May 28, 1935. H. J. BRUNK 2,003,104

ARC LAMP

Filed April 14, 1933 3 Sheets-Sheet 1

Fig. 1

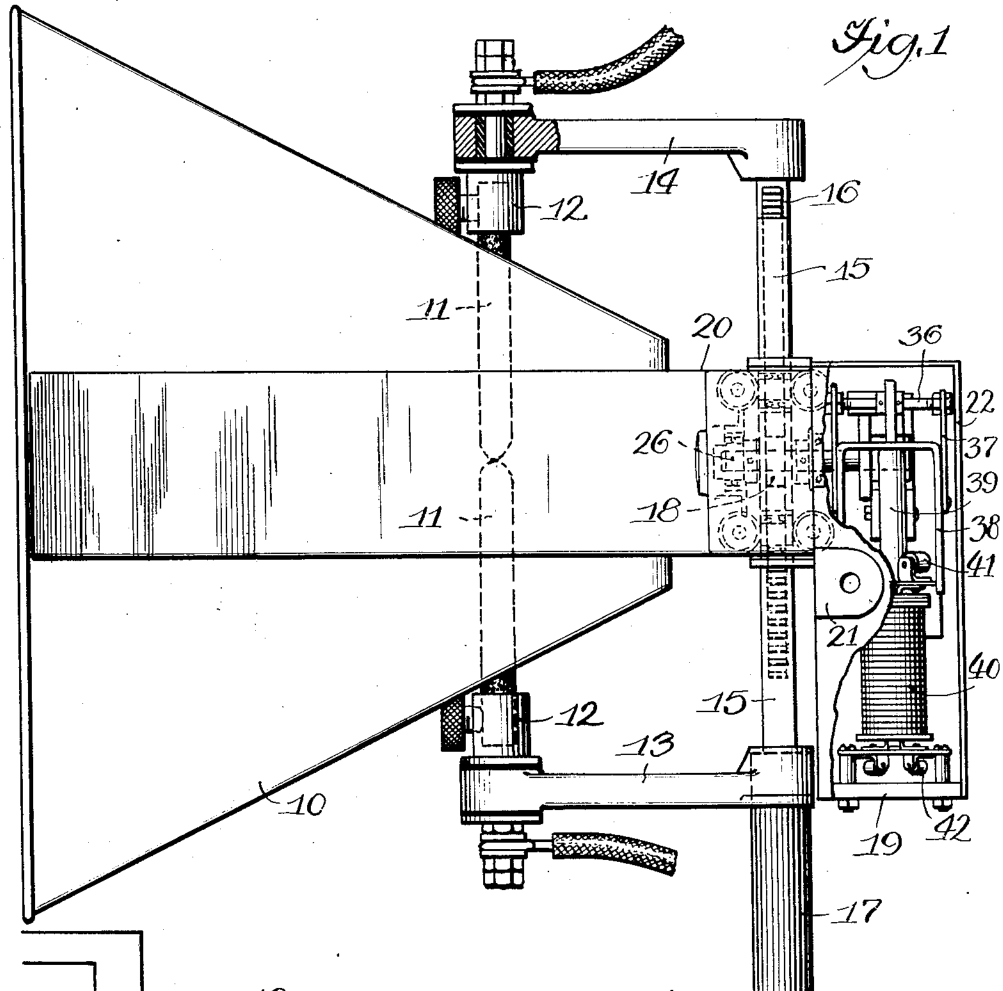
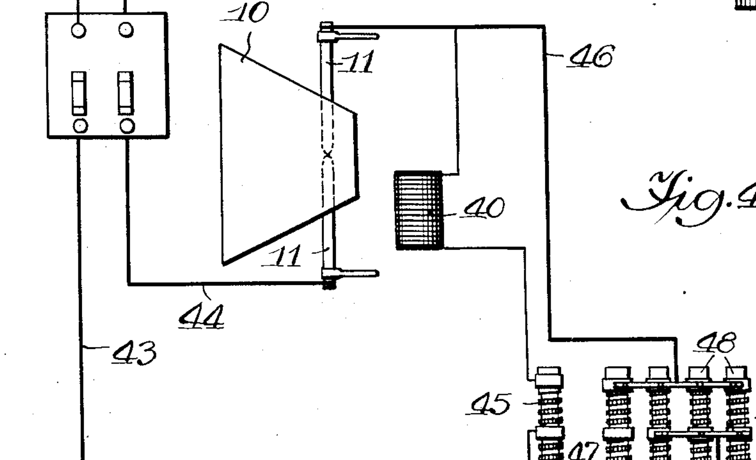


