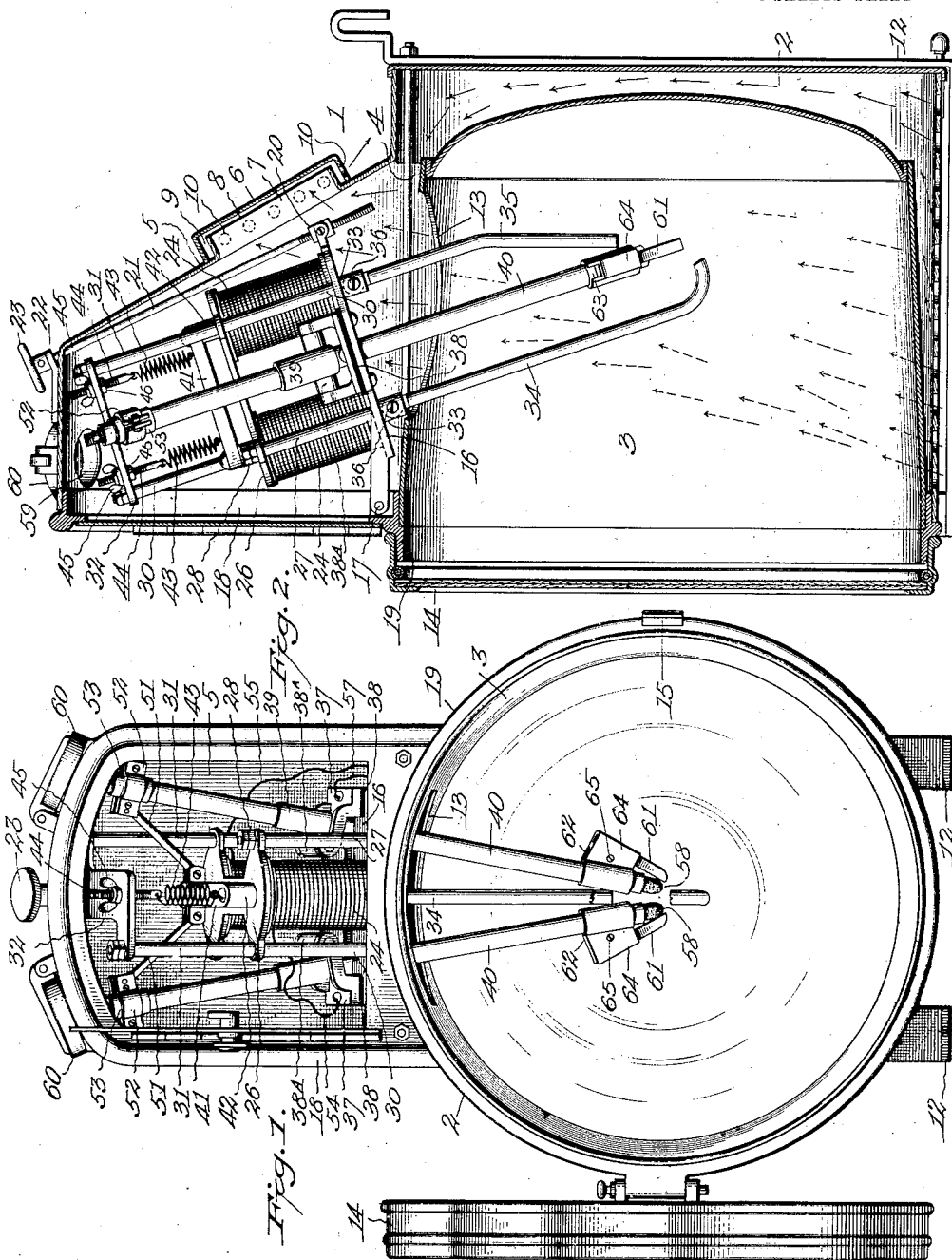


L. M. McBRIDE.
FLAMING ARC HEADLIGHT.
APPLICATION FILED JUNE 12, 1911.

1,062,408.

