E. STRÖMGREN & J. OLSEN.

ASTRONOMICAL TIMEPIECE.

APPLICATION FILED FEB. 16, 1915.

1,187,110. Patented June 13, 1916.

Fig. 1.

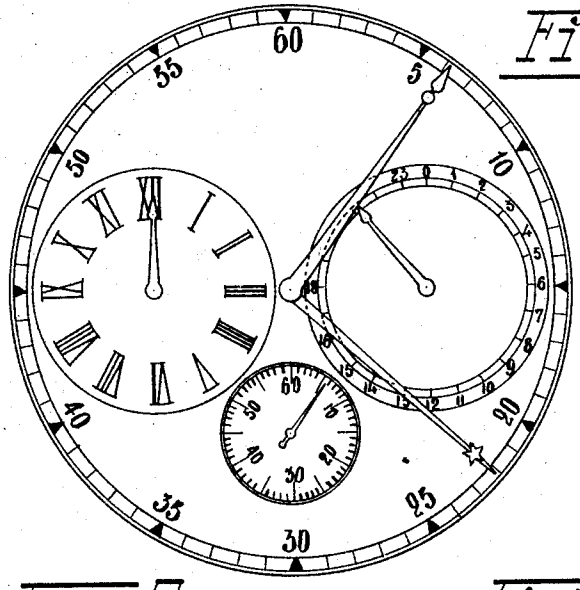


Fig. 2.

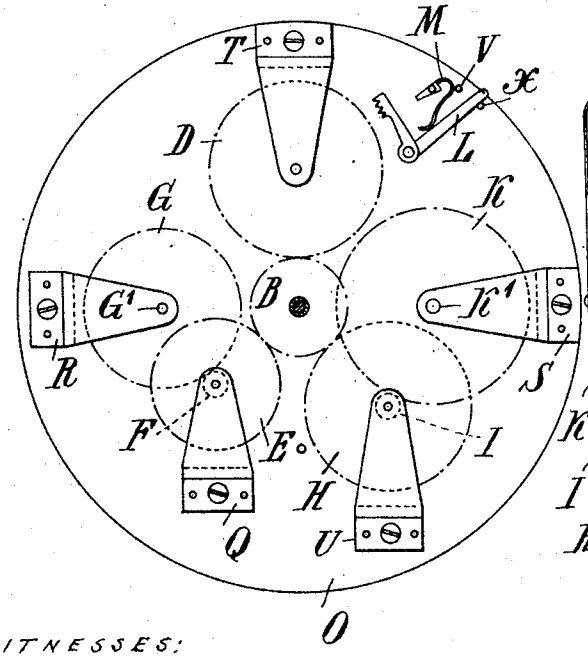
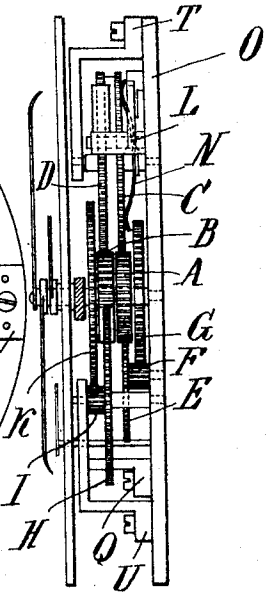


Fig. 3.



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ASTRONOMICAL TIMEPIECE.

1,187,110. Specification of Letters Patent. Patented June 13, 1916.

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To all whom it may concern:

Be it known that we, ELIS STRÖMGREN and JENS OLSEN, subjects of the King of Denmark, the former residing at The Royal Observatory, Copenhagen, Denmark, and the latter at Hallinsgade 8, Copenhagen, Denmark, have invented new and useful Improvements in Astronomical Timepieces, of which the following is a specification.

The object of this invention is a watch or clock for indicating simultaneously the mean solar time and the sidereal time, which is provided with the means for disengaging the two hand-systems from one another for permitting a reciprocal adjustment of them. Thereby the minute hands of the two systems are preferably arranged centric and the hands of the two hour dials, placed aside the center, are moved from the said minute hands by a suitable gearing.

The astronomical year, as known, contains 365,2422 mean solar days and 366,2422 sidereal days. The relation $\frac{3662422}{3652422}$ is about $\frac{366}{365}$ which fraction gives a practical value, for which reason that modification of the watch, which is illustrated in the accompanying drawing, is based upon this fraction.

Figure 1 is a front view of the watch with dial and hands, of which the minute hand for the mean time is provided with a little sun and that for the sidereal time with a star. In Fig. 2 the dial is taken away for illustrating the gearing. Fig. 3 represents a side view of the gearing with the different parts for the sake of clearness separated from one another a little more than in reality.

A, Fig. 3, is a toothed wheel fixed upon the sleeve of the minute hand of the mean solar time, which hand is placed in the center of the watch dial and as in ordinary watches makes one revolution every mean time hour. This wheel possesses 36 teeth and gears with a wheel C with 73 teeth, which by means of a spring N is pressed against another toothed wheel D in such manner that under normal conditions the two wheels revolve simultaneously, but so that, however, a mutual displacement of them is possible, as will be explained later on.

The wheel D is provided with 61 teeth and gears with the toothed wheel B, possessing 30 teeth and fixed upon a sleeve, which turns about the sleeve of the minute hand of the mean solar time and carries the minute hand of the sidereal time which hand is also placed in the center of the watch dial. Hereby the required gearing relation

$$\frac{36.61}{30.73}=\frac{366}{365}$$

is obtained and the minute hand of the sidereal time makes with sufficient exactness one revolution in a sidereal hour, when the minute hand of the mean solar time makes a revolution in a mean solar hour. The extent of the error obtained will be explained later on.

