

Description

CHRONOGRAPH TIME PIECE

Technical Field

The present invention relates to a chronograph time piece, particularly to a chronograph time piece for measuring "hour", "minute" and "second" and displaying respective results of measurement by a chronograph hour hand, a chronograph minute hand and a chronograph second hand.

Background of the Invention

In reference to Fig. 32, according to a conventional chronograph time piece, a barrel complete 110 rotates a front wheel train 312. A mainspring (not illustrated) is arranged in the barrel complete 110 and constitutes a power source of the chronograph time piece. A barrel pinion 912 is attached to the barrel complete 110 via a barrel complete slip mechanism 910. An hour counter intermediate wheel 914 is integrated to rotate by rotation of the barrel pinion 912. An hour counting gear 916 is integrated to rotate by rotation of the hour counter intermediate wheel 914. An hour counting wheel stem 920 is attached to the hour counting gear 916 via an hour counting slip mechanism 918 and by a chronograph hour hand 128 attached to the hour counting wheel stem 920, there is displayed a result of measurement of an elapse time period of "hour" such as an

elapse of 1 hour.

A second counting train wheel 316 is integrated to rotate by rotation of the front train wheel 312. A second counting wheel stem 934 is connected to the second counting train wheel 316 via a second counting slip mechanism 932. By a chronograph second hand 118 attached to the second counting wheel stem 934, there is displayed a result of measurement of an elapse time period of "second" such as an elapse of 1 second.

A minute counting wheel train 940 is integrated to rotate by rotation of the second counting wheel train 316. A minute counting wheel stem 944 is connected to the minute counting wheel train 940 via a minute counting slip mechanism 942. By a chronograph minute hand 124 attached to the minute counting stem 944, there is displayed a result of measurement of an elapse time period of "minute" such as an elapse of 1 minute. Transmission of rotation from the second counting wheel train 316 to the minute counting wheel train 322 is constituted to carry out via a pivoting wheel (not illustrated).

According to such a conventional chronograph time piece, the hour counting slip mechanism 918, the second counting slip mechanism 932 and the minute counting slip mechanism 942 are constituted to include clutch springs. Further, by operating the clutch springs, operation of the counting wheel trains is constituted to control.

Further, according to the conventional chronograph time piece, in pushing a button for starting/stopping the chronograph time piece, there is used an operating lever operated by the button. Further, a line spring is used for positioning the operating lever and by bending a portion of the operating lever, the line spring is hooked to the bent portion.

In zeroing the chronograph hands by pushing a reset button, a hammer is operated by a plate spring.

Further, according to the conventional chronograph time piece, there is provided a cam subjected to operation of a yoke for controlling to start and stop operation and zeroing of the chronograph and the cam is constituted to control various functions of the chronograph.

For example, there is disclosed a constitution of a conventional chronograph in Japanese Patent Laid-Open No. 9463/1975 and Japanese Patent Laid-Open No. 9464/1975.

However, there pose following problems according to the conventional chronograph time piece.

(1) In integrating a chronograph time piece, a mechanism constituting the chronograph time piece must be adjusted finely.

(2) An hour counting slip mechanism, a second counting slip mechanism and a minute counting slip mechanism are constituted to include clutch springs and therefore, a number

of parts constituting the counting mechanisms is large and structure of the time piece is complicated.

(3) Further, the mechanisms including the clutch springs are used and accordingly, a thickness of the time piece is thickened by a thickness of the springs.

In order to resolve such conventional problems, objects of the present invention reside in the following points.

(1) To provide a chronograph time piece capable of being integrated easily with no need of adjusting parts constituting counting mechanisms when integrating the chronograph time piece.

(2) To provide a chronograph time piece having a small number of parts constituting counting mechanisms.

(3) To provide a chronograph time piece in which counting mechanisms are operated with certainty.

(4) To realize a small-sized and thin chronograph time piece by thinly constituting counting train wheels.

Disclosure of the Invention

In order to resolve the above-described problems, a chronograph time piece according to the invention is provided with a front train wheel rotating based on rotation of a barrel complete and a second counter intermediate wheel rotating based on rotation of the front wheel train. In a chronograph measurement mode, a second counting wheel rotates based on

rotation of the second counter intermediate wheel and a chronograph second display member displays a result of measurement of an elapse time period of second. A minute counting train wheel rotates based on rotation of the second counting wheel and a chronograph minute display member displays a result of measurement of an elapse time period of minute.

The chronograph time piece according to the invention includes at least one hour counting train wheel provided to rotate based on rotation of the barrel complete in the chronograph measurement mode and a chronograph hour display member for displaying a result of measurement of an elapse time period of hour based on rotation of the hour counting train wheels.

By constituting in this way, a number of parts of the chronograph time piece can be reduced and the second counting wheel, the minute counting train wheel and the hour counting train wheel can be operated efficiently.

Further, it is preferable according to the chronograph time piece of the invention that the hour counting train wheels include an hour counting slip mechanism constituted such that one of train wheels constituting the hour counting train wheels can slip relative to other one thereof.

Further, the hour counting train wheels of the chronograph time piece according to the invention include a first hour counting train wheel rotating based on rotation of

the barrel complete. It is preferable to include a second hour counting train wheel rotating based on rotation of the first hour counting train wheel in the chronograph measurement mode, and an hour counting slip mechanism constituted such that when chronograph measurement is not executed, rotation of the first hour counting train wheel is not transmitted to the second hour counting train wheel and in the chronograph measurement mode, the rotation of the first hour counting train wheel is transmitted to the second hour counting train wheel.

Further, it is preferable according to the chronograph time piece of the invention to include a center wheel & pinion provided to rotate based on the rotation of the barrel complete, a third wheel & pinion provided to rotate based on rotation of the center wheel & pinion, a second wheel provided to rotate based on rotation of the third wheel & pinion, a second display member rotating based on rotation of the second wheel for displaying second, a minute transmission pinion provided to rotate based on the rotation of the center wheel & pinion, a minute drive wheel provided to rotate based on rotation of the minute transmission pinion, a minute display member rotating based on rotation of the minute drive wheel for displaying minute, an hour wheel provided to rotate based on the rotation of the minute transmission pinion, and an hour display member rotating based on rotation of the hour wheel for displaying hour.

Further, according to the invention, there is provided a chronograph time piece characterized in that in a chronograph time piece capable of measuring elapse time periods of second, minute and hour in a chronograph measurement mode, said chronograph time piece comprising a main plate constituting a base plate of the chronograph time piece, a second counting wheel for measuring the elapse time period of second based on rotation of a barrel complete in the chronograph measurement mode, a minute counting train wheel for measuring the elapse time period of minute based on the rotation of the barrel complete in the chronograph measurement mode, hour counting train wheels for measuring the elapse time period of hour based on the rotation of the barrel complete in the chronograph measurement mode, a chronograph second display member for displaying a result of measurement of the elapse time period of second by rotating the second counting wheel, a chronograph minute display member for displaying a result of measurement of the elapse time period of minute by rotating the minute counting train wheel, a chronograph hour display member for displaying a result of measurement of the elapse time period of hour by rotating the hour counting wheel, second and minute counting coupling means for starting or stopping operation of the chronograph second display member and the chronograph minute display member, and hour counting coupling means for starting or stopping operation of the chronograph hour display

member.

By constituting in this way, operation of start and stop of chronograph measurement of the chronograph time piece can be executed with certainty.

Further, it is preferable according to the chronograph time piece of the invention to include chronograph second and minute zeroing means provided on a front side of the main plate for simultaneously returning the chronograph second display member and the chronograph minute display member to zero, and chronograph hour zeroing means provided on a back side of the main plate for returning the chronograph hour display member to zero.

By constituting in this way, operation of zeroing the chronograph second hand, the chronograph minute hand and the chronograph hour hand of the chronograph time piece can be executed with certainty and swiftly.

Further, it is preferable according to the chronograph time piece of the invention that a rotational center of the chronograph second display member is arranged substantially at a center of the chronograph time piece, wherein a rotational center of the chronograph hour display member is arranged on a straight line connecting the center of the chronograph time piece and a 6 o'clock indicator of a dial or a vicinity thereof, and wherein a rotational center of the chronograph minute display member is arranged on a straight line connecting the

center of the chronograph time piece and a 12 o'clock indicator of the dial or a vicinity thereof.

By constituting in this way, there can be provided the chronograph time piece which is small-sized, thin and easy to see.

Further, it is preferable according to the chronograph time piece of the invention that a second display member for displaying second, a rotational center of the second display member is arranged on a straight line connecting the center of the chronograph time piece and a 9 o'clock indicator of the dial.

By constituting in this way, there can be provided the chronograph time piece capable of executing second display which is easy to see.

Further, it is preferable according to the chronograph time piece of the invention that a button for operating the second and minute counting coupling means and the hour counting coupling means is arranged substantially in a 2 o'clock direction of the chronograph time piece.

