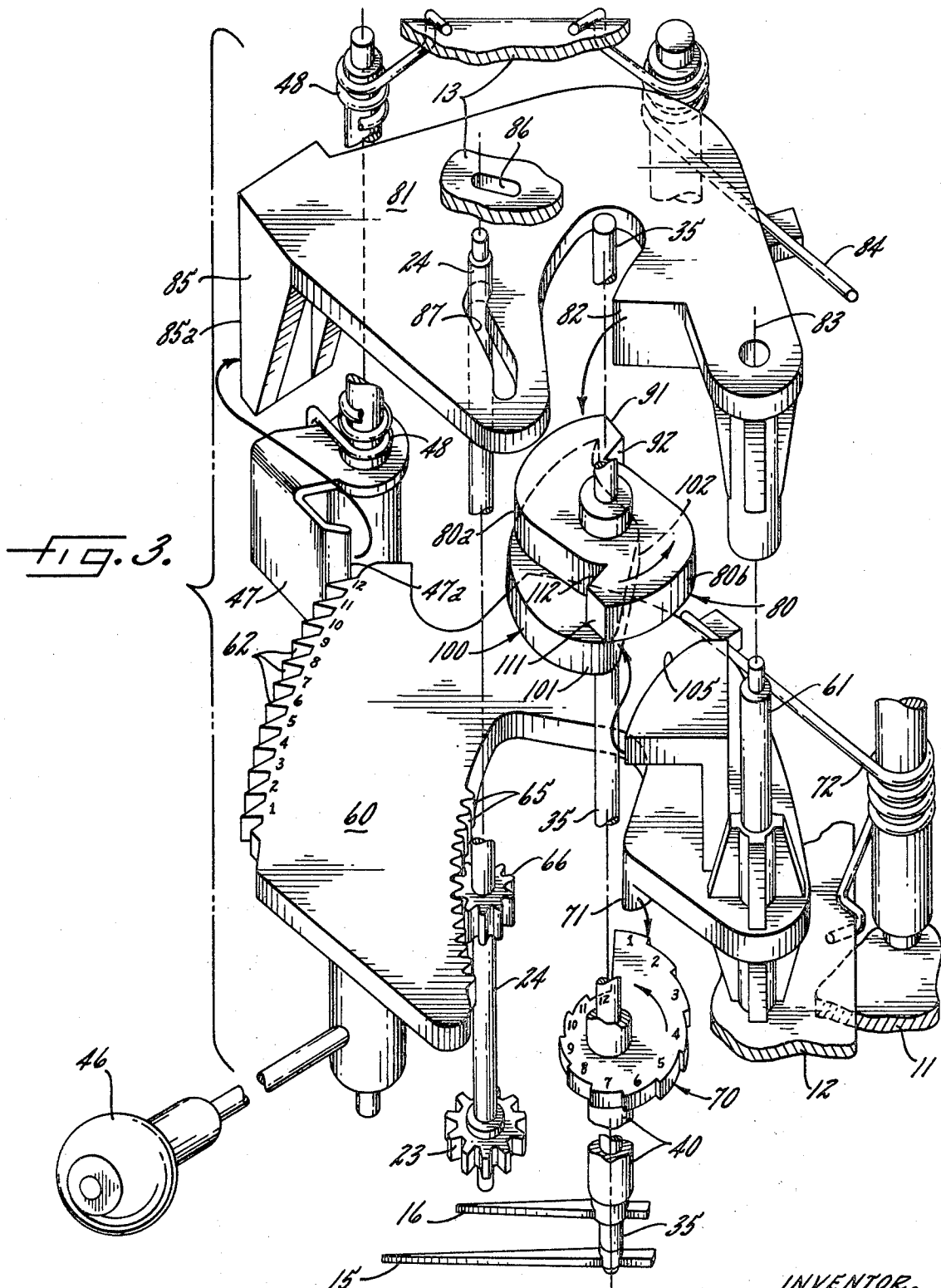
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STRIKER MOVEMENT FOR ELECTRICALLY DRIVEN CLOCK

