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Charbonney, deceased et al.

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[54] **DIGITAL-DISPLAY WATCH MOVEMENT**

[75] Inventors: **Adrien Maurice Charbonney, deceased,** late of Saint Blaise, Switzerland; **Jean-Jacques Therens, legal representative,** Saint-Blaise, Switzerland; **Urs Giger,** Solothurn, both of Switzerland

[73] Assignee: **Eta A.G. Ebacuhes-Fabrik,** Grenchen, (Canton of Soleure), Switzerland

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[51] **Int. Cl.** **G04b 19/24;** G04b 19/02

[58] **Field of Search** ..... 58/5, 58, 125 B, 126 A

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Primary Examiner—George H. Miller, Jr.
Attorney, Agent, or Firm—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

A digital display watch movement comprising three coaxial jumping indicator members, two indicating tens and units figures of minutes and one indicating the hours, and an additional indication of the date and day of the week.

12 Claims, 2 Drawing Figures

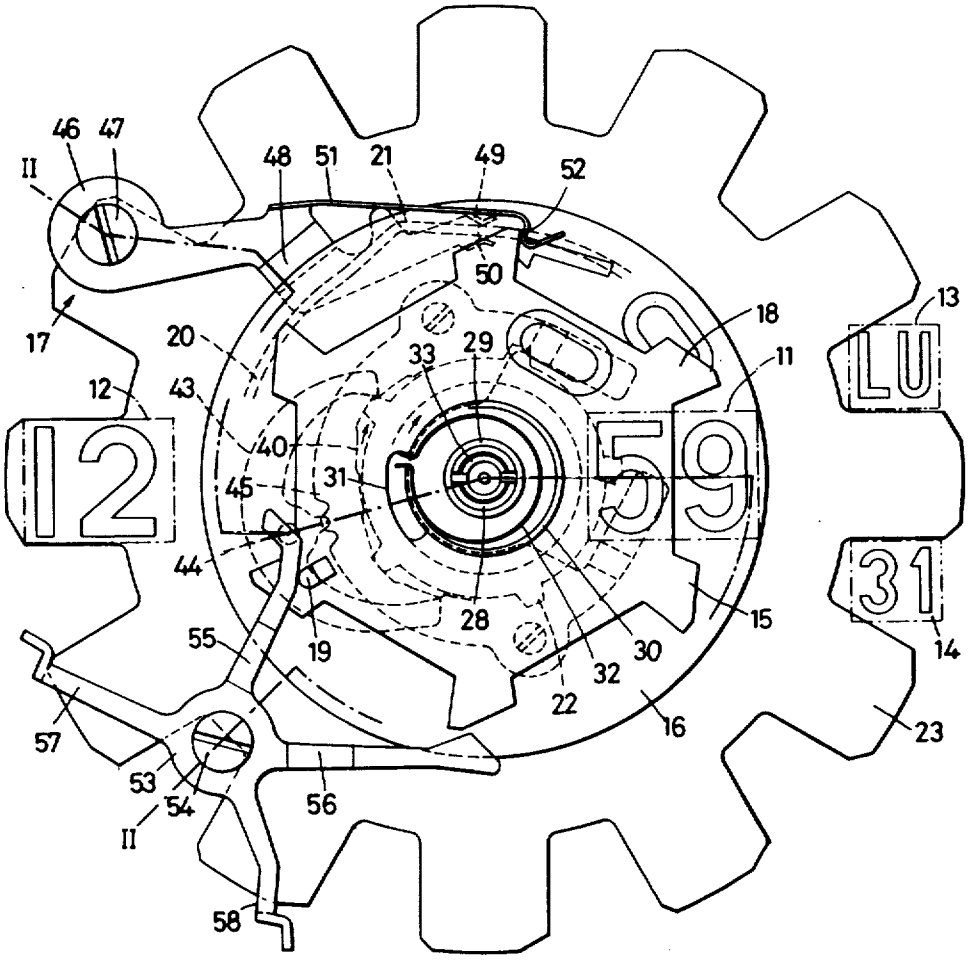

FIG. 1

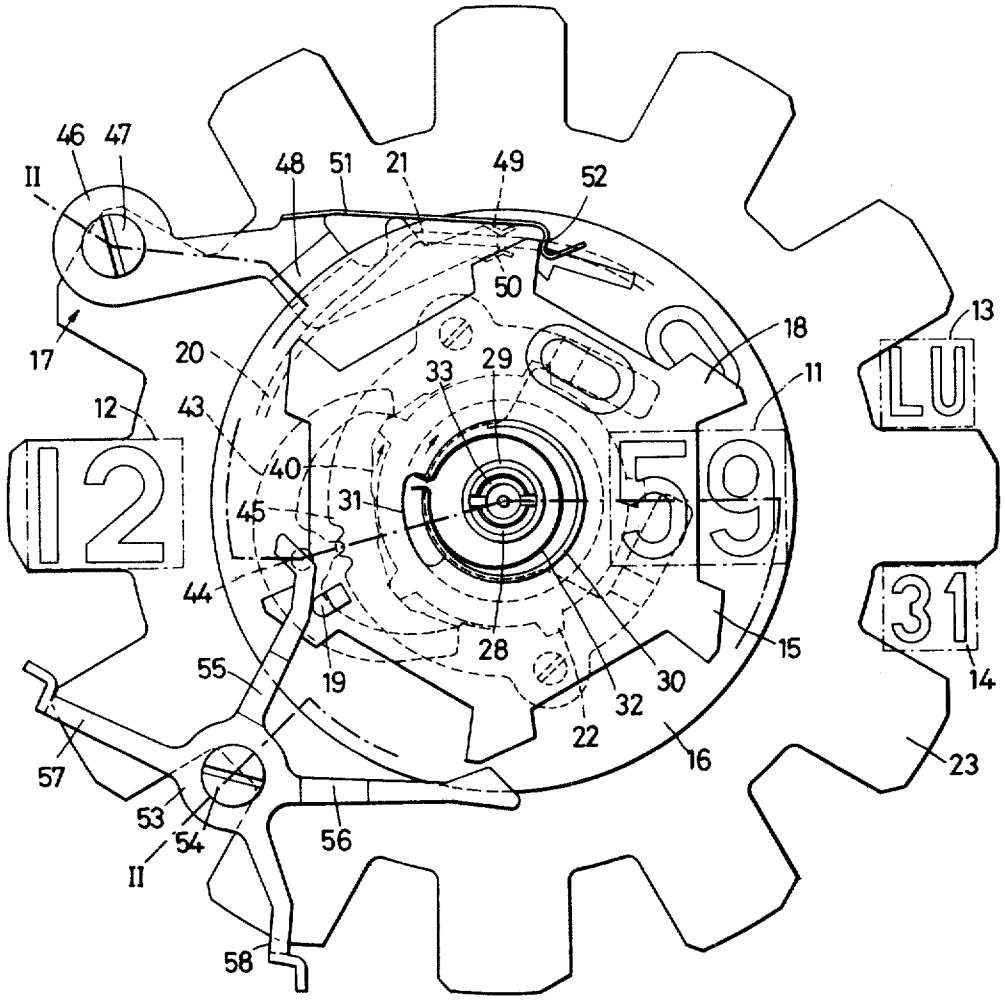
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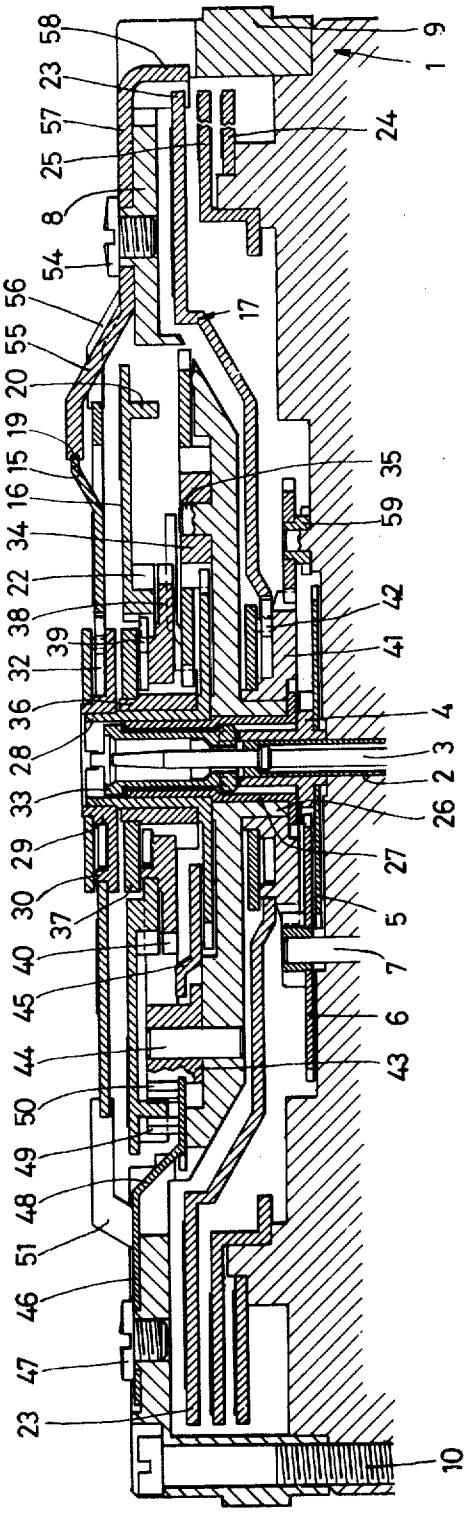
FIG. 2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DIGITAL-DISPLAY WATCH MOVEMENT