Further, it is preferable according to the chronograph time piece of the invention that a button for operating the chronograph second and minute zeroing means and the chronograph hour zeroing means is arranged substantially in a 4 o'clock direction of the chronograph time piece.

By constituting this way, operation of start and stop

of the chronograph time piece is facilitated, further, outlook design of the chronograph time piece is improved.

Further, it is preferable that the hour counting train wheels include an hour counting transmission wheel (A) rotating based on the rotation of the barrel complete, an hour counting transmission wheel (C) rotating based on rotation of the hour counting transmission wheel (A), an hour counting transmission wheel (B) cooperating with the hour counting transmission wheel (C) via a slip mechanism, an hour counting wheel rotating based on rotation of the hour counting transmission wheel (B) in the chronograph measurement mode, and the chronograph hour display member rotating based on rotation of the hour counting wheel for displaying the result of measurement of the elapse time period of hour in the chronograph measurement mode.

By constituting in this way, the hour counting train wheel can be made small-sized and thin.

Further, it is preferable in the chronograph time piece of the invention that the second counting wheel includes a minute driving finger for intermittently rotating the minute counting train wheel and the minute counting train wheel includes a minute counter intermediate wheel rotated by the minute driving finger, and a minute counting wheel rotating based on rotation of the minute counter intermediate wheel.

By constituting in this way, the minute counting train wheel can be made small-sized and thin.

Brief Description of the Drawings

Fig. 1 is an outline partial sectional view showing a coupling portion of a chronograph mechanism (second counting wheel - second counter intermediate wheel - second wheel) in a state in which the chronograph mechanism is not operated according to an embodiment of a chronograph time piece of the invention.

Fig. 2 is an outline partial sectional view showing a minute counting train wheel (minute counter intermediate wheel - minute counting wheel) according to an embodiment of a chronograph time piece of the invention.

Fig. 3 is an outline partial sectional view showing a front wheel train, an escapement apparatus and a speed control apparatus according to an embodiment of a chronograph time piece of the invention.

Fig. 4 is an outline partial sectional view showing a portion of a minute transmission pinion according to an embodiment of a chronograph time piece of the invention.

Fig. 5 is an outline partial plane view showing the front wheel train, the escapement apparatus and the speed control apparatus according to the embodiment of the chronograph time piece of the invention.

Fig. 6 is a functional block diagram showing a train wheel constitution according to an embodiment of a chronograph

time piece of the invention.

Fig. 7 is an outline partial plane view showing a portion of a coupling portion of a chronograph mechanism (second counting wheel - second counter intermediate wheel) in a state in which the chronograph mechanism is not operated according to an embodiment of the chronograph time piece of the invention.

Fig. 8 is an enlarged plane view of a second counting wheel according to an embodiment of a chronograph time piece of the invention.

Fig. 9 is an enlarged front view of the second counting wheel according to the embodiment of the chronograph time piece of the invention.

Fig. 10 is an outline partial sectional view showing an hour counting train wheel (hour counting transmission wheel - hour counting wheel) according to an embodiment of the chronograph time piece of the invention.

Fig. 11 is an outline partial plane view showing the hour counting train wheel (hour counting transmission wheel - hour counting wheel) according to the embodiment of the chronograph time piece of the invention.

Fig. 12 is an enlarged plane view showing an hour counting transmission wheel (C) according to the embodiment of the chronograph time piece of the invention.

Fig. 13 is a functional block diagram showing a train wheel constitution according to an embodiment of a chronograph

time piece of the invention.

Fig. 14 is an outline partial sectional view showing a coupling portion of a chronograph mechanism in a state in which the chronograph mechanism is operated according to an embodiment of a chronograph time piece of the invention.

Fig. 15 is an outline partial enlarged plane view showing the coupling portion of the chronograph mechanism in the state in which the chronograph mechanism is operated according to the embodiment of the chronograph time piece of the invention.

Fig. 16 is a functional block diagram showing a constitution of a coupling mechanism in a state in which the chronograph mechanism is not operated according to an embodiment of a chronograph time piece of the invention.

Fig. 17 is an outline plane view showing a front side of a movement in a state in which the chronograph mechanism is not operated according to the embodiment of the chronograph time piece of the invention.

Fig. 18 is an outline partial sectional view showing an hour coupling lever, an hour coupling operation lever and an hour coupling lever operation lever operating pin according to an embodiment of a chronograph time piece of the invention.

Fig. 19 is an outline partial plane view showing a back side of the movement in a state in which the chronograph mechanism is not operated according to the embodiment of the

chronograph time piece of the invention.

Fig. 20 is an outline partial plane view showing the front side of the movement in a state in which the chronograph mechanism is started according to the embodiment of the chronograph time piece of the invention.

Fig. 21 is an outline partial plane view showing the back side of the movement in the state in which the chronograph mechanism is started according to the embodiment of the chronograph time piece of the invention.

Fig. 22 is an outline partial plane view showing an hour counting train wheel in the state in which the chronograph mechanism is started according to the embodiment of the chronograph time piece of the invention.

Fig. 23 is an outline plane view showing the front side of the movement in a state in which the chronograph mechanism is stopped according to the embodiment of the chronograph time piece of the invention.

Fig. 24 is an outline partial plane view showing the back side of the movement in the state in which the chronograph mechanism is stopped according to the embodiment of the chronograph time piece of the invention.

Fig. 25 is a functional block diagram showing a constitution of a reset mechanism according to an embodiment of a chronograph time piece of the invention.

Fig. 26 is an outline plane view showing the front side

of the movement in a state in which the chronograph mechanism is reset according to an embodiment of a chronograph time piece of the invention.

Fig. 27 is an outline partial plane view showing the back side of the movement in the state in which the chronograph mechanism is reset according to the embodiment of the chronograph time piece of the invention.

Fig. 28 is an outline partial plane view showing the hour counting train wheel in the state in which operation of the chronograph mechanism is reset according to the embodiment of the chronograph time piece of the invention.

Fig. 29 is a plane view showing an outlook of a chronograph time piece in the state in which the chronograph mechanism is not operated according to the embodiment of the chronograph time piece of the invention.

Fig. 30 is a plane view showing the outlook of the chronograph time piece in the state in which the chronograph mechanism is started according to the embodiment of the chronograph time piece of the invention.

Fig. 31 is a plane view showing the outlook of the chronograph time piece in the state in which operation of the chronograph mechanism is reset according to the embodiment of the chronograph time piece of the invention.

Fig. 32 is a functional block diagram of a conventional chronograph time piece.

Best Mode for Carrying Out the Invention

An explanation will be given of embodiments according to the invention in reference to the drawings as follows.

Further, in order to make clear the explanation, in the respective drawings, there is omitted a description of a structure of a portion which is inconsiderably related to the constitution of the invention. Therefore, there is omitted an explanation with regard to a switch apparatus, a hand setting apparatus, an automatic winding apparatus, a hand winding apparatus, a calendar apparatus, a calendar correcting apparatus and so on which can utilize structures similar to those in a conventional chronograph time piece.

(1) Constitutions of a front train wheel and a counting train wheel

(1-1) State in which a chronograph mechanism is not operated

In reference to Fig. 1 through Fig. 5, a movement 100 (machine body) of a chronograph time piece according to the invention is provided with a main plate 102, a center wheel & pinion bridge 120 and a third wheel & pinion bridge 122.

In both sides of the main plate 102, a side having a dial 104 is referred to as "back side" of the movement and a side opposed to the side having the dial 104 is referred to as "front side" of the movement. A train wheel integrated to

the "front side" of the movement is referred to as "front train wheel" and a wheel train integrated to the "back side" of the movement is referred to as "back wheel train".

A dial bridge ring 106 is arranged between the main plate 102 and the dial 104. The dial bridge ring 106 receives a back face of the dial 104.

An outer peripheral portion of a front face of the dial 104 is normally provided with numerals from 1 to 12 or abbreviated characters corresponding thereto. Therefore, respective directions along the outer peripheral portion of the time piece can be expressed by using the numerals.

For example, in the case of a wrist watch,

upper direction and upper side of the wrist watch are respectively referred to as "12 o'clock direction" and "12 o'clock side",

right direction and right side of the wrist watch are respectively referred to as "3 o'clock direction" and "3 o'clock side",

lower direction and lower side of the wrist watch are respectively referred to as "6 o'clock direction" and "6 o'clock side",

left direction and left side of the wrist watch are respectively referred to as "9 o'clock direction" and "9 o'clock side".

Similarly,

direction and position in correspondence with 2 o'clock indicator of the dial are referred to as "2 o'clock direction" and "2 o'clock position",

direction and position in correspondence with 4 o'clock indicator of the dial are referred to as "4 o'clock direction" and "4 o'clock position".