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5 Sheets-Sheet 2



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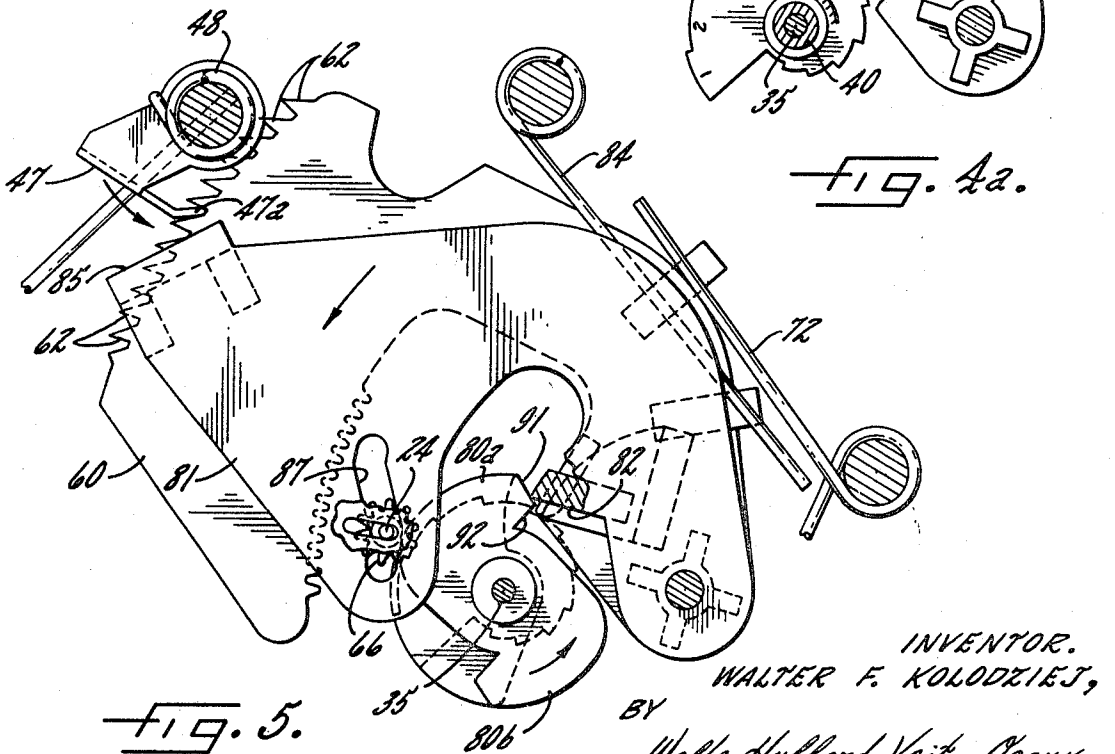
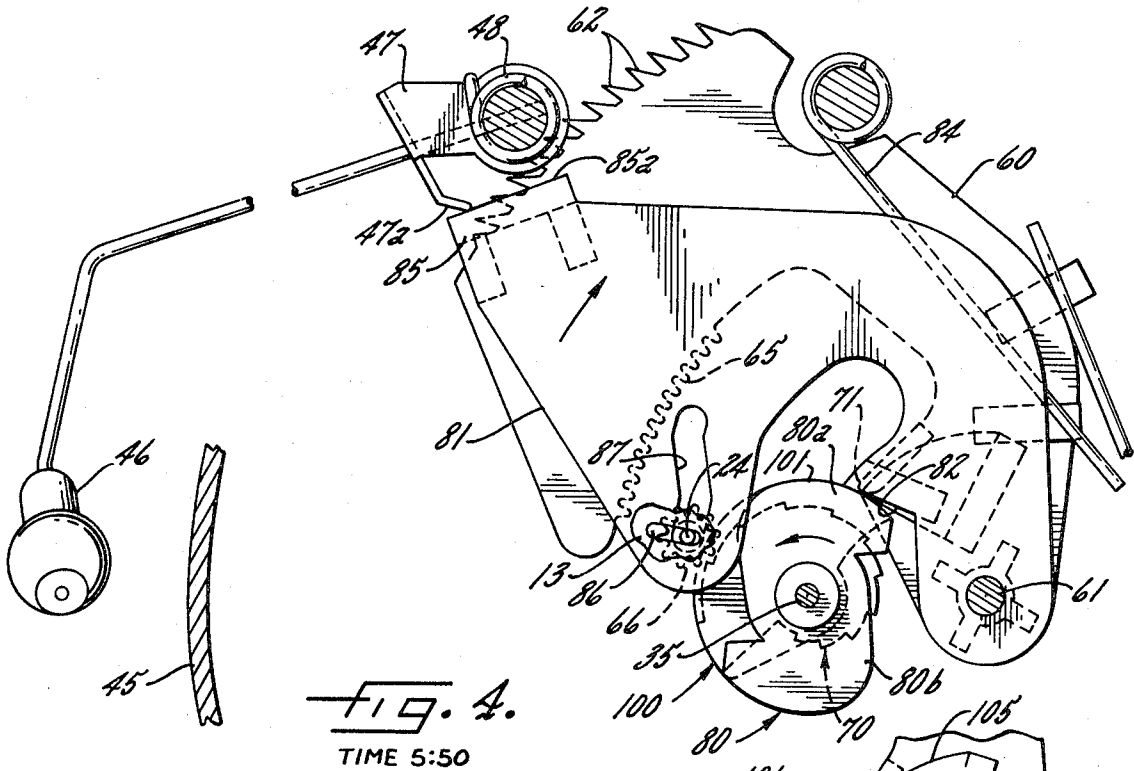
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STRIKER MOVEMENT FOR ELECTRICALLY DRIVEN CLOCK

