Oct. 2, 1951 J. R. MacKAY 2,570,138

SINGLE STATION RANGE LIGHT APPARATUS

Filed Aug. 22, 1947 4 Sheets-Sheet 1

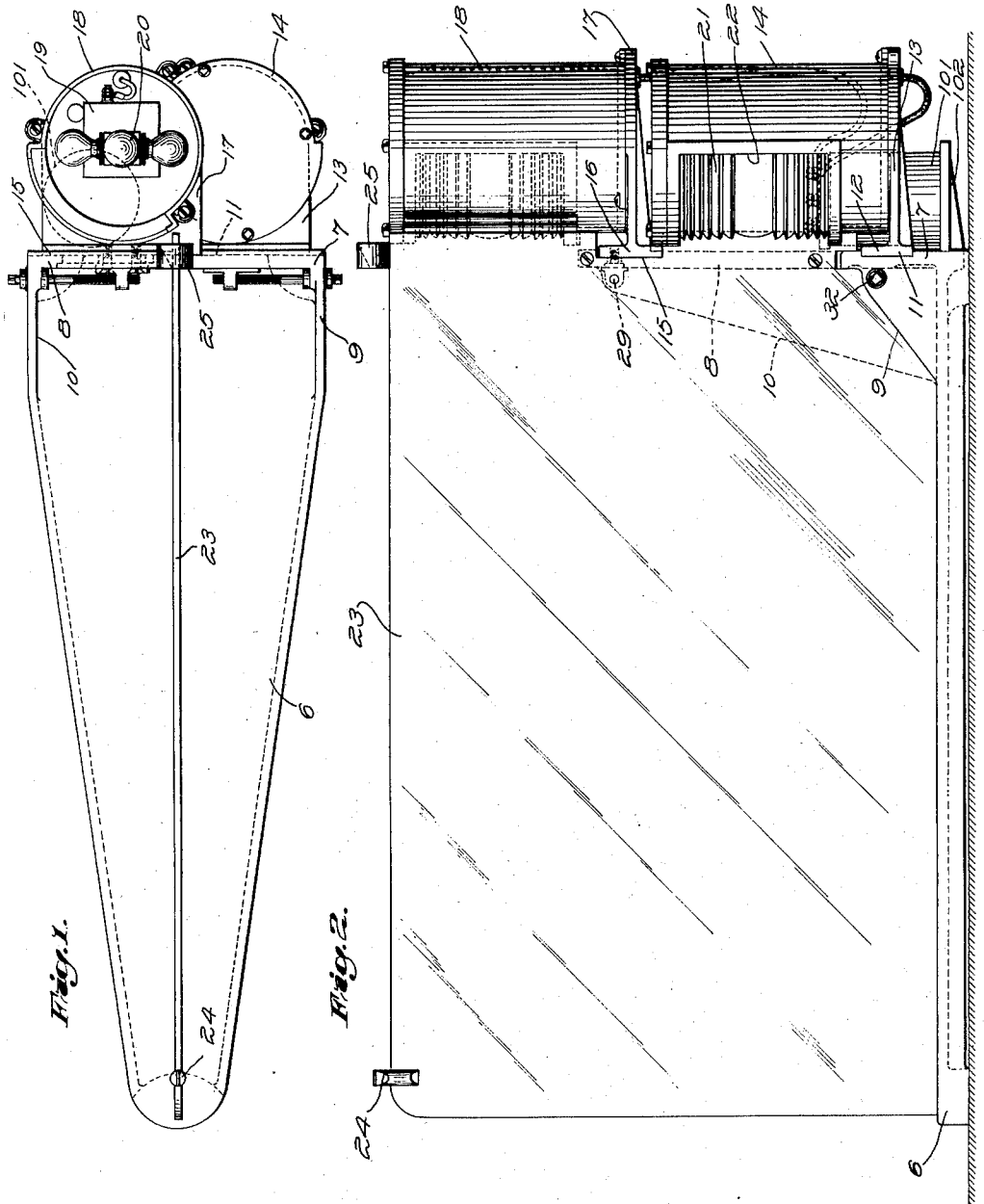

Fig. 1.

Fig. 2.

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SINGLE STATION RANGE LIGHT APPARATUS

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Fig. 5.

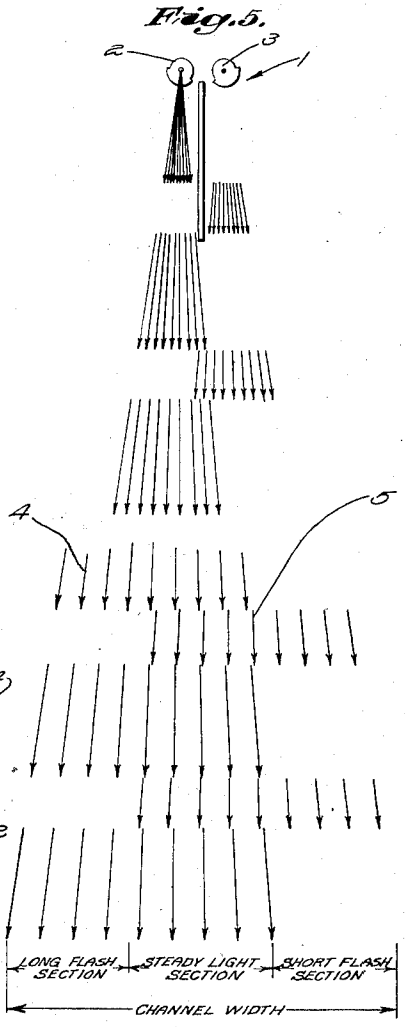


Fig. 3.

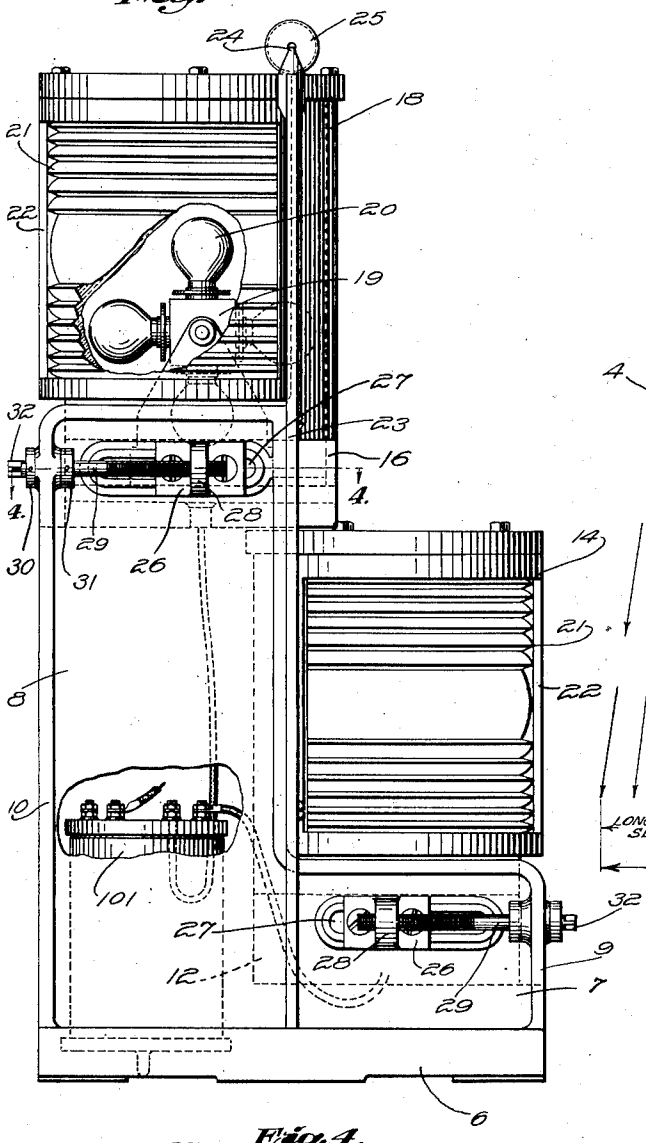
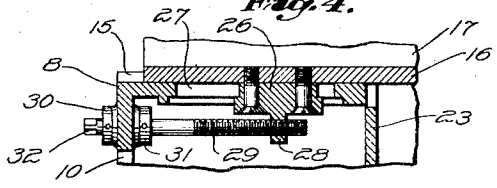


Fig. 4.



