July 18, 1933. J. R. PERKINS 1,919,126

AIR VEHICLE INDICATING MEANS

Filed April 16, 1929

Fig. 1.

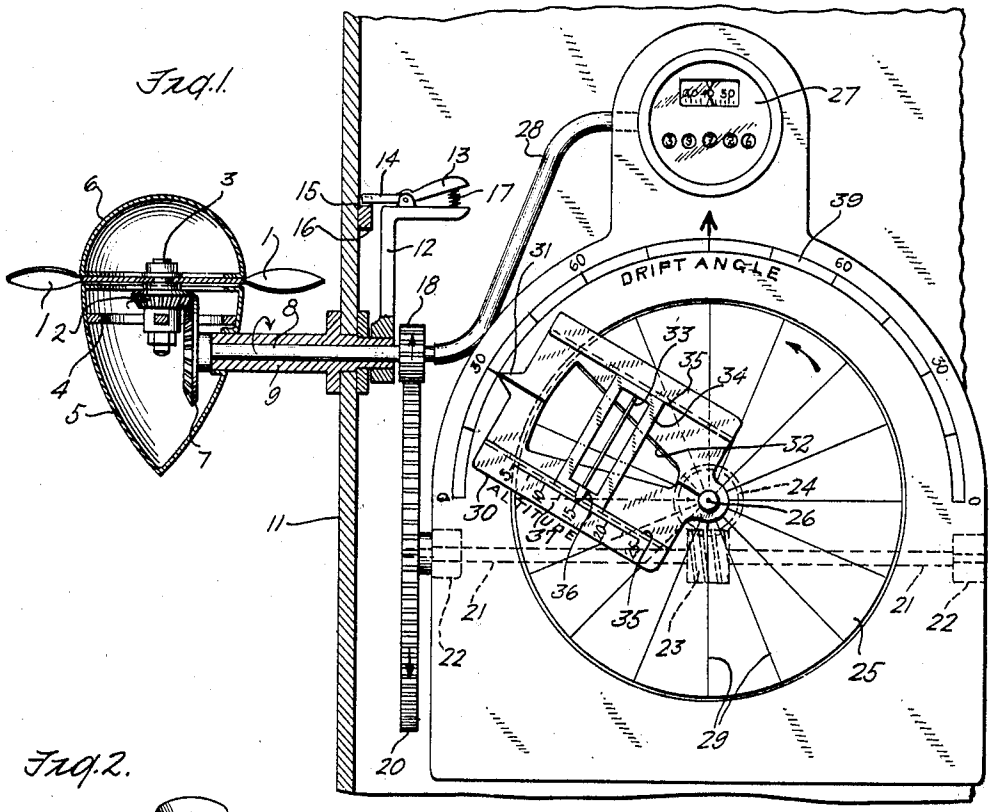


Fig. 2.

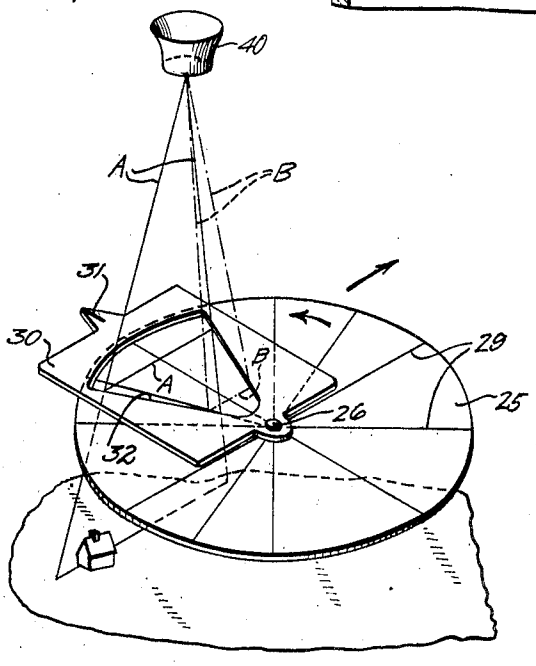
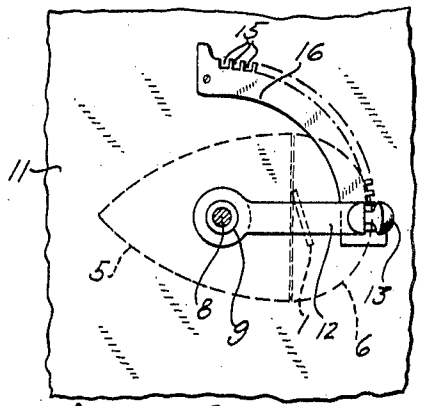


Fig. 3.



