Dec. 5, 1950 H. B. MILLIGAN 2,532,324

STAR WATCH

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Fig. 1.

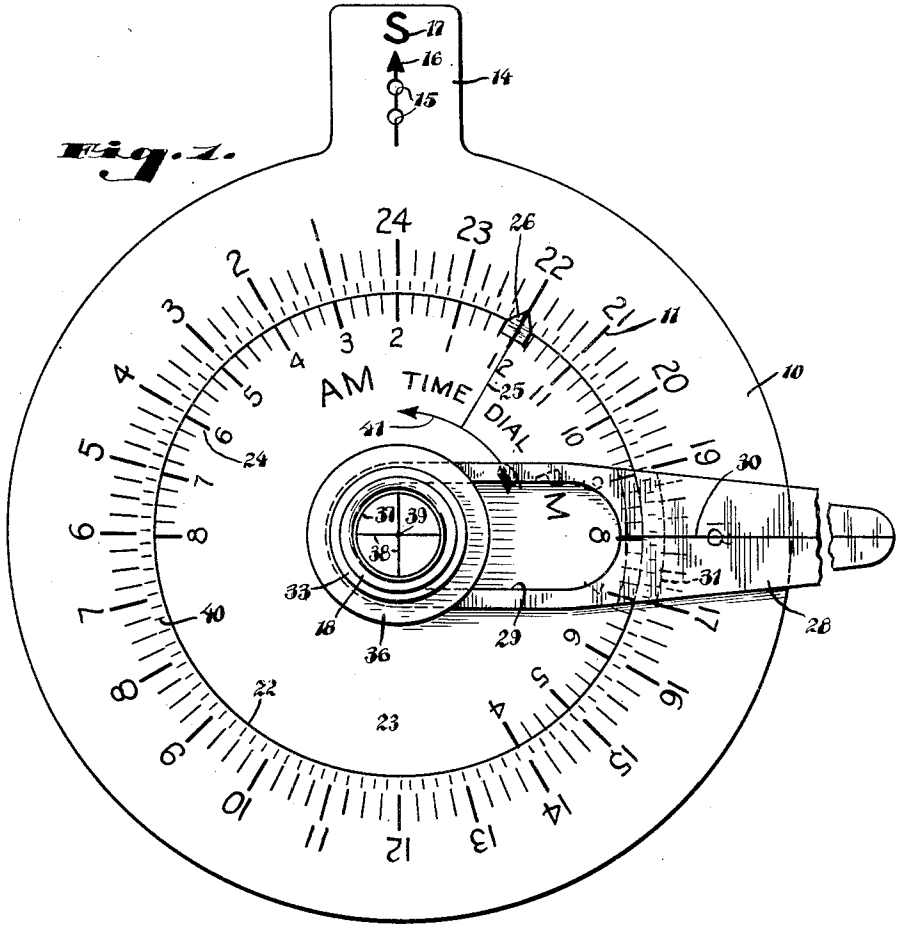


Fig. 2.

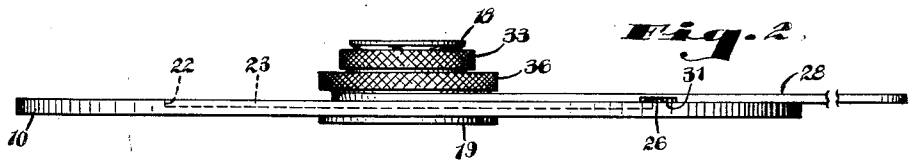
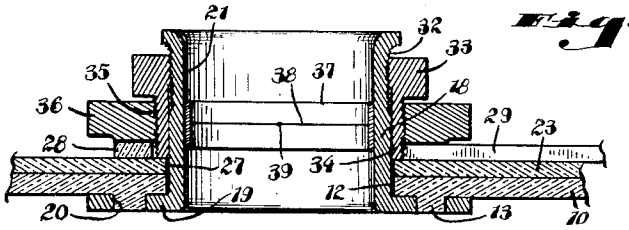


Fig. 3.



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STAR WATCH

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8 Claims. (Cl. 235—83)

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The present invention relates to a star watch, or device for determining, from celestial observation, and with reasonable accuracy, the time of day. The primary object of the invention is to provide a structurally simple and inexpensive device for accomplishing the intended functions. While I recognize the fact that I am not the first to have conceived the broad idea of providing means whereby a measurement of the relative positions of certain stars will produce a time reading, I have invented, and have disclosed and claimed herein, a device of that general character which is novel in construction and which, because of its novel details of structure, possesses certain operational advantages over previous devices known to me.

