May 13, 1952 G. L. BUSH 2,596,370

CAM AND PAWL TRANSFER MECHANISM

Filed Dec. 28, 1949 2 SHEETS—SHEET 1

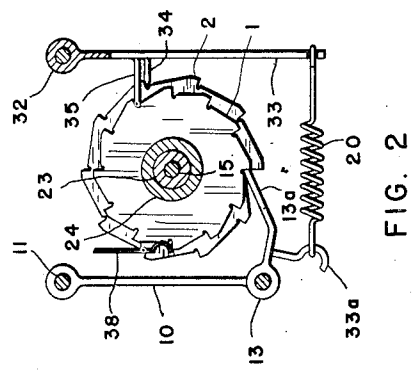


FIG. 2

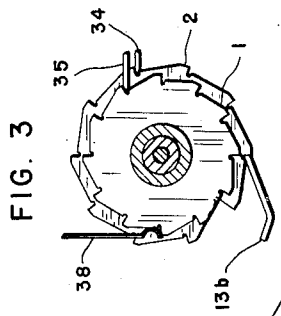


FIG. 3

FIG. 1

FIG. 4

FIG. 5

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Filed Dec. 28, 1949 2 SHEETS—SHEET 2

FIG. 8

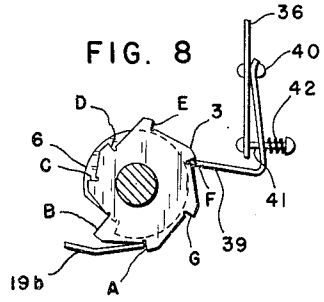


FIG. 7

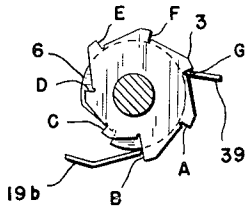


FIG. 6

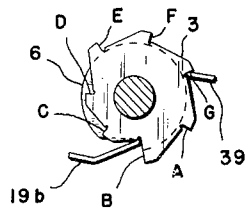


FIG. 10

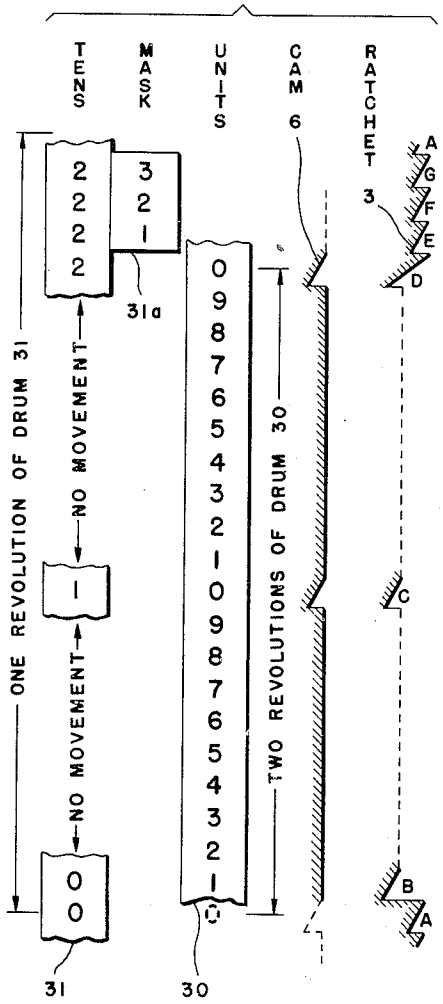
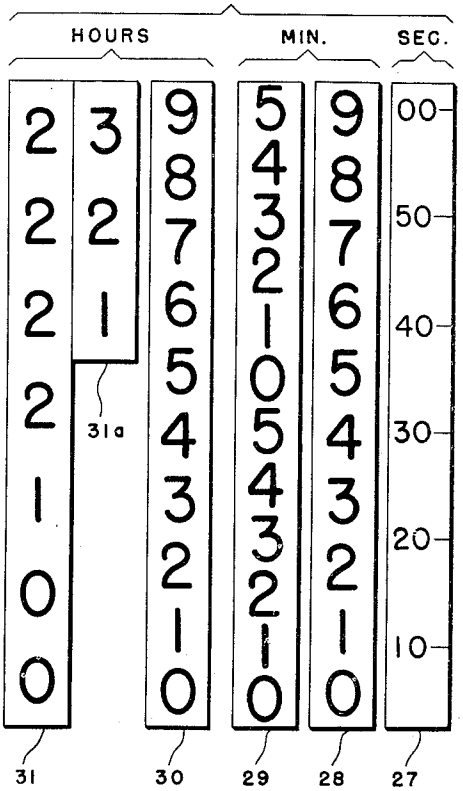