This invention relates to a digital-display watch movement comprising a base plate, a dial provided with at least one aperture, and three coaxial jumping indicator members visible in the aperture or apertures, the first indicator member indicating the tens figures of the minutes, the second indicator member indicating the units figures of the minutes, and the third indicator member indicating the hours.

Various improvements in the design of digital-display watch movements have been made in recent times. In general, these movements comprise a certain number of indicator members in the form of discs, some of which are connected to mechanisms which drive them rotatingly by jumps. In most cases, however, only the hour-indicating member is driven by jumps, and the minute-indicating member is mounted on the cannon-pinion of the movement so as to rotate continuously at the rate of 1 revolution per hour.

The arrangment of a digital-display device comprising indicator discs or rings presents certain difficulties, for it is desirable that the various indications appear in figures of as large a size as possible. This requirement, however, runs counter to the fact that the size of the movement cannot be too greatly increased, so that the discs are limited in size.

When the minute-indicating member moves continuously and bears at its periphery 60 radial markings and digital indications corresponding to the minute figures counting by fives, the aperture in which these indications appear must be sufficiently large to enable a section of the periphery of the minute-disc covering at least 5 to 10 minutes to be visible. This represents an obstacle to a sensible and convenient presentation in a watch movement of this type.

It is the object of this invention to provide a solution to the aforementioned difficulties encountered in the prior art.

To this end, the digital-display watch movement according to the present invention further comprises three continuously rotating driving members, each associated with one of the indicator members to form with it a pair of coaxial rotating parts coupled to one another by a spring, these pairs being superimposed between the dial and the base plate, the first indicator member extending immediately beneath the dial, and further comprises a display bridge and three levers acting as pallets and pivoting on the bridge, each lever cooperating with one of the indicator members to release it periodically, the first of the levers being actuated by the second indicator member, the second of the levers being actuated by the driving member of the second of the pairs of rotating parts, and the third of the levers being actuated by the first indicator member.

A preferred embodiment of the invention will now be described in detail with reference to the accompanying drawings, in which:

FIG. 1 is a top plan view of the movement with certain parts omitted in order to facilitate understanding of the drawing, and

FIG. 2 is a section taken on the line II—II of FIG. 1.

The display mechanism of the watch movement illustrated will be described below. The remainder of the movement is of a classic design, a base plate 1 of which will be seen in FIG. 2. Fixed at the center of the base plate 1 is a pipe 2 which guides a center seconds-arbor 3. About the pipe 2 pivots a cannon-pinion 4 on which a center wheel 5 is fastened. The wheel 5 is engaged on a cylindrical bearing surface of the cannon-pinion 4 so as to produce a friction coupling between these two rotating parts. The wheel-and-pinion 4, 5 is connected to the wheel-train of the movement, by means which are not shown, and rotates at the rate of 1 revolution per hour. The cannon-pinion 4 meshes with the wheel of a minute wheel-and-pinion 6 pivoting on a shaft 7 fastened to the base plate 1 as in a conventional movement. It is also coupled to a mechanism for driving an indicator member, as will be seen further on.