For example, in Fig. 5, there are shown "12 o'clock direction", "3 o'clock direction", "6 o'clock direction" and "9 o'clock direction". In this case, a winding stem 108 is arranged in "3 o'clock direction" of the movement.

In reference to Fig. 3 through Fig. 6, a barrel complete 110 is rotatably integrated to the third wheel & pinion bridge 122 and the main plate 102. A mainspring (not illustrated) provided in the barrel complete 110 constitutes a power source of the chronograph time piece. A center wheel & pinion 130 is provided to rotate based on rotation of the barrel complete 110. A minute transmission pinion 114 is provided to rotate based on rotation of the center wheel & pinion 130. A minute drive wheel 132 is provided to rotate based on rotation of the minute transmission pinion 114. According to the structure, the minute transmission pinion 114 constitutes an idler. A minute hand 134 attached to the minute drive wheel 132 is constituted to display "minute".

In reference to Fig. 3, a third wheel & pinion 136 is provided to rotate based on rotation of the center wheel &

pinion 130. The third wheel & pinion 136 is rotatably supported by the third wheel & pinion bridge 122 and the main plate 102. A second wheel 154 is provided to rotate based on rotation of the third wheel & pinion 136. The second wheel 154 is rotatably supported by the third wheel & pinion bridge 122 and the main plate 102. The second wheel 154 is provided to rotate by one rotation per minute. A second hand 156 attached to the second wheel 154 is constituted to display "second". A rotational center of the second wheel 154 is different from a rotational center of the minute wheel 132. That is, the second hand 156 constitutes a so-to-speak "small second hand".

A balance with hairspring 140 constitutes a speed control apparatus of the time piece and a pallet fork 142 and an escape wheel & pinion 144 constitute an escapement apparatus of the time piece. Rotation of the second wheel 154 is controlled by the balance with hairspring 140, the pallet fork 142 and the escape wheel & pinion 144. The minute drive wheel 132 is provided to rotate by one rotation per hour.

In reference to Fig. 4, a minute wheel 146 is provided to rotate based on rotation of the minute drive wheel 132. An hour wheel 148 is provided to rotate by one rotation per 12 hours based on rotation of the minute wheel 146. A gear portion 148a of the hour wheel 148 is arranged between the main plate 102 and a date indicator holder 272. An hour hand 150 attached to the hour wheel 148 is constituted to display "hour".

According to the constitution of the invention, the rotational center of the minute drive wheel 132 is the same as a rotational center of the hour wheel 148.

In reference to Fig. 5, a rotational center of the barrel complete 110 is disposed between "3 o'clock direction" and "6 o'clock direction" of the movement. A rotational center of the balance with hairspring 140 is disposed between "9 o'clock direction" and "12 o'clock direction" of the movement. The rotational center of the second wheel 154 is disposed substantially in "9 o'clock direction" of the movement. A rotational center of the center wheel & pinion 130, a rotational center of the minute drive wheel 132 and a rotational center of the third wheel & pinion 136 are disposed between "6 o'clock direction" and "9 o'clock direction" of the movement.

In reference to Fig. 1, in a state in which a chronograph mechanism is not operated, a second counter intermediate wheel 212 is rotatably integrated to a coupling lever 442 and the main plate 102. The second counter intermediate wheel 212 is provided with a second counter intermediate pinion 212a and a second counting transmission pinion 212b. The intermediate second counter intermediate pinion 212a is in mesh with the second wheel 154. The second counter intermediate wheel 212 is provided to rotate based on rotation of the second wheel 154.

A second counting wheel 214 is rotatably integrated to

a chronograph bridge 202 and the center wheel & pinion bridge 120. A rotational center of the second counting wheel 214 is the same as the rotational center of the minute drive wheel 132 and the hour wheel 148. A dial washer 170 is integrated between a large diameter portion "g" of the second counting wheel 214 and the center wheel & pinion bridge 120 to push the second counting wheel 214 to the chronograph bridge 202. By using the dial washer 170, operation of a chronograph second hand 118 can be stabilized in rotating the second chronograph wheel 214.

In reference to Fig. 1 and Fig. 7, in the state in which the chronograph mechanism is not operated, the coupling lever 442 is moved to rotate in a direction of an arrow mark 442u centering on a rotational center 442t such that the chronograph mechanism is not operated. As a result, the second chronograph transmission pinion 212b is constituted not to be in mesh with the second counting wheel 214.

In contrast thereto, in the state of operating the chronograph mechanism, as mentioned later, the coupling lever 442 is moved to rotate in a direction of an arrow mark 442v centering on a rotational center 442t such that the chronograph mechanism is operated. As a result, the second counting transmission pinion 212b is constituted to be in mesh with the second counting wheel 214. In such a state in which the second chronograph transmission pinion 212b and the second counting

wheel 214 are in mesh with each other, the second counting wheel 214 is constituted to rotate by one rotation per minute.

The chronograph second hand 118 is attached to the second counting wheel 214 and is constituted to display a result of measurement of an elapse time period of second. The chronograph second hand 118 is a chronograph second display member and may be a time piece hand or may be a mode of hand or foot of a character, flower, star or the like.

When the chronograph time piece according to the invention is constituted by an automatic winding time piece, an oscillating weight (not illustrated) is rotatably integrated to the chronograph bridge 202. The automatic winding time piece may be constituted to wind a mainspring (not illustrated) via an automatic winding mechanism (not illustrated) by rotating the oscillating weight.

A second heart cam 220 is fixed to the second counting wheel 214 and is constituted to rotate integrally with the second counting wheel 214.

As shown by Fig. 1, in the state in which the chronograph mechanism is not operated, the coupling lever 442 positions the second counting transmission pinion 212b such that the second counting transmission pinion 212b is separated from the second counting wheel 214.

In reference to Fig. 2, a minute counter intermediate wheel 258 is rotatably integrated to the chronograph bridge

202 and the third wheel & pinion bridge 122. A minute driving finger 256 is fixed to the second counting wheel 214.

In reference to Fig. 8 and Fig. 9, the second counting wheel 214 is constituted to be provided with a second counting gear 214a, a second counting stem 214b, the second heart cam 220 and the second driving finger 256. The second driving finger 256 is constituted by an elastic material to provide spring performance. A minute driving finger 256a is provided to the minute driving finger 256 and is brought into contact with a gear portion of the second counter intermediate wheel 258.

When the second counting wheel 214 is rotated by one rotation, the minute driving finger 256 feeds the gear portion of the minute counter intermediate wheel 258 to thereby rotate the minute counter intermediate wheel 258 by an amount of one tooth.

A minute counting wheel 260 is rotatably integrated to the chronograph bridge 202 and the main plate 102. The minute counting wheel 260 is constituted to rotate based on rotation of the minute counter intermediate wheel 258. A minute jumper 264 sets rotation of the minute counting wheel 260 by elastic force. A minute heart cam 262 is fixed to the minute counting wheel 260.

A minute chronograph hand 124 is attached to the minute counting wheel 260 and is constituted to display a result of

measurement of an elapse time period of, for example, "minute" such as "1 minute".

The minute chronograph hand 124 is a minute chronograph display member and may be a time piece hand or may be a mode of a circular disk, hand or foot of a character, flower, star or the like.

In reference to Fig. 10 and Fig. 11, an hour counting transmission wheel (A) 246 is rotatably integrated to the main plate 102 and the third wheel & pinion bridge 122 and is constituted to rotate based on rotation of the barrel complete 110. An upper guide shaft portion of the hour counter intermediate wheel (A) 246 may be constituted to be guided by the third wheel & pinion bridge 122 or guided by the chronograph bridge 202.

An hour counting transmission wheel (B) 244 is provided with a gear portion 244a, a guide shaft portion 244b and a fitting portion 244c. According to the hour counting transmission wheel (B) 244, the gear portion 244a is arranged on the dial side of the main plate 102 and the guide shaft portion 244b is rotatably integrated to the main plate 102. An hour counting transmission wheel (C) 242 is integrated to the fitting portion 244c of the hour counting transmission wheel (B) 244.

In reference to Fig. 12, the hour counting transmission wheel (C) 242 is provided with an elastically deformable spring

portion 242a, a contact portion 242b and a guide portion 242c. The contact portion 242b is provided at a front end side portion of the spring portion 242a. The contact portion 242b and the guide portion 242c are integrated to the fitting portion 244c of the hour counting transmission wheel (B) 244. Therefore, the hour counting transmission wheel (C) 242 can slip relative to the hour counting transmission wheel (B) 244 when predetermined slip torque is exceeded. According to the embodiment of the invention, the slip torque is constituted to be, for example, about 0.2 g·cm.

According to the constitution, by rotating the barrel complete 110, the hour counting transmission wheel (A) 246 is rotated and by rotating the hour counting transmission wheel (A) 246, the hour counting transmission wheel (C) 242 and the hour counting transmission wheel (B) 244 are integrally rotated.