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SINGLE STATION RANGE LIGHT APPARATUS

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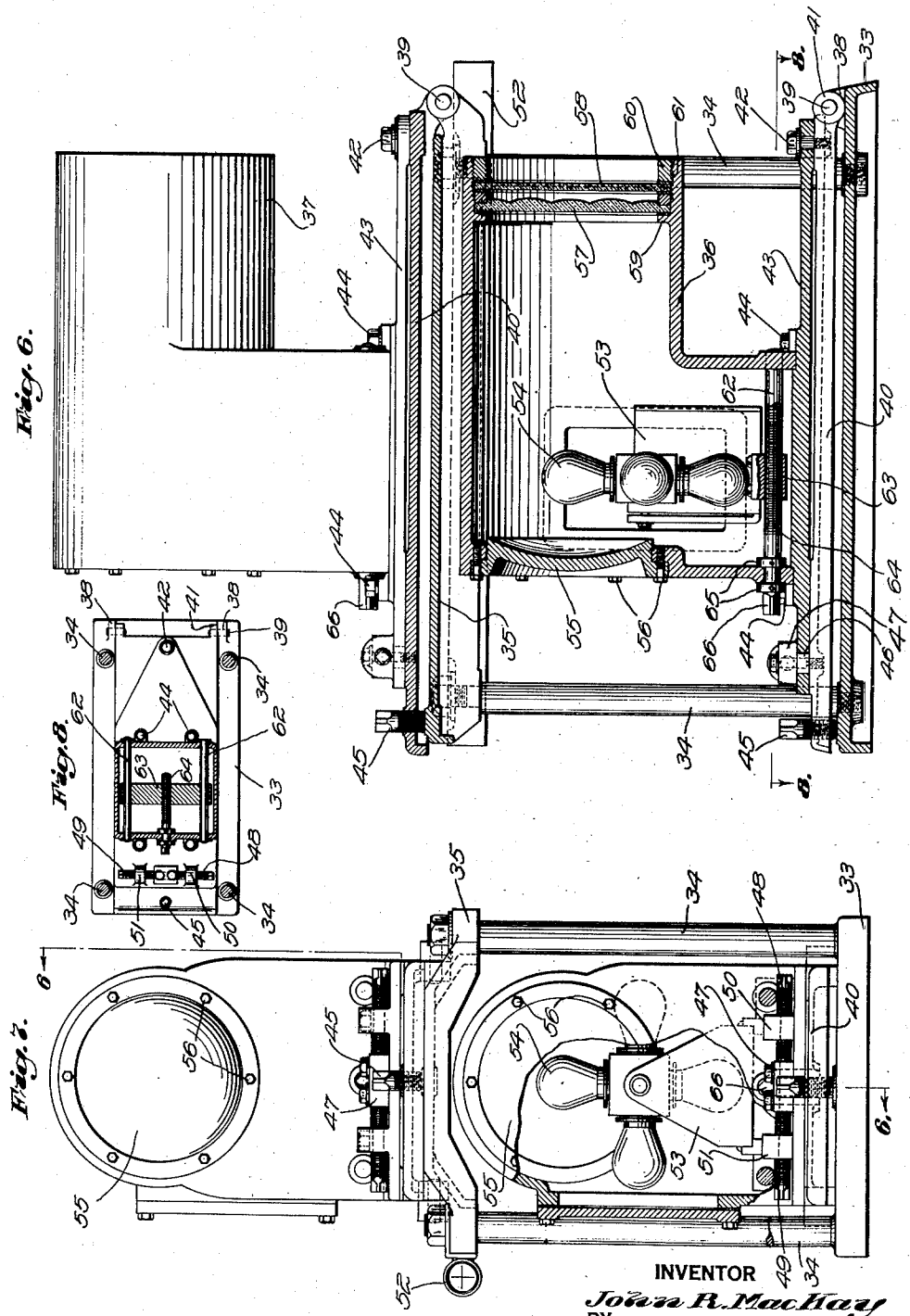

Fig. 6.

Fig. 8.

Fig. 7.

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SINGLE STATION RANGE LIGHT APPARATUS

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Fig. 9.

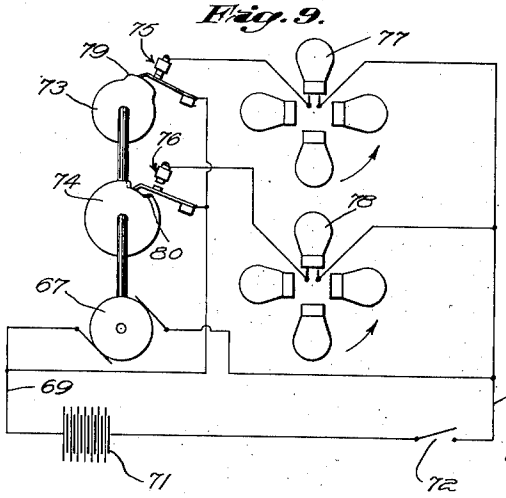


Fig. 12.

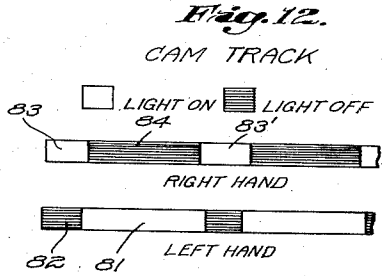


Fig. 13.

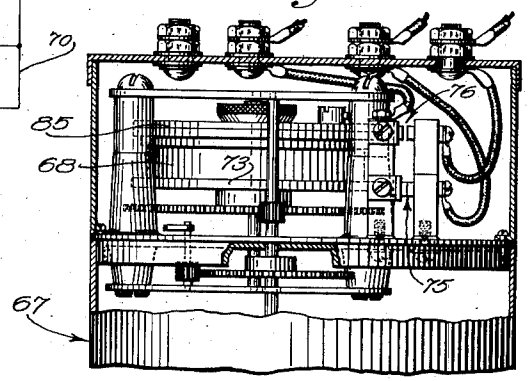


Fig. 10.

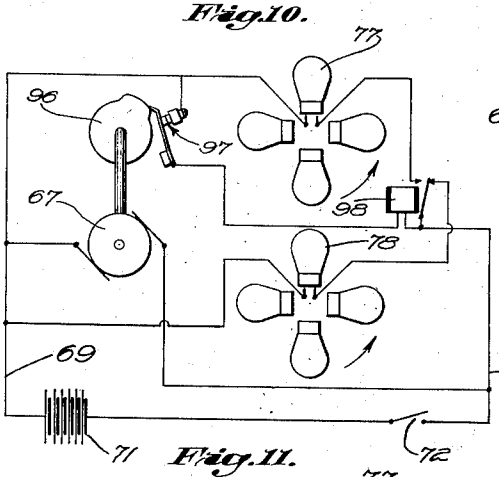


Fig. 14.