Fastened on th base plate 1 is a display bridge 8 having a cup-shaped middle portion and an annular wall 9 at its periphery. The foot of the wall 9 rests in an undercut in the base plate 1, and the bridge 8 is fastened to the base plate 1 by screws. Various openings are made in the bridge 8. It carries the entire display mechanism as well as a dial (not shown) provided with a center opening and four apertures 11, 12, 13, and 14 in which the indicator members appear. Through the center opening in the dial, it is possible to fasten to the upper end of the arbor 3 a seconds-hand which will move above the dial.

As may be seen in FIG. 1, the indications which appear in the apertures 11 and 12 are the indications of the minutes and of the hours, respectively. The minute indications are themselves divided between two indicator members, the first of which, 15, bears the tens figures of the minutes from 0 to 5, and the second of which, 16, bears the units figures of the minutes from 0 to 9. These two members are coaxial, and the second member 16, larger in diameter than the member 15, is situated below the latter. The hour indications are borne by a third indicator member 17, which is appreciably larger in diameter than the member 16 and extends beneath the bridge 8, whereas the other two indicator members 15 and 16 are above the bridge 8.

It will be noted that the six tens figures of the minutes are borne by the indicator member having the smallest diameter and are regularly distributed over a circular annular zone of that member. The indicator member 15 is in the shape of a hexagon having teeth 18 at each of its corners; the function of the teeth 18 will be explained further on. At the base of one of these teeth 18 is a tongue 19 partially blanked out of the member 15 and bent obliquely upwards. The function of this tongue 19 will also be explained further on. The indicator member 16 is circular and bears the units figures of the minutes distributed equidistantly along its periphery. The lower face of the member 16 is provided with a rib 20 situated slightly back from its periphery. The rib 20 follows a circular path along practically its entire extent; but at one place, the path of the rib 20 shifts outward to form a hump 21 (FIG. 1). The indicator member 16 also has a star-toothing 22, comprising five trapezoidal teeth, projecting from its lower face. The third indicator member 17 is cup-shaped, like the bridge 8, its periphery being raised so as to extend immediately beneath the periphery of the bridge 8. The periphery of the member 17 is blanked and presents 12 radial projections 23, each of which bears one of the figures from 1 to 12. The arrangement of the figures on the indicator members 15, 16, and 17 is such that the time in hours and minutes appears in the apertures 12 and 11 in the form of digits of equal size and in the logical sequence, i.e., hour and minute from left to right.

For that purpose, the aperture **12** is disposed to the left of the center when the movement is viewed from above, and the aperture **11** is to the right of and closer to the center. Thus the indications borne by the tens-of-minutes disc **15** appear to the left of the indications borne by the units-of-minutes disc **16.** It will be seen in FIG. **1** that the apertures **14** and **13** are disposed on either side of the radial projection **23** opposite the one appearing in the aperture **12.** In the aperture **14** there appears the indication of the date, borne by a conventional date-ring **24** mounted on the base plate **1** and driven by a calendar mechanism (not shown). The size of the date figures is such that they are visible in the aperture **14** through the space left free between two projections **23.** Furthermore, the movement being described comprises a day-indicator member **25,** likewise blanked as a star which may have **7** or **14** teeth. Each of these teeth bears the abbreviation in letters of one of the days of the week. The blanked disc **25** extends beneath the third indicator member **17** and above the date-ring **24.** It is so positioned that one of its indications appears in the aperture **13.** Under these conditions, no other tooth of the disc **25** hides the date-ring **24.** The calendar mechanism which drives the members **24** and **25** will not be described here inasmuch as it is a conventional one.

The elements of the display mechanism by means of which the cannon-pinion **4** drives the members **15, 16,** and **17** by jumps will now be described. Each of the members **15, 16,** and **17** is coupled to a driving member by means of a coupling comprising a spring which enables the respective indicator member and driving member to shift temporarily with respect to one another. The driving member rotates continuously, so that when the indicator member is blocked, the spring is gradually tensed. When the indicator member is released, it advances by one step under the effect of the spring and catches up with its driving member. These three spring couplings are coaxial and are carried by the display bridge **8.** For this purpose, the bridge **8** has a central hub **26** extending downwards, in which is fastened a pipe **27** which passes all the way through the hub **26** and projects upwardly to the level of the upper face of the raised peripheral portion of the bridge **8.** The pipe **27** serves as a pivot for a tens cannon-pinion **28** comprising a central pipe and, at its base, a toothed disc. The cannon-pinion **28** is the driving member of the indicator member **15.** Fastened to the end of its pipe is a coupling device **29** consisting of two parallel plates, one of which has an annular rib **30** about which the disc **15** pivots. The rib **30** is interrupted for a certain distance, as may be see in FIG. **1,** and the opening thus formed corresponds to a hollow **31** made in the edge of the inside opening of the disc **15.** An arcuately curved spring-blade **32,** the two ends of which are folded back outwardly, is fastened to one end of the rib **30,** on the one hand, and to one end of the hollow **31,** on the other hand. It is held between the two coupling plates **29** so that the disc **15** may rotate by about 60° with respect to its driving member **28,** and this corresponds to the angle through which the disc **15** jumps every 10 minutes.