Fig. 4



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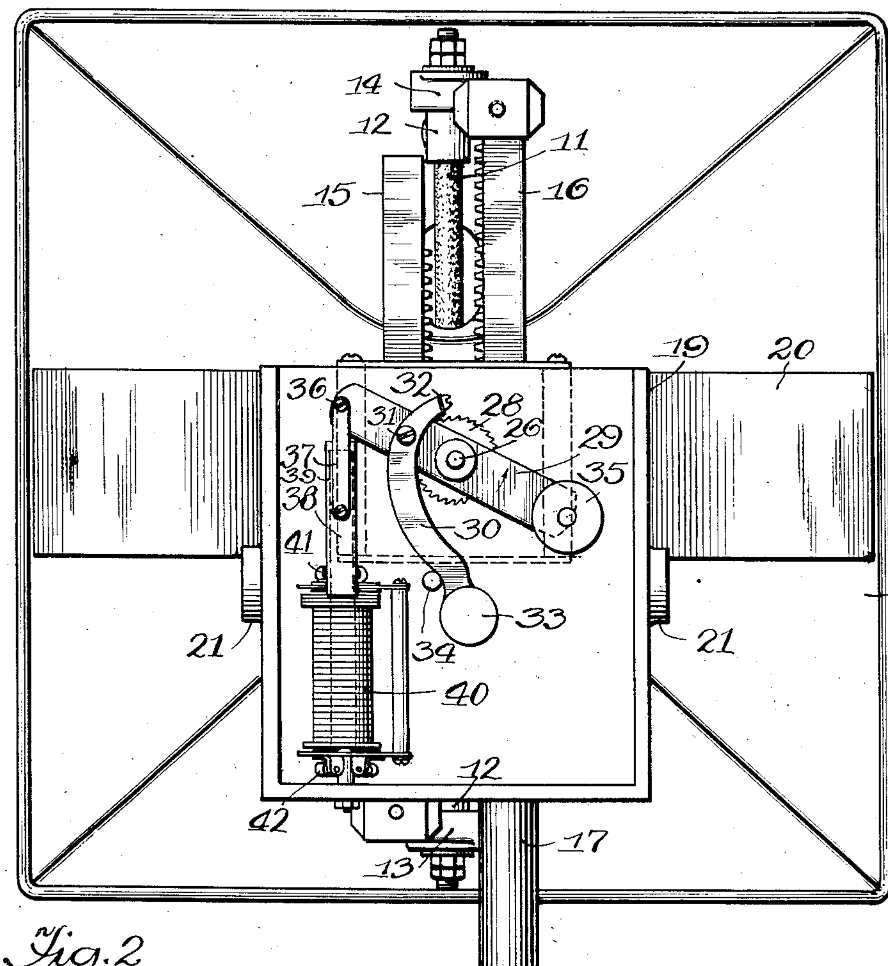

