Oct. 22, 1940. E. R. PARSBERG 2,219,016

METHOD AND MEANS FOR EMITTING SIGNALS WITH VARYING SIGNAL CHARACTER

Original Filed Dec. 22, 1932 2 Sheets-Sheet 1

Fig. 1.

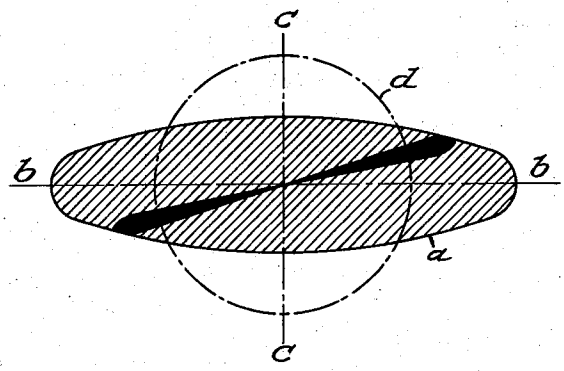


Fig. 2.

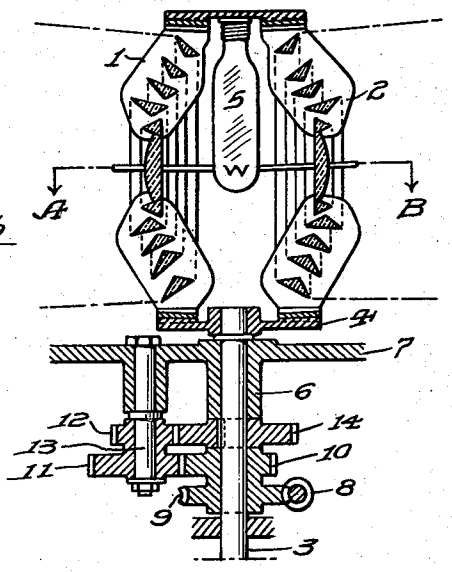


Fig. 3.

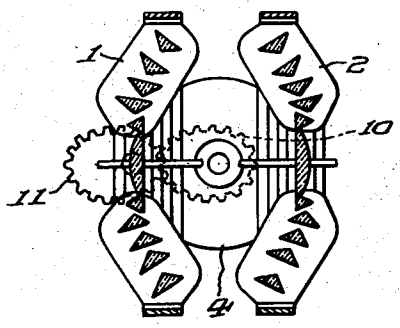


Fig. 4.

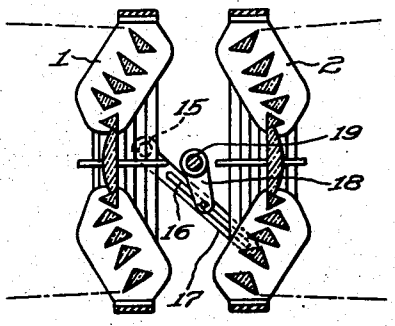


Fig. 5.

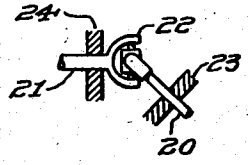
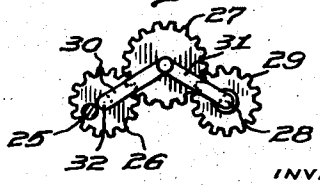


Fig. 6.



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Fig. 7.

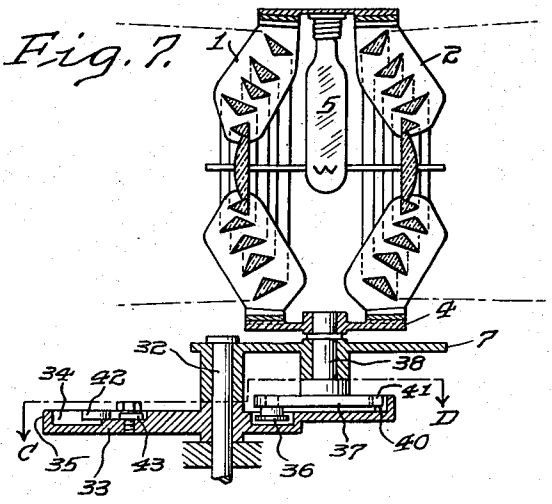


Fig. 8.

