

July 27, 1937.

W. M. PHELPS

2,088,533

CALCULATING DEVICE

Filed Oct. 3, 1936

2 Sheets-Sheet 1

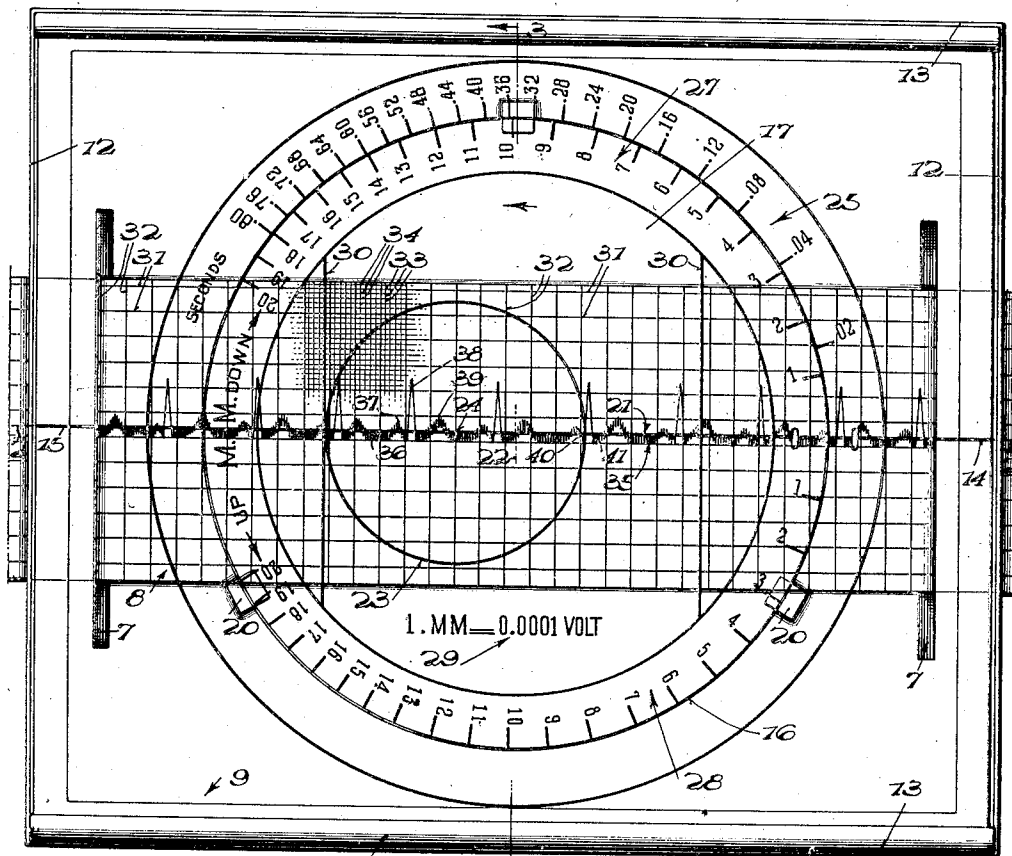


FIG. 1.

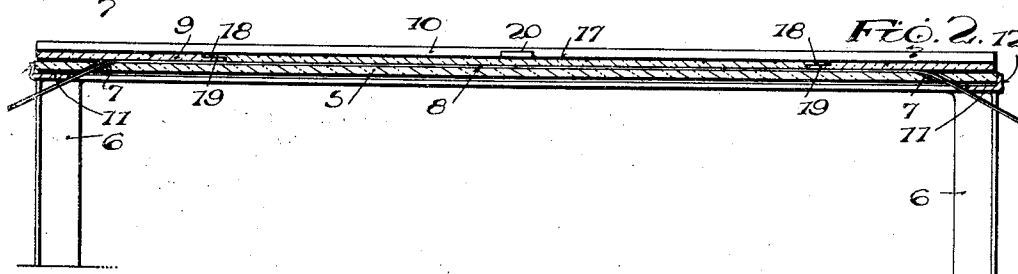


FIG. 2.

