

Method of and Apparatus for Determining the Speed of an Aeroplane, &c.

mirror at an angle of 45 degrees to the horizontal but so arranged that this angle may be varied at will. The mirror frame is connected to suitable mechanism such as a lever operated by a cam or screw whereby it may be tilted to vary the angle of the mirror to the horizontal, the cam or screw being so arranged that the mirror is moved in a periodic manner about its centre moving in one direction slowly and returning to its normal position in a much shorter space of time. The cam or screw is driven continuously at a constant speed by a clockwork or other suitable motor, the variation in the rate of motion of the mirror being obtained by causing the cam or screw to engage with the lever at different positions relatively to its point of suspension and the position of the cam or screw is adjusted until the observer sees no movement in the image of the object viewed. The position of the cam or screw relatively to a scale of height is then an indication of the speed of the aeroplane or other moving body.

The apparatus may be employed to ascertain the speed of travel of the instrument whether carried by an aeroplane or other moving body with reference to a fixed object at known distance or if the instrument be fixed it will give the speed of a moving object at a known distance or if both the instrument or object are moved the speed indicated will be the relative speed between the two. When carried upon an aeroplane or other body subject to oscillation the apparatus may, if desired, be mounted in gimbals.

Dated this 12th day of February, 1913.

MARKS & CLERK,
57 & 58, Lincoln's Inn Fields, London, W.C.,
13, Temple Street, Birmingham, and
25, Market Street, Manchester,
Agents.

COMPLETE SPECIFICATION.

An Improved Method of and Apparatus for Determining the Speed of an Aeroplane or other Moving Body.

I, CONRAD BECK, Optician, of 68, Cornhill, London, E.C., do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an improved method of and apparatus for determining the speed of a moving body and has for its object to devise means which shall be particularly applicable for determining the speed over-ground at which an air vessel is travelling at any height and also for determining the speed at which the air vessel is approaching a moving body.

The invention also has reference to a method of determining the speed of a moving body of the kind in which a camera or like optical projecting apparatus is employed as described, for example, in the Specification to British Patent No. 13,931 of 1911.

In this specification a moving image of the object viewed from the aeroplane or the like is produced upon a lens or screen in the optical projecting apparatus and its speed of travel between fiducial lines or marks upon the lens or the like is measured by means of a stop-watch so that the speed of the aeroplane may thereby be readily determined.

The object of the present invention is to obviate entirely the use of a stop-watch and according to my invention I provide mechanical means for determining the speed of the image of the object viewed.

The invention also consists in providing in conjunction with the screen of the

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optical projecting apparatus a band or the like travelling in the plane of the image, the speed of which may be varied at will, and which is provided with any suitable marks so that the speed may be varied until the speed of the band is equal to that of the image of the object viewed.

The invention also consists in the combination with the optical apparatus 5 producing an image of the object viewed of means such as a moving mirror, prism, or lens for rendering the image stationary, the speed of the mirror or the like being capable of variation.

The invention further consists in the employment in conjunction with the optical apparatus of a mirror or prism movable at a constant rate of speed in 10 combination with means for giving a variable magnifying power thus producing the effect of a variation in the speed.

The invention still further comprises other details and arrangements hereinafter more particularly referred to.

The accompanying drawings illustrate more or less diagrammatically two 15 modes of carrying out the invention.

Figure 1 is a front elevation showing one convenient form of apparatus constructed in accordance with the invention while

Figure 2 is a similar view showing a modified form of apparatus.

Figure 3 is a view illustrating a detail in Figure 2.

In carrying my invention into effect in one convenient manner as, for example, in its application to apparatus for determining the speed over ground of an air vessel I provide an optical projecting apparatus *a* similar in form and construction to that described in the above mentioned British specification and in conjunction with the screen or lens *b* upon which the moving image of the 25 object is projected I provide a movable indicator *c* preferably of some transparent material and having suitable marks thereon so arranged that the indicator moves in close proximity to the moving image of the object viewed so that the indicator, the speed of which is variable may be readily set to travel at the same speed as that of the image upon the screen of the projecting apparatus. 30

In the construction shewn in Figure 1 the indicator takes the form of an endless band passing round pulleys *d e* mounted in convenient positions upon the casing of the projecting apparatus the arrangement of the band being such that while a portion of the same travels across the face of the screen or the like *b* upon which the image is viewed, the band does not traverse across the 35 face of the lens producing such image so that the field may not be in any way impeded by the travelling indicator.