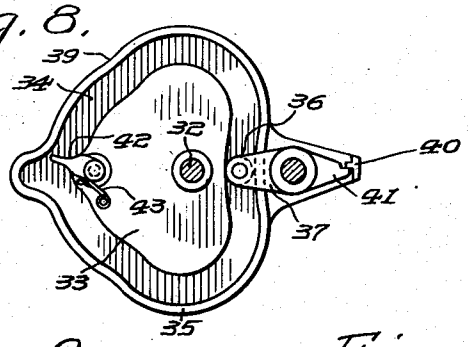


Fig. 9.

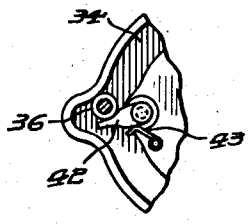
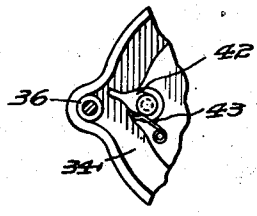


Fig. 10.



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2,219,016

METHOD AND MEANS FOR EMITTING SIGNALS WITH VARYING SIGNAL CHARACTER

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Original application December 22, 1932, Serial No. 648,348. Divided and this application September 30, 1937, Serial No. 166,535. In Sweden December 24, 1931

10 Claims. (Cl. 177—352)

Application for Letters Patent was filed in Sweden December 24, 1931, and in the United States December 22, 1932, Serial No. 648,348. The present application is a division of United States application Serial No. 648,348, on which Patent No. 2,096,755 issued October 26, 1937.

It has become the general practice in arranging the illumination of air routes to use powerful revolving searchlights projecting beams of condensed light which sweep the horizon. When these beams of light sweep past a certain point, the impression obtained in the said point is that of a flashlight character, usually single flash. The period between the separate flashes varies in length in different countries. In America, for instance, it is considered sufficient with one flash every ten seconds, whereas in Germany they have generally gone in for a period of about three seconds. If it is taken into consideration that it has been the practice for years to provide one flash every five seconds for marine traffic, which moves much slower, the conclusion is easily arrived at that for aviation the period should be quicker and not slower, and consequently that a period of three seconds would be more in accordance with the requirements of air traffic.

Flashes at shorter intervals may be obtained by increasing the rotary speed of the apparatus or by dividing the available light energy into several beams. In both cases the efficiency of the beacon will be reduced. In the first case the light impression will be diminished, owing to the reduced duration of the flash (according to the Blondel and Rey law), while in the latter case the light efficiency of the beacon will be reduced by the division of the light energy.

The Frenchmen Blondel and Rey have scientifically proved that, in order to obtain a flashlight of a light range equivalent to that of fixed light, the light power of the flashlight must be larger and must consequently be multiplied by a factor which is less than 1. This factor is dependent on the duration of the flash and diminishes quickly as this is reduced. The factor in question is, for instance, approximately .2 for a flash of .03 second, .48 for a flash of .1 second, and rises to .84 for a flash of .3 second.

From this point of view it would be advantageous, in order to obtain a good light impression or a good signal effect, to have a long duration of the flash, which can be attained by increasing the width of the light beam or by reducing the rotary speed of the beacon. From the point of view of light economy, the first mentioned way of solving the question is not to be recommended. On the other hand, a reduction of the rotary speed will mean that the interval between the separate flashes will be longer. As stated above, it is desirable that this interval should be comparatively short.

It is evident that the two requirements which thus present themselves, particularly in the technique of airway beacons, i. e., long duration of the flash on the one hand and short intervals between the separate flashes on the other, are at variance with each other, inasmuch as compliance with one of the requirements requires a low rotary speed whereas the other requires high rotary speed of the beacon.