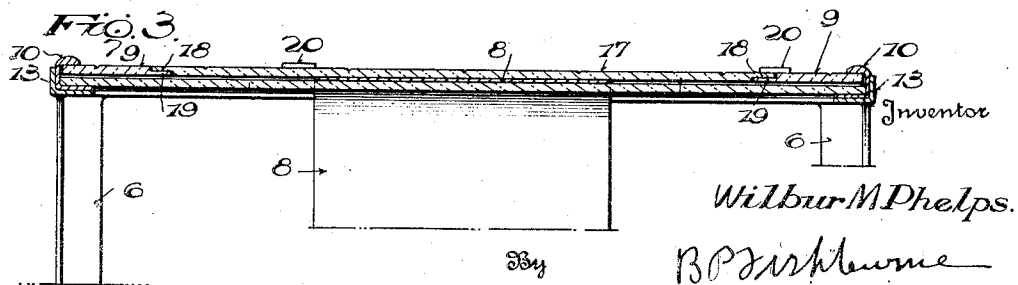


FIG. 3.

Wilbur M. Phelps.

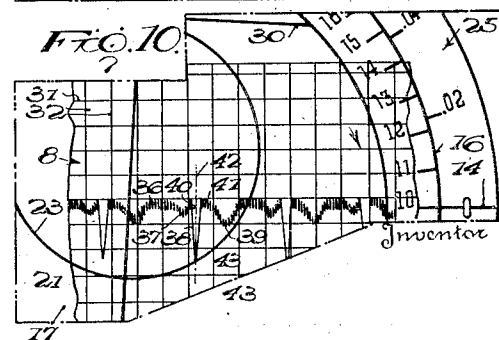
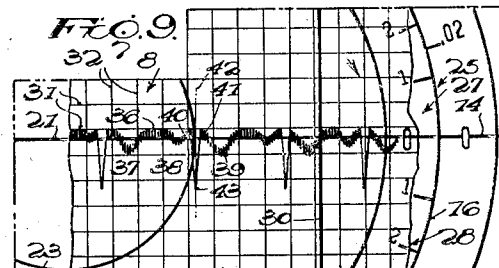
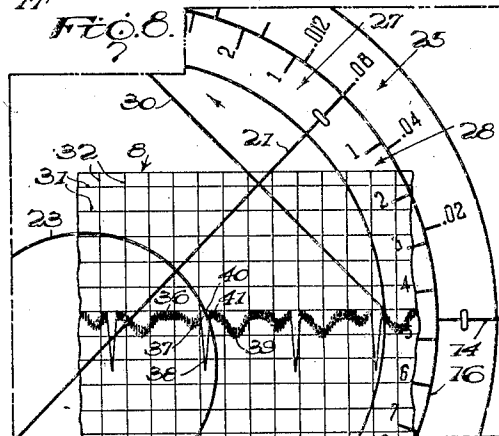
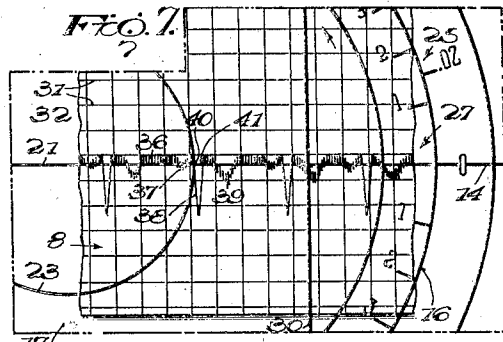
By *Bozark & Co.*

Attorney

2,088,533

Filed Oct. 3, 1936

2 Sheets-Sheet 2



Inventor

Wilbur M. Phelps.

B. P. Fickburne
Attorney

UNITED STATES PATENT OFFICE

2,088,533

CALCULATING DEVICE

Wilbur M. Phelps, Staunton, Va., assignor of
one-third to Harold C. James, Staunton, Va.

Application October 3, 1936, Serial No. 103,934

12 Claims. (Cl. 33—1)

My invention is a device for ascertaining the dimensions of portions of grams or recorded lines and translating the same into units of known values.

In recent years, there has been a rapid development of instruments for use in the medical profession, which render it possible for the physician to make accurate diagnoses and records of the same. As an illustration of these instruments, the electrocardiograph may be given.

An electrocardiograph is an instrument adapted to be applied to the human body for the purpose of making a gram or recorded line for indicating the operations of the heart, such as the expansion and contraction of the heart muscle, which is accompanied by electric currents. The electrocardiograph operates in conjunction with a photographic film, which is usually divided into blocks and each block divided into millimeters. These blocks may be produced upon the film, before or at the time that the gram or recorded line is produced. The gram or recorded line has heretofore been read by reference to its position upon the blocks of millimeters, and the desired values computed from the readings from these blocks. This practice is not wholly satisfactory as it is difficult and time consuming, and errors are liable to creep in.