FIG. 9



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CAM AND PAWL TRANSFER MECHANISM

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Application December 28, 1949, Serial No. 135,497

3 Claims. (Cl. 235—134)

1

This invention relates to twenty-four hour clock movements and, more particularly, to a simpler form of mechanism for driving cyclometer clock dials than has heretofore been known, so far as the applicant is aware.

As prior art with respect to my invention it may be well to mention the pending application of Adolf Holzner, Serial 79,183 which was filed March 2, 1949, and which is licensed to the assignee of the present invention.

Holzner disclosed a cyclometer clock movement which involved the use of gearing, including Geneva movements and mutilated gears. In carrying out my invention, on the other hand, I have found it advantageous to employ ratchet wheels and pawl mechanism, and I have substantially eliminated all gearing of the type which Holzner used. There is, therefore, very little similarity between Holzner's invention and mine, other than with respect to the arrangement of digital drums on the peripheries of which numerals representing the hours and minutes of time are displayed.

The principal object of my invention is to provide a clock movement for stepwise advancement of indicating drum dials, the movement itself being characterized by the use of ratchet wheels, pawls and selecting mechanism, including cams whereby different wheels are advanced appropriately to indicate the passing of time.

Another object of my invention is to provide mechanism in a drum dial clock which minimizes the motion time for stepwise advancement of the indicating drums.

Still another object is to provide a clock mechanism of simple, low-cost design suitable for indicating hours, minutes and seconds, the indications being made to appear as relatively large numerals on the peripheries of drum dials.

A feature of my invention which relates to the use of a novel ratchet-and-pawl mechanism seems worthy of special mention at this point. This mechanism includes a constantly rotatable cam having a periphery of spiral formation and one precipitous step. This cam controls a cam follower directly coupled to a pawl mechanism for slowly retracting a plurality of pawls over the teeth of their respective ratchet wheels, and then suddenly releasing the pawl mechanism in a triggering fashion so that the stroke given to any selected ratchet wheel with which a particular pawl may be engaged will drive a corresponding indicator drum from one to another of its settable positions. The motion time for performing the stepping operation is thus minimized.

2

Furthermore, the drums for the tens- and units-of-hours may be advanced simultaneously with the drums for tens- and units-of-minutes whenever all of them should be advanced together. Hence there is no lag in the stepping of higher order drums in relation to the stepping of the units-of-minutes drum.

Another feature of my invention which is in some respects similar to a corresponding feature of the aforementioned Holzner case lies in the use of a masking portion attached to or forming a part of the drum which serves primarily to indicate tens of hours. This masking portion overlies the periphery of the units-of-hours drum and masks the same during three hours in which the units-of-hours drum is held stationary. Preferably, the units-of-hours drum displays the numeral "0" during the twentieth hour of the day. It is next covered over by the masking portion of the tens drum during the hours 21, 22 and 23. At the beginning of the 00 hour the "0" of the units drum is again displayed for one hour. From that time on the units drum is given hourly steps of advancement through two revolutions and its 5-hour rest period again commences with the 20th hour.

My invention will now be described in more detail, reference being made to the accompanying drawings in which—

Fig. 1 is an exploded isometric perspective view of a clock movement with its indicating drums, the movement being of the ratchet-and-pawl type for stepwise advancement of the several drums to indicate successively the different numerals on their respective peripheries.

Figs. 2 to 8 inclusive are detail views of certain cams, ratchet wheels and pawl mechanisms as used in a preferred embodiment of the clock movement such as shown in Fig. 1.

Fig. 9 is a peripheral development of the drums for indicating hours, minutes and seconds in a 24-hour clock, according to the preferred embodiment herein disclosed, and

Fig. 10 is a diagram showing the effects of hourly setting movements applied to the hour indicating drums through the use of ratchet wheels that are coupled to said drums and through the further use of pawls which may or may not be engaged with teeth of said ratchet wheels, according to requirements for causing steps of advancement to be taken by selected ratchet wheels and their associated drums.

