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SELF-WINDING WRISTWATCH WITH A CHRONOGRAPH MECHANISM

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ABSTRACT OF THE DISCLOSURE

The wristwatch movement comprises a spring motor, a gear train and an escapement mechanism mounted between a base-plate and bridges and the chronograph mechanism is mounted above these bridges, but it comprises shafts for the seconds hand of the chronograph and at least for a minute-register hand, which extend throughout the watch movement. A self-winding mechanism actuated by an oscillatory winding weight is connected to the spring motor of the watch and is wholly mounted under the chronograph mechanism, while avoiding any interference with the chronograph shafts carrying hands.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates to chronographs, more particularly to those for wristwatches having a conventional mechanical movement with spring motor, gears and an escapement mechanism, all these parts being located between a base-plate and bridges, and the chronograph being arranged over the bridges of the watch movement and comprising at least a minute-register mechanism associated with the gear carrying the seconds hand of the chronograph.

Description of the prior art

Chronographs arranged for being mounted over the bridges of a conventional watch movement are known for more than half a century. Chronographs comprising, besides a seconds hand, a minute-register hand and even an hour-register hand have been incorporated in wristwatches as soon as the same appeared on the market.

Self-winding wristwatches are also known for about half a century. However, although a self-winding wristwatch has become a standard since more than ten years, somebody who wanted hitherto a wristwatch with a chronograph mechanism, had to content himself with a watch deprived of self-winding.

SUMMARY OF THE INVENTION

The main object of the invention is therefore to create a chronograph with self-winding, especially a true chronograph, i.e. not a watch merely comprising a seconds hand which can be stopped, returned to zero and started at will, but a watch comprising, in addition thereto, at least a minute-register mechanism.

Since a great number of the self-winding wristwatches put on the market also comprise a calendar mechanism indicating at least the date, it is also an object of the invention to create a self-winding chronograph with a calendar mechanism.

While the known chronographs comprising an hour-register mechanism have the latter arranged on the dial side of the base-plate of the watch movement where it renders impossible mounting a date ring coaxially to the movement and since the hour-register mechanism of the known chronographs are usually of the continuous-action

type, it is still a particular object of the invention to provide a chronograph mechanism with an hour-register hand in which the hour-register mechanism is of the jumping type and is mounted on the same support plate as the remaining members of the chronograph.

It is also a particular object of the invention to provide the usual setting stem of the watch in a position diametrically opposed to the control pushers of the chronograph thus permitting the chronograph mechanism to be oriented with respect to the watch movement in such a way that the escapement remains uncovered and can be observed even when the chronograph is in place.

Still another object of the invention is to provide passages through the watch movement and the winding mechanism at appropriate places for the chronograph shafts carrying hands.

Still further objects of the invention will become apparent in the course of the following description.

BRIEF DESCRIPTION OF THE DRAWING

One embodiment of the watch according to the invention is represented diagrammatically and by way of example in the accompanying drawing.

In the drawing:

FIG. 1 is a plan view of the watch movement, the chronograph mechanism having been removed;

FIG. 2 is a plan view of the same watch movement, but with the chronograph mechanism;

FIG. 3 is a part sectional view of the watch movement and of the chronograph mechanism along lines III—III of FIGS. 1 and 2;

FIG. 4 is a part sectional view of the watch movement and of the chronograph mechanism along lines IV—IV of FIGS. 1, 2 and 8;

FIG. 5 is a part sectional view of the chronograph mechanism along line V—V of FIG. 2;

FIG. 6 is a part sectional view of the chronograph mechanism along line VI—VI of FIG. 2;

FIG. 7 is a plan view of a part of FIG. 2 showing some pieces of the chronograph mechanism in another working position;

FIG. 8 is a plan view of the dial side of the watch movement; and

FIG. 9 is a plan view of the watch on a smaller scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The watch movement represented in FIG. 1 is a conventional mechanical movement. It comprises a spring motor located in a barrel **1** which is supported between a base-plate **2** and a barrel bridge **3** fixed in the usual manner to the base-plate. Barrel **1** drives a conventional gear train comprising an off-centered great wheel **4**, a third wheel **5**, a fourth wheel **6** and an escape wheel **7** (see also FIG. 3). While the upper bearings of these four gears are carried by one and the same wheel bridge **8** fixed to the base-plate **2**, the lower bearings of only the three last gears are carried by the latter. As regards the lower bearing of the great wheel **4**, it is carried by a separate plate **9** fixed onto the dial side of the base-plate **2**.

Driving the watch hands and setting the same are enabled by means of a toothed cannon-pinion **10** which is fitted friction tight onto the arbor of the great wheel **4** (FIGS. 3, 4 and 8).

The watch movement drives the chronograph mechanism by means of a wheel **11** (FIG. 3). Wheel **11** comprises a hub member **12** which is set with force fit onto a pivot of the fourth wheel **6** protruding from the upper side of wheel bridge **8**. Recesses **13** and **14** are provided in the upper surface of bridge **8** for wheel **11** and for a lower portion of its hub member **12**. The portion of hub member 12 projecting beyond the unrecessed upper surface of bridge 8 is provided with a groove 15 which enables removing wheel 11 from the fourth wheel pivot, for instance by means of cutting pliers or nippers, when the gear train 4 to 7 has to be disassembled for a service, a cleaning or a repair.

The running rate of gear train 4 to 7 is controlled by a usual escapement mechanism which comprises a lever 16 and a balance-wheel 17 (FIG. 3). Lever 16 is journalled in the base-plate 2 and in a lever bridge 18 fixed to base-plate 2. The balance-wheel 17 is journalled in shock-absorbing bearings carried by the base-plate 2 and a cock 19, respectively, the latter being secured to the base-plate 2 and carrying a movable stud holder 20 and an adjustable regulator 21.

The barrel 1, the gear train 4 to 7, the lever 16 and the balance-wheel 17 are located within a sector of base-plate 2, the angle of which does not exceed 180° very much as it appears from FIG. 1. The remaining free space on base-plate 2 is occupied by a self-winding mechanism which is entirely located within the boundaries of the watch movement described, i.e. which is located in a plan view entirely within the contour of base-plate 2 and in elevation between the lower surface of base-plate 2 and the upper surface of the bridges such as barrel bridge 3 and wheel bridge 8.

The self-winding mechanism is controlled by a semi-circular substantially plain weight 22 secured to a hollow arbor 23 journalled in two bearings carried by the base-plate 2 and by a cup-shaped member 24, respectively, member 24 being rigidly connected to a plate 25 fixed to baseplate 2 (FIGS. 1 and 4). Arbor 23 carries a disc 26. The latter is set with force fit onto a bearing surface of arbor 23. A toothed ring 27 is fixed to disc 26 coaxially thereto and to arbor 23 for permitting the rotary motions of weight 22 to be transmitted to a ratchet-wheel 28 (FIGS. 1 and 3) set in the usual manner on a square portion of the arbor of barrel 1, which protrudes from the upper surface of barrel bridge 3.

The rotary motions of weight 22 are transmitted to ratchet-wheel 28 by means of a gear train (FIG. 1), the first gear of which consists of a sliding pinion 29 inserted with a small play between the base-plate 2 and a plate 30 secured thereto. Accordingly, pinion 29 can freely move between base-plate 2 and plate 30 in a plane perpendicular to the watch axis. To facilitate the sliding motions of pinion 29 while keeping its axis substantially parallel to the watch axis, this pinion is provided with two flat end surfaces having a relatively large diameter, said surfaces sliding over the base-plate 2 and the plate 30, respectively.

According to the direction in which the weight 22 rotates, its toothed ring 27 brings the pinion 29 into meshing relation with either one of two wheels 31, 32, which mesh together. Safe meshing conditions between pinion 29 and the three gears with which it comes in meshing relation, are ensured by discs similar to disc 26, these discs being associated with the sliding pinion 29 and each one of wheels 31, 32, respectively. All these discs have a diameter equal to the pitch diameters of the corresponding toothings. The disc of the sliding pinion 29 thus rolls over those of the gears with which this pinion comes into meshing relation. The corresponding toothings thus operate as if the corresponding gears had pivots journalled in fixed bearings.