In accordance with my invention, I provide a device for use in connection with the electrocardiogram or photographic film, which is produced by the electrocardiograph. My device is capable of translating longitudinal units of the gram or recorded line into desired units of known value, such as units of time, to thereby indicate the time interval of a heart action, or the time interval between such actions. The device is also capable of translating the pitch or a transverse unit of length of the gram into desired known units, such as units of length, from which units of voltage may be readily computed, thus indicating the voltage of the current which accompanied the heart action. The device will ascertain the dimensions of the deflections and translate the same into units of known value, when the deflections extend above or below the base line of the gram. The device is also capable of translating the deflections of the grams into terms of actions per minute of the various parts of the heart.

While the device is particularly well adapted for use in connection with the electrocardiogram, for the purposes stated, it is not necessarily restricted to this use, as it may be employed in connection with other record devices to measure the

gram or record line and to translate the same into units of known value.

The invention is not necessarily restricted to a device which will perform all of the enumerated functions, and the invention is defined in the subjoined claims, the scope of which is not limited by the recitation of the functions or advantages of the invention.

In the accompanying drawings forming a part of this application and in which like numerals are employed to designate like parts through the same,

Figure 1 is a plan view of a device embodying my invention, showing an electrocardiogram or film in position and the pivoted element in the "0" or starting position.

Figure 2 is a longitudinal section taken on line 2—2 of Figure 1,

Figure 3 is a transverse section taken on line 3—3 of Figure 1.

Figure 4 is a fragmentary plan view of the device adjusted to measure the length or horizontal dimension of an upwardly extending deflection, and the pivoted element shifted to the end of its position to effect such measurement,

Figure 5 is a similar view, with the parts adjusted, and in the "0" or starting position, to measure the height or transverse dimension of the upwardly extending deflection,

Figure 6 is a similar view showing the pivoted element turned to the end of its travel to complete such measurement,

Figure 7 is a similar view, showing the parts adjusted to measure the length or horizontal dimension of a deflection depending below the base line of the gram, and with the pivoted element at the "0" or starting position,

Figure 8 is a similar view with the pivoted element shifted to the end of its movement to complete the measurement,

Figure 9 is a similar view, with the parts adjusted to measure the height or transverse dimension of the depending deflection, the pivoted element being in the starting position, and,

Figure 10 is a similar view showing the pivoted element moved to the end of its travel to complete the measurement.

The device embodies a flat plate or table top 5, preferably formed of transparent material. This table top may be supported by legs 6, at its corners, in a manner to be described. The plate or table top 5 has transverse slots 7, near its ends, and these slots are parallel and are preferably transversely inclined so that their opposite walls converge inwardly. These slots receive and hold

an electrocardiogram or film 8. The plate or table top 5, with its slots 7, serves as holding means for the electrocardiogram or film 8, which may be shifted longitudinally with respect to the plate or table top 5, and may also be shifted transversely with respect to the same, since the slots 7 are longer than the width of the electrocardiogram or film 8, as shown.

Adapted to be mounted upon the plate or table top 5 is a plate 9, which is preferably formed of transparent material. This plate 9 constitutes the support or body portion of the device. The plate 9 operates within guides 10, attached to the plate or table top 5, at its longitudinal edges.

The plate 9 is longitudinally adjustable with respect to the plate 5, but cannot move perceptibly transversely with relation thereto, when within the guides 10. The plate 9 may be separated from the plate 5 by a longitudinal movement which will withdraw the same from the guides 10.

The legs 6 are rigidly attached to an open horizontal frame 11, having upstanding flanges 12 and 13 at its ends and sides. These flanges receive therebetween the assembled plates 9 and 5, and the end flanges 12 are shorter, so that the plate 9 may pass over the same, in its longitudinal adjustment.