As shown in Fig. 1 there are five indicating drums **27, 28, 29, 30** and **31** which must be driven stepwise at suitable times in order to correctly

tell the time during a 24-hour cycle. The seconds-drum 27 is directly driven by any suitable clock motor (not shown) coupled to shaft 14 which has a constant speed of 1 R. P. M. Drum 27 is mounted on shaft 14. Shaft 15 is coaxial with respect to shaft 14, coupling members 16 being provided for causing the two shafts to rotate at the same speed.

Shaft 15 extends through hollow shafts or sleeves 23 and 24 and supports two cams 7 and 8. Cam 7 gives a reciprocal motion to a cam follower 9 which controls a common actuator 10 for a number of pawl members 13, 18 and 19. The spiral periphery of cam 7 causes a slow retraction of the pawl members and the radial face of this cam causes the pawls to act on their ratchet wheels with a jump movement.

The pawl actuator 10 is fulcrumed on a shaft 11 so as to have its lower end swung back and forth, carrying a horizontal shaft 12. Pawl members 13, 18 and 19 are independently swivelled on shaft 12 and are severally urged by springs 20, 21 and 22 to engage with ratchet wheels 1, 2, 3 and 4 and to apply driving strokes thereto when such engagement is not otherwise prevented.

The units-of-minutes drum 28 has ten numerals on its periphery and rotates once every 10 minutes, being driven by a mechanically coupled ratchet wheel 2 which has 10 teeth. The coupling means between the drum and the ratchet wheel is a sleeve 23. The purpose of cam 8 is to control a set of detents such as 34, 35, 36 and 37. All of these detents are mounted on one rocking member 32 and provide latching and unlatching operations by the use of a cam follower 17 which rides over the periphery of cam 8. The detents are drawn out of engagement with the ratchet wheel teeth just prior to the application of the driving pawls for stepwise advancement of their respective ratchet wheels.

It should be borne in mind when reading the further description of my improved clock movement that regardless of which and how many ratchet wheels are to be advanced at each step, means are provided for withholding one or more of the pawls each from engagement with its ratchet wheel whenever the advancement of the same is unwanted.

The ratchet-and-pawl drive for the units-of-minutes drum 28

The units-of-minutes drum 28, and the ratchet wheel 2, are both fixedly mounted on a sleeve 23 and therefore rotate together. Since the cam follower 9, resting on the periphery of cam 7, produces slow retracting movements and quick triggering movements with respect to the operation of all the driving pawls, it will be clear that pawl 13b drives ratchet wheel 2 the distance of one tooth space at the rate of once per minute. Ratchet wheel 2 has 10 teeth and drum 28 has 10 numerals so that in a period of one hour the units-of-minutes are indicated by six revolutions per hour of drum 28.

The ratchet-and-pawl drive for the tens-of-minutes drum 29

Drum 29 and ratchet wheel 1 are both fixedly mounted on a sleeve 24 and are turned as a unit by pawl 13a which is part of a unitary structure of pawl member 13 mounted for free rotation on shaft 12. Pawls 13a and 13b are urged against their respective ratchet wheels 1 and 2 by means of a spring 20 which is stretched between two lever arms 33 and 33a, the latter being an extension from the pawl member 13, and arm 33 being an extension from the detent member 32. Spring 20, as well as other springs similarly stretched, causes pawls and detents to be held in place and these springs also exert the necessary driving force for stepping the several ratchet wheels rotatively when engaged by their pawls.

In order that the ratchet wheels 1, 3 and 4, and the drums to which they are respectively coupled, may be restrained from turning due to friction between the concentric sleeves, and when not positively driven by their associated pawls, I find that resilient detents 38 may be mounted so as to engage with the ratchet wheels. These detents 38 complement the function of detents 34, 35, 36 and 37 and are useful during the moments when the latter are withdrawn from engagement with the ratchet wheels. The detents 38 are shown in Figs. 3 and 5 by way of example. One of them is also applied to ratchet wheel 3.