The driving member **28** of the disc **15** rotates continuously at the rate of one revolution per hour. For that purpose, it is connected to the cannon-pinion **4** by a coupling sleeve **33** housed in the pipe **27.** The lower end of the sleeve **33** is provided with projecting jaws which are engaged in corresponding slots in the pipe of the cannon-pinion **4.** The upper end of the sleeve **33** likewise has projecting tongues forming coupling jaws bent outwardly over the end of the pipe **27** and engaged in slots in the pipe of the cannon-pinion **28.** Thanks to this gimbal-like coupling device, any lack of parallelism between the axes of the guide-pipe **27** and the pipe **2** is compensated. The tens cannon-pinion **28** is therefore continously driven in rotation. Its wheel meshes with the pinion of a transmission wheel-and-pinion **34** which pivots on a stud **35** integral with the bridge **8.** The wheel of this wheel-and-pinion **34** meshes with a pinion **36** which is engaged on the pipe of the tens cannon-pinion **28.** The pinion **36** constitutes the driving member of the second indicator member **16.** On a truncated portion of its toothing, it carries a pair of coupling plates **37** and **38.** The spring coupling between the pinion **36** and the disc **16** is exactly the same size and is made up in exactly the same way as the coupling between the pinion **28** and the disc **15.** The plate **38** comprises an annular rib interrupted over part of its length, within which is a tensed spring-blade **39** hooked to the rib and to the disc **16.** The details of this device need not be described here. It should be pointed out, however, that the periphery of the coupling plate **38** has a cam profile **40** formed of five lugs situated immediately below the star-toothing **22.**

Finally, a third spring coupling is provided between the hour-indicating disc **17** and its driving member **41.** The latter is made in one piece with a coupling plate and with a hub which bears another coupling plate. It pivots on the lower hub **26** of the bridge **8,** and its peripheral toothing is engaged with the pinion of the minute-wheel **6.** The driving member **41** therefore completes one revolution every 12 hours. A spring-blade **42,** the arrangement of which is the same as that of the spring-blades **39** and **32,** makes it possible to block the disc **17** for one hour, corresponding to a rotation of the member **41** through an angle of 30°. Thus the member **17** can be released once every hour, and it makes a jump allowing the indication of the succeeding hour to appear in the aperture **12.**

In order that the operation of the driving mechanisms of the members **15, 16,** and **17** may be understood, it is necessary to describe as well three levers **46, 43,** and **53,** each of which connects one of the indicator members to its control cam. The first to be described will be the second lever, **43,** which cooperates with the second indicator member **16.** It pivots on a stud **44** fastened to the bottom of the cup-shaped portion of the bridge **8.** The lever **43** is held axially in place by a retaining plate **45** which is fastened to the bridge **8** and likewise holds in place the tens cannon-pinion **28** and the transmission wheel-and-pinion **34.** The lever **43** comprises two arcuate arms which embrace the star-toothing **22** of the disc **16** and the cam profile **40** of the driving member **37.** Each of the lugs of the cam profile **40** successively guides the end of each of the two arms of the lever **43** and hence controls a double rocking movement of that lever. At the moment when it arrives at its final phase, each rocking movement releases a tooth of the toothing **22,** which enables the disc **16** to jump forward through an angle of 36° and consequently to cause the succeeding units figure of the minutes to appear in the aperture **11.** Thus the rotation of the pinion **36,** which takes place at a speed of one revolution every **10** minutes owing to the wheel-and-pinion **34,** the cannon-pinion

28, and the center wheel-and-pinion 4, 5, causes, via the lugs of the cam profile 40 and the spring coupling described, the tensing of the spring 39 and then the release of the disc 16, which advances by one step every minute.