Fig. 2

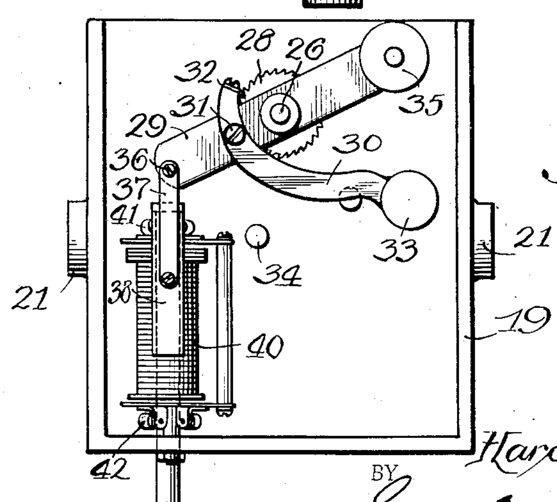

Fig. 3

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Fig. 5

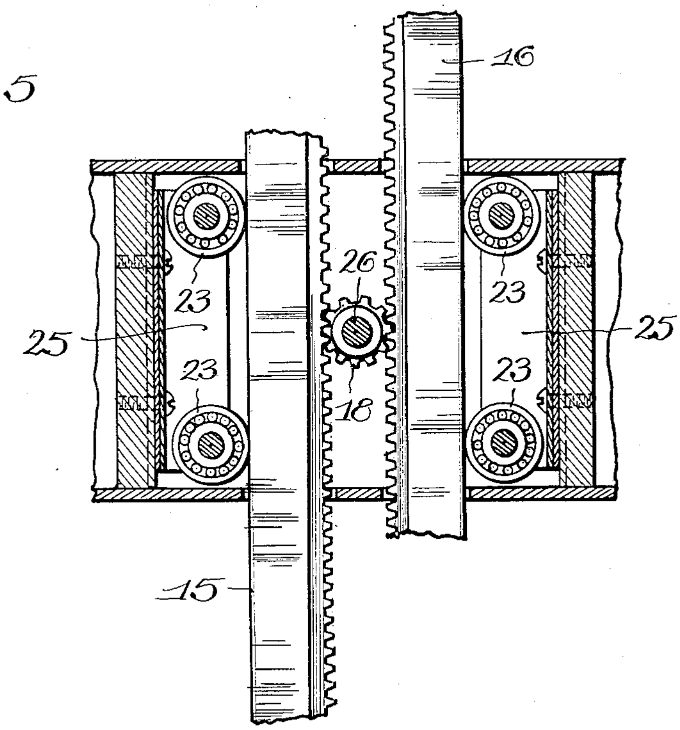
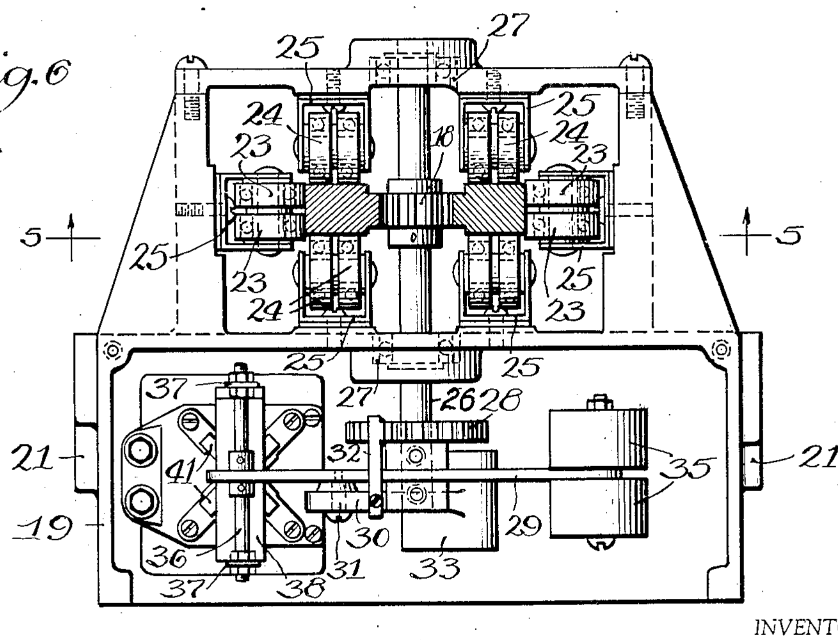


Fig. 6



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UNITED STATES PATENT OFFICE

2,003,104

ARC LAMP

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Application April 14, 1933, Serial No. 666,191

7 Claims. (Cl. 176—99)

My invention relates to improvements in arc lamps and more particularly to open flame arc lamps such as are used in photo-engraving, lithographing and other industries, based on photography.

Open flame arc lamps differ from enclosed arc lamps in that the light from the enclosed arc lamp consists of high frequency, short wave lengths in the neighborhood of the near-ultra violet but with comparatively little visual light. The open flame lamp, however, emits light that is principally suitable for illumination. It covers practically the full visual spectrum band. The value of the light is determined by the class of core material used in the carbons and the requirements are such that the white flame carbons cannot be satisfactorily used within a globe. The open flame lamps now on the market have certain limitations which render them objectionable. For example, those in which the lower carbon is stationary and the upper carbon is movable provide an arc, which, due to the rapid consumption of the carbons, changes its focus very quickly. In another type, embodying the so-called scissors movement, there are two arms swung from the same axis with the carbons mounted in fixed position on the ends of the arms whereby the carbon points travel in the arc of a circle, resulting in a constantly changing distance between the arc and the copy as the carbons are consumed. Furthermore, only a few inches of carbon project through the carbon holder with this type of mechanism, which necessitates frequent manipulation of said carbons.