John R. Perkins
INVENTOR

BY Janney, Blair & Curtis
ATTORNEYS

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JOHN R. PERKINS, OF WASHINGTON, CONNECTICUT

AIR-VEHICLE INDICATING MEANS

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This invention relates to air craft speed determination and more particularly to apparatus for determining the actual speed of an air craft with respect to the ground. Another object is to provide apparatus of the above nature which will be convenient in use and reliable in action. Another object is to provide a ground speed indicator that may be readily adjusted to meet many varying conditions of use. Another object is to provide a practical ground speed indicator that will record the ground distance covered and give reliable information as to the true course of the craft in flight. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combination of elements, arrangement of parts and in the several steps and relation and order of each of the same to one or more of the others, all as will be illustratively described; and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing, in which are shown more or less diagrammatically the features of a selected embodiment of my invention:—

Figure 1 is a diagrammatic plan view illustrating an embodiment of my invention.

Figure 2 is a diagrammatic perspective view of a portion of my device showing the position of the eye piece with respect to the directional wire and an object on the ground directly beneath the air craft.

Figure 3 is a diagrammatic view showing in elevation a structural detail of my device. Similar reference characters refer to like parts in the several views of the drawing.

Now referring to the drawing for a detailed description of the present form of apparatus in the use of which my method is carried out, attention is called to three principal co-related parts, namely, an air driven propeller to provide power for the apparatus, a co-acting synchronizing disk and adjustable direction finder for determining the proper speed at which the propeller is to run to correctly indicate ground speed, and a speedometer head for indicating ground speed and registering ground distance traveled.

The air propeller employed may have any form of blade desired, and it may be constructed in any practical manner. Means must be furnished for controlling its speed of rotation, but so far as the broad features of my invention are concerned, the manner in which this speed control is obtained is immaterial, but the apparatus and devices shown in the accompanying drawing and which are described herein have certain outstanding advantages which make their employment desirable.

Referring to Figure 1 it will be seen that the propeller blades 1 are rigidly mounted, together with the bevelled gear 2 upon a shaft 3, which is supported as by means of the spider 4 within the stream line casing member 5. The casing is completed by a rounded front member 6, carried by the propeller blades. Bevelled gear 2 meshes with a bevelled gear 7, of larger diameter, fixed upon the end of a shaft 8, which is itself rotatably supported in a sleeve 9, formed as part of the casing member 5. This sleeve is rotatably mounted, as at 10, upon some convenient part 11 of the fuselage of the craft. A crank 12 secured upon the inner end of the sleeve provides a convenient means for operating the sleeve by hand, to rotate the entire propeller structure, thus changing the angle of incidence and the projected area of the propeller blades, and producing at will, an increase in, or a diminution of, the rotative speed of the propeller. Any convenient means may be provided for locking the sleeve in its adjusted angular position. As shown in the drawing a manually operated latching lever 13 is pivotally mounted on the crank handle, having a locking finger 14 at its end, which may be selectively engaged with one of a plurality of notches 15, provided on the surface of a segment 16 mounted on the supporting frame 11. A spring 17 normally holds this lug in engagement with the segment, but it may be lifted by pressing the lever handle 13 toward the handle of the crank 12.

The shaft 8 has fastened thereto a gear 18, in driving engagement with another gear 20

fixed at one end of a shaft 21. This shaft may be supported in any suitable bearings, as 22, upon any convenient part of the air craft. A worm 23 is mounted upon the other end of shaft 21 and meshes with a worm wheel 24, rotatably supported together with the synchronizing disk 25 upon a vertical pin 26, which is positioned at any convenient part of the craft. Thus the disk 25 is caused to rotate in a horizontal plane and should be located at some point in the craft where it may be conveniently observed by the pilot. The gearing described is so proportioned as to turn the synchronizing disk at a much slower rate of speed than the speed of the propeller. A speedometer head is shown diagrammatically at 27, which preferably consists of a tachometer and revolution counter, graduated to read in miles or kilometers, as desired. It is similar to those in common use upon automobiles, so needs no further description. The speedometer is connected in the usual manner with the gear 18 by means of a flexible shaft 28.