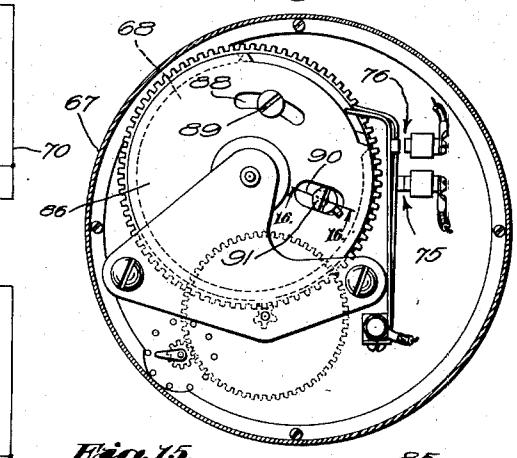


Fig. 11.

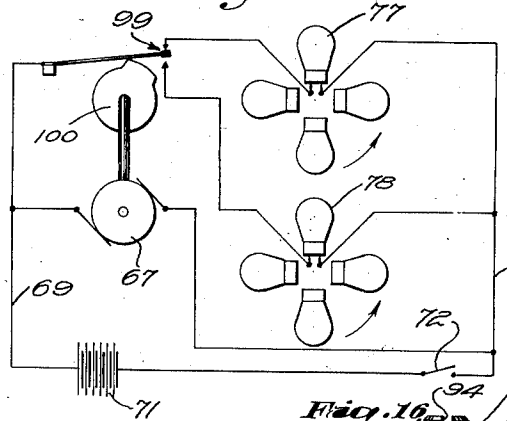


Fig. 15.

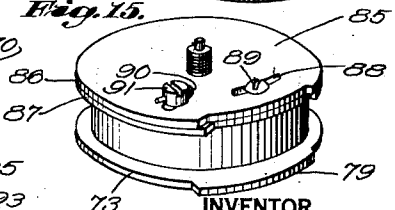
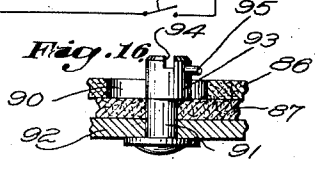


Fig. 16.



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Patented Oct. 2, 1951

2,570,138

UNITED STATES PATENT OFFICE

2,570,138

SINGLE STATION RANGE LIGHT APPARATUS

John R. MacKay, Packanack Lake, N. J., assignor to Wallace & Tiernan Products, Inc., Belleville, N. J., a corporation of New Jersey

Application August 22, 1947, Serial No. 770,072

2 Claims. (Cl. 177—352)

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My present invention relates to a single station range light apparatus for indicating to an observed his position in respect to the center of a predetermined channel, whether that channel be over land, water or in the air, and also to a method of accomplishing these purposes.

Convention range light practice which has been used for a considerable time in assisting navigators to locate themselves in the use of a waterway, such as a river or the entrance to a harbor, consists in providing a pair of lights to mark the channel, these lights being in alignment with the channel but with the rear light usually placed higher than the front light and a considerable distance in back of it, so that the navigator can use the range by keeping the lights vertically in line as he progresses into and along the desired channel. In order to prevent the lights from blending together and appearing as a single light, the vertical distance between the lights must be considerable. Furthermore, in order that the indication to an observer be sufficiently sensitive, the horizontal distance separating the lights must be considerable, often in the neighborhood of one-quarter to one-half mile.

In many instances, it is impractical or too expensive to provide lighted ranges of the convention type aforesaid. For example, sometimes high cliffs or river banks close to a waterway prevent the installation of a rear range light, as the intervening high land would make it invisible to ships navigating the channel. In other cases, there is no land or other structure available on which either a front or a rear light can be installed. At times the site, which would be used for the erection of the rear range light, is in a city or on property, the rental or purchase of which would be prohibitive in cost.

Because of the above difficulties, as well as others, there has been a definite, unfilled demand for a single station range light, i. e. a light or group of lights which are all installed at one location, and which will give the navigator an accurate visual indication as to whether or not he is in a prescribed channel or waterway, and, if he is off his course, the direction in which he should steer his vessel in order to return to the desired course or channel. The fulfilling of this demand is a primary, general object of the present invention.

Some attempts have been made to solve this problem by the use of different colored lights. These attempts have, however, not been completely satisfactory for several reasons. A further object of the present invention, therefore, is to provide a single station range light apparatus and method, which is independent of color.

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It has been found, in the development of the subject matter to which the invention pertains, that a characteristic series of intermittent periods of illumination is easily perceptible to the naked eye and serves efficiently to indicate to an observer the information intended to be conveyed. Thus a primary feature of the present method is to provide to an observer different programmed characteristic periods of visible light and darkness peculiar to the two sides respectively of the desired channel, so that by a rapid observation, an observer or navigator can quickly ascertain on which side of the center of the predetermined channel he is located at any instant.

By providing complementary characteristics of light and darkness respectively on the opposite sides of the channel, i. e. by having one beam of light directed down one side of the channel and a beam of light directed down the other side, and suitably programming the periods of illumination and intervening periods of darkness for each beam, then having the beams directed so that they will overlap, and further by providing that the periods of illumination down one side will correspond substantially to the periods of darkness on the other respectively, a central zone will be provided in which an observer will see a steady light. This central zone is a preferred channel which is normally intended for use. If then the characteristics on opposite sides of this steady light zone are different, for example a series of dots or relatively short lighted periods on the one side and a series of dashes or relatively long lighted periods on the other, an observer may quickly determine his location in respect to the center of the channel. The provision of this method of illumination and apparatus providing it are further principal objects of the present invention.

The above are also general objects of my prior and co-pending application Ser. No. 742,419, filed April 18, 1947, entitled "Single Station Range Light Apparatus and Method." That application discloses and claims the broad generic subject matter common to that and the present application, and also discloses and claims certain specific forms of the invention using but one source of light. The present application is restricted to the forms of the invention using two sources of light, which are stationary and which illuminate stationary predetermined areas which

are unchanged during the normal use of the apparatus and method, but which may be subject to adjustment as hereinafter set forth.

Among the objects of the present invention are to provide a single station range light apparatus and a method of accomplishing the purposes generally above set forth, using two sources of light, which are respectively arranged to illuminate areas each principally on one side respectively of the center of the channel, the illumination on each side, i. e. by each source of light, being intermittent in character, preferably substantially complementary, and such that on each side there will be characteristic different and dissimilar periods of illumination and darkness. Thus an observer on one side or the other of the channel may be enabled, by observing the light characteristics visible to him to ascertain on which side of the channel he is located. A further object is to provide that the areas illuminated by the respective light sources overlap to some predetermined extent, i. e. by a predetermined angle, to provide an overlap zone or sector at the center of the channel in which, due to the substantially complementary character of the illumination of the two side areas, there will apparently be a substantially constant or steady light. In this connection the two light sources are located so close together that from a distance there appears but a single light, irrespective of which light source is illuminated and visible to the observer, or even if both are instantaneously illuminated during a brief time interval.