The two wheels 31, 32 always rotate in the same direction corresponding to the winding direction of ratchet-wheel 28, whatever may be the wheel with which pinion 29 is meshing.

The two wheels 31, 32 and pinion 29 accordingly transform the bidirectional rotary motions of weight 22 in unidirectional rotary motions of the ratchet-wheel 28.

Wheel 32 is rigidly connected to a pinion 33 which drives ratchet-wheel 28 by means of two step-down gears 34 and 35. The gears provided between pinion 29 and ratchet-wheel 28 are journalled in the base-plate 2 and in a bridge 36, respectively, bridge 36 being fixed onto base-plate 2. A retaining pawl 37 cooperates with wheel 31 thus preventing the latter as well as wheel 32 and the two step-down gears 34, 35 from rotating under the action of the spring barrel 1 in the unwinding direction. A further retaining pawl 38 is also associated with ratchet-wheel 28 for preventing a sudden unwinding of the watch spring when the self-winding mechanism is disassembled, for instance for a service or a repair.

The watch movement described also comprises a manual winding mechanism which can be actuated in the usual manner by means of a crown 188 (FIG. 9), secured to a winding and hand-setting stem 39 (FIG. 4). Stem 39, which is located opposite the horal division indicating nine o'clock (see FIG. 9), is journalled in part in base-plate 2 and in part in bridge 8 (FIG. 4). When stem 39 is in winding position, as shown in FIG. 4, its clockwise rotations are transmitted to the ratchet-wheel 28 by means of a clutch wheel 40, a winding pinion 41, a crown-wheel 42 mounted for rotary motion around a core 43 secured to the wheel bridge 8, and two intermediate gears 44, 45, which are mounted, the first one on wheel bridge 8 and the second one on the barrel bridge 3 (see also FIG. 1). Gear 45 is mounted on an oval stud so as to be able to move in a transverse direction with respect to its axis of rotation and to allow in that way driving the ratchet-wheel 28 by the self-winding mechanism while leaving the manual winding mechanism at stillstand. When ratchet-wheel 28 is actuated by the self-winding mechanism, gear 45 moves indeed to and fro in a plane perpendicular to the watch axis without rotating and it jumps over the teeth of ratchet-wheel 28. A spring 46 lightly urges gear 45 toward the ratchet-wheel 28. The relative position of gears 44 and 45 with respect to ratchet-wheel 28 is moreover chosen in such manner that the resultant force of the action of gear 44 on gear 45 and of the resistance opposed by ratchet-wheel 28 to gear 45 holds the latter in meshing relation with the ratchet-wheel 28 when the manual winding mechanism is actuated.

During winding the watch manually the self-winding weight 22 is unclutched from ratchet-wheel 28 in a manner well known to those skilled in the art by means of a free-wheel mechanism (not shown) inserted between the wheel and the pinion of the step-down gear 34.

As already mentioned hereabove, the hands of the watch are driven by means of the cannon-pinion 10 which is fitted friction-tight onto the arbor of the great wheel 4 (FIG. 4). For that purpose, the cannon-pinion 10 is in meshing relation with a minute wheel 47 which is rigidly connected to a pinion 48 freely rotating around a pin 49 set in base-plate 2. Minute wheel 47 itself meshes with a cannon-pinion 50 located in the center of the movement and carrying the minute hand 51. The centrally located cannon-pinion 50 is freely set on a tube 52 secured to base-plate 2 in the center thereof. The hour hand 53 is fixed to an hour wheel 54 which is provided with a toothing 55 for driving a calendar mechanism described hereinafter. A toothed ring 56 meshing with the minute wheel pinion 48 is moreover rigidly secured to the hour wheel 54. Ring 56 thus ensures driving hour wheel 54 and, consequently, hour hand 53 at the desired rate.

Setting the hour hand 53 and the minute hand 51 occurs in the usual manner upon actuating stem 39 by means of crown 188 after having pulled the latter in hand-setting position. That pulling action causes a displacement in the opposed direction of clutch wheel 40 thus causing the latter to come into meshing relation with a setting pinion 57 as shown in FIG. 8. Pinion 57 is pivoted around a projection 58 of base-plate 2 (FIG. 4) and it actuates cannon-pinion 10 by means of an intermediate gear 59 which is also pivoted around a projection of base-plate 2. Pinion 57 and gear 59 are axially held in place by plate **9** carrying the lower bearing of the great wheel **4**.

To avoid any prejudicial dead motion of the minute hand **51** due to the indirect driving thereof (hand **51** is indeed not carried by a gear included in the train connecting the barrel to the escapement), the toothings of cannon-pinion **10**, of cannon-pinion **50** and of minute wheel **47** are serrated and have a triangular shape. Moreover, the toothing of minute wheel **47** is provided on a portion of that wheel which is connected by means of a yielding arm to a hub portion secured to pinion **48**. Finally, the position of stud **49** with respect to the axis of the two cannon-pinions **10** and **50** is chosen in such a manner that the toothing of minute wheel **47** will be pressed as far as possible within the toothings of the two cannon-pinions **10** and **50**, thus excluding any free play between the toothings of these members.

The chronograph mechanism of the watch described forms a unit carried by a supporting plate **60** (FIGS. 2 to 7). It can thus be mounted as a single piece over the bridges of the watch movement shown in FIG. 1, with the exception of the tilting pinion **61** which connects the watch movement to the chronograph mechanism. Plate **60** is fixed to the watch movement by means of three pillars **62** (FIG. 1) and of screws **63** (FIG. 2).

The tilting pinion **61** connecting the watch movement to the chronograph mechanism is journalled in a fixed lower bearing carried by the wheel bridge **8** (FIGS. 3 and 4) and by an upper bearing which can be shifted in a transverse direction and is carried for that purpose by the upper web **64** of a pivoted carriage **65** (FIGS. 2 and 3). Besides web **64**, carriage **65** also comprises a lower web **66**. The two webs **64** and **66** or carriage **65** are rigidly connected to each other by two pillars **67**. Carriage **65** is pivotally mounted on plate **60** by means of a step screw **68** around which said carriage can freely rock. Carriage **65** is, however, set under the action of a spring **69** which urges pinion **61** into meshing relation with a central wheel **70** (see also FIG. 4) set on a shaft **71** which extends throughout the chronograph mechanism and the watch movement represented in FIG. 1. Shaft **71** carries the seconds hand **72** of the chronograph. Gear (**70, 71**) is journalled at its upper end in a bearing carried by a bridge **73** (FIGS. 2 and 4) fixed to plate **60** of the chronograph and, at its lower end, in a bearing formed at the free end of tube **52**. Gear (**70, 71**) is held axially in place by the bearing of bridge **73** and a bearing **98** carried by plate **60**. Shaft **71** also carries a heart-shaped cam **74** rigidly secured to wheel **70** by rivetting as shown at **75** (FIG. 4). Shaft **71** finally carries a driving finger **76** by means of which gear (**70, 71**) drives the minute-register mechanism of the chronograph described hereinafter.

The rocking motion of carriage **65** under the action of spring **69** is limited by the eccentric head of a stud **77** (FIGS. 2 and 3), which is adjusted so as to permit the toothing of wheel **70** to be engaged by that of the tilting pinion **61** exactly to the desired extent when the chronograph is running, spring **69** is pressing a projection **78** of the lower web **66** of carriage **65** against stud **77**. When the chronograph is stopped, carriage **65** is held in a position aside of that represented in FIG. 2 by the eccentric head of a stud **79** carried by a control yoke **80** described in detail hereinafter. For that purpose, stud **79** engages a portion **81** of the upper web **64** of carriage **65**.

If the upper portion of tilting pinion **61** can thus alternatively be put in meshing relation with wheel **70** or be set apart, according to the positions of yoke **80** and of carriage **65**, the lower portion of this pinion **61** permanently meshes with wheel **11** set on the upper pivot of wheel **6**.

The chronograph mechanism of the watch described furthermore includes a minute-register mechanism which comprises three gears (FIG. 2): a driven gear **82** set under the action of finger **76** carried by shaft **71** of hand **72**, a driving gear **83** meshing with the driven gear **82** and driving the hour-register mechanism described hereinafter, and an indicating gear **84** carrying the minute-register hand **85** (FIG. 4).