Patented May 20, 1913.

3 SHEETS—SHEET 1.



Witnesses:

G. Sargent Elliott.

Adella M. Fowle

By

Inventor:
Lewis M. McBride.

H. S. Bailey

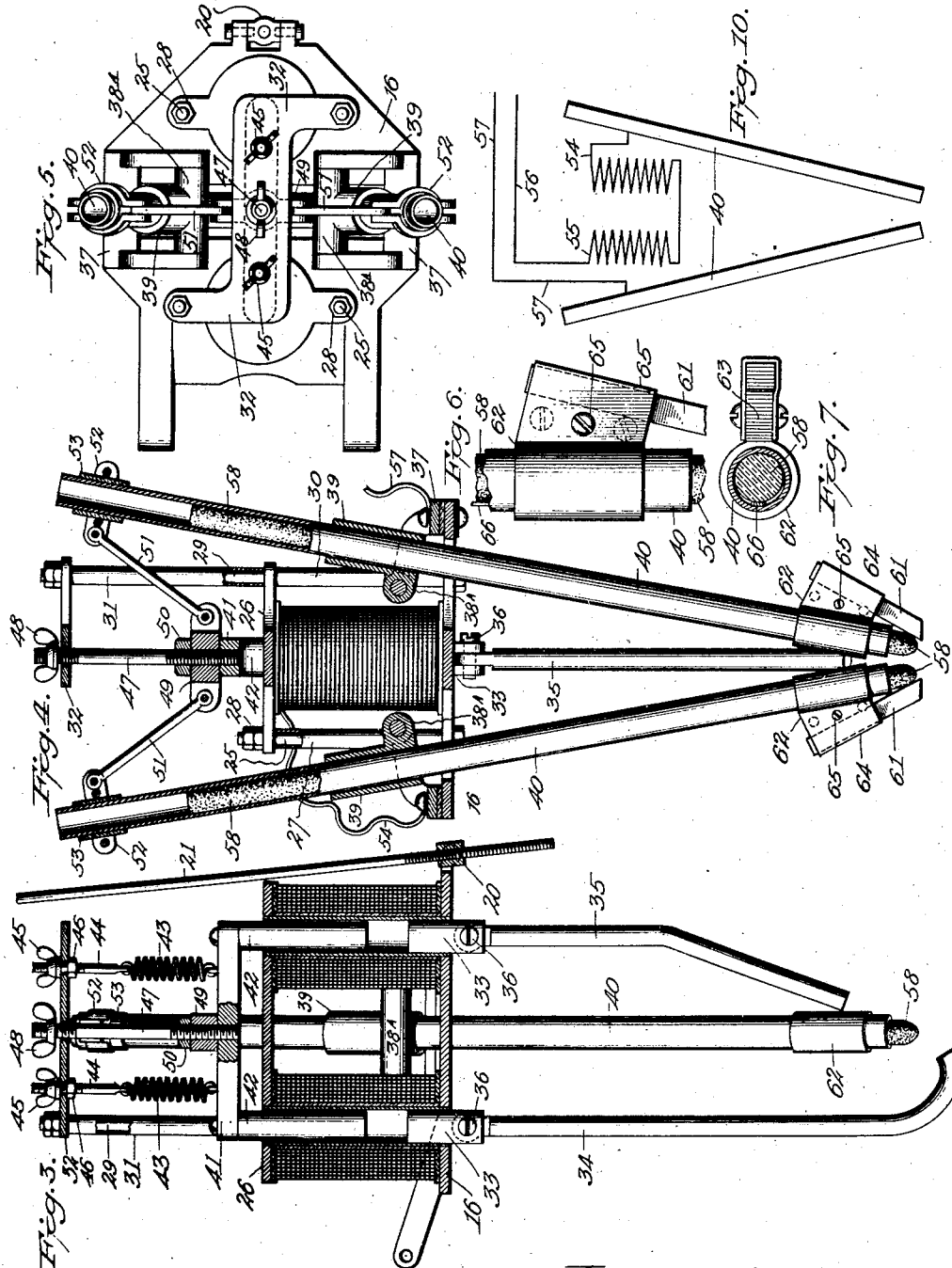
Attorney.