The disk 25 may be made of celluloid or other transparent material and is marked with radial lines 29. It may alternatively consist of a wheel of light structure having thin bladelike radially extending spokes. Overlying the disk 25 is a shield 30, mounted for turning upon the pin 26, that is, it is concentrically mounted with regard to disk 25. This shield is composed of an opaque or translucent material and has formed therein symmetrically with regard to its radial center line, a small segmental opening 32 of about 30 degrees extent. Disposed above this opening is a directional wire 33 which is secured in a frame 34, slidably mounted in any desired manner in two guideways 35 formed upon the shield upon either side of the opening 32. These ways are arranged parallel to the radial center line of the shield, and the directional wire is disposed perpendicular to said center line.

The frame 34 serves as a rotatable mounting upon which the directional wire may be slid toward or away from the pin 26. A pointer 36 on one side of the frame 34 in line with the directional wire is positioned to pass over a scale 37 marked on the side of the shield. This scale is marked in altitude indicia for a purpose to be referred to later. Another marker 31 positioned on the radial center line of the shield overlies a scale 39, which gives the angular displacement of the shield relative to the longitudinal center line or heading of the aircraft, and indicates the angle of drift or deviation of the course of the air craft with respect to the ground from its heading.

Referring to Figure 2, an eye piece 40 is shown diagrammatically at a point directly above the disk. By applying his eye to this eye piece, which may be the eye piece of a telescope or other instrument, the operator may pick different objects on the ground over which he is passing, and move the shield on its pivot until these objects appear to travel along the directional wire. The wire then gives the true course of the craft relative to the ground. Now, if proper altitude corrections have been made, as will be described, he may adjust the speed of rotation of the propeller and synchronizing disk by swinging the propeller unit around the axis of the sleeve 9. When the synchronizing disk is run at such a speed that a point of intersection of one of the radial lines 29 on the disk, with the directional wire, moves along said directional wire at the same rate of speed as objects on the ground appear to pass along said wire, then the angular velocity of the revolving disk is proportionate to the ground speed made, and the speedometer head will read the correct speed and register the correct distance.

An adjustment for altitude must be made because of the fact that the angular velocity of an object on the ground as seen from an air craft moving above it, is less in proportion as the elevation of the air craft above the ground is greater. And it may here be explained that with the synchronizing disk of my device rotating at a given speed, the linear speed of travel of the intersection of a radial line on the disk with the directional wire, as it moves along said wire, is proportionate to the distance of the wire from the axis of rotation of the disk. It therefore follows that as seen from the eye piece 40 the angular velocity of said intersection along said line, which is proportionate to its linear velocity, is also proportionate to the distance of the wire from the axis of the disk. Thus a simple way is offered for correcting for altitude, for by moving the frame 34 toward or away from the pin 26, the directional wire may be moved from one position, as position A in Figure 2, to another position, as position B in Figure 2, thus setting it at the proper point to correctly indicate ground speed from any desired point of elevation. Scale 37 is properly calibrated in altitude indicia, so that the operator after determining his altitude by reference to the proper instruments may set his directional wire at the corresponding altitude marking on the scale.

Briefly, then, these operations are carried out as follows. The directional wire is moved in or out until the marker 36 reads the altitude of the ship as found by barometer or other instruments. The shield is then moved until objects on the ground appear to travel along the wire, and the speed of rotation of the disk is regulated by turning the propeller unit until objects on the ground appear to move along the wire at the same speed as the radial markings on the disk. The dial of the speedometer will now correctly read the speed

of the craft relative to the ground and also the distance covered, providing the speed of the disk is continuously synchronized with the ground speed. The pointer 31 will also read in figures on the scale 39, the drift angle of the craft.

In view of the foregoing, the construction and operation of my apparatus will now be clear, and it will be seen that there has been provided in this invention an apparatus in which the several objects and advantages hereinabove pointed out, together with many others, are successfully achieved. It will be seen that the apparatus is of simple, compact and rugged construction, is capable of great ease and rapidity of manipulation, and gives accurate and speedy results. It will also be seen that the apparatus is well adapted to meet the conditions of hard practical use.

As many possible embodiments may be made of the mechanical features of the above invention, and as the method herein described might be varied, all without departing from the scope of the invention, it is to be understood that all matter herein set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I seek to protect by Letters Patent is:—

1. In a ground speed indicator for aircraft, in combination, a pair of relatively movable members, one of which is driven; and means for driving said driven member and including a propeller driven by relative movement between the aircraft and air, and means for changing the rate of drive of said driven member comprising means for changing the responsiveness of said propeller to said relative movement between the aircraft and the air.