Gears **82** and **83** of the minute-register mechanism are mounted on a carriage **86** located in a recess **87** of the supporting plate **60** of the chronograph mechanism. As shown in FIG. 6, gear **83** driving the hour-register mechanism is set in overhanging condition on a stud **88** rivetted to carriage **86**. It is axially held in place by a ring **89** set with force fit onto the free end of stud **88**. The driven gear **82** of the minute-register mechanism is similarly mounted on carriage **86**. The latter rocks around the eccentric head of stud **90** set in the bottom of recess **87** (see also FIG. 3). Stud **90** thus permits the position of the rocking axis of carriage **86** to be adjusted. Carriage **86** is held axially in place on the bottom of recess **87**, on the one hand, by means of a step screw **91** extending throughout an opening **92** of carriage **96**, the diameter of opening **92** being larger than that of the stepped surface of screw **91** (FIGS. 2 and 3), and, on the other hand, by means of a finger **93** fixed to plate **60** near the edge of recess **87**, finger **93** extending over the end of carriage **86** opposed to that caught by screw **91**. Carriage **86** is, moreover, set under the action of a return-spring **94**. Its stroke under the action of spring **94** can be adjusted by means of the eccentric head of a stud **95** (FIG. 2).

Studs **90** and **95** are adjusted in such manner that, in the position represented in FIG. 2, in which carriage **86** bears against stud **95** under the action of spring **94**, the driven gear **82** and the driving gear **83** are in such positions with respect to finger **76** and to a gear **96** of the hour-register mechanism, respectively, that gear **82** will be moved one step forward by finger **76** at every revolution of the central wheel **70** and that gear **83** will drive gear **96** one step forward at every revolution by means of a finger **97** which is set with force fit onto a hub member of the driving gear **83** (see also FIG. 6).

The rocking motion of carriage **86** against the action of spring **94** is controlled by yoke **80** according to a program disclosed hereinafter. For that purpose yoke **80** is provided with a camming surface **145** adapted for engaging the eccentric head of a stud **99** carried by carriage **86** (FIGS. 2 and 3).

As regards the indicating gear **84** carrying hand **85** of the minute-register mechanism it is provided with a shaft **100** which extends not only throughout the chronograph mechanism, but also throughout the watch movement. As shown in FIG. 4 shaft **100** extends within the hollow shaft **23** of the winding weight **22**, which has an inner diameter larger than shaft **100** so that weight **22** cannot possibly disturb the time records performed by hand **85**, for instance by incidentally driving gear **84**. At its upper end shaft **100** is journalled in a bearing carried by bridge **73** and its lower end it is journalled in a bearing **101** carried by the cover plate **102** of the calendar mechanism described hereinafter.

In order to keep the upper pivot of gear **84** in its bearing of bridge **73**, even when the chronograph mechanism is removed from the watch movement, plate **60** carries a bearing member **103** similar to member **98** provided for shaft **71** of the seconds hand. Member **103** also holds shaft **100** perpendicular to plate **60** when setting the latter onto the framework of the watch movement, thus permitting this shaft **100** to be easily introduced into shaft **23** of weight **22**. Member **103** still serves as an axial abutment for gear **84** once the chronograph mechanism has been mounted on the watch movement. Finally, gear **84** carries a heart-shaped cam **104** (FIGS. 2 and 4) and it is set under the action of a jumper **105** mounted on plate **60**.

As it appears in FIG. 2, the three gears **82** to **84** of the minute-register mechanism have the same diameter.

Each one is provided with thirty teeth and accordingly makes a complete revolution in thirty steps under the action of finger 76, i.e. within half an hour.

The hour-register mechanism comprises two gears: the driven gear 96 already described hereabove, and an indicating gear 106 which carries the hour-register hand 107. FIG. 6 shows that the upper pivots of these two gears 96 and 106 are journalled within bearings carried by a bridge 108. The latter is secured onto plate 60 by means of a pair of pillars 109 (FIGS. 2 and 4). While the lower pivot of the driven gear 96 is journalled in a bearing carried by plate 60 (FIG. 6), shaft 110 of gear 106 extends beyond plate 60 throughout the watch movement (FIG. 4). The portion of shaft 110 extending within the watch movement is surrounded by the great wheel 4, the fourth wheel 6 and the crown wheel 42 (FIG. 1). Moreover shaft 110 passes through an eccentric bore 111 provided in projection 58 around which the hand-setting pinion 57 is pivoted (FIGS. 4 and 8). FIG. 4 also shows that the shaft 110 extends opposite the inner end of the winding and hand-setting stem 39. The lower end of shaft 110 is journalled in a bearing 112 carried by plate 9 which axially holds pinion 57 in place and also carries the lower bearing of the great wheel 4. As with gears 70 and 84 driving hands 72 and 85 plate 60 also carries a bearing member 113 which, on the one hand, axially holds in place gear 106 when the chronograph mechanism is removed from the watch movement and, on the other hand, guides shaft 110 when the chronograph mechanism is set in place onto this watch movement. The position of gear 106 is safely ensured at any moment by a jumper 114 mounted on plate 60 and engaging the toothing of gear 106. To enable returning the hour-register mechanism to zero a heart-shaped cam 115 is rigidly connected to the driven gear 96.

The two gears 96 and 106 of the hour-register mechanism have the same diameter and each is provided with twenty-four teeth so that they make one complete revolution in twenty-four steps under the action of finger 97 of the minute-register mechanism, i.e. in twelve hours.

The different operations of the chronograph mechanism of the watch described (starting, stopping, returning to zero) are controlled by means of a usual starting pusher 116 which is mounted at the periphery of the case band 117 of the watchcase approximately opposite the horal division indicating two o'clock (FIG. 9) and by means of a usual stopping and returning to zero pusher 118 similar to pusher 116 and mounted in the same manner as the latter approximately opposite four o'clock. The inner end of the controlling stem (not shown) of starting pusher 116 is guided by a socket 119 provided in the peripheral side face of base-plate 2 between cock 19 and weight 22 (FIG. 1). The inner end of the controlling stem of the stopping and returning to zero pusher 118 is guided by a similar socket 120 provided in base-plate 2 between weight 22 and bridge 36 of the self-winding mechanism.

The displacements of the pushers 116, 118 are transmitted to yoke 80 by means of two levers, a stopping and returning lever 121 and a starting lever 122. Lever 121 is pivotally mounted on plate 60 by means of a step screw 123. This lever has a projection with a crank end portion 124 set under the action of the controlling stem of pusher 118. Portion 124 therefore enters socket 120 by passing through a slot 125 (FIG. 1) giving access thereto from the upper face of baseplate 2. Lever 121 actuates yoke 80 in a manner described hereinafter by means of alternatively a projection 126 or a nose 127. This lever is set under the action of a return-spring 128 which urges it against a stop pin 129 set in plate 60.

As regards the starting lever 122, it is located on the same level as the stopping and returning lever 121. Like this lever it is pivoted on plate 60 by means of a step screw 130. Lever 122 has an arm with a crank end portion 131 set under the action of the controlling stem of pusher 116 by passing through a slot 132 of base-plate 2, which gives recess to socket 119. The starting lever 122 has a further arm ending in a rounded head portion 133 which enters a notch 134 of yoke 80.