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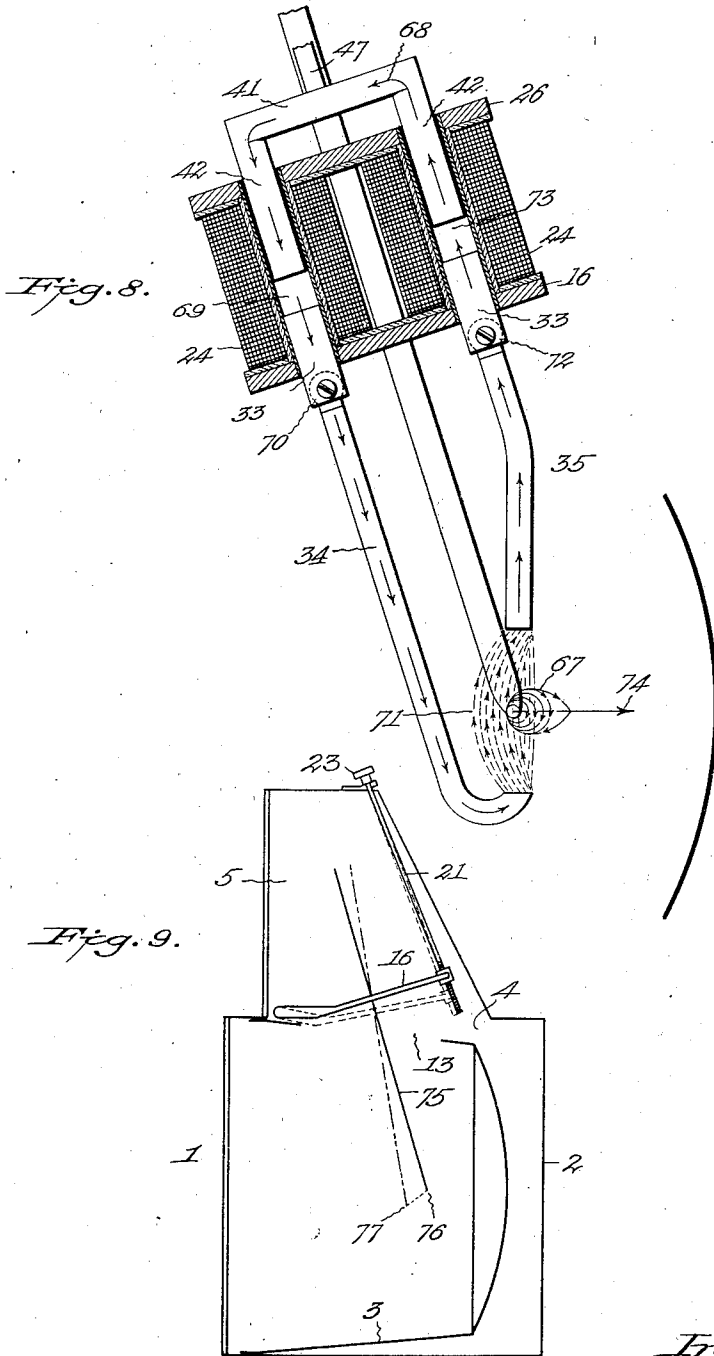
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3 SHEETS-SHEET 3.



Witnesses:

G. Sargent Elliott
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UNITED STATES PATENT OFFICE.

LEWIS M. McBRIDE, OF DENVER, COLORADO, ASSIGNOR TO THE ARCTURUS ELECTRIC AND MANUFACTURING COMPANY, OF DENVER, COLORADO, A CORPORATION OF COLORADO.