A further and detailed object of the present invention is to provide for the initiation of the illumination from one light source a relatively short and preferably adjustable time period prior to the cessation of the illumination from the other light source respectively, so that there will be a light of substantially constant intensity visible to an observer in the central overlap zone aforesaid. In this connection it is noted that certain types of incandescent electric bulbs have different time periods intervening between the instant at which power is supplied thereto and the instant when the bulb is illuminated at its normal intensity of illumination from others. Also the period of "decay" i. e. the time from the shutting off of power to the instant when the illumination ceases may vary independently. It is desirable, therefore, to be able to compensate for these different times, so that the light intensity in the overlap zone may appear substantially constant to an observer. This may be effected in practice by providing a predetermined and preferably adjustable time interval during which power may be supplied to illuminate one light source prior to shutting off the power supply to the other.

Further objects of the invention include the provision of suitable adjustments by which the angular dimensions and preferably also the position of the central overlap zone may be adjustably predetermined, so that it may conform to the preferred portion of the channel which it is desired should be used in approaching the location of the range light apparatus.

Further objects of the invention include the provision of light beam directing means, preferably similar in character and associated with each light source respectively, so as to concentrate the light from each source into a relatively narrow beam, to provide for control of the spreads, at least in a lateral direction, of these beams; and to provide for the adjustment, and preferably the independent adjustment, of the direction of each beam, so that in coordination with the spread thereof, the beams may be used to define the total safe width of the channel reasonably permissive for use. This may be effected, for example, by having the total illuminated area on both sides, collectively considered, to be located within the boundaries of the portions of the channel considered safe for use. In this connection a further object is to obtain such control of the outside limits of illumination as aforesaid independently of the location and angular width of the preferred zone or overlap area in which an observer will see a substantially constant light.

A further object of the present invention is to compensate for the location of the range light apparatus out of the plane of the channel itself, for example, if the channel to be illuminated is a water channel as in a harbor or river and the range light apparatus is located a substantial distance above the surface of the water, to compensate for this difference or height of the range light above the water.

Further and more detailed objects of the present invention relate to the mechanical means for carrying out the objects generally referred to above in a practical apparatus which will be rugged, efficient and effective in use and which will lend itself to uses at places where attendance for maintenance purposes or control of operation may be infrequent. Still further objects and advantages will appear from the following description and appended claims, when considered in connection with the accompanying drawings, in which:

Figure 1 is a view principally in plan of one embodiment of the invention, a part of one of the light source-containing housings being removed to show certain of the internal construction;

Fig. 2 is a view in side elevation of the apparatus shown in Fig. 1;

Fig. 3 is a view principally in end elevation, as seen from the left in Figs. 1 and 2, of the apparatus shown in those figures, certain parts being broken away to show the interior construction;

Fig. 4 is a fragmentary detailed view substantially in horizontal section on the line 4—4 of Fig. 3;

Fig. 5 is a diagrammatic illustration showing the operation of the apparatus of Figs. 1 to 4;

Fig. 6 is a view partly in side elevation and partly in vertical section of another form of the invention, the view being taken substantially on the line 6—6 of Fig. 7;

Fig. 7 is a view substantially in end elevation as seen from the left in Fig. 6 and with some parts broken away to show the interior construction;

Fig. 8 is a view substantially in horizontal section on the line 8—8 of Fig. 6, but on a reduced scale;

Figs. 9, 10 and 11 are various diagrammatic illustrations showing different modified forms of a control circuit and circuit control arrangements for the programming means of the apparatus, any of these circuits being applicable to the forms of Figs. 1 to 4 or Figs. 6 to 8;

Fig. 12 is a diagrammatic view illustrating a timing chart for the operation of the two light sources;

Fig. 13 is a fragmentary view of a portion of a timing or programming means, the outside cas-

ing being broken away in part to show the interior construction;

Fig. 14 is a view substantially in plan of a part of the timing mechanism illustrating the application thereof to the control of a circuit as shown in Fig. 9;

Fig. 15 is a view substantially in perspective of a timing cam means of the type usable in the construction shown in Figs. 13 and 14; and

Fig. 16 is a fragmentary detailed view principally in vertical section on the line 16—16 of Fig. 14, showing an adjustment means for the cams of that figure.

Referring first to Fig. 5, a single station range light apparatus is generally indicated at 1, this apparatus including two light sources designated 2 and 3 respectively, the light source 2 being arranged as shown to illuminate a sector of predetermined lateral angular width (spread) on the left of the channel, considered from the point of view of an observer facing the light, and the light source 3 being adapted to illuminate a similar sector on the right of the channel. These sectors or areas are indicated by the groups of long and short arrows 4 and 5 respectively, and may be considered the areas illuminated, which are located principally on one side or the other of the channel. It is noted that in the illustration in Fig. 5, the periods of illumination of the light source 2 consist of a series of relatively long periods of illumination separated by relatively short periods of darkness; while the periods of illumination from the light source 3 on the right of the channel consist of a series of relatively short periods of illumination separated by relatively long periods of darkness.

In order that an observer in the central portion of the channel, which is that portion preferred for use in the normal course, be informed of his location, the directions of the beams from light sources 2 and 3 are so coordinated, as to their angle of divergence of the center lines of the beams, in conjunction with the lateral angular spreads of the beams, that there will be a central overlap zone, designated by the legend "Steady light section" on Fig. 5, in which an observer will see a substantially steady light. This is due to the fact that the periods of illumination on the two sides of the channel are substantially complementary and as these areas of illumination overlap in this central zone, an observer in that zone will see a steady light coming from one light source or the other. As the light sources are so close together and as the observer is at a considerable distance from the light sources, this will appear as a single light.

In the form of the invention illustrated in Figs. 6 to 8, the lateral border lines of the central overlap zone are in practice not exactly sharp lines, so that the borders are not usually sharply defined. As a result, an observer at the center of the channel, i. e. at the center of the overlap zone, will see a substantially steady light. As such observer moves laterally in one direction or the other he will commence to see the light characteristics of the zone toward which he is moving respectively superimposed upon a continuous high intensity background of light. This modulation becomes more pronounced as an edge of the zone of continuous light is approached. If the observer continues to diverge from the center of the channel into the portion on one side or the other thereof and not included in the overlap zone, the clear cut light interval characteristics of the lateral zones are apparent and there is a progressively less background of continuous or residual light.

This feature, effective to define the center of the overlap zone as distinguished from the side portions of this zone, is not available when using the form of the invention illustrated in Figs. 1 to 4, as that form uses Fresnel type lenses associated with each light source, so that the intensity of illumination throughout the area illuminated by each light source is substantially uniform. When using a concentrated light beam, however, as shown in Figs. 6 to 8, the illumination intensity is greatest at the center of the beam and diminishes rapidly toward the lateral borders thereof.

This was demonstrated in practice by a small model constructed in accordance with the present invention as herein disclosed and which operated on the same principle and wherein at a distance of about one-half mile from the light, an observer located in the center of the channel, i. e. corresponding to the center of the steady light section as shown on Fig. 5, saw a steady light, while movement of as little as five or six feet laterally in either direction resulted in the appearance of a characteristic indication depending upon the direction of such lateral movement. At about twenty to thirty feet one side or the other of the center, the characteristics of the lateral zone of light became distinct and clear cut.

The light modulation is valuable in that it notifies an observer of his departure from the center light position long before he reaches the edges of the steady light zone. The same effect is apparent when the beams 4 and 5 are given substantial lateral spread, so that the central overlap zone is of substantial angular dimensions.