The details of yoke 80, which is actuated by levers 121 and 122, are more particularly shown in FIGS. 2, 5 and 7. Yoke 80 comprises a lower plate 135 provided with a notch 134 enclosing head portion 133 of lever 122. This lower plate 135 has two edges 136 and 137 which stand approximately at right angle with respect to each other and cooperate with projection 126 of the stopping and returning lever 121. Plate 135 is moreover provided with five camming surfaces, three of which 138, 139 and 140 cooperate with a jumper 141 secured onto plate 60 by means of a screw 142 and a pin 143, and the two remaining ones, 144 and 145, cooperate with the eccentric head of stud 99 carried by the carriage 86 of the minute-register mechanism. Yoke 80, moreover, comprises an intermediate plate 146 and an upper plate 147. The three plates 135, 146 and 147 of yoke 80 are rigidly fixed to each other by two rivets 148. Yoke 80 is pivotally mounted on plate 60 by means of a sleeve 149 which is set with force fit in a bore of plate 60 (FIG. 5). A screw 150 holds yoke 80 axially in place around sleeve 149. The intermediate plate 146 of yoke 80 serves both as a distance-piece for plates 135 and 147 and as a holding member for head 133 of lever 122, plate 146 holding head 133 axially in place in notch 134. As regards the upper plate 147 of yoke 80, it is firstly provided with a tail portion 151 carrying stud 79 and controlling a returning lever described hereinafter. It is, moreover, made in one piece with the two returning levers or hammers 152 and 153 which return to zero the seconds hand 72 and the minute-register hand 85, respectively. The relative positions of hammers 152, 153 can be adjusted in a manner well known to those skilled in the art by means of a screw 154 having a conical head. The upper plate 147 finally carries a pin 155 which controls a brake lever 156. Lever 156 is pivotally mounted on plate 60 by means of a step screw 157 which is located at one end of lever 156. The free end of this one-armed lever 156 forms a head portion 158 cooperating with pin 155. Brake lever 156 is made in one piece with a return-spring 159 and it is provided with a shoe 160 arranged for engagement with the center wheel 70 thus preventing any incidental and undesired motion of the seconds hand 72 of the chronograph, when the latter is stopped.

The hour-register hand 107 is returned to zero by means of a hammer 161 (FIGS. 2 and 5). Hammer 161 is set with force fit onto a sleeve 162 which also carries a control plate 163 cooperating with the tail portion 151 of the upper plate 147 of yoke 80. The control plate 163 and the hammer 161 are fixed to each other in a predetermined relative orientation by means of a gudgeon 164 which is engaged by a spring 165 urging hammer 161 towards heart 115.

In the position represented in FIG. 2, the chronograph is running as already mentioned hereabove. In other words, the starting pusher 116 has been actuated so that starting lever 122 has been rocked until yoke 80 has reached the angular position in which its jumper 141 bears on the camming surface 138 of yoke 80 (FIG. 7). In the running position of FIG. 2, spring 69 presses projection 78 of carriage 65 against stud 77 so that the tilting pinion 61 is meshing with the central wheel 70. Consequently, this central wheel 70 is driven by the watch movement by means of wheel 11 set on the pivot of the fourth wheel 6. The seconds hand 72 of the chronograph is travelling. At the end of each revolution of hand 72 the finger 76 connected thereto drives gear 82 and, consequently, gears 83 and 84 one step forwards by causing every time jumper 105 to jump over a tooth of gear 84. When gear 83 has accomplished a complete revolution, i.e. after half an hour, finger 97 connected thereto drives gear 96 and, consequently, gear 106 one step forwards, while causing jumper **114** to jump over a tooth of gear **106**. Driving of the minute-register mechanism by finger **76** and of the hour-register mechanism by finger **97** occurs in running position, because spring **94** then holds carriage **86** in abutting engagement with stud **95**. In the same running position pin **155** of yoke **80** holds shoe **160** of brake lever **156** aside of central wheel **70** and tail portion **151** of plate **147** keeps hammer **161** caught in a retracted position relative to heart **115**.

If pushed **118** is pressed when the chronograph is running, it produces a rocking motion of lever **121** against the action of its return-spring **128**. During this rocking motion nose **127** of lever **121** engages lever **122** and causes this lever to rock in the same direction around screw **130**. Upon rocking under the action of lever **121**, lever **122** drives yoke **80** clockwise in FIG. 2 and jumper **141** leaves the camming surface **138**.

The sizes of lever **121** and of yoke **80** as well as the positions of their rocking axes are chosen in such manner that during the rocking motions occurring upon pressing pusher **118** projection **126** of lever **121** travels in front of edge **136** of yoke **80** as shown in FIG. 7. Due to the relative positions of projection **126** of lever **121** and of edge **136** of yoke **80** with respect to the rocking axes of the latter and of lever **121**, the stroke of lever **121** under the action of pusher **118** is limited by the wedging action occurring between lever **121** and yoke **80**, the end face of lever **121** thereby engaging edge **136** of yoke **80** as shown in FIG. 7. The sizes of lever **121** and of yoke **80** as well as the position of pusher **118** along lever **121** are, of course, chosen in such manner that the pressure which can be exerted by hand on pusher **118** cannot possibly shear either sleeve **149** around which yoke **80** is pivotally mounted or screw **123** around which lever **121** is pivotally mounted.

When lever **121** has reached the end of its stroke under the action of pusher **118**, FIG. 7 shows that yoke **80** has rotated through such an angle that its jumper **141** has reached camming surface **139**. During that rotary motion of yoke **80** studs **79** carried by the tail portion **151** of its upper plate **147** engages portion **81** of carriage **65** and causes the latter to rock around screw **68** against the action of return-spring **69**. This rocking motion of carriage **65** removes pinion **61** from wheel **70** thus interrupting the driving action exerted on the latter. Simultaneously, pin **155** carried by the upper plate **147** of yoke **80** travels opposite a notch **166** provided in the head portion **158** of brake lever **156** (FIG. 7). As a consequence thereof lever **156** rocks under the action of spring **159** until shoe **160** engages wheel **70** and stops it. Moreover, shoe **160** firmly holds wheel **70** in the position in which the chronograph has been stopped. In other words, brake lever **156** holds the seconds hand **72** and permits the exact time at which pusher **118** has been actuated to be easily read and properly recorded.

Upon releasing pusher **118**, spring **128** rocks lever **121** backwards until it butts again against the pin **129**. After lever **121** has left edge **136** of yoke **80**, jumper **141** slides along camming surface **139** and rotates yoke **80** into such an angular position that its edges **136** and **137** reach the dot-and-dash line position shown in FIG. 7.

It will be observed that after this first actuation of pusher **118** (pressing and releasing), yoke **80** lies in a new position in which hammers **152** and **153** do not yet come in contact with the corresponding hearts **74** and **104**. Tail portion **151** of yoke **80** similarly holds hammer **161** aside of heart **115**. Not only the seconds hand **72**, but also the minute-register hand **85** and the hour-register hand **107** consequently remain in the positions they have reached at the moment at which pusher **118** has been actuated.

When the chronograph is in stopping position, two operations are possible. One can either actuate pusher **116** or pusher **118**. If pusher **116** is pressed, lever **122** rocks clockwise around screw **130** and it urges yoke **80** backwards until it reaches the position represented in FIG. 2. During this motion pin **155** slides along the flank of notch **166**, along which it has just slid before. Shoe **160** thus releases wheel **70**. Stud **79** of yoke **80** similarly releases carriage **65** so that spring **69** rocks this carriage backwards into the position represented in FIG. 2. The chronograph thus starts running again and the hands **72, 85, 107** travel farther from the positions in which they were stopped.

Pressing on the contrary pusher **118** in the stopping position described hereabove firstly rocks lever **121** counterclockwise a second time. Since yoke **80** still rotated through a small angle after the first time lever **121** was actuated to and fro, projection **126** does now no longer travels in front of edge **136**, but it engages edge **137** of yoke **80** as it can be observed in FIG. 7. As a consequence thereof lever **121** no longer actuates yoke **80** by means of its nose **127** and of lever **122**, as when stopping the chronograph. It actuates yoke **80** directly and rocks the latter farther clockwise until jumper **141** reaches the camming surface **140**.

During this second rotary motion of yoke **80**, pin **155** slides along the other flank of notch **166** of brake lever **156**. Shoe **160** nevertheless releases wheel **70**. Simultaneously, camming surface **145** of the lower plate **135** of yoke **80** engages stud **99** carried by the carriage **86** and rocks the latter around stud **90** against the action of spring **94**. As a result of this rocking motion of carriage **86**, gear **82** is removed from the travelling path of finger **76** and finger **97** is shifted apart through such a distance that it can no longer engage gear **96**. In other words, the three hands **72, 85** and **107** are now fully independent of one another.