The general object of the present invention is to overcome this and other difficulties by providing a fast, efficient lamp and one which requires little adjustment or manipulation but which gives substantially uniform light with a given setting.

Contributory objects are: to provide carbon feeding mechanism which permits the use of long carbons held at their remote ends, thereby giving a maximum of carbon consumption while maintaining automatically an arc of substantially constant length, without any manipulation throughout the entire burning period; to provide a lamp of this character in which the arc has a fixed focus, i. e. it remains at the same distance from the subject and has a central focus throughout the entire burning period; to provide a perfectly balanced carbon holder mechanism which permits the carbons to be replaced by others of different size without altering the adjustments; to provide a feeding mechanism which is positive, dependable and free of adjustments and for which a dash pot is unnecessary; to provide for selective radiation by the use of resistances connected in circuit in various combinations controlled by switches by means of which the current flowing through the arc may be varied without materially changing the current flowing in the solenoid which regulates the length of the arc, whereby said arc may operate on high currents, insuring very fast photographic work.

Various other objects and advantages will be apparent from the following description.

To illustrate the invention, I have shown in the accompanying drawings one embodiment thereof.

Fig. 1 is a side elevation;

Fig. 2 is a rear view with a cover removed showing the mechanism in its inactive position when no current is flowing;

Fig. 3 is a view of part of the mechanism of Fig. 2 in the position it assumes when current is flowing;

Fig. 4 is a circuit diagram;

Fig. 5 is an enlarged sectional elevation on line 5—5 of Fig. 6 of certain operating mechanism; and

Fig. 6 is a plan view thereof.

The reflector 10 is of the general form heretofore used in photo-engraving, lithographing and like arts employing photography and has top and bottom openings therein through which pass the carbons 11, 11. These carbons are clamped in carbon holders 12 of any suitable design. The lower carbon holder arm 13 may be made of light material such as aluminum, whereas the corresponding upper arm 14 is made preferably of heavier material such as brass or cast iron. As hereinafter pointed out, the difference in weight of these arms is a factor in causing the carbons to move toward each other and make contact after the current has been shut off.

The lower arm is supported by and moves with a vertically movable rack 15 and the upper arm is similarly mounted on a second vertically movable rack 16. A weight 17 is attached to the lower end of the rack 16 to augment the weight of the arm 14. The teeth of the two racks face each other and mesh with the pinion 18. Thus it will be seen that upon rotation of said pinion said racks will move in opposite directions to separate the carbons if they are in contact, or to move them toward or away from each other to vary the length of the arc if they are out of contact as is the case when the lamp is in operation. Said pinion and associated parts are mounted within a suitable housing 19, to which is fixed a bracket or supporting member 20 supporting the reflector 10. Said housing has a pair of perforated ears 21 by means of which the structure as a whole may be pivotally mounted on a suitable standard and whereby such structure may be clamped in any one of a number of different positions, with the light from the reflector directed toward the work either in a horizontal beam or inclined one way or the other. In practice, the lamp may be tilted as much as 30 degrees from the vertical, without interfering with the operation of the carbons and associated mechanism. Said mechanism is mounted in the housing 19 and access thereto may be had by the removable cover 22.

As shown in Fig. 5, the up and down movement of the racks 15, 16 is accomplished with a minimum of friction by the provision of sets of ball bearing rollers 23 which bear against the outer surfaces of said racks, additional ball bearing rollers 24 being provided to bear against the opposite sides thereto at right angles to said first rollers, as shown more particularly in Fig. 6. These ball bearing rollers are supported within vertical channel members 25 secured to the wall of the enclosure.