According to one convenient arrangement I mount the band *c* upon four pulleys, the upper two of which *e* are preferably placed centrally with respect to the optical apparatus *a* so that the band traverses the centre of the screen 40 or the like *b* while the lower pulleys *d* are arranged at a convenient distance from the lower face of the apparatus and at one side thereof as shewn so that the band *c* while free to travel across the side of the projecting apparatus does not in any way interfere with the field of vision. The band is driven by any suitable variable speed gear such, for example, as a pair of cones *g h* oppositely 45 disposed in relation to one another and adapted to gear with one another through the intermediary of a friction disc *i* slidably mounted upon any suitable form of guide *k*. One of the cones or like members, for example, *h* is driven by means of clockwork *l* or other suitable form of constant speed motor and may be arranged in a case forming part of or secured to or separate from the case 50 of the projecting apparatus and it will be seen that by moving the intermediate friction disc *i* in one direction or the other the speed of the travelling indicator *c* may be suitably varied until the speed of a particular mark thereon is equal to that of the image of the object viewed. The speed of the air vessel or other moving body may then be directly read off a dial, the pointer of which is 55 connected in any suitable manner with the sliding member *m* carrying the friction disc, or I may provide in conjunction with the latter a scale of heights

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as n which may be moved with the movement of the friction disc i across the face of a chart o on which are marked lines indicating speeds in miles per hour or other convenient units, the position of which may be arrived at by suitable calculations and the speed of the moving body is thus at once given by that curve upon the chart which is intersected by the particular mark upon the scale of height representing the height of the moving body above the ground at the particular moment at which its speed is required.

It will be clear that many modifications may be introduced into the apparatus without departing from the spirit and scope of the invention, for example, I may provide a moving mirror or prism in front of the image-forming lens and suitable means for varying the speed of the mirror so that the image may be caused to appear stationary and the speed of the moving body can then be readily gauged from the speed of the mirror.

In a further modification the mirror or prism may be arranged between the lenses and moved at a constant rate of speed and suitable means provided for giving a variable magnifying power to the projecting apparatus, thus giving the effect of variable speed of movement to the mirror. One method of accomplishing this would be to have a double lens at one end of the apparatus by which the magnifying power could be altered by altering the distance between the lenses but in such a manner that the image always remains in focus.

In place of employing the chart or dial above described the movable member of the variable speed mechanism may be mounted upon a slide graduated in degrees indicating different intervals of time and a suitably graduated slide rule provided for obviating the speed of the moving body from the indication given upon the graduated slide.

As some difficulty may be experienced in viewing the objects upon the ground from an aeroplane at a height, due to their apparently small size, and as an optical apparatus such as a camera if made to enlarge the view, would be bulky I may sometimes arrange a telescope of moderate power in a horizontal position and preferably so constructed that the observer need not place his eye close to the eye-piece and in front of the object glass of such a telescope I arrange a mirror at an angle of 45° to the horizontal but so arranged that this angle may be varied at will.

One convenient form of apparatus of this nature is shown in Figure 2 in which the mirror r is arranged in front of the telescope a and pivoted at q upon a framework p carrying both the telescope a and a constant speed motor l . The mirror is connected to an arm s adapted to contact with a cam t driven at a uniform speed by the motor l and adapted to be moved upon a guide u by means of an arm v engaging with a collar x upon the cam in such a manner that the distance between the fulcrum q and the point of contact between the arm and the cam may be varied at will. By means of this mechanism the mirror is tilted in such a manner as to vary its angle to the horizontal, the cam or other operating device being arranged so that the mirror is moved in a periodic manner moving in one direction slowly and returning to its normal position in a much shorter space of time. The variation in the rate of motion of the mirror is obtained by causing the cam t to contact with the lever s at different positions relatively to the fulcrum q and the position of the cam is adjusted until the observer sees no movement in the image of the object viewed. The position of the cam or screw relatively to a scale of height is then an indication of the speed of the aeroplane or other moving body.

The apparatus may be employed to ascertain the speed of travel of the instrument whether carried by an aeroplane or other moving body with reference to a fixed object at known distance or if the instrument be fixed it will give the speed of a moving object at a known distance or if both the instrument or object are moved the speed indicated will be the relative speed between the two. When carried upon an aeroplane or other body subject to oscillation the apparatus may, if desired, be mounted in gimbals.