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5 Sheets-Sheet 3



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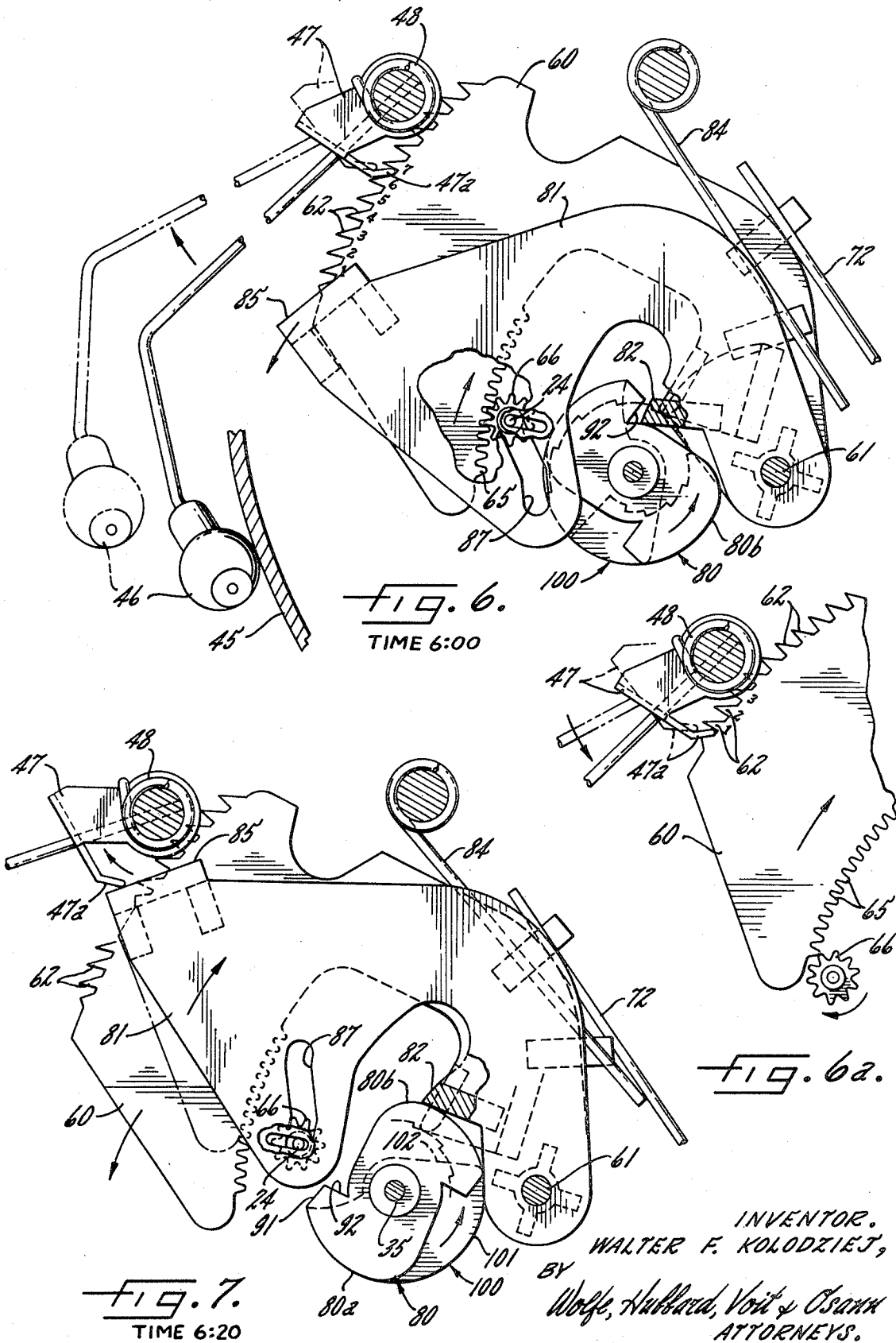
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STRIKER MOVEMENT FOR ELECTRICALLY DRIVEN CLOCK