The pinion 18 is mounted on and turns with a shaft 26 mounted preferably in ball bearings 27 in said enclosure walls and having a ratchet wheel 28 on the overhanging end of said shaft. The rocker arm 29 is mounted to turn freely on said shaft and has a pawl carrying arm 30 pivotally secured thereto at 31 carrying a pawl 32 in the form of a thin blade at one end and a counterweight 33 at the other end. When the parts are at rest in the positions shown in Fig. 2, the effect of said weight is to hold said arm 30 against the stop 34 with the pawl 32 out of engagement with the teeth of the ratchet wheel 28. Thus the shaft may rotate freely to facilitate moving the racks up and down by hand when changing the carbons.

The rocker arm 29 is normally held in the position shown in Fig. 2 by means of a counterweight 35 at one end thereof. The other end carries a cross rod 36 having a pair of depending arms 37, the lower ends of which are pivotally secured to an inverted U shaped member 38 to the center of which the core 39 of the series solenoid 40 is secured. Said core is guided in its up and down movement by groups of small rollers 41—42 at the top and bottom of the solenoid, as shown in Figs. 1 and 6, to reduce friction.

When current flows through the solenoid 40, it draws down the core 39, thereby moving the rocker arm 29 and associated parts to a position such as illustrated in Fig. 3. During this movement the pawl carrying arm 30 swings away from the stop 34 and the pawl or blade 32 engages one of the teeth of the ratchet wheel 28, thereby rotating the latter and also the shaft 26 and the pinion 18 which latter raises the rack 16 supporting the upper carbon and lowers the rack 15 supporting the lower carbon, thereby separating said carbons and striking an arc.

The rocker arm 29, and associated parts, are so designed and balanced by the weight 35 at the end thereof as to provide a delicate adjustment whereby any weakening of the pull of the solenoid causes the carbon points to move toward each other, thus shortening the arc. This weakening of the solenoid is caused by consumption of the carbons as the lamp operates, resulting in a longer arc at a higher voltage and a lower amperage than normal, the effect of which is to decrease the energization of the solenoid as stated, lessen its pull and shorten the arc. By way of illustration, a slight change in amperage amounting to 10 per cent or less of the total of 12 amperes, which may be assumed to be the normal current flow through this coil, is sufficient to bring about a floating condition. If the arc should be extinguished while the lamp is operating, the solenoid is deenergized and the carbons come together, due to the fact that the cessation of the pull on the solenoid core enables the counterweight 35 to swing the rocker arm 29 thus elevating the ratchet carrying arm 30 and releasing the pawl 32 carried thereby from the ratchet wheel 28. During the operation of the lamp, i. e. when current is flowing through the solenoid said pawl is held in engagement with the ratchet wheel by its counterweight 33, as illustrated for example in Fig. 3, and this engagement is maintained in any position which the core may assume, under the influence of the solenoid. Thus the links 37, the rocker arm 29, the pawl and ratchet just mentioned, the shaft 26, the pinion 18, the two racks and certain other associated parts, constitute direct, positive mechanical connections between the solenoid core and the carbon holders whereby any fluctuations in current and consequent variations in the energization of the solenoid due to changes in the length of the arc, are immediately compensated for through these mechanical connections, to change the arc length in such a way as to tend to restore the current flowing through the arc to the desired constant value. In other words, the pawl and ratchet act much like a clutch in that they transmit motion in both directions instead of in one direction only. The parts being carefully balanced, the mechanical operation is regulated within close limits which results in holding the length of the arc at a substantially constant average value. The design is such that any variation in the energy of the solenoid is reflected immediately in the position of the carbons. In other words, said carbons are moving slightly nearly all the time but the movements correspond so closely to the fluctuations in the series coil, due to carbon consumption, that the light is practically uniform.

The use of the double rack and pinion for simultaneously adjusting the upper and lower carbons is an important feature in that it permits the use of carbons of almost any length. It is apparent that said racks could be operated by a pinion shaft by means other than the solenoid coil, as for example by a small motor. Also means other than the rack and pinion arrangement may, of course, be used to move the carbons simultaneously in opposite directions. The rack and pinion mechanism however is entirely dependable as a means for separating the upper and lower carbons and maintaining a central focus. The carbons themselves may vary considerably in dimensions, depending on the character of the work. For example, two twelve inch carbons may be used, which, being mounted at the extreme upper and lower ends would give about nineteen inches of carbon available for consumption without any manual adjustment of said carbons in their holders. Said carbons, being in vertical position except where the structure is tilted, insure uniform burning, greater stability with a minimum of flicker and the arc remains a uniform distance from the subject during the automatic adjustments effected by the solenoid and counterweighted parts.