So far as I am advised, all devices of the general character to which my invention pertains, and which have been known heretofore, are so constructed that, in order to obtain the readings for which they are intended, it is necessary to refer to certain and non-selective fixed stars, the construction of such devices being such that they will give reasonably accurate results only if the specific bodies for which they have been designed are used as references. It is one object of my invention to provide a device through the use of which accurate time readings can be obtained by reference to any fixed star, in association with Polaris, at the election of the user. Previously known devices of this general character read only in sun time. It is well known that, in this country, there are four separate time zones, in each of which one particular time is considered standard; and that, within each time zone, there is only one very narrow band, extending north and south, in which standard time coincides with sun time. It is an object of my invention to produce a device of the general character under consideration so constructed that, after proper adjustment, it will read in standard time. Additionally, it is customary in many parts of this country, to use so-called "daylight saving time" during the summer months; and it is an object of my invention to provide a device so constructed that, during those months, it can be adjusted to read in daylight saving time.

It is known that the stars change their apparent positions relative to Polaris, from day to day from one year's end to the next. An object of the present invention is to provide a device so constructed as to guide the user in adjustment of the parts thereof to compensate for that progressive change in relative positions.

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Further objects of the invention will appear as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

Fig. 1 is a plan view of a star watch constructed in accordance with my invention, showing the indicator arm in extended, or use, position;

Fig. 2 is a side elevation thereof, showing the parts in a different position of relative adjustment; and

Fig. 3 is an enlarged fragmentary axial section through the said device, showing the details of the means which I provide for permitting or preventing relative movements of the several parts.

Referring more particularly to the drawings, it will be seen that I have illustrated a basic disc 10, which may be referred to as a sky dial, said disc being provided with a circular scale 11. The scale 11 is divided into twenty-four major calibrations, said major calibrations being angularly spaced from each other by fifteen degrees. Preferably, each major division of the scale 11 will be further sub-divided into four minor divisions, each representing one-quarter of an hour.

The disc 10 is centrally perforated, as at 12, the axis of said perforation being located on the center of the scale 11; and, in the illustrated embodiment of the invention, studs 13 project axially from the bottom surface of the disc 10 in an annular series concentric with the perforation 12, for a purpose later to become apparent.

The disc 10 is preferably provided with a radial projection or finger 14 formed with two or more small perforations 15 arranged in a line, radial with respect to the axis of the perforation 12, and coinciding with the graduation mark 24 on the scale 11. Preferably, a representation of an arrow 16, pointing away from the center of the disc, will be suitably marked on the finger 14, and preferably the letter "S," as indicated at 17, will be likewise suitably marked on the finger 14, and on the upper surface thereof.

A hollow post 18, interiorly open from end to end, is projected through the perforation 12 of the sky dial 10, said post preferably being provided with a radially extending flange 19 formed with a plurality of perforations 20 adapted to receive the studs 13, whereby the disc 10 is fixed

to the post 18. If desired, the studs 13 may be riveted over against the under surface of the flange 19. It will be seen that the open hollow interior of the post 18 provides a view port 21 for a purpose which will later become apparent.

The upper surface of the disc 10 is recessed, as at 22, for the retention of a disc 23 which carries, on its upper surface, an arcuate scale 24 concentric with the scale 11. An indicator line 25 is suitably marked upon the upper surface of the disc 23, which disc may be called a time dial, said line being radial with respect to the central perforation 27 in the disc 23, and preferably the disc 23 will be provided with a radial projection or finger 26, upstanding above the upper surface of the disc, as shown in Fig. 2, and projecting radially into the region of the scale 11 when the disc 23 is mounted, in the manner clearly shown, upon the post 18. The scale 24 is divided into a plurality of major divisions, in both directions away from the indicator line 25, each of said major divisions including an angle of fifteen degrees, two minutes, thirty seconds. Preferably, and as shown, the indicator line 25 will represent midnight; and the divisions of the scale 24 progressing clockwise from said indicator line will represent evening hours prior to midnight while those progressing counter-clockwise from said reference line will represent morning hours after midnight. Since the device is intended to be used in connection with stars, daylight hours need not be marked upon the scale 24. Preferably, each major division of the scale 24 will be divided into four equal minor divisions.

An indicator arm 28 is provided, adjacent one end, with a longitudinally elongated slot 29 adapted to sleeve upon the post 18; and is further preferably provided with an indicator line 30 which, in all positions of the arm 28, is radial with respect to the common center of the scales 11 and 24. The provision of the slot 29 permits the arm to be shifted between its illustrated position, in which its extremity projects well beyond the outer periphery of the disc 10 for facility in use, and a position in which the arm is located entirely within the outer periphery of the disc 10, for facility in storing or carrying my star watch. It will be obvious that, in any longitudinally adjusted position of the arm 28, it may be rotationally adjusted about the common center of the scales 11 and 24.