An hour counting wheel 250 is rotatably provided to the date indicator maintaining plate 272 and is constituted to rotate based on rotation of the hour counting transmission wheel (B) 244. The hour counting wheel 250 is provided with an hour counting gear 250a, an hour counting stem 250b and an hour heart cam 252, and the hour chronograph stem 250b and an hour heart cam 252 are constituted to be able to rotate integrally.

In Fig. 11, there are shown "12 o'clock direction", "3

o'clock direction", "6 o'clock direction" and "9 o'clock direction" of the movement.

A rotational center of the hour counting wheel 250 is disposed substantially in "6 o'clock direction" of the movement. A switch apparatus 290 is disposed between "3 o'clock direction" and "12 o'clock direction" of the movement. The switch apparatus 290 includes a setting lever, a yoke and a setting lever holder and the like.

An hour chronograph hand 128 is attached to the hour counting stem 250b and is constituted to display a result of measurement of an elapse time period of, for example, "hour" such as "1 hour" when the chronograph mechanism is operated.

The hour chronograph hand 128 is an hour chronograph display member and may be a time piece hand or may be a mode of a circular disk, hand or foot of a character, flower, star or the like.

When the chronograph time piece according to the invention is constituted as a time piece with calendar, a date indicator (not illustrated) is rotatably integrated to the main plate 102. According to such a constitution, display of "date" can be carried out by date characters printed on the date indicator. The date indicator is operated by a calendar feed mechanism (not illustrated) based on rotation of the front train wheel (divided from barrel complete).

In reference to Fig. 13, according to the chronograph

time piece of the invention explained above, the front train wheel 312 is rotated by rotation of the barrel complete 110. The front train wheel 312 includes the center wheel & pinion 130, the minute transmission pinion 114, the minute drive wheel 132, the third wheel & pinion 136 and the second wheel 154. The second counter intermediate wheel 212 is rotated by rotation of the front train wheel 312. In the state in which the chronograph mechanism is not operated, the second counter intermediate wheel 212 is not in mesh with the second counting wheel 214.

In the state in which the chronograph mechanism is operated, the second counter intermediate wheel 212 is in mesh with the second counting wheel 214. Therefore, by the chronograph second hand 118 attached with the second counting wheel 214, there can be displayed a result of measurement of "second" of the chronograph.

A minute counting train wheel 322 is rotated by rotation of the second counting wheel 214. The minute counting train wheel 322 includes the minute counter intermediate wheel 258 and the minute counting wheel 260. Therefore, by the chronograph minute hand 124 attached to the minute counting wheel 260, there can be displayed a result of measurement of "minute" of the chronograph.

A first hour counting train wheel 332 is rotated by rotation of the barrel complete 110. The first hour counting

train wheel 332 includes the hour counting transmission wheel (A) 246 and the hour counting transmission wheel (C) 242. An hour counting slipping mechanism 334 is provided between the first hour counting train wheel 332 and a second hour counting train wheel 336. The hour counting slip mechanism 334 is constituted by the contact portion 242b and the guide portion 242c of the hour counter intermediate transmission wheel (C) 242 and the fitting portion 244c of the hour counter intermediate transmission wheel (B) 244.

The second hour counting train wheel 336 includes the hour counter intermediate transmission wheel (B) 244 and the hour counting wheel 250. The second hour counting train wheel 336 is rotated by rotation of the first hour counting train wheel 332. Therefore, by the chronograph hour hand 128 attached to the hour counting wheel 250, there can be displayed a result of measurement of "hour" of the chronograph.

When the second hour counting train wheel 336 is set, by slip action of the hour counting slip mechanism 334, the first hour counting train wheel 332 is rotated while slipping relative to the second hour counting train wheel 336.

(1-2) State in which the chronograph mechanism is operated

In reference to Fig. 14 and Fig. 15, in the state in which the chronograph mechanism is operated in the chronograph time piece according to the invention, the coupling lever 442

is moved to rotate in the direction of the arrow mark 442v centering on the rotational center 442t such that the chronograph mechanism is operated. As a result, the second counting transmission pinion 212b is constituted to be in mesh with the second counting wheel 214. In the state in which the second counting transmission pinion 212b and the second counting wheel 214 are in mesh with each other, the second counting wheel 214 is constituted to rotate by one rotation per minute.

A guide frame 442d is provided to the coupling lever 442. An upper frame 442e is attached to the guide frame 442d. The upper frame 442e guides rotatably an upper shaft portion of the second counter intermediate wheel 212. By bringing an outer peripheral portion 442f of the guide frame 442d into contact with a contact portion 202d of the chronograph bridge 202, rotation of the coupling lever 442 in the direction of the arrow mark 442v is set. Therefore, by the constitution, the state in which the second counting transmission pinion 212b and the second counting wheel 214 are in mesh with each other can be maintained with certainty.

The chronograph second hand 118 is attached to the second counting wheel 214 and is constituted to display a result of measurement of an elapse time period of second.

By the constitution explained above, according to the chronograph time piece of the invention, the chronograph second

hand 118 constituting the chronograph second display member, displays the result of measurement of the elapse time period of "second", the chronograph minute hand 124 constituting the chronograph minute display member, displays the result of measurement of the elapse time period of "minute" and the chronograph hour hand 128 constituting the chronograph hour display member, displays the result of measurement of the elapse time period of "hour".

(2) Structure and operation of a chronograph operating mechanism

(2-1) Constitutions of respective parts for operating chronograph measurement

An explanation will be given of the structure of a chronograph operating mechanism on the front side of the movement 100 according to an embodiment of a chronograph time piece of the invention in reference to Fig. 17 and Fig. 18.

In 2 o'clock direction of the movement, a start/stop button 830 is provided and by pushing the start/stop button in a direction designated by an arrow mark 410, an operating lever 414 is constituted to be able to move.

Further, in 4 o'clock direction of the movement, a reset button 840 is provided and by pushing the reset button 840 in a direction designated by an arrow mark 412, an hour hammer operating lever 510 is constituted to be able to move.

Here, according to the specification, for convenience

of explanation, in a plane view, when a set screw for setting a member is illustrated and a rotational center of the member or a pin constituting a guide cannot be illustrated, a center position of the set screw is indicated by a cross in the drawing and a reference notation of the pin is attached to the cross to thereby display the position of the pin.

The operating lever 414 is provided to be movable by being guided by an operating lever guide pin 416 (the center position is indicated by 416 in Fig. 17).

An operating lever spring 418 urges to push the operating lever 414 to the start/stop button 830. Therefore, after pushing the start/stop button 830, when the finger is detached from the start/stop button 830, by spring force of the operating lever spring 418, the operating lever 414 moves toward an outer side of the movement and the start/stop button 830 returns to the original position.

Similar operation is applicable also to the reset button 840 by using a hammer operating lever spring 522 and after pushing the reset button 840, when the finger is detached from the reset button 840, by spring force of the hammer operating lever spring 522, the hammer operating lever 520 moves toward the outer side of the movement and the reset button 840 returns to the original position.

An operating cam 420 is rotatably provided with drive teeth 422 and ratchet teeth 424. In the case of the ratchet

teeth 424, a number of teeth is 16. In the case of the drive teeth 422, a number of teeth is 8 which is a half of the number of teeth of the ratchet teeth 424. Therefore, when the ratchet teeth 424 are fed by 1 pitch, the drive teeth 422 are fed by a half pitch. Viewing a portion in correspondence with an outer periphery of the drive teeth 422, every time of feeding the ratchet teeth 424 by 1 pitch, peak portions 424t and valley portions 424u of the drive teeth 422 are rotated to dispose alternately.

So far as the number of teeth of the ratchet teeth 424 is twice as much as a number of teeth of the drive teeth 422, the number of teeth of the ratchet teeth 424 may not be 16. However, the number of teeth of the ratchet teeth 424 is an even number.

There is provided an operating cam jumper 426 having a spring portion and a setting portion 426a sets the ratchet teeth 424 and determines a position of the operating cam 420 with regard to the rotational direction. Therefore, by the ratchet teeth 424 and the operating cam jumper 426, the operating cam 420 is rotated by every $360/16$ degree and is positioned at the position with certainty.

A hammer setting lever 430 is rotatably provided centering on a hammer setting lever rotation guide pin 428 (center position is designated by 428 in Fig. 17). A setting portion 430a of the hammer setting lever 430 is disposed between

2 teeth of the drive teeth 422.

A hammer 432 is rotatably provided centering on the operating lever guide pin 416 (center position is indicated by 416 in Fig. 17). A hammer spring 434 urge the hammer 432 such that the hammer 432 is rotated in the clockwise direction. A minute zeroing portion 432a of the hammer 432 is brought into contact with the minute heart cam 262 of the minute counting wheel 260 and zeros the minute heart cam 262. Therefore, under the state, the chronograph minute hand 124 indicates "zero position".