As above stated, there are particularly disclosed hereinabove complementary flash characteristics including a series of intermittent dots or short flashes (code letter "E") on one side of the channel area, and a series of dashes or long flashes (code letter "T") on the other side thereof. This combination is usually preferable. It is contemplated, however, in accordance with the present invention, that any different characteristic intermittent periods of illumination be provided on the opposite sides of the channel which will be preferably complementary to one another. Another such example of this type of programming could be to provide a succession of flashes corresponding to the code letter "A" on one side (dot-dash or short flash-long flash) and code letter "N" on the other side (dash-dot or long flash-short flash). Another possible combination would be to provide flashes corresponding to the code letter "K" on one side (dash-dot-dash or long flash-short flash-long flash) and code letters "I—T" on the other side (dot, dot-dash or two short flashes, long flash). Any feasible combination of different characteristics of flashes such as those herein suggested and others which will occur to those skilled in the art may be employed within the purview of the present invention.

By light shields or by light beam directing means, such as reflector and lens means combinations, the lateral spread of the illuminated area from each light source, indicated by the zones or arrows 4 and 5, may be controlled at will as hereinafter more particularly set forth. If then the outside boundaries of the areas 4 and 5 be determined as to direction from the location of the sources of light 2 and 3, the illuminated areas

may be made to correspond with the safe portions of a channel permitted for use.

If in addition the inside boundaries of the zones 4 and 5 be controlled as to position or angle, the angular dimensions of the central overlap zone may be adjustably predetermined; and further by individually controlling the spreads of the illuminated areas from the light sources 2 and 3 and their locations, the location of the central overlap zone may be adjustably predetermined. All these are elements of the present invention and are to be considered as a part thereof, both from the point of view of method and also as to the means by which they are effected, from the point of view of apparatus. In this connection, it is desirable that the location and angular dimension of the central overlap zone may be adjustably predetermined independently of the outside dimensions and location of the total illuminated area, which may be coordinated with the shape and location of the safe portions of the channel permitted for use, while the central overlap area may independently define that portion of the channel preferentially desired for use.

Referring now to Figs. 1 to 4, inclusive, there is illustrated a relatively simple and inexpensive form of range light apparatus in accordance with the present invention and including two similar light sources as generally described for the light sources 2 and 3 in Figs. 5. The device as a whole may be suitably mounted in any desired location, which will normally be in substantial prolongation of the channel to be illuminated; and for a horizontal channel, such as a channel for ships which are water-borne, the apparatus will be located in a substantially vertical plane including the center of the desired channel, although it may be located somewhat above the water surface.

The apparatus is intended to be mounted upon any suitable support (not shown) which is preferably secured to and arranged to carry a supporting structure or base 6. This base carries at its rear end, at the right as seen in Figs. 1 and 2, upstanding supporting parts 7 and 8, which are in turn braced by webs 9 and 10, which may be formed integral therewith and with the base 6. The part 7 is formed to provide a substantially horizontal guideway 11, in which is arranged for horizontal sliding movement a part of a slide portion 12 of a base 13. The base 13 carries a housing 14 for one of the light sources. Similarly the upstanding part 8 is formed to provide a guideway 15 for a slide portion 16 carried by a base 17 for a housing 18 for the other light source, this housing being similar to the housing 14.

Due to the fact that the housings 14 and 18 are of substantial size and it may be desired to have them closer together in a lateral direction than would be possible if they were on the same level, they are vertically offset from one another, so as to permit one to overlap the other in a vertical direction as best seen in Fig. 1. This permits of a wider possible adjustment of the horizontal distance between the light sources than would be possible if they were on the same level, while at the same time permitting the housings 14 and 18 to be of sufficient size to accommodate the apparatus designed to be placed therein as hereinafter set forth.

While each light source may be of any desired character, they are preferably similar to each other, so that there will be no perceptible difference to the eye at a distance irrespective of which is being observed. Again, while it is possible to use any source of light, for instance an oil or gas lantern, or any kind of electric light, there are chosen for the purposes of illustration in the present case electric incandescent lamps.

When electrically energized sources of light are used, it is usually satisfactory to control the duration of the intermittent periods of illumination for each light source by a switch in the electric current supply to the light source. If gas is used, suitable means may be provided to control a gas valve leading to the light source, the light being reestablished by reigniting the main burner when desired from a conventional, continuously operating pilot flame. In all cases shutter means, as hereinafter referred to, could be used with any type of light source to effect the same result.

Furthermore, as structures of this kind are intended for use in installations where they may be serviced but infrequently, it is desired that means be provided for insuring continued operation, notwithstanding the burn-out of some one incandescent bulb. For this reason there is shown in Figs. 1 and 3 a lampchanging device generally indicated at 19, the operative bulb of which is located at the position shown at 20. The details of this lampchanger apparatus per se form no part of the present invention any may, for example, take any desired form, for instance any one of those shown in the patents to Wallace No. 2,054,013; Wallace and MacKay No. 2,195,374; MacKay, 2,258,575, or others.

The form of the invention shown in Figs. 1 to 4 as aforesaid uses a simplified construction and thus does not provide for light beam directing means such as parabolic mirrors, etc. There is shown a standard type of substantially cylindrical lens means generally indicated at 21 of the Fresnel type, suitable means being provided as hereinafter set forth for limiting the area illuminated from the light source. Such means as to the outside portions of the illuminated area comprise the side walls of the casings 14 and 18, the outside limits being determined by the angular location of an aperture 22 formed in the side wall of the casing or housing as best shown in Fig. 2. It will be understood that if desired a cylindrical shield having a suitable opening therein could be used and could be adjustably positioned so as adjustably to predetermine the angle of the outside limits of the illuminated areas by adjustment about the vertical axis of the housing 14 or 18, or both.

Located between the light sources and disposed in a substantially vertical plane is a light shield 23, which is supported by the base 6 and by the upstanding part 8 at the rear of the structure. This shield extends forwardly from the light sources a predetermined distance, as best shown in Figs. 1 and 2 and serves to define the inside boundaries of the respective illuminated areas. The shield 23 preferably extends vertically a distance greater than the vertical distance between the light sources and in practice, as shown in the drawing, extends from the base 6 to about the top of the upper casing 18.

As the shield 23 in effect determines the location of the center overlap area, it is desirable that the range light apparatus be so located that this shield will be disposed in a predetermined direction in respect to the preferred portion of the channel desired for use and the base 6 affixed to whatever supporting structure is used therefor in such position. For this purpose a

pair of sight means, including a front sight 24 and a rear or peep sight 25, may be provided on the top of the shield 23 and in the vertical plane thereof, so as to facilitate the location of the apparatus during its initial installation.

Means are provided in accordance with the present invention for controlling the degree of overlap of the illuminated areas from the two light sources, particularly by controlling the distances between the centers of illumination of the light sources and the plane of the shield 23. For this purpose, means are preferably provided, individual to each light source, for adjusting its position laterally in respect to the plane of the shield. As shown each light source is provided with a means such as that particularly shown for the light source within the housing 18, Figs. 3 and 4. Inasmuch as the parts are exactly similar, they will be given the same reference characters.

The slide portion 16 of the base 17 for the housing 18 is provided with a member 26, secured thereto as best shown in Fig. 4, which projects through a slot 27 formed in the upstanding portion 8 and has on its forward portion a lug 28, having a threaded aperture therein for receiving a threaded bolt 29. The member 26 also has parts engaging the forward face of the part 8 to retain the slide portion 16 in the guideway 15. The bolt 29 extends through a suitable aperture in the web 10 and is prevented from endwise movement in respect thereto by a pair of collar members 30 and 31, secured to the bolt 29 as by pins or the like and bearing against the opposite sides of a part of the web 10 through which the bolt passes. At its outer end the bolt 29 may be formed with a square or other noncircular portion, as shown at 32, for receiving a suitable tool by which the bolt may be rotated and the base 17 laterally adjusted as will be obvious from the foregoing description and the accompanying drawings.