Since the carbon holder mechanism is balanced, it permits the carbons to be changed to other sizes without altering the adjustments. For example, the lamp in the form illustrated will operate equally well with any size carbons from three eighths of an inch to one inch in diameter and the lamp can be used with any amperage, for example, from 10 to 100, merely by changing the carbons, i. e. using those of other sizes.

In Fig. 4, a circuit diagram is shown in which some of the same reference numerals have been used to indicate parts previously described. The circuit to the lamp is indicated by conductors 43—44. The solenoid 40 is in series with the carbons 11. An adjustable resistance 45 is also connected in series in this circuit. A parallel circuit 46—47 is provided around the series solenoid 40 and in this shunt circuit additional resistances 48 are provided. These resistances 48 are variable and connected to suitable switches, not shown, by means of taps so that any effective resistance may be obtained. The resistances 45, 48 operate satisfactorily either on alternating current or direct current although, of course, reactances may be used if preferred, in connection with alternating current.

The lamp is adjusted initially by opening the shunt circuit 46—47 and adjusting the resistance of the series circuit or solenoid circuit to such a point that the carbons are separated slightly, the power available being just sufficient for this purpose and no more, as a result of which the parts are balanced mechanically and very delicately, due to the pull on the solenoid core, so that any slight consumption of the carbons will cause said coil to weaken, followed by the immediate approach of the carbons toward each other, with the result that the length of the arc does not vary materially. After this very fine, free, floating condition is established, by means of the series circuit, the shunt circuit is closed and the resistances are adjusted to give the proper light emission for the particular class of service. Any light emission can be obtained within the limits of the particular carbons used and this result is accomplished without materially disturbing the initial adjustment of the series circuit.

By means of this shunt circuit a greater flow of current through the arc is permitted without materially increasing the current flowing through the series solenoid, and, therefore, without materially increasing the magnetic effect or pull of said solenoid. Thus, the carbons are not moved farther apart but the arc remains substantially the same length, under all conditions of operation, although considerably greater current may be caused to flow through said arc than would otherwise be the case, resulting in a very great increase in the light emitted by the lamp.

By means of the circuits illustrated, any portion of the maximum output of the lamp may be rendered available by merely throwing the necessary switches. For example, if a certain exposure required 100 amperes, whereas five other uses of the lamp required five different amperages, as for example, 35, 45, 50, 70 and 90, any of these might be obtained by operating the switches that tap the resistances in the proper places. After the switches have been operated to provide the desired selective radiation, the lamp will continue to burn properly without any adjustment, and furthermore the switches may be operated to change the light emitted, without discontinuing the operation of the lamp.

The use of amperages above 50 is very efficient and in fact a very high efficiency is obtained using 75 amperes and 40 volts at the arc on a 110 volt line. Tests have shown that by using 75 amperes, the light emitted by the lamp is such as to permit certain photographic work to be carried out about three times as fast as with a lamp operating on 40 amperes.

The lamp structure is such as to permit these high currents to be used, with a comparatively light, simple mechanism.

I claim:

1. An arc lamp comprising two carbon supporting racks, a single pinion engaging said racks to move them in opposite directions, a solenoid connected in series in the circuit of said carbons, a core for said solenoid, pawl and ratchet mechanism actuated by the movement of said core for rotating said pinion to move said carbons toward and away from each other, to maintain an arc of substantially constant average length during consumption of said carbons, said mechanism comprising positive mechanical connections operative during the entire period of energization of said solenoid, but inoperative during the deenergization thereof, whereby said racks and carbons may be manipulated without reference to said solenoid when the circuit is open and a circuit in parallel with said solenoid and in series with said carbons to permit a heavy current to flow through the arc formed between said carbons and increase the light emitted thereby without materially increasing the strength of said solenoid.

2. An open flame arc lamp for photo-engraving, lithographing and the like, comprising a reflector, upper and lower carbons passing through openings therein to engage each other, upper and lower carbon holding arms above and below said reflector, a rack supporting each arm, a pinion with which each rack engages, whereby rotation of said pinion will move both of said racks to vary the arc formed between said carbons, and a shaft on which said pinion is mounted, a solenoid connected in series with said carbons, a ratchet wheel fixed to said shaft, a rocker arm rotatable on said shaft, a pawl on said rocker arm to engage said ratchet wheel and maintain said engagement throughout the energization of said solenoid, and a core for said solenoid connected to said rocker arm, said racks and the mechanically connected moving parts being so balanced that a small current through said solenoid will cause it to hold said arc to a substantially constant average length, said solenoid constituting the sole electrical means for regulating said arc.