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5 Sheets-Sheet 4



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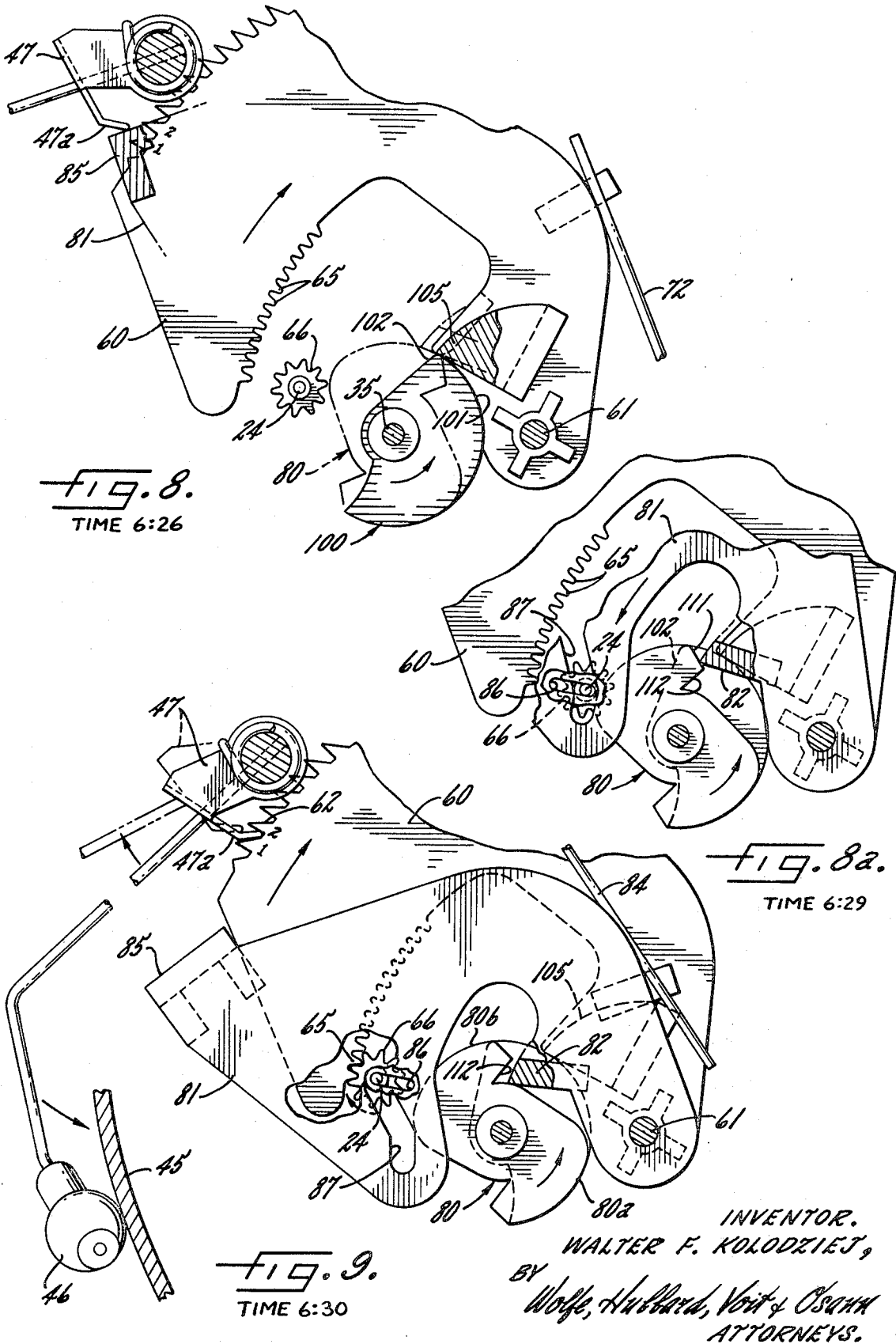
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STRIKER MOVEMENT FOR ELECTRICALLY DRIVEN CLOCK

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5 Sheets-Sheet 5



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STRIKER MOVEMENT FOR ELECTRICALLY DRIVEN CLOCK

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8 Claims

ABSTRACT OF THE DISCLOSURE

A striking clock movement having a counting rack which is advanced past a pawl to operate a striker, the counting rack being located in an initial position by a snail for the striking of the hour and located in a single strike position by a half-hour positioning cam for the sounding of a single stroke at the half hour. A two-lobed minute cam initiates movement of the counting rack at the hour and half hour positions.

It is an object of the present invention to provide a one half hour striking clock movement which is simple, reliable and compact and in which the half-hour strike feature is obtained with little additional complication or expense. It is a related object to provide a half-hour striking clock movement which is well suited for integration into existing designs of clocks and which is particularly well suited for use in clocks having a synchronous driving motor.

It is another object of the invention to provide a half-hour striking movement which is highly accurate and consistent but which is inexpensive to manufacture and assemble, permitting relatively great tolerances in the interfitting of the various parts.

Other objects and advantages of the invention will become apparent upon reading the attached detailed description and upon reference to the drawings in which:

FIG. 1 is a fragmentary elevation of a clock mechanism constructed in accordance with the present invention;

FIG. 2 is a section taken along the line 2—2 in FIG. 1;

FIG. 3 is an exploded and somewhat distorted perspective showing the elements of the striking mechanism.

FIG. 4 is a stop motion view showing the parts in the position occupied at ten minutes before the hour.

FIG. 4a is a fragment, partially diagrammatic, showing the position of the parts a few minutes later with the rack arm engaging the snail;

FIG. 5 shows the parts approximately one minute before the hour with the pawl released for engagement with the rack and just prior to driving engagement of the rack.