FLAMING-ARC HEADLIGHT.

1,062,408.

Specification of Letters Patent.

Patented May 20, 1913.

Application filed June 12, 1911. Serial No. 632,663.

To all whom it may concern:

Be it known that I, LEWIS M. McBRIDE, a citizen of the United States of America, residing in the city and county of Denver and State of Colorado, have invented a new and useful Flaming-Arc Headlight, of which the following is a specification.

My invention relates to improvements in electric headlights, and particularly to the use of a flaming arc lamp in connection with street railway and locomotive headlights, and the objects of my invention are, first: to provide a flaming arc headlight; second: to improve the character and efficiency of the illumination upon the track; third: to eliminate shadows from the projected light; fourth: to provide an electric headlight with an improved means of regulation; fifth: to provide an electric headlight in which the usual intermittent flickering of the light, due to the feeding of the carbons or electrodes, is prevented; sixth: to provide an electric headlight in which the arc is maintained in a predetermined fixed position, such as the focal point of a reflector used in conjunction with said headlight; seventh: to provide in connection with a flaming arc headlight, means for controlling and directing the flame of the arc along the axis toward the vertex of the said reflector; eighth: to provide in connection with a flaming arc headlight an improved form of reflector; and ninth: to provide in connection with an electric headlight a means for diverging or concentrating the light upon the track, at will of the operator. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1, is a front elevation of the improved headlight, the door of the housing which incloses the feed tube operating mechanism being open, as well as the door of the reflector casing. Fig. 2 is a vertical sectional view through the headlight, showing the feed tube operating mechanism in side elevation. Fig. 3 is a vertical, sectional view through the feed tube operating mechanism, showing the same detached from the headlight, and in a vertical position. Fig. 4 is also a vertical section of the feed tube operating mechanism, but at right angles to the line of section of Fig. 3. Fig. 5 is a plan view of the said mechanism. Fig. 6 is a side elevation enlarged, of the lower end of one of the feed tubes and clamps for hold-

ing one of the electrode supports, a thin metal contact strip being shown interposed between the electrode and tube. Fig. 7 is a plan view thereof, the tube and electrode being in section. Fig. 8 is a diagrammatic view illustrating the magnetic circuit through the armature and diverting magnets. Fig. 9 is a diagrammatic view illustrating the manner of moving the arc out of line with the focal point of the reflector. And Fig. 10 is a diagrammatic view illustrating the electric circuit through the solenoids and tubes.

Similar letters refer to similar parts throughout the several views.

For the purposes of this invention, I employ a specially constructed flaming arc lamp using electrodes which are composed of or charged with substances which give off at the temperature of the arc strongly luminous vapor, the proportion of light-giving radiation being greater than from incandescent solids such as the ordinary carbon arc. I preferably employ an electrode impregnated with calcium fluorid to produce a flaming vapor, which gives a golden light of great intensity. The spectrum of calcium fluorid displays its chief intensity in two very strong bands, one in the orange and the other in the greenish yellow, which blend into an orange yellow, and which is highly efficient in light production, as it gives its light in that part of the spectrum to which the eye is most sensitive. From the foregoing it is, therefore, apparent that the use of this flaming arc in conjunction with the reflector of a headlight will, first, give a greater amount of illumination for the same amount of energy consumed, than the carbon arc; second, it will enable engineers and motormen to readily distinguish the true color of signals and objects, and third, it does not have a detrimental effect upon the eyes, as objects are more easily and naturally distinguished. Further, the great penetrating power of yellow light in smoke, fog and dust makes its application ideal for headlight service.

As is well known, the flaming arc gives off fumes and some ash, and scoria is liable to form upon the ends of the electrodes, preventing the establishing of the arc when vertical electrodes are used. For these reasons the flaming arc cannot be inclosed, and for this reason, together with the fact that

the highly conducting vapor permits of a very much longer arc to be maintained between electrodes, two inches not being uncommon, it requires an entirely different lamp construction and mechanism than that employed for ordinary carbon arcs.