2. In a ground speed indicator for aircraft, in combination, means rotatable about a vertical axis and providing a plurality of radial lines between which the ground may be viewed, means movable in the general direction of a radius of said rotating means and carrying a directional line extending transversely of the direction in which said means may be moved, said means being also movable to change the angular relation between said directional line and the axis of the aircraft, and means for varying the speed of said rotating means so that the point of intersection of one of its radial lines with said directional line travels at substantially the same speed as a ground object appears to move along said directional line.

3. In a ground speed indicator for aircraft, in combination, a pair of relatively movable members, one of which is driven; and means for driving said driven member and including a propeller driven by relative movement between the aircraft and air, means mounting said propeller for movement in a direction to change the angle between its axis of rotation and the line of relative movement between the air and the aircraft thereby to change the speed of rotation of said propeller and the rate of drive of said driven member, and means operating upon said mounting means for changing said angle.

4. A ground speed indicator for air craft comprising in combination an eye piece, translatable means positioned beneath said eye piece for providing a directional line along which ground objects appear to move when viewed through said eye piece, a rotating means movable relative to said directional line, said translatable means being adjustable toward and away from the center of rotation of said rotating means, means for controlling the rotative speed of said last means so that the angular velocity of points thereon along said directional line relative to said eye piece will be equal to the angular velocity of ground objects relative to said eye piece, and indicating means with respect to which said translatable means may be adjusted so as to include altitude as a factor determining the speed of said rotating means.

5. A ground speed indicator for air craft comprising in combination an eye piece, means positioned beneath said eye piece for providing a directional line along which ground objects appear to move, a transparent rotating means movable relative to said directional line, means for controlling the rotative speed of said last means so that the angular velocity of points thereon along said directional line relative to said eye piece will be equal to the angular velocity of ground objects relative to said eye piece, and a speedometer connected with said rotating means for indicating the speed thereof in proportionate ground speed units.

6. A ground speed indicator for air craft comprising in combination an eye piece, means positioned beneath said eye piece for providing a directional line along which ground objects appear to move, a transparent rotating means movable relative to said directional line, means for controlling the rotative speed of said last means so that the angular velocity of points thereon along said directional line relative to said eye piece will be equal to the angular velocity of ground objects relative to said eye piece, means relating said first two-mentioned means to permit adjustment of one with respect to the other so as relatively to move said directional line toward or away from the center of rotation of said rotating means, thereby determining the speed of said rotative means, and a speedometer connected with said rotating means for indicating the speed thereof in proportionate ground speed units.

7. A ground speed indicator for air craft comprising in combination a rotatively mounted disk through which ground objects

may be observed provided with a radially extending index, a shield pivotally mounted concentrically with said disk, means mounted upon said shield providing a directional line adapted to occupy positions tangent, respectively, to longer or shorter radii of said disk extending from the pivotal center of said shield, and means for rotating said disk at a speed proportionate to the speed of said air craft relative to ground objects.

8. In a ground speed indicator for aircraft, in combination, means rotatable about a vertical axis and providing a plurality of radial lines between which the ground may be viewed, means movable in the general direction of a radius of said rotating means and carrying a directional line extending transversely of the direction in which said means may be moved, said means being also movable to change the angular relation between said directional line and the axis of the aircraft, guiding means for guiding said movable means in said first-mentioned direction, means for varying the speed of said rotating means so that the point of intersection of one of its radial lines with said directional line travels at substantially the same speed as a ground object appears to move along said directional line, and altitude-correcting indicia and a pointer, one of which is related to said movable means and the other to said guiding means, for determining the movement of said movable means in said first-mentioned direction.

9. A ground speed indicator for air craft comprising in combination a rotatively mounted disk through which ground objects may be observed provided with a radially extending index, a shield pivotally mounted concentrically with said disk, means mounted upon said shield providing a directional line adapted to occupy positions tangent, respectively, to longer or shorter radii of said disk extending from the pivotal center of said shield, means for rotating said disk at a speed proportionate to the speed of said air craft relative to ground objects, and means co-acting with said shield for determining the angle of drift of said air craft.