FIG. 6 shows the parts on the hour with striking about to begin;

FIG. 6a is a fragment showing the completion of the driving stroke;

FIG. 7 shows the parts in the positions occupied ten minutes before the half hour with the pawl and drive pinion fully retracted;

FIG. 8 shows the parts approximately four minutes before the half hour with the counting rack positioned in the single strike position relative to the pawl;

FIG. 8a shows the parts approximately one minute before the half hour with the drive pin in readiness to move upon drop-off; and

FIG. 9 shows the parts in the half hour position with the pawl and drive engaged for sounding of a single strike.

While the invention has been described in connection with a preferred embodiment, it will be understood that I do not intend to be limited to the particular embodiment shown but intend, on the contrary, to cover the

various alternative and equivalent constructions included within the spirit and scope of the appended claims.

Turning now to the drawings, the clock indicated at 10 has frame plates 11, 12 and 13, presenting a minute hand 15 and an hour hand 16. A synchronous driving motor 20, having an output pinion 21, drives through an idler gear 22 to rotate a pinion 23 on a drive shaft 24 which, as will be seen, provides motive power for the sounding of the bell. The pinion 23 meshes with a gear 25 having a pinion 26 which in turn meshes with a speed reducing gear and pinion 27, 28. The latter drives a second speed reducing gear and pinion 29, 30. The pinion 30 in turn drives a gear 31 on an intermediate shaft 32 having a pinion 33 which meshes with a minute wheel 34 which drives the minute shaft 35 to which the minute hand 15 is connected.

A pinion 36 on the minute shaft meshes with step-down gearing consisting of gear 37, pinion 38 and gear 39 to provide a twelve to one reduction of motion for driving the hour shaft 40 which supports the hour hand 16.

In summary, then, the synchronous motor 20 rotates the minute shaft 35 and the hour shaft 40 which control the operation of the striking mechanism to be described while the shaft 24 rotates to provide the motive power for the hammer or striker. The mechanism is surrounded by a gong 45 having a striker or hammer 46 which is raised and released by a pawl 47 biased into striking position by a spring 48.

To facilitate understanding of the structure and its operation, use will be made of an exploded perspective drawing, identified as FIG. 3, and a series of stop motion views identified as FIGS. 4 to 9 inclusive. In the discussion which immediately follows, reference may be made to FIG. 3 keeping in mind that the exploded nature of the view has separated from one another parts which are in normal engagement, the normal engagement being indicated by the free form arrows in this figure.

For the purpose of actuating the striker pawl 47, a rack member 60 is provided having a shaft 61 and a counting rack 62 having a series of teeth in saw tooth configuration which act upon the pawl 47 in succession to produce a series of strokes. For the purpose of moving the rack member 60 relative to the pawl, a drive rack 65 is formed along one edge of the member for meshing with the pinion 66 which is secured to the constantly running drive shaft 24. As will appear, the pinion 66 performs a clutching function, being movable into mesh with the rack 65 to provide the motive power for striking, but being retracted between the striking cycles.

In order to locate the counting rack in the appropriate starting position for the hour which is to be struck, a snail 70, having a total of twelve steps of decreasing height, is secured to the hour shaft 40. The snail is arranged in the path of bottoming movement of a follower or stop member 71 which is formed integral with the rack member 60, with a basing spring 72 serving to urge the rack member in the snail-engaging direction. As will be seen, when the stop 71 on the rack member engages the six o'clock step on the snail, the rack member is positioned to present the sixth notch of the counting rack to the striker pawl 47 to produce six strokes of the striker.

For the purpose of normally disabling the pawl 47, and for releasing it into engagement with the counting rack prior to each hour, and for clutching the pinion 66 into mesh with the drive rack 65, precisely on the hour, a minute cam 80 is provided on the minute shaft 35 which cooperates with a minute cam follower or arm 81 having a cam follower surface 82 and which is rockable about an axis 83. The arm is biased counterclockwise as shown in FIG. 3, by a spring 84. Integrally formed in the outer end of the arm 81 is a pawl-disabling and release member 85. As brought out more satisfactorily in the stop motion

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views to be discussed, the "back" face 85a of this member is positioned to directly engage the front edge 47a of the pawl.

In accordance with one of the features of the invention, the final portion of the movement of the minute cam arm 81 is utilized for clutching the pinion 66 with the drive rack 65. To impart clutching movement to the pinion, the upper end of the drive shaft 24 is floatingly mounted in a slot 86 formed in the frame. A cam slot 87 arranged at an angle in the arm 81 serves to cam the shaft from a right-hand disengaged position to a left-hand engaged position as the arm rocks counterclockwise under the urging of the spring 84. In order to insure that the release of the striker pawl and the advancement of the counting rack occur sequentially, the minute cam is formed with a sloping surface 91 terminating at a point of drop-off 92. Thus, as the cam rotates in the direction of the arrows, arrival of the edge of the cam follower surface 82 at the point of drop-off 92 causes the final portion of the movement of the arm 81 to take place abruptly to produce positive and precisely timed driving engagement between the pinion 66 and rack 65 to initiate the striking action.