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Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. Apparatus for determining the speed of a moving body comprising in combination an optical projecting apparatus for producing an image of an object which is moving relatively to the apparatus and mechanical means for determining the speed of the image of the object viewed. 5
2. Apparatus for determining the speed of a moving body comprising in combination an optical apparatus for producing the image of an object moving relatively to the apparatus, an indicator which travels at known but varying speeds in the plane of the image and means for adjusting the speed of the indicator until it travels at the same rate as the image of the object, substantially as described. 10
3. Apparatus according to Claim 2 in which the indicator takes the form of an endless transparent band having marks thereon adapted to be driven by variable speed gear, substantially as described. 15
4. Apparatus for determining the speed of a moving body comprising in combination an optical apparatus producing an image of an object moving relatively to the apparatus and a moving mirror, prism, or lens for rendering the image stationary, the speed of the mirror or the like being capable of variation, substantially as described. 20
5. Apparatus for determining the speed of a moving body comprising in combination an optical projecting apparatus for producing an image of an object moving relatively to the apparatus, a mirror or prism movable at a constant rate in the field of vision and means for giving a variable magnifying power, substantially as and for the purpose set forth. 25
6. Apparatus for determining the speed of a moving body comprising in combination an optical projecting apparatus for producing an image of an object moving relatively to the apparatus, a reflecting mirror, prism or lens, a constant speed motor, means for converting the constant speed of the motor into a variable speed of the mirror, prism, or the like, and a scale indicating the variation of such speed, substantially as and for the purpose set forth. 30
7. The forms of apparatus for determining the speed of a moving body, substantially as hereinbefore described and as illustrated by the accompanying drawings. 35

Dated this 12th day of August, 1913.

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[This Drawing is a reproduction of the Original on a reduced scale.]

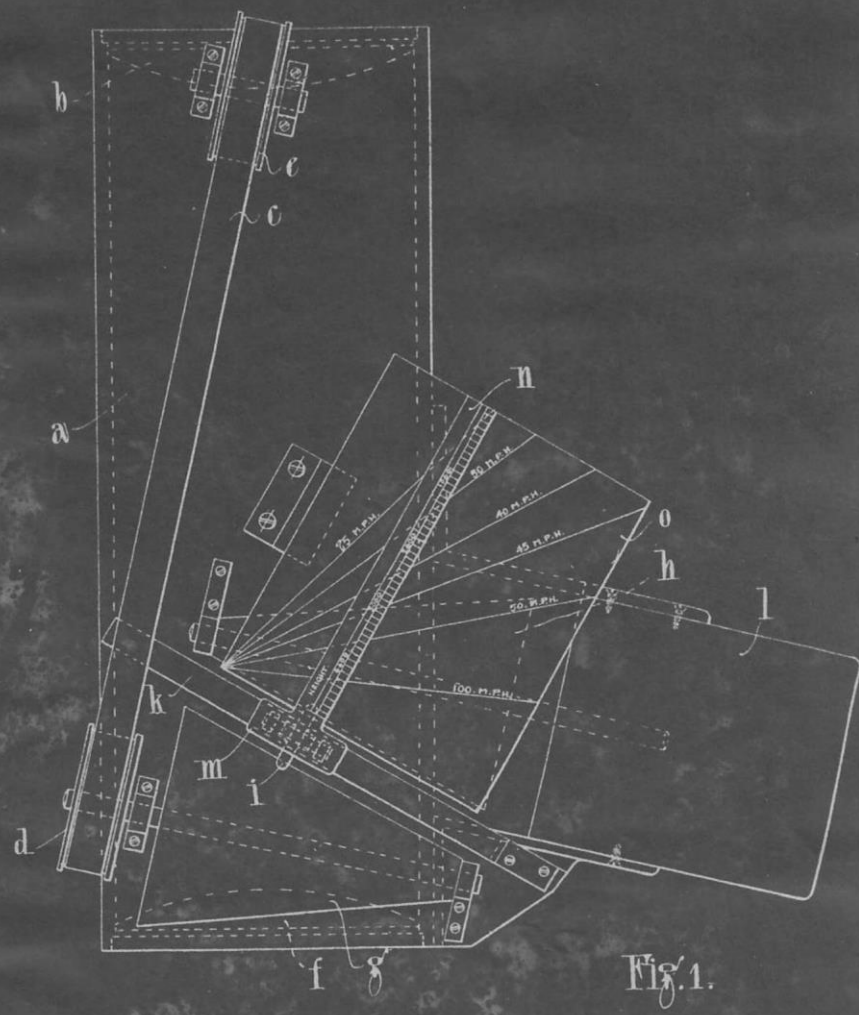


Fig. 1.

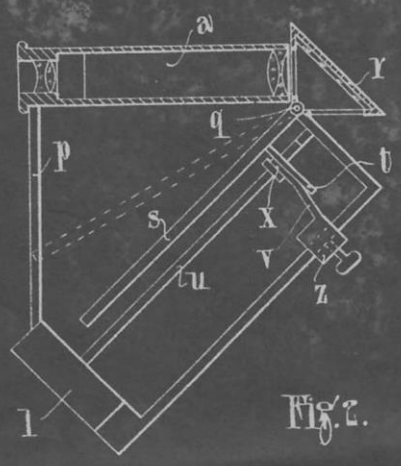


Fig. 2.



Fig. 3.