The plate 9 is provided with base lines 14 and 15 which are equi-distantly spaced from the longitudinal edges of the plate 9 and extend parallel with these edges. The plate 9 is provided with a circular opening 16 between the base lines 14 and 15 and the center of the circular opening is in alignment with the base lines 14 and 15. A rotary element or disc 17 is mounted within the opening or recess 16 and is provided at its periphery with an annular tongue 18 overlapping and resting upon an annular tongue 19, formed upon the plate 9. These tongues prevent the downward displacement of the pivoted element or circular disc 17, while its upper displacement is prevented by cleats 20 or the like, attached to the plate 9. The pivoted element or disc 17 is also formed of transparent material. The pivoted element or disc 17 also has a base line 21, passing through its center 22 and extending to its periphery, and adapted to register with base lines 14 and 15, as will be more fully described. The pivoted element or disc 17 is provided with a circular indicator 23, which is stationary with relation to the element or disc 17 and may be in the form of a line drawn or otherwise produced upon the disc 17. The circular indicator 23 has its center 24 arranged in the base line 21, but eccentric with respect to the center 22 of the disc 17, and upon that side of the center 22 which is remote from the base line 14. The major portion of the diameter of the circular indicator 23 is therefore arranged upon that side of the center 22 which is remote from the base line 14.

The plate 9 is provided with circularly curved scale 25. This scale is graduated to denote units of time and extends from "0" to "0.30" second. The scale 25 extends counter-clockwise. This scale is concentric with respect to the opening or recess 16, is adjacent thereto and the "0" is arranged upon the base line 14, as shown.

The pivoted element or disc 17 is provided with scales 27 and 28. These scales are graduated in units of length, such as millimeters, and each scale may extend from "0" to "20". The scale 27 extends counter-clockwise and the scale 28 extends clockwise, and these scales are arranged at the periphery of the disc 17 and are concentric therewith. The "0" is common to the scales 27

and 28 and is applied to the base line 21. The base line 14 which is designated "0" serves as a pointer for the scales 27 and 28, while the base line 21, also designated "0", serves as a pointer for the scale 25. The scale 27 is designated "Down" while the scale 28 is designated "Up". While the scales 27 and 28 are graduated in millimeters, they also denote units of voltage, as one millimeter equals 0.0001 volt as indicated at 29. The disc 17 is also provided with lines 30, arranged at a right angle to the base line 21. The space between these lines indicates a unit of time, such as 3 seconds. When this is the case, the lines 30 are spaced for a distance of 75 millimeters, since the electrocardiogram or film 8, when being produced, travels at the rate of 25 millimeters per second. By noting the number of deflections occurring between the lines 30 and multiplying these by 20, the number of deflections per minute are obtainable.

The electrocardiogram or film 8 has its recording produced photographically. This film has a grid which is formed thereon before or at the time of the photographing of the gram or recorded line. The grid embodies longitudinal and transverse lines 31 and 32, which divide the film into squares which are 0.5 centimeter. The grid further comprises longitudinal and transverse lines 33 and 34, dividing each large square into smaller squares of 1 millimeter. The numeral 35 designates the gram or recorded line which may be photographed or otherwise produced upon the electrocardiogram or film. This gram or recorded line is produced by the action of the electrocardiograph, by the electrical impulses which accompany the contraction and expansion of the heart. The film is advanced at the rate of 25 millimeters per second. The gram or recorded line 35 has a base 36, and variations from this base are deflections and are designated 37, 38 and 39. The deflection 37 is caused by the electrical impulses accompanying the contraction of the auricles, while the complex deflection 38 and the deflection 39 are produced by the electrical impulses from the ventricles. Between these various deflections are intervals. These intervals are measured from the end of one deflection to the beginning of the next deflection. In Figures 1 to 6, inclusive, the deflections extend above the base 36, while in Figures 7 to 10, the deflections extend below the base. This may be caused by the variations in the origin or location or route of a transmission of the electrical impulses in the heart.

In measuring deflections which extend above the base 36, attention is now called to Figures 1 to 6, inclusive. The electrocardiogram or film 8 with the gram or recorded line 35 produced thereon is placed upon the table top 5, the plate 9 being now removed, and the ends of the film are passed through the slots 7, which are wider than the film, as stated. Due to the inclination of the slots 7, the film is held upon the table top 5 and will lie flat thereon. The transparent plate 9 is now passed into the guides 10 and is thereby positioned above the table top 5 and film 8. The pivoted disc 17 is now turned until the "0" end of the base line 21 registers with the "0" end of the base line 14, at which time the pivoted disc will be at the "0" or starting position. Since the deflections extend upwardly from the base of the gram or recorded line 35, the ends of the film 8 beneath the table top 5 are engaged by the operator and the film is adjusted laterally until the base line 21 of the disc 17 registers with the upper