One of the teeth of ratchet wheel 2 is adjacent to a more deeply cut notch than the other notches in this same wheel. When pawl 13b drops into this deeper notch it permits engagement of pawl 13a with a tooth of ratchet wheel 1 for driving the same. If the pawl 13b drops into a shallow notch of ratchet wheel 2, this condition holds pawl 13a in the clear so that ratchet wheel 1 will not be turned. Thus the steps applied to ratchet wheel 1 and its associated drum 29 are at the rate of once every 10 minutes. In other words, the ratchet wheel 2 must make a full revolution in order to produce an effective stroke for pawl 13a in its engagement with ratchet wheel 1. The revolution rate for ratchet wheel 1 is one every two hours.

The numerals on the tens-of-minutes drum 29 are in two series from "0" to "5" inclusive, because ratchet wheel 1 has twelve teeth and drum 29 has twelve settable positions. If the ratchet wheel 1 were to have only 6 teeth, then a single series of numerals "0" to "5" inclusive would be sufficient. One objection to a 6-tooth ratchet wheel for this purpose is the requirement of a longer stroke to be made by the driving pawls.

The ratchet-and-pawl drive for the units-of-hours drum 30

This drum 30 is mounted on a sleeve 25 which commonly supports a 10-tooth ratchet wheel 4 and a cam 6 having one notch therein. The function of the cam 6 will be explained in reference to an operation of the tens-of-hours drum 31.

Mounted on the same sleeve 24 together with ratchet wheel 1 is a cam 5 having two diametrically opposed notches therein. Cam 5 controls a cam follower 18a which extends from the right end of a yoke 18. At the left end of yoke 18 is a pawl 18b. Since the yoke 18 swivels on shaft 12 under control of cam follower 18a, the pawl 18b is selectively engaged with teeth of ratchet wheel 4 only on hourly strokes of the actuator 10 and engagement is prevented when taking the intervening one-minute strokes. It was previously stated that ratchet wheel 1 is stepped through a full revolution once every 2 hours, so once every hour the cam follower 18a drops into one of the two notches in cam 5. The pawl driving stroke which is selected for engagement of pawl 18b with ratchet wheel 4 occurs once every hour thereby to advance the units-of-hours drum 30 one step each time.

The ratchet-and-pawl drive for the tens-of-hours drum 31

Mounted on the same sleeve **25** together with ratchet wheel **4**, and the units-of-hours drum **30**, is a cam **6** which cooperates with a cam follower **19***a*. The steps of advancement of ratchet wheel **4** and drum **30** are at the rate of once per hour throughout a period of 20 hours in every 24 hours. Means are provided, however, for avoiding the advancement of drum **30** at the hourly changes beginning with hours 20, 21, 22 and 23. For indicating the hours 21, 22 and 23 the tens-of-hours drum **31** is advanced progressively while masking the units-of-hours drum **30**. Therefore, drum **31** is provided with a masking portion **31***a* which bears numerals "1," "2" and "3" for progressive display while numeral "0" on drum **30** rests in its display position and is concealed.

The tens-of-hours drum **31** preferably has seven settable positions and displays one or another of the numerals 0, 1 or 2 in order to correctly indicate the tens-of-hours during a 24-hour day. Drum **31** and ratchet wheel **3** are both fixedly mounted on a sleeve **26** and therefore rotate together. Ratchet wheel **3** has a peculiar formation of its ratchet teeth in that five of the teeth have their crests of greater radius than the other two. In Figs. 6, 7 and 8 ratchet wheel **3** is shown in different positions relative to the cam **6** and these positions will presently be explained as being incident to the cyclic operation of the driving mechanism for the hours-drums. The notches between the teeth of the ratchet wheel **3** have been labeled "A" to "G" inclusive because the dropping of pawl **19***b* into these different notches has different effects at different times of the day, as will be explained presently when describing Fig. 10.

The pawl member **19** has a cam follower portion **19***a* and a driving pawl **19***b*. The member **19** also has fingers **19***c* and **19***d* which form yoke elements one above and the other below the driving pawl **18***b* where the latter is operatively associated with ratchet wheel **4**.

The driving strokes applied to ratchet wheel **4** are at the rate of once per hour through a period of 20 hours, even though there are 59 ineffective strokes every hour given to the entire pawl assembly while pawl **18***b* is held clear of ratchet wheel **4**, due to the fact that cam follower **18***a* rides on the arcuate portion of cam **5** and holds pawl **18***b* clear of the teeth of ratchet wheel **4**. Pawl **19***b* is also held clear of ratchet wheel **3** by downward pressure of pawl **18***b* on finger **19***d* during the one-minute strokes of actuator **10** between hourly strokes.