Upon rotating farther under the direct action of lever **121**, yoke **80** causes the hammers **152** and **153** to engage the corresponding hearts **74** and **104**, thus returning the seconds hand **72** and the minute-register hand **85** to zero. Simultaneously, the tail portion **151** of yoke **80** moves beyond the nose of plate **163**, with which it cooperated till now, thus releasing hammer **161**. Spring **165**, consequently, urges hammer **161** abruptedly toward heart **115**, thus returning the hour-register hand **107** to zero. The chronograph is then at rest; ins three hands **72, 85** and **107** are held at zero by the hammers **152, 153** and **161**, respectively.

If pusher **118** is pressed once again, when the chronograph is at rest, it moves lever **121** without any action on the remaining members of the chronograph mechanism. A pressure exerted on the contrary on pusher **116** has, as a consequence, that all the members of the chronograph mechanism are moved backwards into the position represented in FIG. 2, thus starting the chronograph. Pressing pusher **116** a second time has not any action on the chronograph members.

The watch described still comprises a calendar mechanism which is located on the dial side of baseplate **2** (FIG. 8). This calendar mechanism indicates the date **167** in a window **168** of dial **169**, which is located opposite six o'clock (FIG. 9). The numbers from "1" to "31" are therefore printed on a date ring **170** carrying an inner toothing **171**. This date ring **170** is mounted for free rotary motion coaxially to the watch movement around a cylindrical portion of cover plate **102** which is provided with cut-outs and comprises a peripheral rim **172** (FIG. 4). This rim extends over the teeth **171** thus holding ring **170** axially in place on baseplate **2**. As shown in FIG. 8, plate **102** covers the handsetting mechanism of the watch movement as well as minute wheel **47**.

The minute wheel pinion **48**, the toothed ring **56** fixed to the hour wheel **54**, as well as a driving gear **173** extend, on the contrary, on the same level as plate **102** within corresponding cut-outs thereof. A jumper **174** engages toothing **171** under the action of a spring **175** and normally holds ring **170** in such angular positions that the date indication 167 always appears in the center of window 168.

As already indicated hereabove, the date ring 170 is automatically driven by toothing 55 of hour wheel 54. As regards gear 173, it is of the type described in U.S. Pat. No. 2,948,107 of the same assignee.

It comprises two units which can be moved separately and which are mounted coaxially to each other on a stud 176 set in base-plate 2. The first one of these units comprises a hub 177 pivoted on stud 176 and made in one piece with a pinion 178 bearing on the base-plate 2. A disc 179 provided with a slot 180 is rigidly secured to hub 177 at the upper end thereof as viewed in FIG. 8. Pinion 178 is driven by toothing 55 of the hour wheel 54 by the intermediate of two gears 181 and 182. The diameter of pinion 178 is chosen in such manner with respect to that of toothing 55 that pinion 178 makes three revolutions during the time the hour wheel 54 makes one, i.e. in such manner that pinion 178 makes six revolutions in twenty-four hours. The second unit of the driving gear 173 comprises a toothed wheel 183 which is idly mounted on hub 177 between pinion 178 and disc 179. A circular plate 184 is eccentrically fixed to wheel 183. A split ring 185 is freely set around plate 184 and a pawl 186 is inserted for free rocking motion in the opening of ring 185. Pawl 186 carries a stud 187 entering slot 180 of disc 179. Wheel 183 directly meshes with toothing 55 of hour wheel 54. The diameter of wheel 183 is chosen with respect to that of toothing 55 in such manner that wheel 183 makes one complete revolution when the hour wheel makes two. In other words, wheel 183 makes one revolution in twenty-four hours.

As a consequence of the abovestanding description of the driving gear 173, it will be observed that the first unit thereof drives pawl 186 as well as ring 185 by the intermediate of disc 179, slot 180 and stud 187 six times around stud 176, while the second unit comprising wheel 183 and plate 184 makes only one revolution. In other words, during each complete revolution of wheel 183, pawl 186 travels five times over the apex of eccentric plate 184. The five positions of coincidence, in which pawl 186 is on the apex of plate 184, occur always in the same radial planes through the axis of stud 176, once pinion 178 and wheel 183 have been set in meshing relation with the gears driving them. These positions of coincidence are, moreover, regularly staggered at 72° from each other around the axis of stud 176. The units of driving gear 173 are now oriented in such manner around stud 176, when setting them thereon, that one of these five positions of coincidence lies near the toothing 171 in the radial plane of the watch movement passing through the axis of stud 176. When pawl 186 reaches that position of coincidence, it drives the date ring 170. Pawl 186 obviously comes in that position of coincidence only once a day, i.e. during one of its six passages through said radial plane of the watch movement. On the occasion of the five other passages through said plane, pawl 186 does not lie on the apex of plate 185 so that it is farther away from toothing 171 than on the occasion of the sixth passage opposite thereto. The eccentricity of plate 184 accordingly need only be chosen great enough in order that pawl 186 does not reach toothing 171 on the occasion of said five passages.

As shown in FIG. 8, pawl 186 has such a form that it rocks out of the path of teeth 171 without driving ring 170, when the watch hands are moved counterclockwise. As described in detail in the abovementioned U.S. Pat. No. 2,948,107, that particular permits the position of the date ring 170 to be reset very quickly. For that purpose the watch hands 51 and 53 need only be set at midnight and the crown 188 be rotated alternatively in either direction.

As shown in FIG. 9, the dial 169 is provided opposite three o'clock with a small dial 189 carrying a scale comprising thirty divisions 190 and, opposite nine o'clock, with a small dial 191 carrying a scale comprising twelve divisions 192. Every time the seconds hand 72 travels opposite twelve o'clock, the minute-register hand 85 is driven one step forwards and jumps from one of the divisions 190 to the next one. Similarly, when hand 85 comes again opposite division 190 designated by the number "30," the hour-register hand 107 jumps one step forwards while moving through half the way comprised between two consecutive divisions 192.

It appears from the preceding description that a complete chronograph mechanism, i.e. a chronograph with a seconds had and register mechanisms for the minutes and the hours can very well be mounted over the bridges of a self-winding watch movement. This movement need only be provided with passages for the shafts of the chronograph gears carrying the hands. Moreover, these passages through the watch movement must of course be located in radial planes which are properly oriented with respect to that in which stem 39 lies. The dials of the register mechanisms cannot be located anywhere on dial 169. From an aesthetic point of view, they have to be provided at suitable predetermined places of dial 169. FIG. 9 shows the preferred positions of the two dials 189 and 197. In another embodiment these small dials could be provided for instance on the axis twelve-six o'clock of dial 169. While keeping a calendar window opposite six o'clock, the dials 189 and 191 could also be located opposite ten and two o'clock, or between ten and eleven and between one and two o'clock. If the calendar window were located opposite three o'clock, the small dials of the register mechanisms could also be provided either between seven and eight and between ten and eleven o'clock or opposite seven and eleven o'clock. Moreover, the dials of the register mechanism are advantageously located at some distance of the periphery of dial 169 in order to avoid interferences with the scales which are usually provided at the periphery of the dial. With chronographs there are often as many as tree of four scales provided according to the nature of the measures which the chronograph seconds hand should enable.

With a chronograph which would only comprise a minute-register mechanism, the self-winding watch movement need only be provided with a passage in the center for the shaft of the seconds hand and with a single further eccentric passage for the shaft of the minute-register hand. In that event, the watch movement could be set in such an angular position within the watchcase that the single eccentric passage could be provided no longer through the shaft of a gear of the watch movement, like in the embodiment described with reference to the drawing, but between two gears, for instance between the self-winding weight and the balance-wheel.

Alternately, the selfwinding weight and the hand-setting pinion are not the sale gears of the watch movement through which a passage for an eccentric shaft of the chronograph mechanism can be accommodated; one could also provide such a passage through the barrel arbor, provided that the latter be located in an appropriate radial plane of the watch movement with respect to the radial plane passing through the winding and hand-setting stem and provided that the barrel arbor be located at an appropriate distance of the watch movement axis.