In its under surface, the arm 28 is provided with an arcuate groove 31 permitting the passage of the projection 26.

The post 18 is threaded, as at 32, throughout a portion of its length, and a nut 33 is threadedly adjustably mounted upon the threaded portion of said post. The nut 33 is provided with an axial extension 34 adapted to be adjusted between its illustrated position, in which it bears upon the disc 23 to clamp said disc against rotary movement relative to the disc 10, and a position in which said disc 23 is released for such relative movement. The neck 34 is exteriorly threaded as at 35 for the reception of a second nut 36 threadedly adjustably mounted upon said nut 33, and adapted for movement between its illustrated position, in which its bears upon the arm 28 to clamp the same against movement relative to the disc 23, and another position in which said arm is released for such relative movement.

Preferably, but not necessarily, a collar 37, having a press-fit in the view port 21, is mounted within the post 18, said collar supporting a pair of cross hairs 38 which cross hairs intersect at a point 39 located in the axis of the port 21 which, as has been said, is coincident with the common center of the scales 11 and 24.

In use, my sky watch is held by the user in a position in which the disc 10 is substantially perpendicular to the line of sight between the user's eye and Polaris, and in which the point 39 lies in that line of sight. While the discs 10 and 23 may be made of any desired material, I prefer to construct them of transparent moldable plastic, whereby the centering of the point 39 on Polaris is facilitated. The arrow 16 will be held in such a position that it points as nearly as possible to the south while the reading is taken.

The nuts 33 and 36 being loosened, the user now selects any prominent fixed star as a reference body, and adjusts the arm 28 to a position such that the line 30 will point directly toward the selected body. Now, holding the parts of the instrument in adjusted positions, the user reads the position of the line 30 upon the scale 11. As illustrated, that line coincides with the major division 18 of that scale.

Now, the user refers to his watch to determine standard time at his point of observation; and adjusts the dial 23 to bring the graduation on the scale 24 corresponding to that watch time into registry with the line 30. When he has made this adjustment, he tightens the nuts 33 and 36.

This adjustment of the parts has brought the reference line 25 on the dial 23 into a position in which its points directly, when the instrument is held in the manner above described, at the position in the sky which will be occupied, at midnight, by the selected star. If desired, the arm 28 may now be shifted radially inwardly, after loosening the nut 36, and secured in carrying position.

At any later time that night, the nut 33 remaining in clamping position to hold the dial 23 in its position of adjustment relative to the dial 10, if the instrument is held in the manner above described, and if the arm 28 is moved into a position in which the line 30 points directly toward the same selected star, the line 30 may be read against the scale 24 to ascertain the exact standard time at the instant of reading.

The rate of apparent movement of a fixed star about Polaris gains over mean solar time at a rate of approximately one minute in six hours. As has been said, the scale 11 is graduated uniformly, each of its four major divisions occupying an angular extent of fifteen degrees. Because daylight hours may be omitted from the scale 24, it is possible, in designing that scale, to compensate for the above-mentioned gain, by making each major division of the scale 24 occupy an angular extent of fifteen degrees, two minutes, thirty seconds. Because of that arrangement, time readings made upon the scale 24 will be accurate, taking into account the above-mentioned gain.

The same gain produces, from day to day, a change in the apparent position of any fixed star of approximately four minutes, the figure ordinarily used in astronomical calculations being three minutes, 55.1 seconds. The error inherent in manipulation of my star watch by the user will probably amount to at least that much; and therefore, in most instances, it will not be worth while to make a compensating adjustment of the parts of my star watch each day. However, that inherent error will amount to less than ten minutes, according to my experience; and therefore I prefer to provide, on the dial 10, an additional

scale 40, the divisions of which are spaced apart to an angular extent approximately equivalent to a time span of eleven minutes, forty-five seconds. In order to make accurate readings, from day to day, with my star watch, then, the time dial 23 should be adjusted, in a counter-clockwise direction relative to the sky dial 10, to the extent of one graduation on the scale 40 at the end of each third day.

Alternatively, of course, the dial 23 may be reset, in the manner originally described above, each night or each second or third night; but the provision of the scale 40 renders adjustment by celestial observation, from day to day, unnecessary. Preferably, an arrow 41 will be suitably marked on the dial 23 to indicate the direction in which the dial 23 should be adjusted, from day to day, to compensate for the above-mentioned gain.

It is obvious that extremely accurate readings can be taken from the instrument of the present invention if the instrument is made upon a relatively large scale, if it is supported upon a tripod or other standard for adjustment, and particularly if supplemental sighting devices are provided for use in connection therewith. But I have found that, even using the device in the simple form illustrated, holding it in my hand and adjusting its parts manually, the time readings taken therefrom are accurate within four to seven minutes, in substantially all instances. Because of errors which inevitably creep into adjustments and/or readings, it will ordinarily be advisable to reset the dial 23, by a reading against selected celestial bodies, at least once every two weeks.