The high teeth with their adjacent shallow notches in ratchet wheel **3** possess the function of causing pawl **18***b* to be disengaged from its associated ratchet wheel **4** when stepping strokes need to be prevented. Thus, at the commencement of hours 21, 22, 23 and 00 the pressure of finger **19***c* on the top side of pawl **18***b* holds this pawl in the clear. This action neutralizes the control which at other times would derive from the dropping of cam follower **18***a* into a notch of cam **5**.

Reference to Fig. 10 will show more clearly the irregularities of stepping which apply to the advancement of the tens- and units-drums. The numerals which are displayed by these drums and by the mask **31***a* are represented for each of 24 hours, reading the chart of Fig. 10 upward. In horizontal alignment with the numerals as shown on the development of the drum peripheries I

show where the notches in cam **6** and the high and low teeth in ratchet wheel **3** are made effective to produce the successive hourly indications. Taking the lettered notches of ratchet wheel **3**, for example, and assuming that notch "A" of this ratchet wheel has been engaged by pawl **19***b*, the completion of this stroke will be at the commencement of the 00-hour, thus showing one of the "0" numerals on the tens drum and a "0" numeral which is exposed on the units drum. This particular zero of units drum is the same as is displayed during the 10th hour and during the 20th hour, but because drum **30** has only 10 settable positions and rotates through two complete revolutions every 24 hours, the development of its periphery as shown in Fig. 10 covers only a period of 20 hours and its numeral "0" for the 00-hour is indicated in broken outlines as being a duplicate showing of the same "0" which first appeared at the commencement of the 20th hour. It will be remembered that the units-of-hours drum **30** is held stationary for 5 hours. In other words, four of its hourly steps are omitted at the commencement of hours 21, 22, 23 and 00.

When a stroke is completed by the engagement of pawl **19***b* with notch "B" of ratchet wheel **3**, this is at the commencement of the "01" hour. Notch "B" is deep and allows pawl **18***b* to be engaged with a notch of ratchet wheel **4**. In order to indicate this "01" hour both the tens drum and units drum must be advanced one step. For each succeeding hour, however, no movement is to be permitted to the tens-of-hours drum **31** but the pawl **18***b* at the commencement of every hour 02 to 09 inclusive, will be engaged with a tooth of ratchet wheel **4** and will step both the units-of-hours drum **30** and the cam **6** around to a point where on the 10th hour a stroke will be delivered to the tens-of-hours drum **31** through the engagement of pawl **19***b* with notch "C" of ratchet wheel **3**. This operation is performed by the co-phasing of the single notch in cam **6** and notch "C." The out-of-phase relation between these two notches causes pawl **19***b* to be cleared of engagement with notch "C," thereby holding the tens-of-hours drum stationary. On the 10th hour drum **31** is advanced one step to indicate that hour and thereafter for indicating the hours 11 to 19 inclusive the units-of-hours drum **30** is stepped at an hourly rate by the control of cam **5** and cam follower **19***a*, the same as was described above with reference to the stepping of this drum to indicate the hours "02" to "09" inclusive.

During the hours 11 to 19 inclusive, pawl **19***b* is held clear of the low tooth between notches "C" and "D" by the fact that cam follower **19***a* rides on the arcuate portion of cam **6**. At the commencement of the 20th hour pawl **19***b* drops into notch "D" while cam follower **19***a* drops into the notch of cam **6**. At this time, therefore, both of the hour drums **30** and **31** are stepped together to produce the indication of the 20th hour. The next step is where pawl **19***b* rides over the crest of a high tooth into notch "E" and drives the tens-of-hours drum **31** one step without permitting the stepping of the units-of-hours drum since notch "E" holds pawl **18***b* clear of engagement with ratchet wheel **4**. Successive steps are then taken hourly to advance the tens-of-hours drum with its mask **31***a* so as to indicate the hours 21, 22 and 23. During these hours, as before stated, the units-of-hours drum **30** is held stationary with the numeral "0" underlying the mask **31***a*.