Although it would also have been possible to set the stem 39 at the usual place opposite three o'clock, the location of that stem represented in the drawing has the advantage that the chronograph may comprise a gear for driving the seconds hand wheel, which is located in the movement half opposed to that occupied by the control pushers of the chronograph. Moreover, the location chosen for the stem 39 in the watch described does not constitute a handicap. Since that watch is provided with a self-winding mechanism, the crown 188 will only be actuated incidentally. Its location opposite nine o'clock has rather the advantage that the pushers 116 and 118 are more readily accessible. Finally, opposite nine o'clock, the crown 188 is substantially less exposed than opposite three o'clock.

With respect to the known wristwatches provided with a chronograph mechanism in which the seconds hand is driven by a tilting pinion, the watch described has also the advantage that its tilting pinion is easier to set in place. With the known watches the bearing of the lower pivot of this pinion is indeed carried by the base-plate of the watch movement. Now, when that pinion has to be set in place, it is less easy to introduce its lower pivot into the corresponding bearing, which is practically invisible, than into the bearing of the watch described, which is carried by the wheel bridge of the watch movement. The tilting pinion truly has to be made shorter in the watch described than in the known watches, but not very much, because of the recesses 13 and 14 provided in the wheel bridge of the watch movement. Due to these recesses, it has been possible to set the tilting pinion 61 in meshing relation with a wheel 11, which lies at a relatively great distance from wheel 70 carrying the seconds hand of the chronograph. The tilting angle of pinion 61 could accordingly be kept relatively small. In any case, the meshing conditions of wheel 11 and pinion 61 are not noticeably disturbed by the tilting motion of the latter.

In contradistinction with most of the known wristwatches provided with a chronograph mechanism in which the gears of the hour-register mechanism are mounted on the dial side of the base-plate, the watch described has the advantage that all the members of the chronograph are mounted on one and the same supporting plate which can itself be mounted as a single unit onto the watch movement. Due to that arrangement, it has not only been possible to rationalize the mounting operations of the watch when manufacturing the same in series, but also to simplify the task of the repairers. The watch movement is, indeed, accessible as soon as plate 60 has been removed. The chronograph mechanism itself need not be disassembled for the purpose. Moreover, if this mechanism happens to be defective, it can be removed as a whole very quickly, returned to the manufacturer and immediately replaced by a new mechanism.

It will also be observed in FIG. 2 that the different parts of the chronograph mechanism could be assembled in such an area that the portion of the watch movement occupied by the escapement remains free. The watchmaker can thus observe the escapement even when the chronograph mechanism has been set in place.

The arrangement of all the gears of the hour-register mechanism above the bridges of the watch movement in the embodiment described has still the advantage that the space comprised between the base-plate and the dial remains free for mounting an additional mechanism. In the example described this space has been used for a calendar mechanism, the date ring of which could be mounted coaxially to the watch movement. With such a date ring the window 168 need not be located at a predetermined place of dial 169 as with date rings mounted in an eccentric position on the movement. The date ring of the watch described accordingly enables freely choosing the location of window 168 and consequently to give the dial the desired appearance.

Instead of the calendar mechanism described, a mechanism indicating for instance the moon phases could also be mounted between the base-plate 2 and the dial 169 of the watch described.

In spite of the numerous pieces of the watch movement described, the latter could nevertheless be provided with a balance-wheel having a moment of inertia compatible with the chronograph mechanism. It could also be provided with a barrel having an amply sufficient torque for properly driving all the mechanisms disclosed without jeopardizing the precision of the running rate of the watch. Thus, with a circular caliber of 13¾''', i.e. with a movement having a diameter approximately equal to 31 mm., it has been possible to use a barrel, the spring of which exerted a torque stronger than 800 g.mm. when it was completely wound up, and a balance-wheel having a moment of inertia greater than 16 mg.cm.^{2}, all the members of the movement as well as those of the chronograph and of the calendar mechanisms being located within a total height of 7.50 mm.

Although one embodiment and some modifications have been described in detail hereabove, it should be understood that various other changes will appear obvious to those skilled in the art without departing from the spirit of the invention or sacrificing the advantages thereof.

We claim:

1. In a wristwatch movement including a spring motor, a gear train driven by said spring motor, an escapement mechanism controlling the running rate of said gear train and a motion work connected to said gear train, the combination of a chronograph mechanism and of a self-winding mechanism comprising a winding weight mounted for free rotary motion around an axis and transmitting means connecting said winding weight to said spring motor.

2. In a wristwatch comprising the movement of claim 1 and a casing enclosing said movement, the combination of a first control button of the chronograph mechanism carried by said casing and being located at the periphery thereof approximately opposite the horal division indicating two o'clock, a second control button of the chronograph mechanism being also carried by said casing and located at the periphery thereof approximately opposite the horal division indicating four o'clock, a setting stem for actuating the motion work manually and an opening for said stem provided at the periphery of said casing approximately opposite the horal division indicating nine o'clock.

3. In the wristwatch movement of claim 1, said chronograph mechanism comprising a seconds gear having a shaft carrying a seconds hand and a register gear having a shaft carrying a register hand, and said movement comprising a central opening extending axially throughout the movement for the passage of the shaft of said seconds gear and an eccentric opening extending axially throughout the movement for the passage of the shaft of said register gear.

4. In the wristwatch movement of claim 3, said winding weight being mounted for free rotation around a hollow shaft partly providing said eccentric opening for the shaft of said register gear.

5. The wristwatch movement of claim 4, further comprising a base-plate having a cylindrical projection on its dial side, a setting stem for actuating the motion work manually and a setting pinion inserted between said setting stem and said motion work and mounted for rotary motion around said cylindrical projection of the base-plate, an opening being provided in said cylindrical projection and extending axially throughout the movement thus constituting a second eccentric passage therethrough, said chronograph mechanism comprising a second register gear having a shaft carrying a second register hand, the shaft of said second register gear extending within said second eccentric passage through the watch movement.

6. The wristwatch movement of claim 5, further comprising a date ring coaxial thereto and being mounted for rotary motion on the dial side of said base-plate, and an actuating mechanism driven by said motion work and driving said date ring.

7. The wristwatch movement of claim 1, in which said spring motor, said gear train and said escapement mechanism are located in a framework comprising a base-plate and bridges secured to said base-plate on one side thereof, said chronograph mechanism being arranged above said bridges and said self-winding mechanism being arranged below said chronograph mechanism.

8. In the wristwatch movement of claim 7, the chronograph mechanism comprising a supporting plate carrying all the members thereof and being secured to said framework above said bridges.

9. The wristwatch movement of claim 7, further comprising a chronograph driving pivot protruding from the outer face of one of said bridges, a recess being provided in the outer face of said one bridge around said chronograph driving pivot, said one bridge carrying a lower pivot bearing in the bottom of said recess, a chronograph driving wheel being removably set on said chronograph driving pivot and extending within said recess, and the chronograph mechanism comprising a seconds wheel and a tilting pinion driving said seconds wheel and having a

lower pivot journalled in said lower bearing, said tilting pinion permanently meshing with said chronograph driving wheel.

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U.S. Cl. X.R.