10. In a ground speed indicator for aircraft, in combination, means rotatable about a vertical axis and providing a plurality of radial lines between which the ground may be viewed, means movable in the general direction of a radius of said rotating means and carrying a directional line extending transversely of the direction in which said means may be moved, said means being also movable to change the angular relation between said directional line and the axis of the aircraft, guiding means pivoted to swing about said vertical axis and in a plane substantially parallel to the plane of rotation of said rotating means, said guiding means having guides along which said movable means is movable in said first-mentioned direction, the pivotal mounting of said guiding means effecting, upon swinging thereof about said axis, movement of said movable means in said second-mentioned direction, and means for varying the speed of said rotating means so that the point of intersection of one of its radial lines with said directional line travels at substantially the same speed as a ground object appears to move along said directional line.

11. In a ground speed indicator for aircraft, in combination, means including a rotatable transparent disk for deriving ground speed as a function of the speed of rotation of said disk, means for turning said disk comprising a rotatably mounted propeller member and means for changing the pressure surface of said propeller member as projected on a plane normal to the line of travel of said craft.

12. In a ground speed indicator for aircraft, in combination, a rotatable disk, a propeller for turning said disk adapted to be driven by air pressure resulting from the travel of the aircraft, and means for controlling the speed of said propeller.

13. In a ground speed indicator for air craft, in combination, a rotatable disk, and means for turning said disk comprising a pivotally mounted casing, a propeller member journalled in said casing, and means for adjusting the angular position of said casing relative to the line of flight to vary the angular velocity of said propeller member.

14. In a ground speed indicator for aircraft, in combination, a pair of relatively movable members, one of which is driven; and means for driving said driven member and including a propeller driven by relative movement between the aircraft and air, driving connections between said propeller and said driven member and including a shaft extending substantially transversely of the direction of relative movement between the aircraft and the air, and means mounting said propeller for tilting adjustment about the axis of said shaft, thereby to vary the speed of said propeller.

15. In a ground speed indicator for aircraft, in combination, an eye piece, means positioned underneath said eye piece and providing a directional line along which ground objects appear to move when viewed through said eye piece, rotatable means having a plurality of radial lines adapted, when said means is rotating, to successively intersect said directional line as seen through said eye piece, and means for controlling the speed of rotation of said rotatable means to give the point of intersection of a radial line with said directional line a rate of travel substantially the same as the rate of apparent move-

ment of a ground object along said directional line as seen through said eye piece.

16. In a ground speed indicator for air craft, in combination, a rotatably mounted transparent disk, having a plurality of radial lines marked thereon, a shield pivotally arranged to turn about the axis of said disk, means movable with said shield and providing ways disposed parallel to the radial center line of said shield, a member slidably mounted in said ways a directional wire supported by said member, and a scale laid over a portion of said shield to determine the positioning of said directional wire to correspond with the pre-determined altitude of said air craft.

17. In a ground speed indicator for aircraft, in combination, means rotatable about a vertical axis and providing a plurality of radial lines between which the ground may be viewed, means movable in the general direction of a radius of said rotating means and carrying a directional line extending transversely of the direction in which said means may be moved, said means being also movable to change the angular relation between said directional line and the axis of the aircraft, a propeller for turning said rotatable means and adapted to be driven by air pressure resulting from the travel of the aircraft, and means for varying the speed of said propeller to bring about synchronization of the rate of movement of the point of intersection of a radial line with said directional line with the rate of apparent movement of a ground object along said directional line.

18. In a ground speed indicator for aircraft, in combination, means rotatable about a vertical axis and providing a plurality of radial lines between which the ground may be viewed, means movable in the general direction of a radius of said rotating means and carrying a directional line extending transversely of the direction in which said means may be moved, said means being also movable to change the angular relation between said directional line and the axis of the aircraft, a propeller for turning said rotatable means and adapted to be driven by air pressure resulting from the travel of the aircraft, means for varying the speed of said propeller to bring about synchronization of the rate of movement of the point of intersection of a radial line with said directional line with the rate of apparent movement of a ground object along said directional line, and speed-indicating means operated by said propeller.

19. In a ground speed indicator for aircraft, in combination, means providing a directional line along which ground objects appear to move, said means being adjustable about a substantially vertical axis, rotatable means providing a point angularly movable about said axis and also movable along said directional line, and means for synchronizing the angular velocity of said point whereby its linear velocity along said line is proportional to ground speed.

JOHN R. PERKINS.