Fig. 2 is a cross section of the concentric sleeve 23 and 24, looking at the right-hand side of ratchet wheel 1, the teeth of ratchet wheel 2 and the outlines of other components being also shown. When the two drums 28 and 29 are to be simultaneously set for indicating the "00" minute, the 10th minute or any multiple thereof, pawl 13b must drop into the one deep notch of ratchet wheel 2 in order to permit engagement of pawl 13a with a tooth of ratchet wheel 1. The positions of orientation of ratchet wheels 1 and 2 are shown in Fig. 2 as at the time of completion of one of these once-in-ten-minute strokes. In between such strokes there are the once-a-minute strokes applied to the pawls solely for advancing the ratchet wheel 2 and its intercoupled units-of-minutes drum 28. During these strokes pawl 13a is held in the clear because pawl 13b engages with shallow notches in ratchet wheel 2.

Fig. 3 shows the relative positions of ratchet wheels 1 and 2 upon completing the setting stroke at the commencement of the 9th minute. Here it will be observed that the deep notch in ratchet wheel 2 is in position to be engaged by pawl 13b when next retracted. Hence, on the next stroke pawl 13a will be engaged with ratchet wheel 1 for giving it the necessary stepping stroke.

Fig. 4 is a cross section through sleeves 23 and 24 taken just to the right of cam 5. One or the other of two notches in cam 5 determines the times (once per hour) when pawl 18b is permitted to engage with ratchet wheel 4 for advancement of the units-of-hours drum 30. Such operation is repeated hourly in order to rotate drum 30 through two complete revolutions. But further steps of advancement of drum 30 are skipped by the action of ratchet wheel 3 while pawl 19b rides over high teeth and shallow notches therein; that is, for setting the dials to indicate the 21st, 22nd, 23rd and 00 hours.

Fig. 4 shows the orientations of cam 5 and of ratchet wheel 4 on completion of any setting stroke which would advance the units-of-hours drum 30. Fig. 5 shows the orientations of cam 5 and ratchet wheel 4 at a time 59 minutes later, one of the notches in cam 4 being in position to be engaged by pawl 18b when it is next retracted.

Fig. 6 shows the relative orientations during the hour "01" of ratchet wheel 3 and cam 6. The pawl stroke at commencement of hour "01" is made when the notch in cam 6 and the deep cut B in ratchet wheel 3 are in phase. On this stroke, therefore, the two drums 30 and 31 are both stepped forward.

To indicate hours "02" through "09" the stepping of the units-drum 30 must be accomplished without stepping the tens-drum 31. Therefore the tooth of ratchet wheel 3 which is between notches "B" and "C" has a low crest and can only be engaged by pawl 19b when cam follower 19a drops into the notched portion of cam 6. This occurs at the commencement of the 10th hour and again at the commencement of the 20th hour. The pawl engagement in notch "C" causes advancement of drum 31 to indicate the tens-numeral "1." Engagement in notch "D" gives an indication of the tens-numeral "2." Fig. 7 shows the relative orientations of ratchet wheel 3 and cam 6 when the hour "01" is indicated. Here it can be seen that, after eight further retracting strokes given to pawl 19b, the position of cam 6 will cause pawl 19b to be engaged in notch "C" for advancing the tens-drum, as distinguished from the on-the-hour strokes for the eight preceding hours for which no advancement of drum 31 is wanted.

Fig. 8 shows the ratchet wheel and cam orientations during the hour "00" and preparatory to the pawl stroke whereby pawl 19b drops into the first deep notch "B" and causes the hourly stepping of the units-drum 30 to be resumed.

The various stepping operations which are performed as above described are, of course, accompanied by the reciprocal action of the detent member 32 under control of cam 8 and cam follower 17. The member 32 operates in proper time relation to the driving strokes which are obtained under control of cam 7 and cam follower 9 so as to disengage the detents 34, 35, 36 and 37 from their respective ratchet wheels just prior to being driven forwardly by the driving pawls. After each one-minute stepping operation of the driving pawls has been completed the cam follower 17 drops over the crest of the one hump in cam 8 and restores the locking engagement of detents 34, 35, 36 and 37 with notches in the several ratchet wheels. It will thus be seen that between the strokes of the driving pawls the various parts of the clock movement are prevented from being thrown out of phase.