With the flaming arc practically all of the light emanates from the flame, which covers quite an appreciable area; therefore it is much easier, and in headlight practice is possible to maintain this large flame, or what might be termed a ball of light, upon and surrounding the focal point of a parabolic reflector. This large area of light permits of a certain movement of the flame without passing outside of the focal point of the reflector, hence a shifting of the flaming arc does not unfocus the light; also, inasmuch as the light is emanating from all points of this large area of flame its rays converge about any object which may be between it and the front of the lamp, such as the electrode feed tubes, diverting-magnet poles, or even small objects in front of the glass door of the headlight, which feature permits of the use of a grating in front of the glass door to prevent the breaking of the same by any objects coming in contact with the front of the headlight.

It has been admitted that considerable of the flame of the arc is surrounding the focal point of the reflector, and hence some of the rays from the flame will be out of focus, and in order to utilize those rays which are unfocused, as well as the direct side rays from the flame which do not in any case reach the reflector, I employ a shallow type of parabolic reflector to which is attached a reflecting casing located forward of and slightly divergent from the reflector. This casing serves to direct the rays out from the lamp and to intercept the unfocused rays and reflect them forward. This construction permits of the use of a reflector without any openings in it, hence eliminates shadows which would occur therefrom, and in addition gives a much greater reflecting surface than could otherwise be obtained. Further, the focal point of this type of reflector is farther forward from the apex of the reflector than in the deep type reflectors, which allows the lamp mechanism to be mounted over the forward casing with the electrode feed tubes extending through an opening in said casing at an angle with both tips of the electrodes toward the reflector, thereby delivering their light unobstructed to the reflector.

In street railway operation a wide range of voltage is frequently met with, also the variation of steam pressure in locomotive service causes a variation of speed of the steam driven turbines operating the headlight generator, resulting in extremes of voltage or current at the headlight, and to

meet these conditions and to maintain a constant source of light at all times at the headlight, I have devised a novel means of regulation of the arc lamp for this headlight. This said means of regulation is accomplished by a variable magnetic field across or surrounding the flame producing arc, said magnetic field being produced by the solenoids which also operate the mechanism of the lamp and which are energized by the same current as flows through and produces the flaming arc by virtue of the solenoid windings being in series with the flaming arc; therefore, any variation in the current passing through the flaming arc also varies in the windings of the solenoid and thereby causes a consequent variation in the magnetic field across or about the flame of the arc. As the magnetic field tends to increase with an increase of current in the windings of the solenoids, it therefore exerts a greater effect upon the arc, tending to divert it from its normal path and increase its length, consequently increasing its resistance and tending to maintain the current in the flaming arc constant. This effect, however, is very greatly intensified and augmented by the means and construction which I employ in the following described manner:

Referring to the drawings: the numeral 1 designates a flaming arc headlight embodying my invention. This headlight comprises an operative reflector casing 2, provided with a perforated bottom and with a light reflecting shell 3, that is arranged within the casing to leave a ventilating space all around it, and is provided with an opening 4, through the top of the headlight's casing that enters a hood portion 5 formed on top of the casing, the rear side of which is provided with an air outlet ventilating cage 6, within which there is a side wall portion 7 having an open top portion 8. This side wall portion is positioned all around the inside of the cage at a short space from it to leave a clear space 9 all around the side wall portion between it and the cage 6. The side walls of this ventilating cage are perforated with a plurality of apertures 10, which permit the air to escape to the atmosphere, as there is an air circulating draft through the perforated bottom around the reflecting casing into and through the casing and out through the cage as the air enters the front lower end of the headlight's casing, which moves forward when on a locomotive or car and creates a wind pressure against it. The air naturally circulates through the headlight and discharges through the cage at the rear of the hood where it is in the suction wake of the hood and headlight. The bottom portion of the headlight is provided with depending supporting feet strips 12, which support the headlight in an upright position

on suitable resting portions of a locomotive or car provided for them. These strips are extended up along the back of the casing of the headlight and their upper ends are provided with hook portions that are adapted to hook to suitable hook receiving members placed on the locomotive or car to receive them.