edge of the base 36 of the gram or recorded line. This is rendered possible by having the slots 7 longer than the width of the film. With the elements thus adjusted, the plate 9 may be adjusted longitudinally of the film and table top 5 to bring the edge of the circular indicator 23 at the beginning of the selected deflection at the upper edge of the base 36. The edge of the indicator 23 may therefore register with the point 40, as shown in Figure 1. With the parts thus adjusted, the disc 17 is now turned counter-clockwise until the edge of the circular indicator 23 registers with the opposite end 41 of the deflection 38, as shown in Figure 4. By this time "0" end of the base line 21 will register with the proper graduation in the scale 25, shown as .08, or any other unit of the scale, depending upon the character of the deflection. The distance between the points 40 and 41 is therefore translated by the device into .08 second, which means that the deflection 38 indicates an electrical impulse consuming .08 second. This operation may be repeated for determining the time interval of any other deflection, or the time interval of any interval occurring between deflections. This is accomplished by adjusting the parts as explained and arranging the indicator at the starting end of the deflection or interval portion and rotating the disc 17 counter-clockwise until the edge of the indicator 23 registers with the opposite end of the deflection or interval portion. The device will thus readily translate the longitudinal dimension of a given portion of the gram or recorded line 35 into the units of scale 25, which may be time units, or other known units.

To measure the height of any upwardly projecting deflection and hence its voltage, the disc is again adjusted so that the "0" end of the base line 21 registers with the "0" end of the base line 14, Figure 5, and the base line 21 registers with the upper edge of the base 36 of the gram or recorded line. The plate 9 is now longitudinally adjusted to bring the edge of the indicator 23 in registration with the center line 42 of the deflection 38. The line 42 is of course an imaginary line passing through the center of the deflection. This adjustment is shown in Figure 5, and the disc 17 is then turned counter-clockwise until the edge of the indicator 23 registers with the apex 43 of the deflection, at which time the reading is taken from scale 25, Figure 6. The "0" end of the base line 14 will now register with "10" of the "Up" scale 28, thus giving the height of the deflection as 10 millimeters. These 10 millimeters may be readily translated into volts by multiplying the same by 0.0001. Of course the scale could be graduated in units of voltage, but this is not advantageous as the characters would occupy too much space, but this is contemplated as within the scope of the invention.

When it is desired to measure the time interval of a deflection extending below the base of the gram or recorded line 35, the parts are adjusted as shown in Figure 7. The pivoted disc 17 is turned so that its base line 21 has its "0" end registering with the "0" end of the base line 14. The electrocardiogram or film is now adjusted so that the base line 21 of the disc 17 will register with the lower edge of the base 36 of the recorded line 35, and the plate 9 is adjusted longitudinally so that the edge of the indicator 23 will register with the end 40 of the depending deflection 38, as shown in Figure 7. The pivoted disc 17 is now turned counter-clockwise until the

edge of the indicator 23 registers with the opposite end 41 of the deflection 38, at which time the "0" end of the base line 21 will register with ".08" of the scale 25, thus indicating the time interval between the points 40 and 41 of the deflection is .08 second.

To measure the height of the depending deflection 38, the parts are adjusted to assume the position shown in Figure 9, which is identical with the adjustment of parts shown in Figure 5, except that the base line 21 registers with the lower edge of the base 36 of the recorded line 35, the edge of the indicator 23 registering with the center line 42. The disc 17 is now turned clockwise until the edge of the indicator 23 registers with the apex 43 of the deflection, at which time the "0" end of the base line 14 will register with "10" in the "Down" scale 27, thus indicating that the height of the deflection is 10 millimeters, and this height may be readily translated into voltage by multiplying "10" by 0.0001. Ordinarily the base line 21 is made to register with the upper or lower edges of the base 36 of the line 35, but if this base 36 is too irregular, an average edge is obtained by applying the base line to the same, and this average edge is used by having the base line register with such average edge, which will be near the upper or lower edges of the base 36.

As before stated, the electrocardiogram or film, when photographing the gram or recorded line travels at the rate of 25 millimeters per second and the lines 30 are spaced a distance of 75 millimeters apart, thereby indicating a time interval of 3 seconds. By counting the number of deflections 38 occurring between the lines 30, it will be seen that there are 5 of these deflections, and it is therefore known that 5 of them occurred in 3 seconds. By multiplying the 5 deflections by 20, there will be 100 deflections which would occur in one minute. In a similar manner, the number of deflections or the number of intervals between deflections may be determined per minute. It is preferred to have the parts of the device made of transparent material, but the invention is not restricted to the use of the same. The film 8 might be made of transparent material, and placed upon the top of the plate 9 and associated element, and the gram or line 35 thus properly used in connection with the disc 17 and associated elements.