The detent 36 as hereinabove mentioned, when designed for most practical functioning, is a subassembly of parts which could not be shown in Fig. 1 without unduly complicating that figure. The preferred arrangement appears in Fig. 8. In Fig. 1 two references 36, 39, have been applied to a single detent arm to imply that it is composed of two jointed elements 36 and 39 loosely held together by pins 40 and 41 (Fig. 8). Sufficient clearance is provided between the head of the pin 40 and the element 39 so that element 39 may swing away from element 36 when it engages in a shallow notch of the ratchet wheel 3. At that time a coil spring 42 is compressed between the head of pin 41 and the heel portion of element 39. When this element latches into a deep notch of ratchet wheel 3 spring 42 expands and closes the gap between the elements 36 and 39. This arrangement permits proper functioning of the detent as a latch member cooperating with the ratchet wheel 3, despite the fact that this wheel has both deep and shallow notches between its teeth. Furthermore, the functioning of the more simple detent arms 34, 35, and 37 is in no way impaired by the fact that the element 39 has to latch into deep notches at times and into shallow notches at other times.

Another matter of practical design which could not readily be shown in the drawing relates to the extent to which the pawl 19b is drawn away from ratchet wheel 3 at all times other than when the cam follower 18a rides into one of the notches of cam 5. The rotation of pawl member 19 when its extension 19d is depressed by pawl 18b is sufficient to insure clearance between pawl arm 19a and the high teeth of ratchet wheel 3. This clearance prevails during contact between cam follower 18a and the circular periphery of cam 5. If this were not so, then the minute-by-minute excursions of the pawl assembly would cause advancement of the units-of-hours drum at a once-a-minute rate for four minutes instead of at hourly intervals as heretofore described.

Provision for manually setting the clock

Devices for manually setting the drum dials of a clock such as herein shown are well known in the art. My invention does not contemplate any novel structure for performing this setting opera-

tion. To have shown such a setting device would have merely complicated the showing of essential details of my invention. It might be well to mention, however, that any setting device, however applied, would involve momentarily moving the latch fingers of detent **32** out of the paths of the ratchet wheel teeth, as is obvious from the foregoing description and from the drawings themselves. One embodiment of a setting device might, for example, be substantially in accordance with the disclosure of the aforementioned Holzner application wherein knurled wheels extend through openings in the clock case. These wheels can be manipulated and, by their geared connections with the clock movement for minutes indication independently of the clock movement for indicating the hours, these two sets of gear mechanisms may be independently manipulated for setting purposes. All such structure, however, is disclaimed in the instant disclosure.

It will be apparent to those skilled in the art that while I have illustrated my invention by a specific embodiment, various modifications may be made without departing from the spirit of the invention. Certain of the structural features of the ratchet-and-pawl mechanism are applicable to a 12-hour clock, as well as to a 24-hour clock. This is also a matter which will be clearly understood by those skilled in the art.

I claim:

1. A mechanical movement for stepwise advancement of indicating drums in a clock, said movement comprising a ratchet wheel certain teeth of which have relatively high crests separated by shallow notches while other teeth have relatively low crests intervening between deep notches, this wheel being shaft-coupled to one of said drums, a second ratchet wheel sleeve-coupled to the other of said drums and coaxial with respect to the first said ratchet wheel, a reciprocating device having common retracting and releasing means for operation thereof and

comprising separately swivelled pawls each engageable with a respective one of said ratchet wheels, resilient means for urging said pawls into engagement with said ratchet wheels and for driving the same after pawl retraction and release, and a control arm extending from one pawl to a position of engagement with the other pawl, the one pawl being that which cooperates with the first said ratchet wheel, said control arm being effective to maintain clearance between said other pawl and its associated ratchet wheel when said one pawl is engaged in any of said shallow notches.

2. A mechanical movement according to claim 1 and including a notched cam which is sleeve-mounted to rotate with said second ratchet wheel, and a cam follower operably integrated with said one pawl, said follower when engaged in a notch in said cam being effective to cause engagement of said one pawl with a deep notch in the first said ratchet wheel.

3. A mechanical movement according to claim 1 and including a notched cam which is coaxially mounted with respect to said ratchet wheels and is rotated independently thereof, and a cam follower operably associated with this cam and mechanically linked with said other pawl for selecting a portion only of the strokes of said reciprocating device to be effective in causing engagement of said pawls with their respective ratchet wheels.

GEORGE L. BUSH.

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