The effect of this adjustment as to each light source is to vary the base of a triangle formed as the distance between the light source and the plane of the shield 23. As the altitude of this triangle is constant, being the lateral length of the shield, from left to right, as seen in Figs. 1 and 2, the angle of the hypotenuse to the base is varied accordingly, thus varying the angle of the inside limit of the illuminated area from each of the light sources and from the plane of the shield 23. From the above, it will be seen that the adjustment effected by the rotation of the bolt 29 associated with each of the light sources, will be effective to change one boundary respectively of the central overlap area. Thus by the conjoint adjustment of both, the central overlap area, wherein an observer will see a substantially steady light, may be varied within certain limits, both in position and angular extent.

Another method of controlling the angular width of the overlap zone is to provide an adjustable length shield in place of the shield 23, for example, by making the shield in two parts, one of which is slidable forwardly and rearwardly with respect to the other. This could be effected by providing a fixed section as shown in Figs. 1 and 2 for the shield 23 and providing a slidable section of substantially the same height, which could be adjusted to extend a desired amount to the left thereof as seen in Figs. 1 and 2. Such an arrangement is to be considered within the purview of the present invention.

Referring now to the form of the invention shown in Figs. 6 to 8 inclusive, there is shown a somewhat more refined embodiment of the invention, which is arranged to afford more accurate adjustment and a more accurately controllable arrangement than is provided in the simpler form shown in Figs. 1 to 4 and hereinabove described. The purpose, however, is substantially the same.

In this form the two light sources are arranged one above another and each independently adjustable as to angular direction of the light beam therefrom in two planes at right angles to one another. Further, the arrangement is such that light beam directing means, here shown as including a mirror and lens means for concentrating the light from the source into a relatively narrow beam, is used in association with each light source. It is contemplated, however, that a light source plus suitable lens means alone could be used to provide a usable light beam, but at some sacrifice in light efficiency.

The device as a whole is mounted upon a base 33, which is adapted to be stationarily supported in a suitable position in the same manner as the base 6 of the preceding form of the invention. Supported from the base 33 through stationary posts 34 is an upper stationary base 35. The two light sources in this case are each similar to the other and each is arranged within a similar housing, which is similarly supported respectively on the lower base 33 and the upper base 35. Inasmuch as these support arrangements are exactly similar in character, but one will be described in detail, it being understood that the other is substantially identical with the exception of the actual adjustments which are made in respect thereto in practice. As shown, there is a lower housing 36 for one light source and an upper housing 37 for the other or upper light source. The drawings show in detail the mounting for the lower housing.

As shown, the base 33 is provided at its forward end (to the right as seen in Fig. 6), with a pair of upstanding ears 38 in which is mounted a hinge pintle 39 for connecting the base 33 to an underbase member 40, the latter having a suitable hinge bearing portion 41 surrounding the pintle 39. Arranged rigidly in the underbase 40 adjacent to its forward end is a substantially vertically disposed pintle bolt 42 for pivotally connecting the underbase 40 with the upper base 43 by which the housing 36 is rigidly carried, bolts 44 being shown for connecting the housing to the base member 43.

When a range light apparatus of the type herein shown is used, for example, in illuminating a water channel and is located at a point a substantial distance above the surface of the water, it may be desired to direct the beam somewhat downwardly, i. e. at an angle to the horizontal, to compensate for the height of the light means above the water. For this reason each housing 36 and 37 is arranged to be adjusted in respect to the horizontal about the axis of the associated pintle 39 by angular adjustment between the positions of the bases 33 (or 35) and 40. For this purpose a screw stud 45 is provided threaded through a part of the base member 40 and bearing upon a part of the base 33. It will be seen that by screwing down the stud 45, the housing 36 will be inclined to the right, i. e. by clockwise rotation about the axis of the pintle bolt 39 as seen in Fig. 6, so as to direct the beam of light from the light source within the housing 36 downwardly.

For adjusting the beams laterally for purposes more in detail to be described hereafter, the base member 43 may be adjusted about the substantially vertical axis of the pintle bolt 42. For this purpose, the rear portion of the base 43 is formed with an arcuate slot 46, the center of which is the axis of the bolt 42. Projecting through this slot is a member 47 (similar in construction to the member 26, Fig. 4), the upper part of which overlies the slot and prevents undesired dislocation of the bases 43 and 40, and the member 47 being rigid with the base 40. Bearing against the opposite sides of member 47 are a pair of set screws 48 and 49 which are threaded through upstanding lugs 50 and 51 respectively formed rigid or integral with the base 43. The set screws 48 and 49 are provided with non-circular ends as shown for the reception of a suitable tool. Thus by suitably adjusting the set screws 48 and 49, the angular position of the housing 36 (or 37) may be individually adjusted at will within certain predetermined limits.

Means are provided corresponding in function to the sight means 24—25 of the previous form of the invention, for assisting in the setting up of the device. For this purpose the upper base 35 may be provided with a sight tube 52, or alternatively this sight tube may be merely a receiver or support for a telescope which may be attached at this point during the setting up operation and thereafter removed from the device.

Within each of the housings 36 and 37 there is provided a lampchanging device 53, which may be the same as or similar to the corresponding device 19 above referred to and which provides a plurality of electric bulbs, but one of which is in an operative position, shown for the bulb 54, Figs. 6 and 7. This lampchanging device may be of any of the types hereinabove referred to, but the details of which per se form no part of the invention. Associated with the source of light, here shown as the bulb at the position 54, there is preferably provided a mirror as shown at 55, which may be a parabolic or otherwise shaped mirror. As shown, this mirror is secured in a part of the housing by a plurality of bolts 56. Also associated with the light source and mirror is a lens means here shown as a pair of lenses 57 and 58, which may individually be spread-light lenses, each adapted to provide a particular predetermined spread of the light in a given direction. The lenses 57 and 58 are arranged so as to control the spreads in two directions at right angles to one another, such, for example, as horizontal and vertical. In the form of the invention shown in Fig. 6, the lens 57 is arranged to give a predetermined vertical spread while the lens 58 provides a predetermined horizontal or lateral spread for the beam. These lenses may be mounted in suitable receptacles or annular supports and may be interchangeably positioned in the housings according to the desired spread, the lenses being secured in position by an annular flange 59 extending inwardly from the housing and if desired integral therewith, and an annular threaded nut 60, which may be removably associated with the housing by screw threads as shown at 61 or in any other suitable manner.

In order to provide a further control of the spread of the beam, and also as a set up adjustment, means are provided for adjustably controlling the distance between the mirror 55 and the center of illumination of the operative source of light shown as the incandescent bulb 54. For this purpose the lamp-changer 53 as a whole may be mounted on a pair of parallel rods 62, Fig. 8, which are suitably fixed in the associated housing 36 or 37. Rigid with the lampchanger structure is a depending member 63 through which is threaded a bolt 64, this bolt being also mounted in at least one wall of the housing 36 (or 37). As shown, the bolt is mounted in the rear wall only and is prevented from endwise movement in respect to this wall by a pair of collars 65 engaging the opposite surfaces of the housing wall. The outer end of the bolt 64 is suitably formed non-circular, as shown at 66, for manipulation by a suitable tool. It will be understood that if the mirror 55 is parabolic in contour, it will normally be desired that the center of illumination of the operative light source be located at the focus of the mirror. On the other hand, some slight adjustments toward and away from such a mirror or a mirror of some other contour may be effective practically to obtain a desired spread of the beam and to effect a desired adjustment of such spread or to adjust the focus. This is for some purposes a simpler and quicker way of effecting this adjustment than the interchange of one or both the lenses 57 and 58. It is intended primarily for effecting relatively small adjustments.