A minute jumper 264 is provided with a setting portion 264a and the setting portion 264a sets a gear portion of the minute chronograph wheel 260. Therefore, a position of the minute chronograph wheel 260 in the rotational direction is set by the minute jumper 264.

A second zeroing operating portion 432b of the hammer 432 is brought into contact with the second heart cam 220 of the second chronograph wheel 214 to thereby return the second heart cam 220 to zero. Therefore, under the state, the chronograph second hand 118 indicates "zero position".

A stop lever 440 is rotatably provided centering on a stop lever rotation guide pin 438 (center position is indicated by 438 in Fig. 17). The stop lever 440 is provided with a second counting wheel contact portion 440a, an hour coupling lever pin operating portion 440b, a coupling lever contact portion

440c and a setting portion 440d. The setting portion 440d of the stop lever 440 is positioned between 2 teeth of the drive teeth 422.

There is provided a coupling lever spring 444 having a stop lever spring portion 444a and a coupling lever spring portion 444b. The coupling lever spring portion 444b urges the stop lever 440 in the counterclockwise direction and the second counting wheel contact portion 440a is brought into contact with a gear of the second counting wheel 214.

The coupling lever 442 is rotatably provided centering on a coupling lever rotation guide pin 446 (center position is indicated by 446 in Fig. 17). As described above, the guide frame 442d is provided to the coupling lever 442 and the upper frame 442e is attached to the guide frame 442d. The upper frame 442e rotatably guides the upper shaft portion of the second counter intermediate wheel 212. By spring force of the coupling lever spring portion 444b, the coupling lever 442 is urged to rotate in the counterclockwise direction. By bringing a contact portion 442a of the coupling lever 442 into contact with the coupling lever contact portion 440c of the stop lever 440, a position of the coupling lever 442 in the rotational direction is determined. In the state shown by Fig. 17, the second counting transmission pinion 212b of the second counter intermediate wheel 212 is not in mesh with the second counting wheel 214.

An hour coupling transmission lever 452 is rotatably provided centering on an hour coupling operation lever rotation guide pin 456 (center position is indicated by 456 in Fig. 17). The hour coupling operation lever 452 is provided with an hour coupling operation lever operating pin 450 and an hour coupling lever operation lever operating pin 454. The hour coupling operation lever operating pin 450 is engaged with the hour coupling lever pin operating portion 440b of the stop lever 440. Therefore, a position of the hour coupling operation lever 452 in the rotational direction is determined by the stop lever 440.

In Fig. 17, the rotational center of the minute counting wheel 260 is disposed substantially in "12 o'clock direction" of the movement. The rotational center of the minute counter intermediate wheel 258 is disposed between "12 o'clock direction" and "3 o'clock direction" of the movement. The rotational center of the operating cam 420 is disposed substantially in "3 o'clock direction". The rotational center of the second counter intermediate wheel 212 is disposed substantially in "9 o'clock direction" of the movement. The contact portion 442a of the coupling lever 442 is disposed substantially in "6 o'clock direction" of the movement. The coupling lever 442 and the hour coupling operation lever 452 are disposed between "6 o'clock direction" and "9 o'clock direction" of the movement. The hammer 432 is disposed between

"12 o'clock direction" and "3 o'clock direction" of the movement.

In reference to Fig. 18, the coupling lever operation lever operating pin 454 is arranged to penetrate a portion of the main plate 102 from the front side of the movement to the back side of the movement. The hour coupling lever operation lever operating pin 454 is provided with an hour coupling lever operating portion 454a. The hour coupling lever operating portion 454a is constituted to be able to engage with the hour coupling lever 254. The hour coupling lever operation lever operating pin 454 is disposed substantially in "9 o'clock direction" of the movement.

In reference to Fig. 19, the hour coupling lever 254 is rotatably provided centering on an hour coupling lever rotation guide pin 280 (center position is indicated by 280 in Fig. 19). The hour coupling lever 254 is provided with an hour coupling lever spring portion 254a, an hour hammer transmission lever operating portion 254b, an hour counting wheel contact portion 254c, a first pin engaging portion 254d and a second pin engaging portion 254e. The first pin engaging portion 254d is disposed more proximate to the inner side of the movement than the second pin engaging portion 254e.

By spring force of the hour coupling lever spring portion 254a, the hour coupling lever 254 is urged to rotate in the counterclockwise direction. In the state shown by Fig.

19, the hour counting wheel contact portion 254c is brought into contact with a gear portion of the hour counting wheel 250.

An hour hammer transmission lever 510 is rotatably provided centering on an hour hammer transmission lever rotation guide pin 512 (center position is indicated by 512 in Fig. 19). The hour hammer transmission lever 510 is provided with an hour hammer lever operating pin 514 and an hour coupling lever engaging portion 510a. The hour hammer 440 is provided rotatably centering on an hour hammer rotation guide pin 448 (center position is indicated by 448 in Fig. 19).

The hour hammer 440 is provided with the hour hammer operating pin engaging portion 440a and the hour zeroing portion 440b. The hour hammer operating pin 514 of the hour hammer transmission lever 510 is engaged with the hour hammer operating pin engaging portion 440a and a position of the hour hammer 440 in the rotational direction is determined. It is preferable to constitute the hour hammer operating pin engaging portion 440a in a shape of a long hole.

By operating the reset button 840, the hour zeroing portion 440b of the hour hammer 440 is brought into contact with the hour heart cam 252 of the hour counting wheel 248 to thereby zero the hour heart cam 252. Therefore, under the state, the chronograph hour hand 128 indicates "zero position". In the state shown by Fig. 19, the hour zeroing portion 440b of

the hour hammer 440 is disposed to be remote from the heart cam 252.

(2-2) Operation in chronograph measurement

Next, in reference to Fig. 20, the start/stop button 830 disposed in 2 o'clock direction of the movement is pushed in the direction of the arrow mark 410. When the chronograph time piece is set to a chronograph measurement mode, the operating lever 414 is guided by the operating lever guide pin 416 and is slidably moved toward the inner side of the movement against spring force of the operating lever spring 418.

By the slidable movement of the operating lever 414,, an operational end portion 414f of the operating lever 414 rotates the ratchet teeth 424 of the operating cam 420 by one tooth in the clockwise direction. The position of the ratchet teeth 424 in the rotational direction is positioned by the setting portion 426a of the operating cam jumper 426.

The number of teeth of the ratchet teeth 424 is 16, the number of teeth of the drive teeth 422 is 8 and accordingly, when the ratchet teeth 424 are rotated by one tooth, the drive teeth 422 are also rotated by a half pitch in the clockwise direction. Therefore, by rotating the drive teeth 422, the hammer setting lever 430 is rotated in the counterclockwise direction while centering on the hammer setting lever rotation guide pin 428 and the positioning portion 430f of the hammer setting lever 430 is engaged with the setting portion 432f of

the hammer 432. As a result, the hammer setting lever 430 is mounted on the outer peripheral face of the peak portion 424t of the drive teeth 422 and is held in a state shown by Fig. 20.

By such rotation of the hammer setting lever 430, the setting portion 432f of the hammer 432 is pushed and the hammer 432 is rotated in the counterclockwise direction centering on the operating lever guide pin 416. As a result, the minute zeroing portion 432a of the hammer 432 is separated from the minute heart cam 262 of the minute counting wheel 260. Therefore, under the state, the chronograph minute hand 124 is rotated and "minute" of the result of measurement of the chronograph can be displayed.

Further, since the hammer 432 is rotated in the counterclockwise direction, the second zeroing portion 432b of the hammer 432 is separated from the second heart cam 220 of the second counting wheel 214.

By rotating the drive teeth 422, the stop lever 440 is rotated in the clockwise direction centering on the stop lever rotation guide pin 438. Further, as described above in reference to Fig. 14, the outer peripheral portion 442f of the guide frame 442d is brought into contact with the contact portion 202d of the chronograph bridge 202 to thereby set the position of the coupling lever 442 in the rotational direction. Under the state, the stop lever 440 is held to be separated

from the coupling lever 442.

The stop lever 440 mounts on the outer peripheral face of the peak portion 424t of the drive teeth 422 and is held in the state shown by Fig. 20. Therefore, the second counting wheel contact portion 440a is separated from the gear of the second counting wheel 214. Therefore, under the state, the chronograph second hand 118 is rotated and "second" of the result of measurement of the chronograph can be displayed.

By rotating the stop lever 440, the coupling lever 442 is rotated in the counterclockwise direction centering on the coupling lever rotation guide pin 446. As described above, by the spring force of the coupling lever spring portion 444b, the coupling lever 442 is always urged to rotate in the counterclockwise direction.

Therefore, under the state, the state in which the second counting transmission pinion 212b and the second counting wheel 214 are in mesh with each other is maintained with certainty.