This invention refers to an arrangement by means of which the above mentioned features are both attained simultaneously, the lens or reflector system of the beacon being so arranged as to rotate with a revolving motion in such a way that the signal character of the beam or beams of light will be different in different directions. According to the invention the lens or reflector system of the beacon is not allowed to revolve uniformly as has been the practice hitherto, i. e., with an approximately constant speed in the same direction, but is instead given a non-uniform revolving motion. By non-uniform revolving motion is to be understood in this connection that in certain sections of the revolution the system revolves at a slower speed than in other sections.

The intention with such a non-uniform revolving motion is to improve the light impression in certain sections of the revolution at the expense of the light impression in the other sections. When the beacon is intended as an airway beacon, the flying direction is suitably laid through the first mentioned sections because the beacon light should be most visible in that direction, whereas the other sections do not as a rule require full light power.

In one form of employing the invention the lens or reflector apparatus is, as mentioned above, given a lower angular speed when the beam or beams of light sweep past the flying direction and a higher angular speed when the same beams sweep past sections outside the flying direction. In this way the duration of the flash time will be longer in the sections through which the flying direction is laid, whereas it will be shorter in the other sections. A beacon having two lens panels arranged at an angle of 180° between their optical axis, and giving at a constant revolving speed and a period of, say five seconds, a flash of a duration of .10 second, thus will be arranged succes-

sively to alter the revolving speed. When beams of light from the lens panels pass the flying direction, the speed of the beacon is reduced to one third, whereas the speed is increased three times when the same light beams pass directions which are at right angles to the flying direction. Then the light efficiency of the beacon in the flying direction will successively be increased by about 80%, whereas the light efficiency in directions which are at right angles to the flying direction will be reduced successively to about half.

Fig. 1 on the attached drawings shows a light efficiency diagram of such a beacon, i. e., a polar diagram, showing the effective light power, or the light power transformed according to the Blondel and Rey law;

Fig. 2 shows a vertical section through a lens apparatus for practising the invention;

Fig. 3 shows a horizontal section of the same apparatus along the line A—B of Fig. 2;

Fig. 4 shows a horizontal section of a lens system similar to the one described above, to which a periodically varying revolving motion is transmitted by means of a link mechanism;

Fig. 5 shows schematically a cardanic link arrangement serving the same purpose as the above described transmission mechanisms;

Fig. 6 shows schematically another arrangement for transformation of a uniform revolving motion into a periodically varying motion;

Fig. 7 is a vertical section through a lens apparatus and a further arrangement of driving mechanism therefor;

Fig. 8 is a horizontal section along the line C—D of Fig. 7; and

Figs. 9 and 10 are detailed views similar to Fig. 8 but showing the parts in different positions.

Referring to Fig. 1, the curve *a* represents the limit curve for the light efficiency of a beacon revolving at a periodically varying angular speed. As is seen, maximum and minimum light efficiency, respectively, is obtained in two diametrically opposite directions *b*—*b* and *c*—*c*, respectively, which correspond to minimum and maximum speed, respectively. The direction *b*—*b* is the flying direction. For the sake of comparison, curve *d* shows the light efficiency of the same beacon revolving at the same time per revolution but at constant angular speed.

In the above given example the light efficiency curve will thus have the approximate appearance of an ellipse, the major axis of which, *b*—*b*, is about three times as long as the minor axis *c*—*c*. The aviator should naturally try to keep the direction in which the flash is of the longest duration.

Lights of the description in question make the use of special so-called "course lights" unnecessary, because the aviator will notice an alteration in the flying character as soon as he deviates from the flying course.

The above described arrangement of the light may naturally also be used for maritime beacons, or for maritime and airway beacons combined.