The top portion of the reflector casing 3 is provided with an aperture 13, which acts as a vent aperture for the heated air within the reflector casing and which is drawn out readily from the reflector casing by the suction effect of the draft or air circulating around the reflector casing. This reflector casing may be of any type best adapted to reflect the light of a flaming arc. The front end of the headlight casing is provided with a hinged door 14 and a suitable spring catch 15 is provided to hold the door in a closed position.

The hood 5 is arranged and adapted to house the flaming arc providing mechanism which forms the essential feature of my invention. Within the hood or housing 5, is supported a base plate 16, which is hinged at its forward end upon a rod 17, which extends across the hood and is secured at each end to the sides of a frame 18, to which the hood is secured, this frame forming the upper portion of a circular frame 19, to which the inner and outer headlight casings 3 and 2 respectively are secured. The rear end of the plate 16 carries a swiveled nut 20, through which the lower threaded end of an adjusting rod 21, passes. The upper end of this rod passes out through an aperture in the hood, and through an aperture in a plate 22, which is secured upon the top of the hood, and is provided with a knob 23, having a hub, which bears against the plate 22. By turning the rod 21, the angle of the plate 16 may be varied, as will be understood by reference to Fig. 2. The plate 16 carries the electrode feed tubes, and the operating mechanism therefor, and the adjustment of the plate is for the purpose of varying the position of the arc, relatively to the focal point of the reflector, as will hereinafter be fully set forth.

A pair of solenoids 24, are secured to the plate 16, by rods 25, which are secured at the lower ends to the plate, and extend up through a plate 26, which rests upon the upper ends of the solenoids, tubes 27, through which the rods pass, being interposed between the base plate and the plate 26, which latter plate is clamped upon the tops of the tubes, by nuts 28, which are screwed upon the upper end of the rods 25, against the said plates. Two additional rods 29 extend up through the base plate and plate 26, and above the latter plate, being surrounded by spacing tubes 30 between the plates 16 and 26, and by tubes

31 above the plates 26, which support a plate 32, as shown. Poles 33 are rigidly secured in the lower ends of the solenoids, and are provided with hinged extensions 34 and 35, respectively, the lower end of the extension 34 terminating on a plane a suitable distance below the focal line of the reflector, while the lower end of the extension 35, terminates on a plane above the said line. The extensions, together with the poles 33, constitute a pair of diverting magnets, the function of which will appear later. These extensions are pivotally connected to the lower ends of the poles, by screws 36, which permit the extensions to be adjusted and held at the desired adjustment.

On opposite sides of the base plate, and on a line midway between the two solenoids, are secured brackets 37, which are insulated from the base plate by suitable non-conducting media 38, such as sheets of mica. These brackets are each provided with a pair of inwardly extending arms, between which are pivotally supported hinge members 38 A, forming part of a pair of sleeves 39, which support a pair of electrode feed tubes 40. The solenoids are furnished with an armature 41, having plungers 42, which extend slidably into the upper ends of the solenoids, to within a short distance of the poles 33. The armature is supported by coil springs 43, which are attached at their opposite ends to threaded rods 44, which extend down through the plate 32. These rods are adjusted to vary the tension on the springs, by thumb nuts 45 on their upper ends, and are held against accidental movement by jam nuts 46.