Therefore, the second counting wheel 214 can be rotated and measurement of "second" and "minute" of the chronograph is started.

Based on rotation of the barrel complete 110, the second counting wheel 214 is rotated via rotation of the center wheel & pinion 130, the third wheel & pinion 136, the second wheel 154 and the second counter intermediate wheel 212. A number

of teeth of the train wheel of the second counting wheel 214 is set such that the second counting wheel 214 is rotated by one rotation per minute.

Every time of rotating the second counting wheel 214 by one rotation, the minute counter intermediate wheel 258 is rotated by one tooth by the minute driving finger 256. The minute counting wheel 260 is rotated by rotation of the minute counter intermediate wheel 258 and after elapse of one minute, the chronograph minute hand 124 is rotated by an angle in correspondence with one minute of the minute chronograph indicator. The position of the minute chronograph wheel 260 in the rotational direction is set by the minute jumper 264.

Further, by rotating the stop lever 440, the hour coupling lever operation lever operating pin 450 engaged with the hour coupling lever pin operating portion 440b is rotated and the hour coupling operation lever 452 is rotated in the counterclockwise direction centering on the hour coupling operation lever rotation guide pin 456. As a result, the hour coupling lever operation lever operating pin 454 is also rotated in the counterclockwise direction.

As described above in reference to Fig. 18, the hour coupling lever operation lever operating pin 454 penetrates a portion of the main plate 102 from the front side of the movement to the back side of the movement.

In reference to Fig. 21, when the hour coupling lever

operation lever operating pin 454 is rotated, the first engaging portion 254d is pushed. Therefore, the hour coupling lever 254 is rotated centering on the hour coupling lever rotation guide pin 280 in the clockwise direction against the spring force of the hour coupling lever spring portion 254a. As a result, the hour counting wheel contact portion 254c is separated from the gear portion of the hour counting wheel 250. Therefore, under the state, the hour counting wheel 250 can rotate, the chronograph hour hand 128 is rotated and "hour" of the result of measurement of the chronograph can be displayed.

In reference to Fig. 22, the hour counting transmission wheel (A) 246 is rotated based on rotation of the barrel complete 110. The hour counting transmission wheel (C) 242 is rotated based on rotation of the hour counting transmission wheel (A) 246. The hour counting transmission wheel (B) 244 is rotated integrally with the hour counting transmission wheel (C) 242. By rotating the hour counting transmission wheel (B) 244, the hour counter wheel 250 is rotated. Therefore, after elapse of one hour, the chronograph hour hand 128 is rotated by an angle in correspondence with one hour of the hour chronograph indicator.

(2-3) Operation in stopping chronograph measurement

In reference to Fig. 23, in the state of operating the chronograph measurement, the start/stop button disposed in 2

o'clock direction of the movement is pushed in the direction of the arrow mark 410.

By the operation, the operating lever 414 is slidably moved toward the inner side of the movement against the spring force of the operating lever spring 418 while being guided by the operating lever guide pin 416.

By the slidable movement of the operating lever 414, the operational end portion 414f of the operating lever 414 rotates the ratchet teeth 424 of the operating cam 420 in the clockwise direction by further one tooth. The position of the ratchet teeth 424 in the rotational direction is positioned by the setting portion 426a of the operating cam jumper 426.

When the ratchet teeth 424 are rotated by one tooth, the drive teeth 422 are also rotated in the clockwise direction by further half pitch.

Also in this state, the positioning portion 430f of the hammer setting lever 430 stays to be engaged with the setting portion 432f of the hammer 432. As a result, the hammer setting lever 430 is held at a position the same as that in the state shown by Fig. 20.

Since the hammer setting lever 430 is not rotated, the minute zeroing portion 432a of the hammer 432 stays to be separated from the minute heart cam 262 of the minute counting wheel 260. Further, the second zeroing portion 432b of the hammer 432 stays to be separated from the second heart cam 220

of the second counting wheel 214.

Since the drive teeth 422 are rotated by a half pitch, the setting portion 440d of the stop lever 440 is positioned between two teeth of the drive teeth 422. By the coupling lever spring portion 444b, the stop lever 440 is always urged in the counterclockwise direction and accordingly, the stop lever 440 is rotated in the counterclockwise direction centering on the stop lever rotation guide pin 438. By rotating the stop lever 440, the coupling lever 442 is rotated in the counterclockwise direction. Therefore, the outer peripheral portion 442f of the guide frame 442d is separated from the contact portion 202d of the chronograph bridge 202. Under the state, the second counting transmission pinion 212b and the second counting wheel 214 are brought into out of mesh.

At the same time, the second counting wheel contact portion 440a of the stop lever 440 is brought into contact with a gear of the second counting wheel 214. Therefore, under the state, the rotation of the second counting wheel 214 is set. As a result, the chronograph second hand 118 is stopped and display of "second" of a result of measurement of the chronograph at the time point is maintained. Further, at the same time, the chronograph minute hand 128 is also stopped and display of "minute" of the result of measurement of the chronograph at the time point is maintained.

As described above, on the front side of the movement,

by rotating the stop lever 440, the coupling lever 442 is rotated in the counterclockwise direction centering on the coupling lever rotation guide pin 446. As a result, on the back side of the movement, the hour coupling lever operation lever operating pin 454 is rotated in the counterclockwise direction toward the outer side of the movement.

In reference to Fig. 24, by the rotational movement of the hour coupling lever operation lever operating pin 454, the hour coupling lever 254 is rotated in the counterclockwise direction while centering on the hour coupling lever rotation guide pin 280. Therefore, the hour counting wheel contact portion 254c is brought into contact with the gear portion of the hour counting wheel 250.

When rotation of the hour counting wheel 250 is set, also the hour counting transmission wheel (B) 244 cannot be rotated. Meanwhile, by rotation of the barrel complete 110, the hour counting transmission wheel (A) 246 is rotated and by rotating the hour counting transmission wheel (A) 246, the hour counting transmission wheel (C) 242 is rotated.

Therefore, the fitting portion 244c of the hour counting transmission wheel (C) 242 is slipped relative to the fitting portion 244c of the hour counting transmission wheel (B) 244. By the constitution, while maintaining rotation of the barrel complete 110, rotation of the hour counting wheel 250 can be stopped.

Therefore, under the state, the chronograph second hand 118, the chronograph minute hand 124 and the chronograph hour hand 128 are stopped in the state respectively displaying "second", "minute" and "hour" of an elapse time period from the start time point.

Further, by rotation of the barrel complete 110, the front train wheel continues operating and accordingly, by the hour hand 150, the minute hand 134 and the second hand 156, "hour", "minute" and "second" of current time can be displayed.

(2-4) Case of restarting measurement of chronograph

In the state of stopping the chronograph measurement shown by Fig. 23 and Fig. 24, by pushing again the start/stop button 830 in the direction of the arrow mark 410, the chronograph time piece can be set again to the chronograph measurement mode.

By the slidable movement of the operating lever 414, the operational end portion 414f of the operating lever 414 rotates the ratchet teeth 424 of the operating cam 420 by one tooth in the clockwise direction. By rotating the drive teeth 422, the hammer setting lever 430 is rotated in the counterclockwise direction centering on the hammer setting lever rotation guide pin 428 and the hammer setting lever 430 mounts on the outer peripheral face of the peak portion 224t of the drive teeth 422 and is held in the state shown by Fig. 20.

By such rotation of the hammer setting lever 430, the minute zeroing portion 432a of the hammer 432 is separated from the minute heart cam 262 of the minute counting wheel 260. Therefore, under the state, the chronograph minute hand 124 can be rotated again.

Further, since the hammer 432 is rotated in the counterclockwise direction, the second zeroing portion 432b of the hammer 432 is separated from the second heart cam 220 of the second counting wheel 214.

By rotating the drive teeth 422, the stop lever 440 is rotated in the clockwise direction centering on the stop lever rotation guide pin 438 and the stop lever 440 mounts on the outer peripheral face of the peak portion 424t of the drive teeth 422 and is held in the state shown by Fig. 20. Therefore, the second counting wheel contact portion 440a is separated from the gear of the second counting wheel 214. Therefore, under the state, the chronograph second hand 118 can be rotated again.

Further, by rotating the stop lever 440, the hour coupling lever operation lever operating pin 454 is rotated and the hour counting wheel contact portion 254c is separated from the gear portion of the hour counting wheel 250. Therefore, the hour counting wheel 250 can be rotated again.

(2-5) Reset operation

In reference to Fig. 25 through Fig. 27, in the state

in which measurement of the chronograph is stopped, reset operation can be carried out by pushing the reset button 840 disposed in 4 o'clock direction of the movement in the direction designated by the arrow mark 412.