The first indicator member 15, which advances by one step once every 10 minutes, i.e., each time the member 16 has made one complete revolution, is controlled by the first lever 46, which is very different in shape from the second lever 43. It consists of a blanked metal plate which pivots at one end on a collet in the periphery of the bridge 8 and is held in place by a screw 47. This blanked plate comprises a tongue 48 which is bent downwards and engages under the rib 20 of the member 16. It is further provided with two lateral catches which are folded back upwardly so as to constitute feelers 49 and 50 which embrace the rib 20. The result is that the lever 46 remains stationary as long as the circular portion of the rib 20 passes between the feelers 49 and 50, but it oscillates to and fro when the hump 21 passes between those feelers. The operation of this part is analogous to that of a pallet although it is made up quite differently. The plate 46 of which the lever consists is blanked with a second tongue 51 folded back edgewise, the bent end 52 of which (FIG. 1) constitutes a stop member cooperating with the teeth or stop elements 18 of the first indicator member 15. Thus every 10 minutes, at the moment when the indicator member 16 jumps so that the O succeeds the 9 in the right-hand portion of the aperture 11, the stop element 52 releases the disc 15, then immediately resumes its position. After having been tensed during these 10 minutes by the rotation of the driving member 28, the spring 32 relaxes, causing the disc 15 to rotate, and the following stop element 18 comes to strike against the end 52 of the tongue 51. Thus the disc 15 rotates in jumps at the same average speed as the cannon-pinion 28 and the cannon-pinion 4, and the tens figures of the minutes from 0 to 5 appear successively in the left-hand half of the aperture 11.

Upon each revolution of the first indicator member 15, the raised tongue 19 actuates the third lever 53, which will release the third indicator member 17 and allow the hour indication appearing in the aperture 12 to advance by one unit. The lever 53 likewise consists of a blanked and bent metal plate. It pivots on another collect of the bridge 8 and is held in place by a screw 54. Its shape is that of a star with four arms of irregular size and distribution. Two of these arms, 55 and 56, are bent slightly upwards and directed towards the center of the movement. The arm 55 is the one which is intended to cooperate with the tongue 19 of the indicator member 15. The second arm 56 has a triangular end in the shape of a jumper. It is situated at the level of the stop elements 18 and cooperates with them as will be explained below. The remaining two arms, 57 and 58, extend towards the outside of the movement and are bent downwards so that the one cooperates with one of the projections 23 of the disc 17, and the other cooperates with the adjacent projection 23. The operation of the lever 53 will now be described. Normally, it is held stationary because the end of the arm 57 is hooked on one of the projections 23; but even in the case of a shock, no accidental disengagement can take place, for if the lever 53 were to start rotating counterclockwise, as viewed in FIG. 1, which would be liable to disengage the indicator member 17, the arm 56 would immediately come to strike against one of the stop elements 18. On the other hand, when the member 15 is in the position shown in FIG. 1, the raised tongue 19 causes the member 17 to shift at the moment when the disc 15 advances, for the latter is then pulled forward by its spring, so that the lever 53 is compelled by the tongue 19 to pivot counterclockwise. As the element 18 situated in front of the end of the arm 56 likewise rotates, the rotation of the lever 53 is not hindered, and the arm 56 disengages the member 17. The following element 18 which advances clockwise by one stop, and the following projection 23, act upon the inclined end planes of the arm 56 and of the arm 58, respectively to return the lever 53 to the position where it blocks the member 17. The lever 53 stays in this position for 1 hour, i.e., until the disc 15 has completed one revolution. During this time, the spring 42 has been tensed owing to the rotation of the driving member 41 and consequently causes the hour-indicating member 17 to be driven when the next shift takes place.

Thus the mechanism described comprises in a very compact form all of the elements necessary to actuate by jumps three indicator members giving the units and tens figures of the minutes plus the hours. Moreover, the means for driving the calendar members may be connected to the driving member 41, which acts as a conventional hour-wheel. Thus a transmission wheel-and-pinion 59, pivoting on the base plate 1, may be seen in the drawing. Furthermore, the various elements of the mechanism are so arranged as to lock one another so that no untimely jump is possible.