The functional operation of the adjustment means effected by the screw stud 45 for controlling the vertical angle of the beams has previously been described. It will ordinarily be desired, however, that there be some predetermined angle of divergence between the center lines of the beams from the two light sources, which angle will be chosen with consideration to several elements, including the spread of the beams, the desired outside dimensions of the channel in question and the desired angular width and location of the center preferred zone for the overlap of the illuminated areas. When all these factors are known, it will be possible to plot or to determine by trial and error the desired spread of each beam. This can be effected as to each beam by a suitable selection of the horizontal spread light lens 58 associated therewith and by the adjustment of the bolt 64 controlling the distance between the center of illumination of the light source and the mirror 55. The spreads of the two beams and the direction of the center lines thereof will then determine the angular extent and location of the central overlap zone for the beams. The directions of the center lines may be determined by an adjustment made by the set screws 48 and 49 as to each housing or source of light therein independently.

While it is contemplated that independent means be provided for adjusting the light beams both vertically and horizontally, some common means, not herein shown in detail, but which will be obvious from the foregoing to those skilled in the art, is contemplated for use to effect a single adjustment for the angle of divergence between the beams in the lateral direction and another single adjustment for the vertical angle of both beams in respect to the horizontal.

Associated with the range light apparatus in whichever or whatever form it may take is a programming means by which the duration of illumination, i. e., initiation and cut-off periods of illumination as to each source of light, may be controlled in a regular and sequential manner. For this purpose any suitable means, usually comprising a constant speed prime mover, may be employed. The means particularly contem-

plated for use in accordance with the present invention is a constant speed electric motor, although it is contemplated that any other suitable prime mover which will operate, preferably by rotation, at a substantially constant rate, may be employed if desired. Such other means would include spring or weight operated motors, or even motors or engines driven by some other source of power than electricity, in accordance with what power may be available at the place where the apparatus is to be used. Other operative types of programming means will occur to those skilled in the art, e. g. a thermostatic type of flasher would be satisfactory, providing it had a snap-action movement and dwelled on one of its contacts for a period of time greater than on its other contact. Flasher mechanisms made from time delay relays having, for instance, a quick pull-up time and a slow drop-out time could also be used. All such means are to be considered as contemplated in accordance with the present invention and to be included in the scope of the appended claims not limited to preclude them.

As shown, however, there is preferably employed a substantially constant speed electric motor arranged to drive program cams at a desired rate of speed, possibly by gearing down the motor speed to a desired speed of rotation for the cam means. In accordance with the present invention, only one such motor is used, although it is contemplated that two or more may be used as specifically taught in my prior application Ser. No. 742,419 aforesaid. Each said motor which is indicated generally at 67, Figs. 13 and 14, may be of a known or conventional type, such for example as those shown in the patents to Wallace and MacKay No. 2,181,841, and to MacKay No. 2,181,842, both granted November 28, 1939. The arrangement shown in Figs. 13 and 14 is such as to drive a cam drum means 68 at a substantially constant speed and in a counterclockwise direction as seen in Fig. 14. This motor and the arrangement shown in Figs. 13 to 16 correspond generally to the circuit diagram shown in Fig. 9, wherein the motor per se is indicated diagrammatically at 67. Inasmuch as the motor from the present point of view is not claimed as a novel part per se of the general construction, it will not be described in detail but reference may be had to the patents aforesaid for a particular description of an appropriate motor for this purpose.

Referring now to Fig. 9, there is shown a possible wiring circuit for the apparatus of the present invention, the circuit being diagrammatic in character and merely including the principal elements thereof. As shown there are two line wires 69 and 70, to which electric energy may be supplied from any suitable source, such as a battery 71 under control of a master switch 72. It will be understood that any suitable source of electrical energy which may be available, including batteries or commercial power lines, may be employed as desired. As shown, the motor 67 is arranged across the lines 69—70 to operate whenever the master switch 72 is closed. This motor is shown driving program cams 73 and 74, the drive being shown as direct in Fig. 9, i. e. on a common shaft with the motor, although it will be understood that any suitable gear reduction may be employed as desired. The cams 73, 74 respectively control switches 75 and 76 for the two light sources here shown as 77 and 78, respectively. The diagrammatic illustration in Fig. 9 shows the light source in its operative position as connected to be illuminated, while the others on the same lampchanger are not in the circuit. This is the practical effect of the operation of the lampchanger referred to hereinabove. Further as shown, Fig. 9, the cam 73 has a large diameter portion shown at 79, effective to close its associated switch 75 during a time period in which the cam 74 has a small diameter portion 80 so that its associated switch 76 will at that time be open. The preferred arrangement is one in which the light sources are arranged to illuminate their respective areas in some substantially complementary time schedule as above set forth. The simplest or dot and dash arrangement is shown here for purposes of illustration. Thus as shown the light source 77, Fig. 9, will be illuminated once during each rotation of the cams for a short period only and the light source 78 will be illuminated once during each rotation of the cams for a relatively long period, the period of illumination of each light source corresponding substantially to the period of darkness of the other.

In an apparatus of this kind, it is desirable that a person located in the central overlap zone or steady light section, as designated in Fig. 5, should see a substantially steady light of constant intensity. For this purpose it is always necessary to initiate the illumination of one light source prior to the actual cessation of illumination of the other. However, when the light sources are electric incandescent bulbs and the control is effected by switches located in the current supply thereto, this result may not necessarily depend on initiating current flow to one lamp prior to the discontinuance of current flow to the other. Some lamps have a substantial period of "decay" of the illumination following the cessation of current flow therethrough and yet may respond very rapidly to the initiation of current flow therethrough. By a careful selection of such bulbs, the apparent illumination intensity may be substantially constant at least to an observer at some distance from the light sources. It is often desirable, however, to initiate the flow of current through one light source a sufficient time prior to the cessation of current flow through the other, so that there will be a slight overlap in time relation between these two. The effect of this is shown in Fig. 12, wherein the left hand light (referring to Fig. 5) will have relatively long periods of illumination, indicated at 81, and relatively short periods of darkness indicated at 82, while the right hand light will have relatively short periods of illumination indicated at 83 and 83', and relatively long periods of darkness shown at 84. While the periods of illumination and darkness are substantially complementary, as shown in Fig. 12, it will be seen from an examination of this figure that the period of illumination 83 extends a slight distance overlapping that at 81, and the period 81 extends a certain distance overlapping the initiation of the next period of illumination 83', etc. This can be effected by suitably constructing the high and low parts 79 and 80 for the cams 73 and 74 and by having these cams properly oriented upon a common drive shaft.