A rod 47 is secured centrally to the armature and extends up loosely through an aperture in the plate 32, and is provided above the plate with a thumb nut 48, the purpose of which will be hereinafter set forth. The lower portion of the rod 47 is threaded, and it passes through a cross head 49, which rests upon the armature 41, and is clamped thereto against rotation, by a jam nut 50 on the said rod. The ends of the cross head are bifurcated, and in these bifurcated ends are pivoted the lower ends of rods 51, which are pivoted at their upper ends to clips 52, which are clamped upon the upper ends of the feed tubes 40, suitable insulating material 53 being interposed between the clips and tubes.

The solenoids are wound in series, and the terminal end 54 of one of their windings connects with one of the brackets 37, which supports one of the feed tube holding sleeves, while the terminal end 55 of the winding of the other solenoid connects with a feed wire 56, which leads to a source of power. A feed wire 57 connects the opposite bracket 37 with the source of power. When the current is on a circuit is established through

the feed tubes and their electrodes, the solenoids and arc. The solenoids are thereby energized and the armature drawn toward the poles 33, carrying with it the cross head 49, which draws upon the rods 51, which are attached to the feed tubes. The tubes are thereby rocked on their pivots and their lower ends are spread, the spreading movement being defined by the thumb nut 48, on the rod 47, contacting with the plate 32. The springs 43 exert a counter pull upon the armature to that exerted by the solenoids, and tend to draw the lower ends of the feed tubes together.

Electrodes 58 are inserted in the tubes 40 through openings 59 in the hood, which are covered by hinged caps 60. The lower ends of the electrodes pass out through the lower ends of the tubes, and engage stops 61, which are adjustably secured in brackets 62, secured upon the lower ends of the tubes. These stops are made of any suitable heat resisting material, preferably copper, and they are arranged at an angle to the direction of the tubes, so as to cross the path of the electrodes far enough to prevent them from slipping out of the tubes, as will be understood by reference to Figs. 1 and 4. The stop holding brackets 62 comprise sleeve portions, from which extend wings 63, to which are secured U-shaped metal plates 64, which hold the stops. One side of each plate is held to the wing 63 by a screw 65, which clamps the plate upon the stop, the stop being slightly wider than the wing 63. By loosening the screw 65, the stop may be adjusted to the required position. A thin strip 66 of brass or other metal, may be inserted in each tube 40, between the tube and the electrode, as shown in Figs. 6 and 7, their object being to insure uniform contact between the tube and the electrode and thus prevent arcing.

The current flowing through the windings of the solenoids, which also flows through the arc, causes the armature to be drawn down and thereby separates the feed tubes and the tips of the electrodes, striking the arc at 67, as shown in Fig. 8, and at the same time producing a magnetic flux through the magnetic circuit 68, 69, 70, 71, 72, and 73, as indicated by the arrows, 69, 73, and 71, being air gaps in the magnetic circuit.

As the armature 41 descends, the air gaps at 69 and 73 are decreased, consequently decreasing the reluctance of the magnetic circuit and thereby greatly increasing the magnetic flux in said magnetic circuit and across the field 71 at the arc, distending the arc and increasing its resistance and reducing the current, tending to retard the action upon the armature and causing a very close regulation of the current and the arc with a minimum of movement of the lamp parts.

When the magnetic flux is varying, due to a variation of the air gaps 69 and 73, it is at the same time further varied by the change of current strength in those turns of winding of the solenoids surrounding the upper ends of the diverting-magnets 34 and 35, all of which has a regulating effect upon the arc. The connections of the solenoid windings with reference to the direction of the current in the electrodes and across the arc are made, and the poles of the diverting magnets so placed that the flame of the arc will always be diverted toward the apex of the reflector, as shown by the arrow 74, Fig. 8, and along the line of the axis of the reflector.

The flaming arc is represented at 67 in which the current is flowing away from the observer, hence the lines of force about the arc are in a clockwise direction, as shown by the arrows of the circles about the arc. The magnetic lines of force of the field 71 across the air gap about the arc are from the north pole to the south pole of the diverting magnets, as indicated by the arrows. The lines of force about the arc 67 and the lines of force across 71 tend to coincide and in the mutual effort to do so they exert a crowding effect upon each other which diverts the arc in the direction of the arrow 74 and proportional to the strength of the current in the arc and the strength of the magnetic flux across the gap 71.