While I have shown and described my device as used in connection with an electrocardiogram or film as produced by the electrocardiograph, it is not necessarily restricted to this use, as it may be employed to measure or read the longitudinal or transverse units of other grams, graphs or recorded lines, and to translate the same into other units of measurement, as may be desired.

It is to be understood that the form of my invention herewith shown and described is to be taken as a preferred example of the same and that various changes in the size, shape, and arrangement of parts may be resorted to without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. In a device for use in connection with a strip having a recorded line embodying a base and a deflection, a support to have cooperative relation with the strip, means movable with relation to the support to traverse the distance along the base from a point near one end of the deflection to a point near the opposite end of the deflection, and means to translate the extent of move-

ment of the first named means into units of known value.

2. In a device for use in connection with a strip having a recorded line embodying a base and a deflection, a support to have cooperative relation with the strip, means movable with relation to the support to traverse the distance transversely of the base from a point near the base to the apex of the deflection, and means coacting with the first named means to translate the extent of movement of the first named means into units of known value.

3. In a device for use in connection with a strip having a recorded line embodying a base and a deflection, a support, an element connected with the support and movable with relation thereto to measure the distance along the base from a point near one end of the deflection to a point near the opposite end of the deflection and to also measure the distance transversely of the base from a point near the base to the apex of the deflection, and means coacting with the first named means to translate its extent of movements into units of known value.

4. In a device for use in connection with a strip having a recorded line embodying a base and a deflection, a circularly curved indicator mounted to turn upon an eccentric axis so that a portion thereof may move from a given point in the recorded line to another given point, and means to translate the extent of turning movement of the indicator into units of known value.

5. In a device for use in connection with a strip having a recorded line embodying a base and a deflection, a circularly curved indicator mounted to turn upon an eccentric axis so that a portion thereof may move from a given point in the recorded line to another given point therein, and means to translate the extent of turning movement of the indicator into units of known value including a relatively movable scale and pointer.

6. In a device for use in connection with a strip having a recorded line thereon, means to support the strip, a support to be arranged above the supported strip in close relation thereto, a movable indicator carried by the support and adapted to be shifted from one given point in the recorded line to another given point therein, and means to translate the extent of movement of the indicator into units of known value.

7. In a device for use in connection with a strip having a recorded line thereon, a support having means to adjustably support the strip, a second support arranged near and above the first named support and the strip and adjustable with relation to the first named support, a movable indicator carried by the second named support and shiftable from a given point in the recorded line to another given point therein, and means to translate the extent of movement of the indicator into units of known value.

8. In a device for use in connection with a strip having a recorded line thereon, a plate to receive the strip thereon and having spaced slots for the passage of the ends of the strip with the slots longer than the width of the strip, a second plate arranged near and above the strip and the first plate, means to guide the second plate in its movement with relation to the first plate longitudinally of the strip, an indicator mounted may be shifted from a given point in the recorded line to another given point therein and means to translate the extent of movement of the indicator into units of known value.

9. In a device of the character described, a support, a circular disc mounted upon the support to turn upon its center and having a circular indicator which is stationary with respect to the disc, said circular indicator also being eccentric with respect to the circular disc, said disc having a base line passing through its center and the center of the indicator, and a scale for coaction with the disc.

10. In a device of the character described, a support, a disc mounted upon the support to turn upon its axis and having a circular indicator which is movable with the disc, the circular indicator being eccentric with respect to the turning axis of the disc, said disc having a base line passing through its turning axis and the center of the indicator, said disc also having a scale extending about its periphery and starting at the base line, said support having a pointer to coact with the scale.

11. In a device of the character described, a support, a disc mounted upon the support to turn upon its center and having a circular indicator which is stationary with respect to the disc, said circular indicator also being eccentric with respect to the disc, said disc having a base line passing through its center and the center of the indicator, said disc having scales extending in opposite directions about its periphery and starting at the base line, said support having a pointer to coact with said scales, and means providing a further scale for coaction with the disc.

12. In a device of the character described, a support having an opening, a transparent disc mounted upon the support to turn with relation thereto and covering the opening, said disc having a circular indicator movable with the same, the indicator being eccentric with respect to the turning axis of the disc, said transparent disc having a base line, said disc having a scale starting at the base line and extending about the periphery of the disc, said support having a pointer to coact with the scale of the disc, and means for providing a further scale for coaction with the disc.