In the apparatus shown herein, two lenses, for instance Fresnel lenses, 1, 2, are supported by a foundation plate 4 connected to a vertical revolving shaft 3 as shown in Fig. 2. Inside the lenses a source of light is arranged, in this case consisting of an electric incandescent lamp 5, the light from which is refracted by the lenses 1 and 2 in such a way that one beam of light is reflected from each one of the lenses, as indicated by the dotted lines. On the shaft 3, resting in the bearing 6 at the fixed foundation 7, a revolving screw wheel 9 is placed, which gears with a worm 8. The worm 8 is connected to a suitable source of power, for instance an electric motor, which causes the worm to revolve at a constant speed. As is shown, the screw wheel 9 is cast in one piece with or in some other way connected to an eccentric geared elliptic cog-wheel 10 which is also placed on the shaft 3 and which engages with an eccentric geared elliptic cog-wheel 11 of the same size, this latter wheel, as well as a cylindrical cog-wheel 12 that is firmly secured tothe cog-wheel 11, being placed on an intermediate shaft 13 arranged at the foundation 7. The cog-wheel 12 is arranged to gear with a pinion 14 wedged on to the shaft 3. If the worm 8 revolves at a constant speed it is evident that the cog-wheel 12 will receive through the elliptic gear 10, 11 a periodically varying angular speed, which after gearing to about half by means of the cylindric gear 14 is transmitted to the shaft 3 and the lens system connected to same. By the reduction of the speed the speed cycle is repeated twice in each revolution of the lens system, whereby, as shown by the diagram of Fig. 1, minimum and maximum value of the light efficiency will be obtained in two directions which are at right angles to each other.

Referring to the arrangement shown in Fig. 4, on the driving shaft 15 a link 17 is placed, on which there is a groove 16. In this groove a journal for another link 18 slides, this latter link 18 being placed on a shaft 19 connected to the lens system. If the shaft 15 is caused to revolve at a constant speed, the link 17 will be included in this motion and the journal for the link 18 will slide back and forth in the groove 16 at the same time causing the shaft 19 to revolve. It is evident that this shaft will thereby be caused to revolve at a periodically varying speed, seeing that its momentary speed depends on the angle between the two links.

In the driving apparatus shown in Fig. 5, the driving shaft 20, resting in fixed bearings 23, is arranged in an inclined position in relation to the shaft 21 which is connected to the lens system and rests in a bearing at 24. The two shafts are connected by means of a universal joint 22. When the shaft 20 is revolving at constant speed the shaft 21 will, as is known, be caused to revolve at a periodically varying speed.

Referring to the apparatus shown in Fig. 6, on the driving shaft 25 a cog-wheel 26 is secured in an eccentric position, this cog-wheel engaging with a pinion 27, which in its turn gears with a third-cog-wheel 29 placed on the shaft 28 connected to the lens system. The pinion 27 is supported by two arms 30, 31 turning around the centre of the pinion,—one of these arms, 30, turning around a journal 32 in the centre of the wheel 26, whereas the other arm 31 turns around the shaft 28. If the shaft 25 revolves at constant speed, the cog-wheel 26 will turn eccentrically around this shaft, but the gearing with the intermediate pinion 27, as well as the gearing between this pinion and the cog-wheel 29, is maintained because, simultaneously with the rotation of the wheel 26, the pinion 27 is moved by means of the arm 30. The pinion 27 will thus roll back and forth along a part of the periphery of the wheel 29, whereby this wheel will be caused to revolve at a periodically varying speed. If a suitable ec-

centricity of the wheel 26 is chosen and the three cog-wheels are of suitable size in relation to each other this motion may also be caused to change direction periodically.