In accordance with the present invention, means coupled to the minute shaft are provided for positioning the rack member 60 in its single stroke position with respect to the pawl 47 and for initiating a cycle of movement of the cam follower arm 81 to release the strike pawl and to clutch in the drive rack 65 for the sounding of a single stroke at the half hour. This is accomplished in the present instance by providing on the minute shaft 35 a half hour cam 100 having a lobe 101 which is in the path of bottoming movement of the rack member at the half hour, but which is undercut, as indicated at 102, and therefore out of obstructing position during regular striking on the hour. (See for example, FIG. 8). For cooperating with the half hour cam 100, a cam follower surface 105 is integrally provided on the rack arm. The parts are so dimensioned that when the cam follower surface 105 bears upon the lobe 101, the rack member 60 occupies a position in which the single stroke notch is positioned opposite the edge of the striker pawl 47. For cycling the arm 81 at the half hour positions, the minute cam 80 is provided with a second lobe 80b, in addition to the first lobe 80a, phased with the half hour, and having a sloping surface 111 and point of drop-off 112. Thus, as the half hour approaches, the rack member 60 will be rotated around to its single stroke position, followed by the release of the striker pawl into the single stroke notch. Upon drop-off of the cam follower arm 81 at the point 112 on the cam, the drive shaft 24 is abruptly shifted to clutch in the pinion 66 so that the rack member 60 is "walked" by the pinion 66 to complete a single stroke of the striker 46.

In order that the construction and operation may be clearly understood, a fairly elaborate set of stop motion views have been provided showing the relative positions of the significant parts at representative times of the day.

TIME: 5:50—FIG. 4

At this point of time, the preparation for striking the hour of six has not yet begun. The cam follower surface 82 on the follower arm 81 rides upon the lobe 80a of the minute cam, retracting the arm, in a clockwise direction, against the biasing force of the spring 84. With the cam follower arm in this position, the surface 85a of the pawl release member engages the edge 47a of the striker pawl, disabling the pawl and holding it clear of the counting rack 62. The drive shaft 24, and the pinion 66 which it carries, are in the retracted, declutched condition. Note that the follower 71 on the rack arm 60 is out of contact with the snail. This is because the lobe 101 of the half hour cam is in obstructing engagement with the cam follower surface 105 on the rack member. Subsequently, however, as shown in FIG. 4a, the edge of

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the cam follower surface 105 drops off of the lobe 101 on the half hour cam permitting the cam follower 71 to drop down upon step six of the snail.

TIME 5:59—FIG. 5

Upon continued rotation of the minute shaft 35, the edge of the cam follower surface 82 rides down upon the sloping cam surface 91 causing the minute cam follower to rotate counterclockwise retracting the pawl release member 85 from the striker pawl 47 so that the latter is free, under the urging of the spring 48, to drop down into the sixth notch of the counting rack, the notch having been placed in receptive position by the engagement of the rack member with step six on the snail. The same movement of the follower arm 81 causes the shaft 24 to be moved to a position of readiness at the beginning of the angled portion of the slot 87.

TIME: 6:00—FIG. 6

Precisely at six o'clock, the edge of cam follower surface 82 clears the point of drop-off 92 on the minute cam, causing the follower arm 81 to move abruptly counterclockwise under the urging of the spring 84. During this portion of the movement, the angled slot 87 on the cam follower arm shifts the drive shaft 24 to the clutching position in which the drive pinion 66 engages the drive rack 65. Once engaged, the pinion 66 "walks" the rack member 60 clockwise causing the six remaining teeth of the counting rack to successively engage the pawl 47 to produce six strokes of the striker. At the end of the "walking" movement the pinion 66 clicks idly at the end of the rack 65 as shown in FIG. 6a. Such idle clicking is normally inaudible.

TIME: 6:20—FIG. 7

By the time twenty minutes has elapsed, the minute cam 80 will have rotated around into a position in which the cam follower surface 82 is supported by the second lobe 80b of the cam. The accompanying movement of the cam follower 81 in the clockwise direction performs two functions. In the first place, the pawl release member 85 moves against the pawl to disable it. Secondly, the retracting movement causes the drive shaft 24 to be shifted, by the angled slot 87, into its declutched position in which the pinion 66 is out of engagement with the rack. The rack member 60 is thus free to rotate counterclockwise to the position shown under the urging of the biasing spring 72.