Inasmuch as the driving mechanisms of the various indicator members are connected to one another in a chain, there can be no error in display. It follows from the foregoing that the indication of the tens figure of the minute inevitably changes at the moment when the indication of the units figure of the minute passes from 9 to 0. If the two indicator members were controlled independently of one another, there would be a risk that the time might be misread, e.g., in the event that the units figure had already passed from 9 to 0 when the tens figure had not yet passed to the succeeding figure.

By the same token, the indication of the hour is controlled by the tens-of-minutes disc and consequently changes only when the indication of the tens figure of the minute passes from 5 to 0. This precludes any accidental error of 1 hour which would be possible if the members were controlled independently of one another.

It will be noted that, all in all, the entire display mechanism comprises just three springs, so that the burden on the mainspring is reduced to a minimum.

Finally, the presentation of the indication of the hours and the minutes on one line, and in perfectly legible figures of the same size, gives the movement described a particularly attractive appearance.

What is claimed is:

1. A digital-display watch movement comprising a base plate, a dial provided with at least one aperture, and three coaxial jumping indicator members visible in said aperture or apertures, the first said indicator member indicating the tens figures of the minutes, the second said indicator member indicating the units figures of the minutes, and the third said indicator member indicating the hours, further comprising three continuously rotating driving members, each associated with

one of said indicator members to form with it a pair of coaxial rotating parts coupled to one another by a spring, said pairs being superimposed between said dial and said base plate, said first indicator member extending immediately beneath said dial, and further comprising a display bridge and three levers acting as pallets and pivoting on said bridge, each lever cooperating with one of said indicator members to release it periodically, the first of said levers being actuated by said second indicator member, the second of said levers being actuated by the driving member of the second of said pairs of rotating parts, and the third of said levers being actuated by said first indicator member.

2. A watch movement in accordance with claim **1**, wherein the periphery of said bridge is fastened to said base plate.

3. A watch movement in accordance with claim **1**, wherein the second of said driving members comprises a cam countour of five lugs regularly distributed along its periphery, and each of said lugs actuates said lever twice in the course of one complete rotation of the second of said driving members.

4. A watch movement in accordance with claim **1**, wherein said first indicator member comprises a release member actuating said third lever once during each complete rotation of said first indicator member, and said second indicator member comprises a release member actuating said first lever once during each complete rotation of said second indicator member.

5. A watch movement in accordance with claim **1**, wherein said indicator members bear indications in the form of digits, said digits being equal in size, and said third indicator member is provided with twelve radial projections regularly distributed along its periphery, each said projection bearing a said indication.

6. A watch movement in accordance with claim **5**, further comprising an annular date-indicating member having the same outside diameter as said third indicator member and being disposed below said third indicator member in such a way that date indications appear in a said aperture and between two said projections.

7. A watch movement in accordance with claim **6**, further comprising a day-indicating member having its periphery blanked in a star shape, said day-indicating member being disposed between said third indicator member and said date-indicating member, the outside diameter of a circle described by day indications borne by said day-indicting member being the same as that of said date-indicating member, said day indications appearing in a said aperture and between two said projections.

8. A watch movement in accordance with claim **1**, wherein said first indicator member is guided in rotation by a cylindrical surface of the first of said driving members, said bridge comprises a projecting tubular portion whereon said first driving member is engaged, and a coupling member housed within said tubular portion connects said first driving member to a center wheel-and-pinion mounted on said base plate.

9. A watch movement in accordance with claim **8**, wherein the driving member of said third indicator member is engaged with a minute-wheel which pivots on said base plate and is driven by said center wheel-and-pinion.

10. A watch movement in accordance with claim **8**, wherein said first driving member comprises a pipe engaged on said tubular portion, said second pair of rotating parts pivots on said pipe, said pipe being integral with a toothed wheel, and said bridge carries a transmission wheel-and-pinion actuated by said toothed wheel and actuating the second of said driving members.

11. A watch movement in accordance with claim **10**, wherein each end of said coupling member comprises projections engaged with play in notches provided respectively in a hub of said center wheel-and-pinion and in said pipe so as to constitute a gimbal-type coupling.

12. A watch movement in accordance with claim **10**, wherein the third of said pairs of rotating parts is disposed between said bridge and said base plate and pivots on a central, downwardly projecting second tubular portion of said bridge.

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