A further arrangement of apparatus for the same purpose is shown in Figs. 7, 8, 9 and 10. On the driving shaft 32, resting in a bearing in the frame 7, a disk 33 is secured, in which there is a cam or guiding groove 34. In this groove, bordering on the edge 35 of the disk, a roller 36 slides which is arranged on an arm 37 of the shape of a crank on the shaft 38 connected to the lens apparatus. The crank 37 is arranged above the disk 33 in such a way that the crank does not prevent the disk from turning. When the disk 33 turns at a constant speed the roller 36 is obliged to follow the groove 34 whereby the shaft 38 is also caused to revolve. The angular speed of the crank 37 in different moments depends naturally on the shape of the groove 34. In order to obtain the intended periodically varying speed with two speed cycles during each revolution of the shaft 38, the groove should be shaped approximately as a heart. By making an indentation in the groove, for instance at 39, the angular speed of the crank may be reduced in that place to zero, or the crank may even be made to move backwards along a certain angular arc in each half of the revolution.

In the position of the disk 33 and the crank 37 shown in Figs. 7 and 8, the crank does not receive any revolving component of force when the disk 33 revolves. In order to move the crank out of this dead position, a knob 40 is arranged on the disk 33, this knob co-operating with a corresponding knob 41 on the crank 37 in such a way that when the disk 33 turns the knob 40 causes the crank to leave the dead position. The position of the roller 36 in the groove 34 will thereafter be such as to cause the shaft 38 to revolve when the disk 33 turns. In order to make the roller continue to follow the groove at the apex of the "heart" when the disk 33 has turned 180° (Fig. 9), a pawl 42 is employed and is normally kept in such a position by a spring 43 that the groove is blocked. When the roller 36 arrives at the pawl, this is pushed aside by the roller and the roller is thus forced into the apex of the groove (see Fig. 10). When this has been done the spring 43 can push the pawl back and the roller 36 continues to move in the groove.

From the above description it will be apparent that the improved method and apparatus provide a signaling system which is particularly useful for airways. With this improvement the movement of the signaling beam around its vertical axis of rotation is at no time discontinued, and the beam is rotated in such a manner that its angular velocity is substantially decreased as it sweeps over a given section within which the flying course is laid. As illustrated in Fig. 1 of the drawings, the maximum speed of movement of the beam takes place as the beam moves across the line *c*—*c*, and the minimum speed takes place as the beam moves across the line *b*—*b*, the latter line representing the flying direction. It will therefore be apparent that the duration of the flash in different directions varies as the beam sweeps around its axis of rotation, being shortest as the beam sweeps over the line *c*—*c*, and longest as it sweeps over line *b*—*b*. As the beam sweeps over the angle between line *c*—*c* and line *b*—*b*, its angular movement is retarded from a maximum to a minimum, and as the beam sweeps over the angle between the line *b*—*b* and the line *c*—*c* its movement is accelerated from a minimum to a maximum.

With the specific apparatus disclosed herein, the retardation of the movement of the beam occurs throughout the angle between line *c*—*c* and line *b*—*b*, and the acceleration of the movement occurs throughout the angle between the line *b*—*b* and the line *c*—*c*. It will be understood, however, that such retardation and acceleration, to produce decreased angular velocity, need not extend throughout an angle of 180°. The decreased angular velocity may be confined to a much smaller angle, such as will merely include the flying course. This decrease in velocity is not necessarily variable, although that may be preferable from a mechanical standpoint.

When a variable decreased velocity is utilized, the variation of the duration of the flash in different directions enables the aviator to approximate his position at any time, so long as he is within the range of the signaling device and within the angle within which the variation in movement of the beam takes place. With such a system, the aviator endeavors to fly in the direction in which the flash is of longest duration. In case he departs from the flying direction as indicated by the line *b*—*b*, the direction of movement of the beam and the duration of the flash as the beam sweeps past, will indicate to him his approximate position, thus enabling him to locate his proper flying direction.

Obviously the method of transmitting directed beams above mentioned can be used in connection with beams of all kinds. Here the use of beams of visible light has been shown, but it is assumed that radio beams or beams of other than visible light may be transmitted in the same manner equally well.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. The method of producing signals with different signaling character in different directions, comprising the directional emission of a beam of radiant energy or the like from a source, continuously rotating the directional emitting means to produce complete rotary movements of the beam in a pre-determined plane within uniform time intervals, and varying the angular velocity of said beam over a given section of its rotation by retarded motion over a portion of said section, thence by accelerated motion over the remaining portion of said section.