TIME: 6:26—FIG. 8

The next occurrence is the positioning of the rack member 60 for the single stroke to be sounded at the half hour. Thus as the half hour cam 100 rotates from the position shown in FIG. 7 to that shown in FIG. 8, the cam follower surface 105 of the rack member rides upwardly on the surface 102 of the half hour cam and onto the positioning lobe 101. This places the first notch of the counting rack in receiving position under the striker pawl 47. At 6:29, as the half hour approaches (FIG. 8a), the edge of the cam follower surface 82 on the cam follower arm 81 rides downwardly upon the sloping surface 111. This retracts the pawl release member 85, permitting the pawl to drop into the single stroke notch of the rack member. All that remains to strike the half hour is for the drive pinion 66 to be engaged.

TIME 6:30—FIG. 9

Upon slight continued rotation of the minute cam, drop-off occurs at the point 112, causing the cam follower 81 to rotate abruptly counterclockwise which results in the camming of the drive shaft 24 in the clutching direction. This "walks" the rack member upwardly, causing the pawl 47 to be engaged just once to impart a single stroke to the striker to designate the half hour. As shown in FIG. 6a, the drive pinion 66 clicks idly at the end of

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the rack until sufficient additional time passes so that the cam follower surface 82 rides up upon the lobe 80a of the minute cam to rotate the cam follower arm 81 clockwise retracting the pawl and disengaging the drive so that the rack member 60 is again free to move to the position shown in FIG. 4 to begin a new cycle. Such cycle will be the same as that previously described except that the stop surface 71 on the rack member 60 will be seated upon step seven of the snail for the striking of seven o'clock. The portion of the cycle for the striking of 7:30 will correspond to that previously discussed in connection with FIGS. 7-9.

The structure achieves a high degree of reliability and consistency. Because of the sharp point of drop-off on the minute cam, striking is initiated precisely on the hour and half hour. The mechanism is ideally suited to low cost production line manufacture since, except for the point of drop-off, the parts need not be precise or closely fitted. It is to be particularly noted that striking on the half hour is achieved with a minimum of added components, namely, the forming of an additional lobe 80b on the minute cam, the provision of the adjacent half hour cam, and the half hour cam follower surface 105 on the rack member. As a result of the present construction, complete striking, on the hour and half, may be incorporated in low cost clocks and the feature is no longer limited to the top clocks in the line.

In the following claims, the term "snail" will be understood to refer to a cam having a progressively stepped outer surface. The term "minute shaft" shall be understood to mean any shaft within the clock mechanism having a one hour cycle. The term "hour shaft" shall be understood to mean any shaft within the clock mechanism having a twelve hour cycle. The term "half hour" shall be understood to mean that instant of time half way between successive hour positions of the minute shaft. The term "clutch" covers any means for coupling the rack member to a source of driving energy. The term "single stroke position" refers to the positioning of the rack member with the first notch thereon opposite the striker pawl for a subsequent single stroke of the striker.

I claim as my invention:

1. In a striking clock having a minute shaft and an hour shaft as well as a drive shaft, the combination comprising a movable counting rack member, a pawl cooperating therewith having a striker, means including a snail on the hour shaft for establishing the starting position of the rack with respect to the pawl depending upon the hour, a clutch for coupling the drive shaft to the counting rack member for movement of the rack with respect to the pawl, means coupled to said minute shaft for engaging the clutch on the hour for striking of the hour, half hour positioning means coupled to said minute shaft and effective prior to the half hour for positioning the rack member in single stroke position with respect to the pawl, means coupled to the minute shaft for engaging the clutch on the half hour to produce a single stroke of the striker, and means actuated by the minute shaft subsequent to striking for disengaging the clutch and the pawl to free the rack member for subsequent positioning.

2. In a striking clock having a minute shaft and an hour shaft as well as a drive shaft, the combination comprising a movable counting rack member, a pawl cooperating therewith having a striker, means including a snail on the hour shaft for establishing the starting position of the rack with respect to the pawl depending upon the hour, a clutch for coupling the drive shaft to the counting rack member for movement of the rack with respect to the pawl, a minute cam on said minute shaft, means including a minute cam follower for engaging the clutch on the hour to produce striking on the hour, and means coupled to said minute shaft (a) for positioning the rack member in single stroke position with respect to the pawl shortly before the half hour and (b) for engaging the clutch on the half hour to produce a single stroke of the striker.

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3. In a striking clock having a minute shaft and an hour shaft as well as a drive shaft, the combination comprising a movable counting rack member, a pawl cooperating therewith having a striker, a snail on the hour shaft in the path of bottoming movement of the counting rack member for establishing an initial position of the rack with respect to the pawl depending upon the hour, a clutch for coupling the drive shaft to the counting rack member for movement of the rack with respect to the pawl, a minute cam on said minute shaft, means including a minute cam arm cooperating with said minute cam for normally disabling the pawl but for releasing the pawl in a respective initial position on the rack shortly before the hour and for engaging the clutch on the hour for striking of the hour, a half hour positioning cam on said minute shaft having a lobe which moved into the path of bottoming movement of the counting rack member prior to the half hour for positioning the rack in single stroke position with respect to the pawl, said minute cam having means for releasing the pawl in the single stroke position on the rack and for engaging the clutch to produce a single stroke of the striker on the half hour.