The wheel A, with 36 teeth, gears also with another toothed wheel E with 54 teeth on the axle of which is placed a pinion F with 8 teeth, gearing with a toothed wheel G, possessing 64 teeth. The axle G^1 of that wheel G supports the hour hand of the mean solar time or mean time. The gearing relation $\frac{A}{G}$ is

$$\frac{36.8}{54.64}=\frac{1}{12}.$$

During one revolution of the minute hand of the mean time, the hour hand of the mean time thus makes $\frac{1}{12}$ of a revolution, viz. turns from one hour numeral of the corresponding dial to the next.

The minute wheel B (with 30 teeth) of the sidereal time system gears with a wheel H, possessing 60 teeth and provided with a pinion I with 6 teeth, gearing with the wheel K, having 72 teeth. Upon the axle K^1 of this wheel the hour hand of the sidereal time is fixed. The gearing relation is thus

$$\frac{B}{K}=\frac{30.6}{60.72}=\frac{1}{24}$$

and when the minute hand of the sidereal time makes one revolution the hour hand of the sidereal time makes $\frac{1}{24}$ revolution, viz. turns from one hour numeral on the corresponding dial to the next.

R, S, T, U and Q are brackets for supporting the axles of the toothed wheels. In Fig. 3 the bracket S, however, for sake of clearness is omitted.

The correct gearing relation being $\frac{3662422}{3652422}$ but in the construction now described being taken as $\frac{366}{365}$, an error arises, which appears in such a way, that if the motion of the mean time hands remain correct the motion of the minute hand of the sidereal time is hastened about one minute, exactly 57,294 seconds mean time, during 365 days, viz. about 5 seconds in one month. For that reason the two hand systems must be reciprocally adjustable, which moreover also is necessary in the event that the watch or clock should have stopped for a long time. This adjustment according to the present invention may be effected in the following manner: L, Figs. 2, 3, is a double lever turning on a pivot in the plate O and being acted upon by a spring M in such a manner that it normally is held against a stud X. At the edge of the watch case there is arranged a slide as in repeater watches, which slide, however, is not represented in the drawing because it is assumed to be known by means of which slide the lever L can be turned against another stud V, whereby the toothed arm of the lever L gears with the wheel D and stops the motion of that wheel and all the wheels connected therewith. The two hands of the sidereal time thus are stopped, while the wheel C, which is pressed against the wheel D by the weak spring N, and all the wheels connected thereto, viz. the whole mean solar time gearing system, continue their motion in the same manner as in a common watch. The hour and minute hands can be adjusted during the continued motion of the second hand. The adjustment of the watch now takes place in the manner under mentioned. I. If the mean time system of the watch during a long period has moved exactly, the sidereal time system has gained 0,15697 seconds every day, viz. about 57 seconds in an astronomical year. This amount is of no importance for rough calculations, for which reason it would be sufficient to stop the sidereal time system during 57 seconds once a year, for instance on the 1st January. Should greater precision be required, the sidereal time system of the watch may be stopped during 14 seconds each quarter of the year or during 5 seconds monthly. II. If the mean time system should have lost or gained some minutes or seconds, it is put forward or back as in common watches, and the sidereal time system thereby corrects itself. III. If the watch have stopped some time it becomes necessary to correct the sidereal time hands as well as those of the mean time. The former hands are then in the usual manner, without any action upon the lever L, set for any sidereal time, and are then stopped in that position by means of the lever and slide, and the mean time hands are set at the corresponding mean time. The slide is then released, and the mean time hands are set at the correct mean time. IV. For different purposes it may be advantageous, to let the hands of the mean time and those of the sidereal time refer to different meridians, for instance the mean time hands to a special zone time and the sidereal time hands to the meridian of a special observatory. For that purpose it is only sufficient to correct once for all in a manner evident from the foregoing description.

Having now particularly described the nature of our invention and the manner of its operation, what we claim is:

1. In a timepiece, the combination of two time-measuring movements regulated to sidereal and solar time respectively and having indicating means connected therewith, and releasable means for normally interconnecting both of said movements for simultaneous operation in a set relation.

2. In a timepiece, the combination of two time-measuring movements regulated to sidereal and solar time respectively and having indicating means connected therewith, releasable means for normally interconnecting both of said movements for simultaneous operation in a set relation, and means by which one of the said movements may be locked against the action of the said interconnecting means for the purpose of relative adjustment of both movements.

3. In a timepiece, the combination of two time-measuring movements regulated to sidereal and solar time respectively and having indicating means connected therewith, and a spring-pressed friction clutch interconnecting said movements normally for simultaneous operation in a set relation.

4. In a timepiece, the combination of two time-measuring movements regulated to sidereal and solar time respectively and having indicating means connected therewith, a spring-pressed friction clutch interconnecting said movements normally for simultaneous operation in a set relation, and means by which one of the said movements may be locked against the action of the clutch for the purpose of relative adjustment of both movements.

5. In a timepiece, the combination of a main clock-mechanism, two time-measuring movements regulated to sidereal and solar time respectively and having indicating means, one of the said movements being connected directly with the main clock-mechanism and the other being driven from the first-named movement, and releasable means normally interconnecting the said move-

ments for simultaneous operation in a set relation.

6. In a timepiece, the combination of a main clock-mechanism, two time-measuring movements regulated to sidereal and solar time respectively and having indicating means, one of the said movements being connected directly with the main clock-mechanism and the other being driven from the first-named movement, releasable means normally interconnecting the said movements for simultaneous operation in a set relation, and means by which the second-named movement may be locked against the action of the said releasable means for the purpose of relative adjustment of both movements.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ELIS STRÖMGREN.
JENS OLSEN.

Witnesses:
IDA KNUDSON,
JOHS BRAAE.