2. The method of producing signals for a flying course, which comprises projecting a beam of radiant energy or the like from a source in said course, continuously rotating said beam around said source substantially in a plane in uniform periods of time, substantially decreasing the angular speed of said beam in certain pre-determined directions including the flying course, and substantially increasing the angular speed of said beam in all other directions.

3. A beacon having signaling means for emitting a signal in the form of a beam of radiant energy, supporting means for continuously rotating said signaling means to thereby rotate said beam in a plane around said signaling means in uniform periods of time, and mechanism for substantially decreasing the angular velocity of said supporting means as said beam sweeps over a given section of its rotation, said mechanism including means for retarding the movement of said support as said beam sweeps over a portion of said section and for accelerating the move-

ment as said beam sweeps over the remaining portion of said section.

4. In signaling apparatus, the combination of a source of radiant energy, projecting means for producing a beam from the energy emitted by said source and for directionally controlling said beam in a plane, and mechanism for continuously rotating said beam about a fixed axis at right angles to said plane in uniform periods of time and for substantially decreasing the angular velocity of said beam while sweeping over a predetermined angle of its rotary movement.

5. In signaling apparatus, a source of radiant energy, projecting means for producing a beam from the energy emitted by said source and for directionally controlling said beam within a plane, a rotary support for said projecting means, mechanism for continuously rotating said support in one direction in uniform periods of time about an axis at right angles to said plane and including a continuously rotating driving shaft, and motion-transmitting mechanism interposed between said driving shaft and said support to decrease the angular movement of said support as said projecting means moves said beam through a pre-determined angle.

6. In signaling apparatus, a source of radiant energy, projecting means for producing a beam from the energy emitted by said source and for directionally controlling the said beam within a plane, a rotary support for said projecting means, mechanism for continuously rotating said support in one direction in uniform periods of time about an axis at right angles to said plane and including a continuously rotating driving shaft, and a pair of intermeshing eccentric gears interposed between said driving shaft and said support to decrease the angular movement of said support as said projecting means moves said beam through a pre-determined angle.

7. In signaling apparatus, a source of radiant energy, projecting means for producing a beam from the energy emitted by said source and for directionally controlling said beam within a plane, a rotary support for said projecting means, and mechanism for continuously rotating said support in one direction in uniform periods of time about an axis at right angles to said plane, said mechanism including a continuously rotating driving shaft having two angularly arranged portions connected by a universal joint to decrease the angular movement of said support as said projecting means moves said beam through a pre-determined angle.

8. In signaling apparatus, a source of radiant energy, projecting means for producing a beam from the energy emitted by said source and for directionally controlling said beam within a plane, a rotary support for said projecting means, mechanism for continuously rotating said support in one direction in uniform periods of time about an axis at right angles to said plane and including a continuously rotating driving shaft, a crank arm on said support, a cam roller on said crank arm, and a cam on said driving shaft and having a cam groove therein for co-operating with said cam roller to decrease the angular movement of said support as said projecting means moves said beam through a pre-determined angle.

9. In signaling apparatus, a source of radiant energy, projecting means for producing two oppositely directed beams from the energy emitted by said source, a rotary support for said projecting means, means for continuously rotating said support in one direction, including a continuously rotating driving shaft and motion-transmitting mechanism interposed between said driving shaft and said support to decrease the angular speed of said support as said projecting means moves said beams through a pre-determined angle.

10. In signaling apparatus, a source of radiant energy or the like, projecting means for producing two oppositely directed beams from the energy emitted by said source, a rotary support for said projecting means, means for rotating said support to thereby rotate said beams around said source in uniform periods of time, and motion-transmitting mechanism for substantially decreasing the angular speed of said support as each of said beams is moved through a pre-determined angle, said mechanism retarding the movement of said support as each of said beams sweeps over a portion of said angle and accelerating its movement as each beam sweeps over the remaining portion of said angle.

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