It may be that in some instance it is desired adjustably to vary the overlap time intervals between the initiation of illumination of one light source and the cessation of illumination of the other. For this reason an arrangement is shown in Figs. 13 to 16 as to the cam means there shown at 85, which corresponds generally to the cam 74 of Fig. 9. As shown, the cam 85 is made as a

pair of juxtaposed discs 86 and 87. One of these discs, such as the disc 87, may be rigidly secured to the driving shaft by which the cam 85 as a whole is carried and the other (disc 86) may be secured to and adjustable angularly in respect to the disc 87 to provide a shorter period of darkness in which the associated switch such as the switch 76 will be open. As shown, the disc 86 is provided with an arcuate slot 88, through which extends a set screw 89 to secure the discs 86 and 87 together once the adjustment has been made. In addition the disc 86 may be provided with a substantially radial slot 90, Figs. 14 and 16, through which extends a bolt 91, secured against dislocation in respect to the under disc 87 and a suitable support 92 by which the cam discs may be carried and provided with an eccentric portion 93 operating against the sides of the slot 90. The bolt 91 may be provided with a suitable screw slot 94 for manipulation by an appropriate tool such as a screw driver, and may further be provided with an indicating stud 95 extending radially therefrom so as to indicate the adjustment made. It will be understood that the cam follower is controlled by both the discs 86 and 87, so that relative angular adjustment of these discs as indicated in Fig. 15 will be effective to cut down the arc in which the cam follower will be at the lower diameter section of the assembled cam 85 in respect to the total length of the lower diameter portions of either the discs 86 and 87. Such an arrangement may be effected as to one or both cams 73 and 74, shown in Fig. 9, or as to the cams shown in Figs. 10 and 11 and hereinafter to be described.

When fixed cams only are used, it is necessary that they be very carefully cut to provide a substantially constant intensity of light in the central overlap zone. The cam dimensions must match fairly exactly the characteristics of the lamps used as to their time from initiation of current flow to full illumination and period of "decay" or time from cessation of current flow to little or no illumination. By providing adjustable cam means as described, such accuracy is no longer essential, as inaccuracies may be compensated for by adjustment of the cam discs as described. In addition such adjustable cam means may be used to compensate for lamps having different characteristics, which may be used from time to time.

Referring now to Fig. 10, a somewhat simpler arrangement is shown wherein no provision is made for an overlap of the periods of illumination of the two light sources. The power supply, master switch and motor are given the same numbers in this figure for convenience of reference as are also the two light sources. As shown, however, there is but one cam 96 driven by the motor 67 in this form of the circuit, this cam being arranged to open and close a switch shown diagrammatically at 97. It is contemplated, however, that this cam may be made removable and interchangeable if desired. This switch 97, which is preferably of a quick acting type, in turn is arranged to energize and deenergize a solenoid coil 98 which has associated therewith a double-throw switch, so arranged to make contact from the line wire 70 through the switch selectively to either the light source 77 or 78, according to whether the solenoid 98 is energized or not. The operation of the circuit will be obvious from inspection.

The circuit of Fig. 11 is even simpler than that of Fig. 10, corresponding parts being indicated by the same reference numbers for convenience. In this circuit the supply line 70 is connected directly to each of the light sources 77 and 78, while the supply line 69 is connected through a double throw switch 99 alternatively to the light source 77 or 78 according as the switch is affected by a high or low diameter portion of a controlling cam 100 as shown. In operation this circuit is shown making contact completing a circuit through a light source 77 under control of the higher diameter portion of the cam 100, which is of relatively small angular extent. Thus the light source 77 will be operated to give a series of short flashes, while the light source 78, illuminated when the cam follower is resting on a smaller diameter portion of the cam 100, will be effective to give a series of long flashes.

Referring to Figs. 1, 2 and 3, the programming means may be arranged on the base 6, as shown at 101, a suitable bracket 102 being provided for that purpose. The location of the programming means in the Figs. 6 to 8 form of the invention is not shown it being understood that the programming means may be located at any suitable location, preferably adjacent to the apparatus shown in those figures and suitable connections being made, in a manner not particularly illustrated, to the lampchanger and light sources in each of the housings 36 and 37.

While the several embodiments of the invention hereinabove particularly described include the control of the light beams as to turning them on and off by an electrical control of the current to the light source, which is an incandescent bulb, it is contemplated that any other means by which the illumination may be rendered intermittent should be considered within the purview of the invention. Such other means could, for example, be mechanical in nature and include shutter means, such as are well known in the art of light control, the shutter means being either oscillable to open and closed positions or rotatable in a continuous or intermittent manner with one or more suitable light openings which are periodically and successively brought in alignment with the light beam. In any event the light control means could be operated by a constant speed prime mover as described above, in a manner which will be obvious to those skilled in the art.

While the device in its various forms has been described primarily as one for use in guiding ships over navigable waters, it is specifically contemplated that apparatus of this same general type could be used for guiding persons or vehicles across essentially trackless areas such as those in a desert country. Furthermore, apparatus of this kind could be employed in guiding airplanes either along a course or toward a landing, considering the direction of guidance as generally lateral or in a horizontal plane, so as to indicate to a pilot of an airplane whether he is on a desired course or channel or to one side or the other thereof laterally. On the other hand, it is further contemplated that if desired, apparatus substantially in accordance with the present invention could be mounted at substantially right angles to that in which the present device is particularly arranged as herein shown, so as to indicate deviations from a desired channel in a vertical plane. If then the desired channel were, for example, an inclined glide path to be employed by airplanes in descending to a landing at an airport, a device according to the present invention could be used to indicate to the pilot

whether he was above or below the desired glide path at any instant. Any such use or others for which the apparatus of the present invention is reasonably susceptible and the method of using it are to be considered within the purview of the present invention and within the scope of the appended claims, which are to be construed validly, as broadly as the state of the prior art permits.

I claim:

1. Single station range light apparatus for visually indicating to an observer his position in respect to the center of a predetermined channel, comprising two electrically actuated sources of visible light located adjacent to one another and both located substantially in a predetermined plane containing the center of said channel and substantially in prolongation thereof in said plane, means for limiting the areas illuminated by said sources of light substantially to the respective sides of said channel but with an overlap zone substantially at the center of the channel included in the areas respectively illuminated by said light sources, and programming means for automatically controlling the time periods of illumination of said areas respectively to provide substantially complementary time periods of illumination of said areas respectively, said programming means being constructed and arranged to provide dissimilar and characteristic intermittent periods of illumination and darkness on opposite sides of said channel respectively, said light sources being electrically actuated and having a time delay period between the time of closing an electric actuating circuit and the emanation of substantially normal light intensity and a similar time delay between circuit interruption and disappearance of substantially normal light intensity, and said programming means further including means compensating for said time delays and providing a time overlap between the interruption of the electric actuating circuit for causing a cessation of illumination from one of said light sources and the closing of an electrical actuating circuit for the initiation of illumination from the other thereof, so that an observer located in the central overlap zone of said areas will see a substantially steady light uninterrupted due to any interval between the stopping of illumination from either one light source and the starting of illumination from the other.

2. Single station range light apparatus in accordance with claim 1, wherein said programming means comprises a substantially constant speed prime mover, cam means driven thereby, and means responsive to said cam means for controlling the illumination of each of said light sources, and wherein said cam means includes at least one cam made up of overlapping and relatively adjustable cam portions, so as to provide adjustable time periods for the initiation and cessation of illumination for said light sources, said cam means being further constructed and arranged so that an electric actuating circuit will be closed so that illumination of each light source will be initiated a predetermined adjustable time prior to the opening of an electric actuating circuit to cause cessation of illumination from the other light source, so as to provide a substantially constant light intensity in said central overlap zone independent of the periods of illumination and darkness on both sides thereof.

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