58—82

SELF-WINDING WRISTWATCH WITH A CHRONOGRAPH MECHANISM

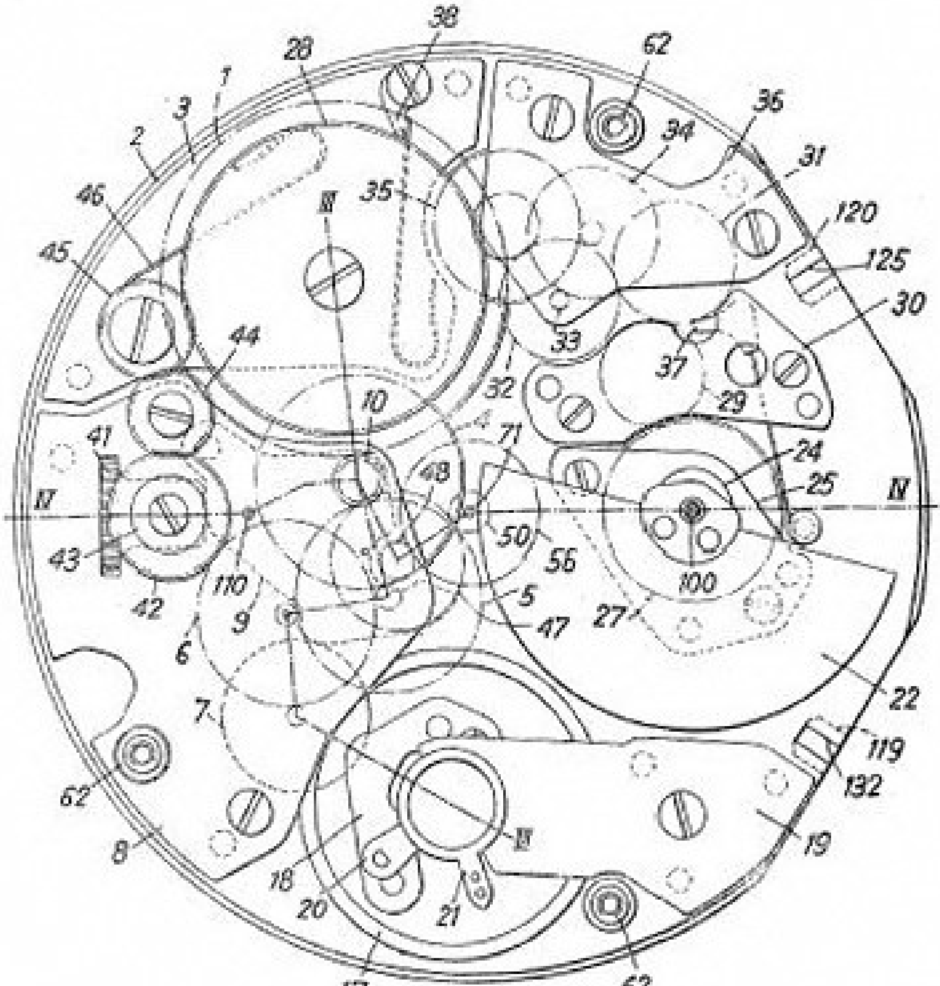

FIG. 1

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SELF-WINDING, WRISTWATCH WITH A CHRONOGRAPH MECHANISM

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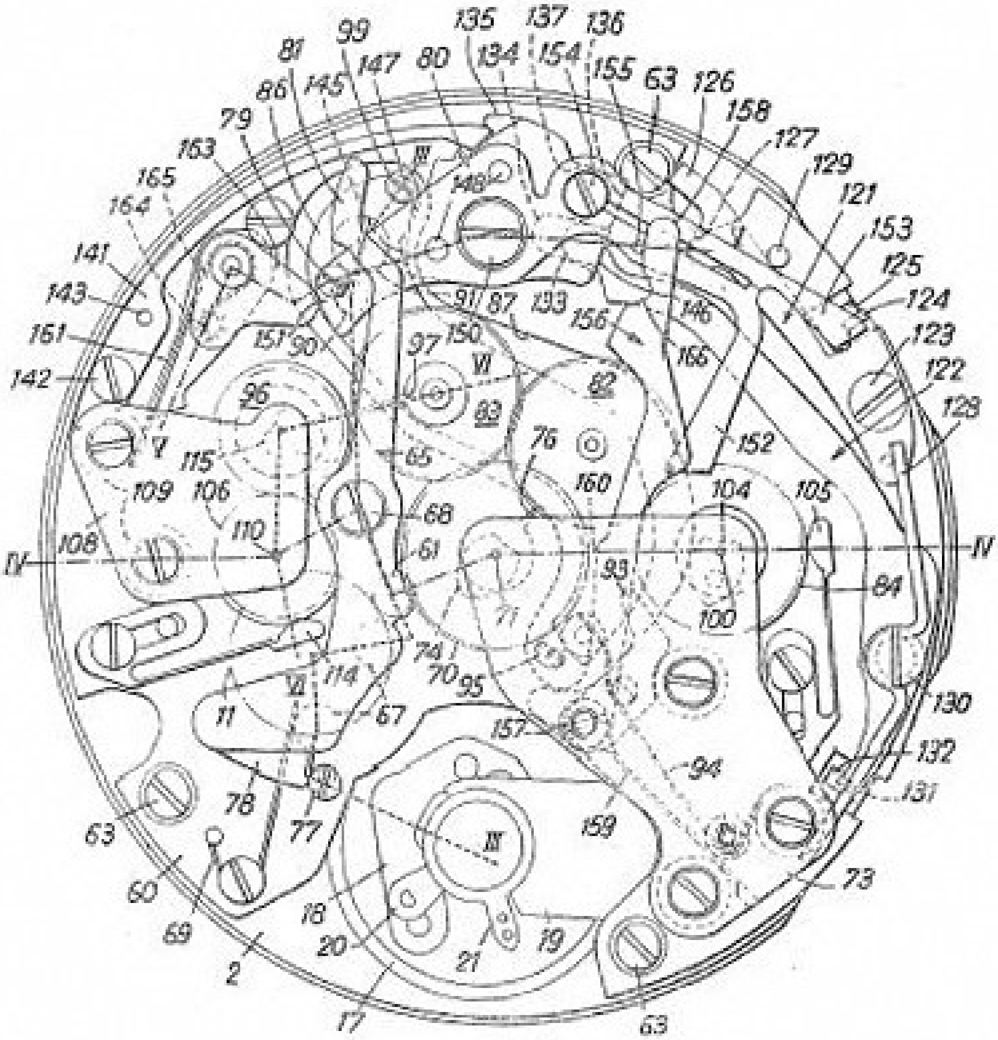

FIG. 2

FIG. 7

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SELF-WINDING, WRISTWATCH WITH A CHRONOGRAPH MECHANISM

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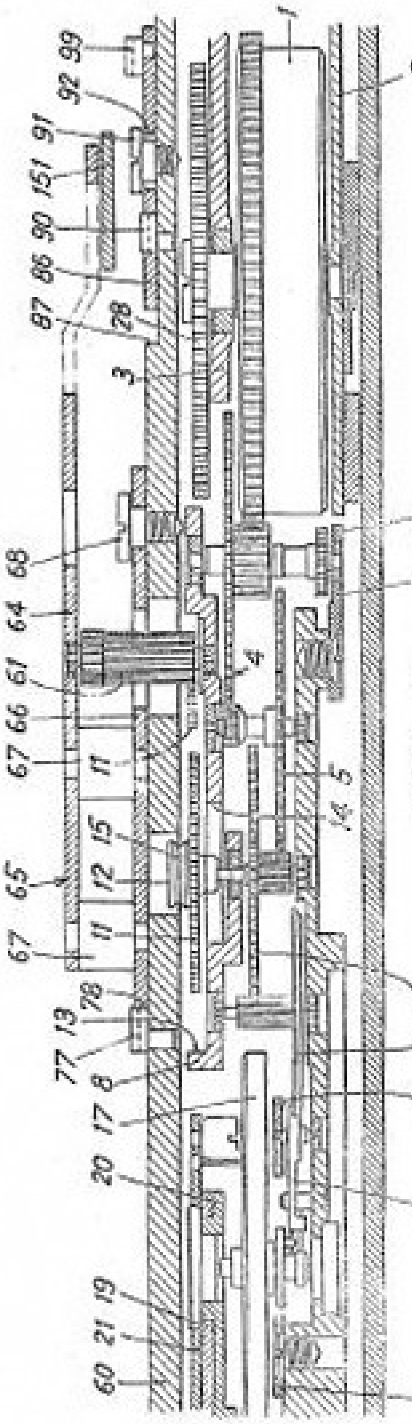