In reference to Fig. 25 and Fig. 27, when the reset button 840 is pushed, on the back side of the movement, the hour hammer transmission lever 510 is rotated in the counterclockwise direction and by the hour hammer operating pin 514, the hour hammer 440 is rotated in the clockwise direction. Then, the time zeroing portion 440b of the hammer 440 is brought into contact with the hour heart cam 252 of the hour counting wheel 248 to thereby zero the hour counting wheel 248.

At the same time, by rotating the hour hammer transmission lever 510, the hour coupling lever engaging portion 510a of the hour hammer transmission lever 510 is engaged with the hour hammer transmission lever operating portion 254b of the hour coupling lever 254 to thereby rotate the hour coupling lever 254 in the clockwise direction. Then, the hour counting wheel contact portion 254c is separated from the gear portion of the hour counting wheel 250.

Therefore, as a result of such reset operation, the chronograph hour hand 128 returns to and stops at "zero position" before starting to operate the chronograph mechanism.

In reference to Fig. 28, when rotation of the hour counting wheel 250 is set, also the hour counting transmission wheel (B) 244 cannot be rotated. Meanwhile, by rotation of the barrel complete 110, the hour counting transmission wheel (A) 246 is rotated and by rotating the hour counting transmission wheel (A) 246, the hour counting transmission wheel (C) 242 is rotated.

Therefore, the fitting portion 244c of the hour counting transmission wheel (C) 242 is slipped relative to the fitting portion 244c of the hour counting transmission wheel (B) 244.

Further, in reference to Fig. 27, when the hour coupling lever 254 is rotated in the clockwise direction, the second contact portion 254e of the hour coupling lever 254 is rotated in the clockwise direction and the hour coupling lever operation lever operating pin is moved toward the inner side of the movement. Then, in reference to Fig. 26, the hour coupling operation lever 452 is rotated in the counterclockwise direction. Then, the hour coupling operation lever transmitting pin 450 provided to the hour coupling operation lever 452 is also rotated in the counterclockwise direction and the hour coupling operation lever transmitting pin 450 rotates the stop lever 440 in the clockwise direction. As a result, the second counting wheel contact portion 440a is separated from the gear of the second counting wheel 214. Under the state, the second counting transmission pinion 212b is not

in mesh with the second counting wheel 214 and accordingly, the second counting wheel 214 is not rotated.

In reference to Fig. 25 and Fig. 26, on the front side of the movement, the hammer transmission lever 520 is rotatably provided centering on the hammer transmission lever rotation guide pin 508. The hammer transmission lever 520 is provided with the hammer setting lever engaging portion 520a. The hammer transmission lever spring 522 urges the hammer transmission lever 520 to rotate in the counterclockwise direction.

When the reset button 840 is pushed, the hammer transmission lever 520 is rotated in the clockwise direction via operation of the hour hammer transmission lever 510 and the hammer setting lever engaging portion 520a pushes the hammer setting lever 430. Then, the hammer setting lever 430 is rotated in the clockwise direction and the positioning portion 432f of the hammer setting lever 430 is separated from the hammer setting portion 432f of the hammer 432. Then, by the spring force of the hammer spring 434, the hammer setting lever 430 is rotated in the clockwise direction. Then, the minute zeroing portion 432a of the hammer 432 is brought into contact with the minute heart cam 262 of the minute counting wheel 260, the minute counting wheel 260 is zeroed, at the same time, the second zeroing portion 432b of the hammer 432 is brought into contact with the second heart cam 220 of the second

counting wheel 214 to thereby zero the second counting wheel 214.

According to the above-described reset operation, dimensions and shapes of related parts are determined such that operation of "separating the second counting wheel contact portion 440a of the stop lever 440 from the gear of the second counting wheel 214" is completed prior to operation of "zeroing the second counting wheel 214".

That is, in correspondence with the stroke of pushing the reset button 840, the hour hammer transmission lever 510, the hour coupling lever 254 and the hour coupling operation lever 452 are operated, the stop lever 440 is rotated and the second counting wheel contact portion 440a is separated from the gear of the second counting wheel 214. Thereafter, by operating the hammer transmission lever 520, the hammer setting lever 430 and the hammer setting lever 430, the minute zeroing portion 432a of the hammer 432 returns the minute counting wheel 260 to zero and the second zeroing portion 432b of the hammer 432 is constituted to return the second counting wheel 214 to zero.

Therefore, the operation of returning the second counting wheel 214 and the minute counting wheel 260 is achieved with certainty without interfering with stopping force of the stop lever 440.

The above-described operation relates to the state in

which measurement of the chronograph is stopped. In measurement of the chronograph, the hammer setting lever 430 mounts on the outer peripheral face of the drive teeth 422 and therefore, the chronograph time piece is not reset.

(3) Explanation of operation of chronograph time piece

(3-1) State in which the chronograph mechanism is not operated

In reference to Fig. 29, in a state in which the chronograph mechanism is not operated, the hour hand 150 indicates "hour" in current time, the minute hand 134 indicates "minute" in current time and the second hand 156 (so-to-speak small second hand) indicates "second" in current time. The chronograph time piece shown by Fig. 29 displays intermediary time between "10 o'clock 8 minute 12 second" and "10 o'clock 8 minutes 13 seconds".

In this state, the chronograph hour hand 128 is stopped at a position indicating "12", the chronograph minute hand 124 is stopped at a position indicating "30" and the chronograph second hand 118 is stopped in 12 o'clock direction of the time piece, that is, at a position indicating "60".

The chronograph second hand 118 is constituted to rotate by one rotation per minute and chronograph second indicators 810 in correspondence with the chronograph second hand 118 are provided with "5", "10", "15" ... "50", "55" and "60" along the outer periphery of the time piece, that is, along a rotational

locus of a front end of the chronograph second hand 118.

As an example, the embodiment of the chronograph time piece according to the invention is constituted by so-to-speak "8 oscillation". "8 oscillation" is referred to as a constitution in which the balance with hairspring makes 28800 sway per hour.

Here, "sway" indicates a state in which the balance with hairspring is rotated in one direction and the balance with hairspring returns to the original position by "2 sway". That is, in the case of the time piece of "8 oscillation", the balance with hairspring makes 1 sway per second and is oscillated to reciprocate by 4 times per second.

The chronograph time piece may be constituted to be a time piece of so-to-speak "10 oscillation". "10 oscillation" is referred to as a constitution in which the balance with hairspring makes 36000 sway per hour. In the case of the time piece of "10 oscillation", the balance with hairspring makes 10 sway per second and is oscillated to reciprocate 5 times per second.

By constituting in this way, there can be realized a chronograph time piece capable of carrying out chronograph measurement by a unit of "1/10 second". In this constitution, the chronograph second indicators 810 may be provided at every "1/10 second" or the chronograph second indicators 810 may be provided at every "1/5 second".

By constituting in this way, there can be realized a chronograph time piece having high accuracy.

A chronograph time piece may be constituted to be a time piece of so-to-speak "5.5 oscillation" or "6 oscillation". According to the constitution, the chronograph second indicators 810 are set in conformity with a number of oscillation and a number of teeth of a train wheel is set in conformity with the number of oscillation.

The chronograph minute hand 124 is constituted to rotate by one rotation per 30 minutes and chronograph minute indicators 812 in correspondence with the chronograph minute hand 124 are provided with "5", "10", "15", "20", "25" and "30" along a rotational locus of a front end of the chronograph minute hand 124. The chronograph minute hand 124 may be constituted to rotate by one rotation per 60 minutes.

The chronograph hour hand 128 is constituted to rotate by one rotation per 12 hours and chronograph hour indicators 814 in correspondence with the chronograph hour hand 128 are provided with "1", "2", "3" ... "11" and "12" along a rotational locus of a front end of the chronograph hour hand 128. The chronograph hour hand 128 may be constituted to rotate by one rotation per 24 hours.

A date character 820 of a date indicator 270 displays current date. According to the chronograph time piece shown by Fig. 29, "date of 5" is displayed.

According to the chronograph time piece of the invention, the rotational center of the hour hand 150, the rotational center of the minute hand 134 and the rotational center of the chronograph second hand 118 are arranged substantially at center of the time piece, the rotational center of the second hand 156 (so-to-speak small second hand) is arranged on 9 o'clock side of the time piece, the rotational center of the chronograph minute hand 124 is arranged on 12 o'clock side of the time piece and the rotational center of the chronograph hour hand 128 is arranged on 6 o'clock side of the time piece. Therefore, according to the chronograph time piece of the invention, display of the respective indicator hands is very easy to understand.

(3-2) State in which the chronograph mechanism is operated

In reference to Fig. 30, the start/stop button 830 disposed in 2 o'clock direction of the chronograph time piece is pushed and measurement of chronograph is started.

According to the state shown by Fig. 30, the chronograph hour hand 128 continues rotating while indicating between "1" and "2" of the chronograph time indicators 814, the chronograph minute hand 124 continues rotating while indicating "22" of the chronograph minute indicators 812 and the chronograph second hand 118 continues to rotating while indicating between "16" and "17" of the chronograph second indicators 810.