4. In a striking clock having a minute shaft and an hour shaft as well as a drive shaft, the combination comprising, a movable rack member having a counting rack and a drive rack, a pawl cooperating with the counting rack and having a striker, a snail on the hour shaft in the path of bottoming movement of the rack member for positioning the counting rack with respect to the pawl in a position which depends upon the hour, a clutch for coupling the drive shaft to the drive rack for movement of the counting rack with respect to the pawl, a minute cam on said minute shaft having a first lobe phased with the hour, means including a cam follower actuated by the first lobe on the hour for engaging the clutch for striking of the hour, a half hour positioning cam on said minute shaft which is moved into the path of bottoming movement of the rack member as the half hour approaches for positioning the counting rack in single stroke position with respect to the pawl, said minute cam having a second lobe phased with the half hour for actuating the minute cam follower for engagement of the clutch for the striking of a single stroke on the half hour.

5. In a striking clock having a minute shaft and an hour shaft as well as a drive shaft, the combination comprising, a movable rack member having a counting rack and a drive rack, a pawl cooperating with the counting rack and having a striker, a snail on the hour shaft in the path of bottoming movement of the rack member for establishing a starting position for the counting rack with respect to the pawl depending upon the hour, means including a laterally movable drive pinion connected to the drive shaft for advancing the counting rack with respect to the pawl, a minute cam on said minute shaft having a first lobe phased with the hour, means including a minute cam follower cooperating with said minute cam for normally disabling the pawl but for releasing the pawl in a starting position on the rack shortly before the hour and for moving the drive pinion into driving engagement with the drive rack on the hour for striking of the hour, a half hour positioning cam on said minute shaft which is moved into the path of bottoming movement of the rack member as the half hour approaches, for positioning the counting rack in single stroke position with respect to the pawl said minute cam having a second lobe phased with the half hour for moving the minute cam arm for releasing of the pawl in its single strike position on the rack and for moving the drive pinion into engagement with the drive rack for the striking of a single stroke on the half hour.

6. In a striking clock having a minute shaft and an hour shaft as well as a continuously running drive shaft, the combination comprising a movable rack arm having a concentric counting rack and drive rack, a pawl cooperating with the counting rack and having a striker, a

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snail on the hour shaft in the path of movement of the rack arm for establishing a starting position of the counting rack with respect to the pawl depending upon the hour, a movable pinion for coupling the drive shaft to the drive rack for movement of the rack with respect to the pawl, a minute cam on said minute shaft having a first lobe, means including a minute cam arm actuated by the first lobe as the hour approaches for releasing the pawl in a respective starting position on the rack and for moving the pinion into mesh with the drive rack on the hour for striking of the hour, a half hour positioning cam on said minute shaft movable into the path of movement of the rack arm as the half hour approaches for positioning the rack arm so that the counting rack is in single stroke position with respect to the pawl, said minute cam having a second lobe thereon opposite the first lobe for moving the minute cam arm to release the pawl in the single stroke position on the rack shortly before the half hour and for moving the pinion into mesh with the drive rack for the sounding of a single stroke on the half hour.

7. The combination as claimed in claim 6 in which the minute cam is provided with abrupt points of drop-off at the one hour and half hour positions for abrupt movement of the drive pinion into mesh with the drive rack for accurate timing of the initial stroke.

8. In a striking clock having a minute shaft and an hour shaft, the combination comprising a constantly running laterally movable drive shaft having a pinion secured thereto, a swingable rack arm having a counting rack and a drive rack concentrically arranged thereon, means for biasing the rack arm in one direction, a biased pawl cooperating with the counting rack and having a

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striker, a snail on the hour shaft in the path of biased movement of the rack arm for establishing a starting position of the counting rack with respect to the pawl depending upon the hour, the drive pinion being arranged opposite the drive rack for engagement therewith to produce swinging movement of the counting rack with respect to the pawl for counting out the strokes of the striker, a two-lobed minute cam on said minute shaft, means including a minute cam arm biased against the minute cam and having a pawl release member in the path of biased movement of the pawl for normally holding the pawl out of engagement with respect to the counting rack but for releasing the pawl just prior to the hour and half hour, said minute cam arm having a shifting cam for shifting the drive shaft resulting in meshing the drive pinion with the drive rack, said minute cam having abrupt points of drop-off at the hour and half hour positions for achieving abrupt engagement of the drive rack by the pinion precisely at the hour and half hour for accurate timing of the initial stroke, and a half hour positioning cam on said minute shaft phased to be in the path of movement of the rack arm at the half hour for positioning of the counting rack in single stroke position with respect to the pawl for producing a single stroke of the striker.

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