FIG. 3

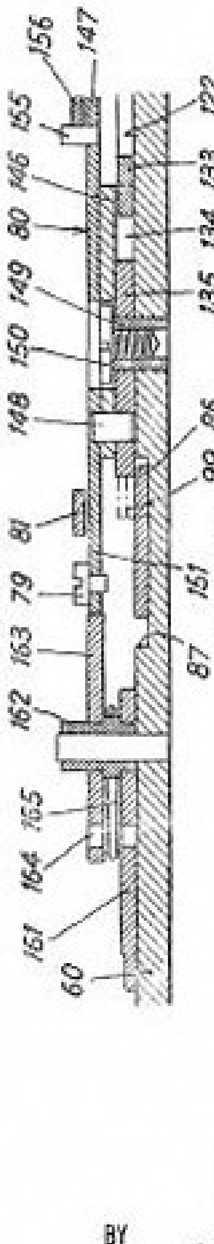

FIG. 5

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SELF-WINDING, WRISTWATCH WITH A CHRONOGRAPH MECHANISM

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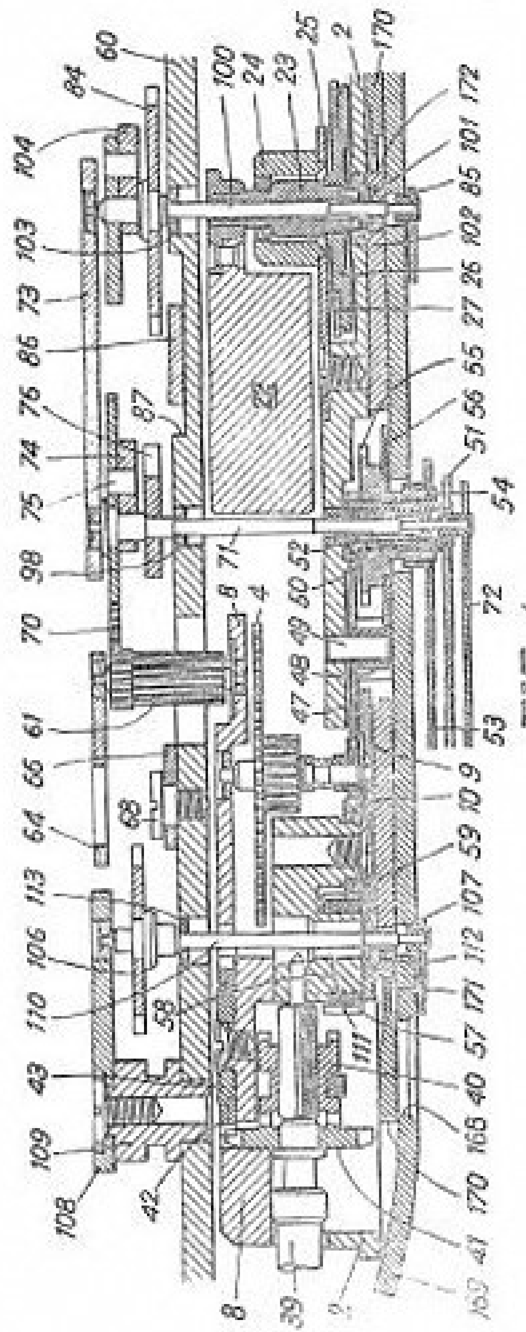

FIG. 4

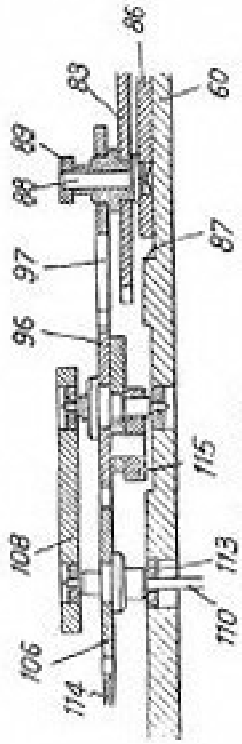

FIG. 5

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SELF-WINDING, WRISTWATCH WITH A CHRONOGRAPH MECHANISM

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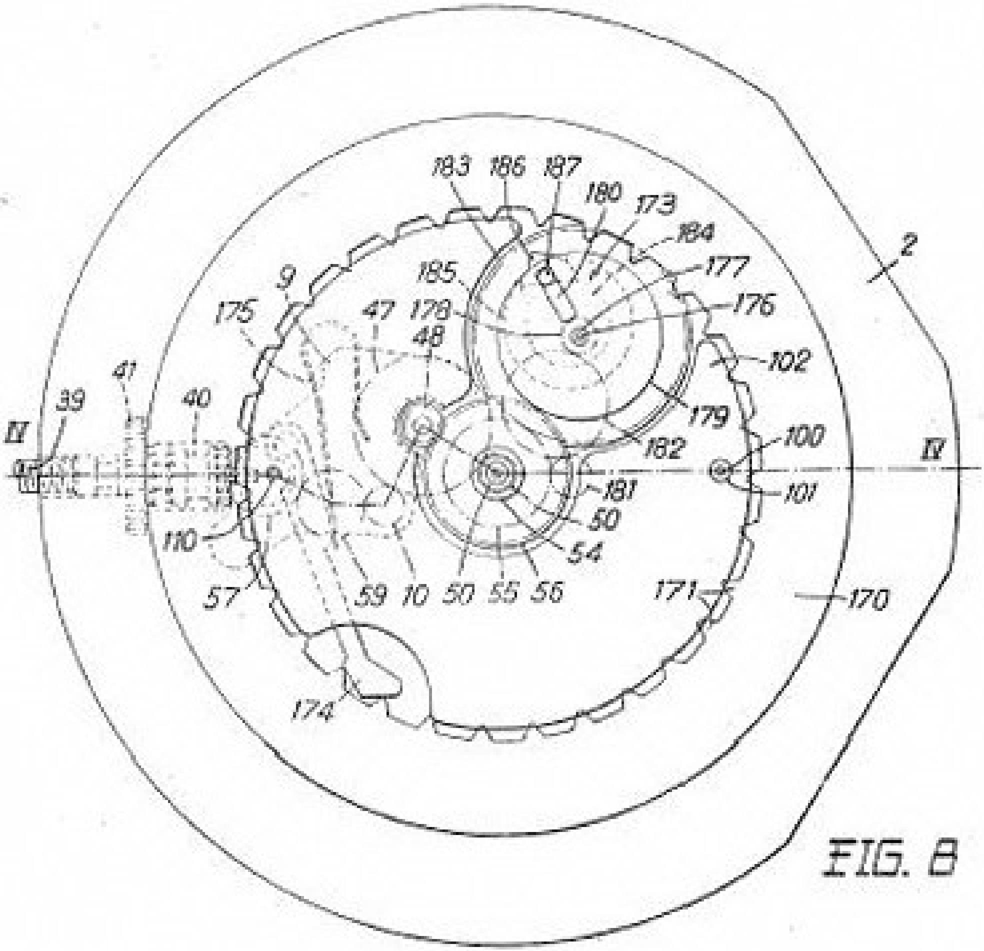

FIG. 8

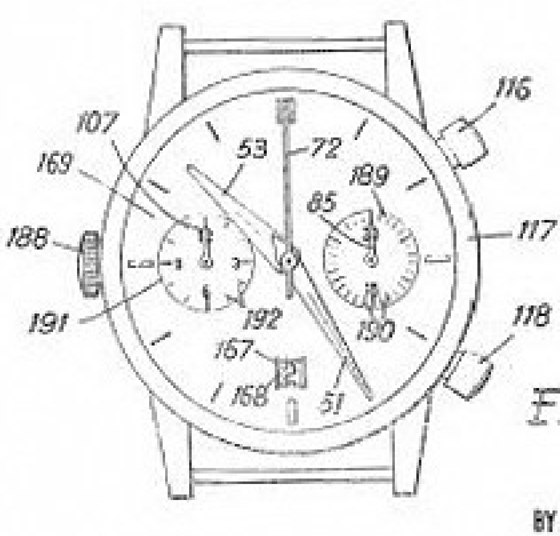

FIG. 9

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(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,543,506 Dated December 1, 1970

Inventor(s) GERALD DUBOIS ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 6,, after "spring" insert -- of --. Column 5, line 33, "or" should read -- of --; line 59, cancel "is" (second occurrence). Colum line 21, "96" should read -- 86 --. Column 8, line 8, cancel "a"; line 2, "recess" should read -- access --. Column 9, line 10, "pushed" should read -- pusher --. Column 10, line 44, "ins" should read -- its --. Column 12, line 12, "had" should read -- hand --; line 24, "197" should read -- 191 -- line 34, "mechanism" should read -- mechanisms --; line 38, "tree" should read -- three --; line 54, "sale" should read -- sole --. Column 13, line 38, "the" should read -- that --.

Signed and sealed this 13th day of April 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR
Commissioner of Patents