It is quite often desirable, especially in street and interurban railway service, to have a widely diverged light on city streets, while in sparsely settled districts where high speed is attained, a long powerful beam of light is necessary; this latter light is attained when the flaming arc is in the focal point of the reflector, while a diverged light is attained by moving the flaming arc forward from the said focal point. I have devised means of accomplishing this, as will be understood by referring to Figs. 2 and 9. The position of the electrode is shown by the full line 75, Fig. 9, and the arc is in focus when at 76; however, if the knob 23 be turned so as to allow the base plate 16 to be lowered, carrying with it the mechanism and electrode feed tubes, the electrodes and consequently the arc will be moved from 76 forward in the axis of the reflector toward 77, which consequently unfocuses the light and produces a widely diverged light.

As has been mentioned, a flaming arc produces a vapor which condenses into solid fumes, and it will be readily appreciated that in utilizing a flaming arc for headlight service that it is necessary to dispose of these fumes and prevent them from condensing upon the working parts of the lamp as well as the reflector and the headlight glass. The fumes which are generated at

the arc, immediately rise, due to the heated air about the arc, and pass out through the opening 13 and mingle with the air currents passing from the perforated bottom to the ventilator, all of which is indicated by the arrows. This serves to dispose of all fumes and gases within the lamp, and also supplies air to the arc which is necessary for its proper operation; however, the novel construction described prevents any direct draft of air against the flaming arc, which is very essential, as any such direct drafts against the flaming arc will cause it to flicker badly.

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

1. A headlight, having a casing with a light-regulating mechanism and a curved light reflector within the casing, arc-producing electrodes within the casing, having their ends adjacent the focal point of the reflector, and a pair of magnet poles in the casing adjacent the ends of said electrodes, the ends of said magnet poles being in the same plane with the center of the arc, and the focal point of the reflector.

2. A headlight, having a casing with a light-regulating mechanism and a curved light reflector within the casing, arc producing electrodes within the casing having their ends adjacent the focal point of the reflector, a pair of magnet poles in the casing terminating one above and one below the ends of said electrodes, said poles, the center of the arc, and the focal point of the reflector being in the vertical plane containing the focal axis of the reflector.

3. A headlight having a casing and a light-regulating mechanism within said casing, arc-producing electrodes within the casing, a pair of solenoids within the casing, fixed poles in the lower portion of the bores of said solenoids, extensions adjustably piv-

oted to said fixed poles for movement in a vertical plane and extending into the casing to points adjacent the ends of said electrodes.

4. A headlight having a casing and a light-regulating mechanism within the casing, arc-producing electrodes within the casing, a pair of solenoids within the casing, fixed poles in the lower portion of the bores of said solenoids, extensions adjustably pivoted to said fixed poles for movement in a vertical plane and extending into the casing to points respectively above and below the ends of said electrodes.

5. A headlight having a casing with a light-regulating mechanism and a curved light reflector within the casing, arc-producing electrodes inclined rearwardly within the casing toward the reflector at an angle to the vertical, and a pair of magnet-poles in the casing terminating one directly above and one directly below the ends of said electrodes.

6. A headlight, having a curved light reflector and arc-producing electrodes, said reflector and electrodes being so disposed that the focal axis of the reflector and the line of the arc are perpendicular to each other but in the same plane, and means for diverting the arc along said axis.

7. A headlight, having a curved light reflector and arc-producing electrodes, said reflector and electrodes being so disposed that the focal axis of the reflector and the line of the arc are perpendicular to each other but in the same plane, and a pair of magnet poles, one above and one below the center of said arc.

In testimony whereof I affix my signature in presence of two witnesses.

LEWIS M. McBRIDE.

Witnesses:

G. SARGENT ELLIOTT,
ELIZABETH SMITH.