3. Mechanism as in the preceding claim in which the pawl comprises an arm pivoted to said rocker arm, a thin piece of metal at one end thereof to engage the ratchet teeth, a counterweight at the other end thereof and a stop for limiting the swinging movement of said arm with reference to said rocker arm.

4. An open flame arc lamp comprising an upper and a lower carbon holder each having means to grip a carbon near one end thereof, interconnected counterbalancing means for said holders, whereby said carbons may be moved simultaneously toward or away from each other to vary the length of the arc, the effective weight of the counterbalancing parts associated with said upper carbon being greater than those of the lower carbon whereby said carbons tend to engage each

other, a solenoid in series with said carbons, means normally tending to withdraw the core of said solenoid from the same, a pawl and ratchet mechanism connected to said solenoid core to actuate said counterbalancing means in a direction to separate said carbons when said solenoid is energized, said pawl and ratchet mechanism being weighted to insure a floating condition of said carbons when the lamp is operating and to maintain a direct mechanical connection between said solenoid core and said carbons, whereby an arc of substantially uniform, average length is maintained by said solenoid, and means to automatically disengage said pawl and ratchet when said solenoid core is being withdrawn upon deenergization of said solenoid, whereby said carbon holders may be moved and the carbons replaced without disturbing the adjustment of the remaining parts.

5. An arc lamp as in claim 4 having in addition a shunt circuit around the series solenoid but connected in series with said carbons, a resistance in said shunt circuit whereby the current flowing through said arc may be increased to any value within a range of about 10 to 100 amperes or more, without materially affecting the current flowing through said solenoid.

6. An open flame arc lamp for photo-engraving, lithographing and the like, comprising a reflector pivotally supported about a horizontal axis, upper and lower carbons passing through openings in said reflector to engage each other, upper and lower carbon holding arms above and below said reflector, a rack supporting each arm, anti-friction guides therefor, a pinion with which each rack engages, whereby rotation of said pinion will move both of said racks to vary the arc formed between said carbons, a shaft on which said pinion is mounted, ball bearing supports for said shaft, a solenoid connected in series with said carbons, a ratchet wheel fixed to said shaft, a rocker arm rotatable on said shaft, a pawl near one end of said rocker arm to engage said ratchet wheel, a counterweight at the other end of said rocker arm and a core for said solenoid connected therewith to rock said arm and engage said pawl with said ratchet wheel, thus maintaining a connection between said core and said racks to control the movement of said carbons, whereby the moving parts operate freely and are so balanced that said solenoid maintains a substantially constant average length of arc, with said lamp operating either in vertical or in inclined position, depending on the adjustment of said reflector about its horizontal axis.

7. An open flame arc lamp for photo-engraving, lithographing and the like, comprising a pair of substantially parallel rack bars mounted in a vertical plane, an arc sustaining electrode carried by each of said rack bars, a pinion between said rack bars engaging the teeth of both racks to insure simultaneous movement of the electrodes in opposite directions, a horizontal shaft to which said pinion is secured, a ratchet wheel fixed to said shaft, a rocker arm mounted to turn freely about the axis of rotation of said shaft, an arm pivotally mounted on said rocker arm, a pawl carried thereby and normally disengaged from said ratchet wheel but moved to engage the latter when said rocker arm is swung from its normal position of rest, a solenoid in series with said electrodes, a core therefor, a link connecting said core and rocker arm to turn said shaft and thus move said rack bars to separate said electrodes and strike and maintain an arc when the circuit is closed, and means for shunting a variable amount of current around said solenoid to permit an increase or decrease of current through said arc to vary the light emitted thereby, without substantially varying the length of said arc, said rack bars, pinion, pawl, ratchet, and link serving to maintain the control of the arc length by said solenoid, and to maintain a balanced condition for any desired adjustment of current through said arc as long as the circuit remains closed, whereby uniformity of illumination is maintained as the carbons are consumed.

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