Sun time varies between points on the earth, by an amount of approximately one hour for each 15 degrees of longitude, or one minute for each fifteen angular minutes of longitude traveled east or west. Therefore, if the star watch, having been set with standard time at one point, is carried east from that reference point, the dial 23 must be adjusted in a counter-clockwise direction to an extent corresponding to one minute of time for each fifteen minutes of longitude traveled if it is to remain in accord with standard time; and must be correspondingly adjusted in a clockwise direction to compensate for westward travel.

It will be obvious that, at will, the user may reset the instrument to read against a different fixed star in association with Polaris. So long as a reading is taken against the same star used as a reference in producing the initial setting of the parts of the device, however, accurate time determination will result.

I have not overlooked the fact that Polaris is approximately one degree, two minutes removed from the true axis of the celestial sphere. Because the angle included between lines joining Polaris with the selected star and with the true axis of the celestial sphere remains a constant, the accuracy of my star watch is not affected by the eccentricity of Polaris. The initial setting of the time dial 23 takes into account that eccentricity.

My star watch is a durable, inexpensive device for ascertaining approximate time, within very close tolerances, on starlit nights and under conditions in which an expensive timepiece would be subject to possible damage or loss. For instance, my star watch will not be damaged by immersion in water; and its loss will produce a minimum financial loss not at all comparable with the loss of an expensive watch. Watches may

stop, as a result of carelessness or accident, whereas my star watch can never run down and is always available to determine approximate time so long as stars are visible. If proper records are kept or remembered, my star watch will serve also as a calendar, because of the progression of the time dial in a counter-clockwise direction relative to the sky dial, from day to day, as above described. For children, learning the rudiments of camp life and life in the open, my star watch will have a substantial educational value, and will inspire an interest in, and at least a casual study of, the heavenly bodies and their apparent movement upon fixed orbits in the universe.

I claim as my invention:

1. In a device of the class described, a sky dial provided with a circular scale graduated into twenty-four major divisions each having an angular extent of fifteen degrees, a time dial mounted for rotation relative to said sky dial about the center of said scale, said time dial being provided with a scale including a reference point and a plurality of major graduations arranged on each side of said reference point upon an arc of a circle concentric with said first-named scale, each of the major divisions of said last-named scale having an angular extent of fifteen degrees, two minutes, thirty seconds, and indicator means mounted for rotation relative to said dials about the common center of said scales, said device being provided with a sight-opening therethrough at said common center.

2. The device of claim 1 in which said indicator means comprises an arm shiftable in the direction of its length transversely relative to said common center, between a position in which it projects radially beyond the outer periphery of the larger of said dials and a position in which said arm is located wholly within such periphery.

3. The device of claim 2 in which said arm is transparent and is provided with longitudinally-extending reference means always truly radial relative to said common center, said reference means overlapping both said scales when said arm is in projected position.

4. The device of claim 1 in which said sight opening is provided by a tubular post open from end to end, said post providing a journal mounting for said relatively rotatable elements, and a collar mounted within said post intermediate the ends thereof and carrying a pair of cross hairs intersecting in the axis of said post, said axis coinciding with said common center.

5. The device of claim 1 in which said sky dial is further provided with a further scale concentric with said first-named scale and calibrated to compensate for apparent movement of "fixed stars" during the progress of the year.

6. The device of claim 1 in which said sky dial is further provided with a further scale concentric with said first-named scale, said further scale extending through a full circle, and the angular spacing between the calibrations of said scale being approximately 360/121.75 degrees.

7. In a device of the class described, a sky dial provided with a graduated circular scale and with a view port located at the center of said scale, indicator means associated with said sky dial for orienting the device relative to the visible celestial dome, a time dial assembled with said sky dial for rotation relative thereto about said center and provided with a graduated arcuate scale concentric with said first-named scale, a pointer assembled with said dials for ro-

tation relative thereto about said center and adapted to be aimed at any selected celestial body when said sky dial is properly oriented and positioned to permit the user to view Polaris through said view port, said time dial being shiftable to align with said pointer that graduation of the time dial scale corresponding to the standard time at the moment of adjustment, and indicator means moving with said time dial relative to said sky dial and positioned on said time dial to indicate the position which will be occupied by said selected body at midnight, standard time.

8. The device of claim 7 in which said sky dial is provided with a further scale calibrated in accordance with changes in the apparent position of said body from day to day, whereby said indicator moving with said time dial may be shifted, from day to day to compensate for such changes in apparent position of such body.

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