That is, measurement of the chronograph time piece is brought into a state at which "1 hour 22 minutes 16 seconds 7" has elapsed.

Further, also in such a state, the hour hand 150 indicates "hour" in current time, the minute hand 134 indicates "minute" in current time and the second hand 156 indicates "second" in current time.

(3-3) State in which the chronograph mechanism is stopped

In the state shown by Fig. 30, when the start/stop button 830 disposed in 2 o'clock direction of the chronograph time piece is pushed by one more time, measurement of the chronograph time piece can be stopped. Therefore, the chronograph time piece is brought into a state in which the chronograph is stopped while displaying "1 hour 22 minutes 16 seconds 7".

Further, even in the state, the hour hand 150 indicates "hour" in current time, the minute hand 134 indicates "minute" in current time and the second hand 156 indicates "second" in current time.

(3-4) Operation of reset

In reference to Fig. 31, when the reset button 840 is pushed, the chronograph second hand 118, the chronograph minute hand 124 and the chronograph hour hand 128 return to "zero positions" before starting to operate the chronograph mechanism and are stopped.

Further, even in the state, the hour hand 150 indicates "hour" in current time, the minute hand 134 indicates "minute" in current time and the second hand 156 indicates "second" in current time.

Industrial Applicability

As explained above, the invention achieves effects described below since there is constructed the constitution described above in the chronograph time piece.

(1) According to the chronograph time piece of the invention, a number of parts is small and the structure is simple.

(2) According to the chronograph time piece of the invention, operation of counting mechanisms is extremely stabilized.

(3) According to the chronograph time piece of the invention, the hour counting train wheel and the minute counting train wheel are small-sized and thin.



Claims

1. A chronograph time piece which is a chronograph in which a mainspring provided in a barrel complete constitutes a power source, said chronograph time piece comprising:

a top train wheel (312) rotating based on rotation of the barrel complete (110);

a second counter intermediate wheel (212) rotating based on rotation of the top train wheel (312);

a second counting wheel (214) rotatably provided based on rotation of the second counter intermediate wheel (212) in a chronograph measurement mode;

a chronograph second display member (118) for displaying a result of measurement of an elapse time period of second based on rotation of the second counting wheel (214);

a minute counting train wheel (322) provided to rotate based on the rotation of the second counting wheel (214);

a chronograph minute display member (124) for displaying a result of measurement of an elapse time period of minute based on rotation of the minute counting train wheel (322);

at least one hour counting train wheel (332, 336) provided to rotate based on the rotation of the barrel complete (110) in the chronograph measurement mode; and

a chronograph hour display member (128) for displaying a result of measurement of an elapse time period of hour based





on rotation of the hour counting train wheel (332, 336).

2. The chronograph time piece according to Claim 1, characterized in that the hour counting train wheels (332, 336) include an hour counting slip mechanism (334) constituted such that one of train wheels constituting the hour counting train wheels (332, 336) can slip relative to other one thereof.

3. The chronograph time piece according to Claim 1, characterized in including:

a first hour counting train wheel (332) rotating based on rotation of the barrel complete (110);

a second hour counting train wheel (336) rotating based on rotation of the first hour counting train wheel (332) in the chronograph measurement mode; and

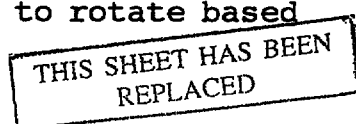
an hour counting slip mechanism (334) constituted such that when chronograph measurement is not executed, rotation of the first hour counting train wheel (332) is not transmitted to the second hour counting train wheel (336) and in the chronograph measurement mode, the rotation of the first hour counting train wheel (332) is transmitted to the second hour counting train wheel (336).

4. The chronograph time piece according to any one of Claim 1 through Claim 3, characterized in further including:

a center wheel & pinion (130) provided to rotate based on the rotation of the barrel complete (110);

a third wheel & pinion (136) provided to rotate based

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on rotation of the center wheel & pinion (139);

a second wheel (154) provided to rotate based on rotation of the third wheel & pinion (136);

a second display member (156) rotating based on rotation of the second wheel (154) for displaying second;

a minute transmission pinion (114) provided to rotate based on the rotation of the center wheel & pinion (139);

a minute drive wheel (132) provided to rotate based on rotation of the minute transmission pinion (114);

a minute display member (134) rotating based on rotation of the minute drive wheel (132) for displaying minute;

an hour wheel (148) provided to rotate based on the rotation of the minute transmission pinion (114); and

an hour display member (150) rotating based on rotation of the hour wheel (148) for displaying hour.

5. A chronograph time piece characterized in that in a chronograph time piece capable of measuring elapse time periods of second, minute and hour in a chronograph measurement mode, said chronograph time piece comprising:

a main plate (102) constituting a base plate of the chronograph time piece;

a second counting wheel (214) for measuring the elapse time period of second based on rotation of a barrel complete (110) in the chronograph measurement mode;

a minute counting train wheel (332) for measuring the

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elapse time period of minute based on the rotation of the barrel complete (110) in the chronograph measurement mode;

hour counting train wheels (332, 336) for measuring the elapse time period of hour based on the rotation of the barrel complete (110) in the chronograph measurement mode;

a chronograph second display member (118) for displaying a result of measurement of the elapse time period of second by rotating the second counting wheel (214);

a chronograph minute display member (124) for displaying a result of measurement of the elapse time period of minute by rotating the minute counting train wheel (322);

a chronograph hour display member (128) for displaying a result of measurement of the elapse time period of hour by rotating the hour counting wheel (326);

second and minute counting coupling means (414, 420, 422, 440, 442) for starting or stopping operation of the chronograph second display member (118) and the chronograph minute display member (124); and

hour counting coupling means (450, 452, 454, 254) for starting or stopping operation of the chronograph hour display member (128).

6. The chronograph time piece according to Claim 5, characterized in further comprising:

chronograph second and minute zeroing means (520, 430, 432) provided on a front side of the main plate (102) for





simultaneously returning the chronograph second display member (118) and the chronograph minute display member (118) to zero; and

chronograph hour zeroing means (510, 440) provided on a back side of the main plate (102) for returning the chronograph hour display member (128) to zero.

7. The chronograph time piece according to any one of Claim 1 through Claim 6:

wherein a rotational center of the chronograph second display member (118) is arranged substantially at a center of the chronograph time piece;

wherein a rotational center of the chronograph hour display member (128) is arranged on a straight line connecting the center of the chronograph time piece and a 6 o'clock indicator of a dial (104) or a vicinity thereof; and

wherein a rotational center of the chronograph minute display member (124) is arranged on a straight line connecting the center of the chronograph time piece and a 12 o'clock indicator of the dial (104) or a vicinity thereof.

8. The chronograph time piece according to any one of Claim 1 through Claim 7, characterized in further comprising:

a second display member (156) for displaying second;

wherein a rotational center of the second display member (156) is arranged on a straight line connecting the center of the chronograph time piece and a 9 o'clock indicator of the

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dial (104).

9. The chronograph time piece according to any one of Claim 5 through Claim 8, characterized in that a button (830) for operating the second and minute counting coupling means (414, 420, 422, 440, 442) and the hour counting coupling means (450, 452, 454, 254) is arranged substantially in a 2 o'clock direction of the chronograph time piece.

10. The chronograph time piece according to any one of Claim 6 through Claim 9, characterized in that a button (840) for operating the chronograph second and minute zeroing means (520, 430, 432) and the chronograph hour zeroing means (510, 440) is arranged substantially in a 4 o'clock direction of the chronograph time piece.

11. The chronograph time piece according to any one of Claim 1 through Claim 10, characterized in that the hour counting train wheels (332, 336) include:

an hour counting transmission wheel (A) (246) rotating based on the rotation of the barrel complete (110);

an hour counting transmission wheel (C) (242) rotating based on rotation of the hour counting transmission wheel (A) (246);

an hour counting transmission wheel (B) (244) cooperating with the hour counting transmission wheel (C) (246) via a slip mechanism;

an hour counting wheel (250) rotating based on rotation

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of the hour counting transmission wheel (B) (244) in the chronograph measurement mode; and

the chronograph hour display member (128) rotating based on rotation of the hour counting wheel (250) for displaying the result of measurement of the elapse time period of hour in the chronograph measurement mode.

12. The chronograph time piece according to any one of Claim 1 through Claim 11:

wherein the second counting wheel (214) includes a minute driving finger (256) for intermittently rotating the minute counting train wheel (322) and the minute counting train wheel (322) includes:

a minute counter intermediate wheel (258) rotated by the minute driving finger (256); and

a minute counting wheel (260) rotating based on rotation of the minute counter intermediate wheel (258).

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