Dec. 22, 1936. P. S. RAO 2,065,023

ELECTRIC FLAME PRODUCING DEVICE

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Fig. 1.

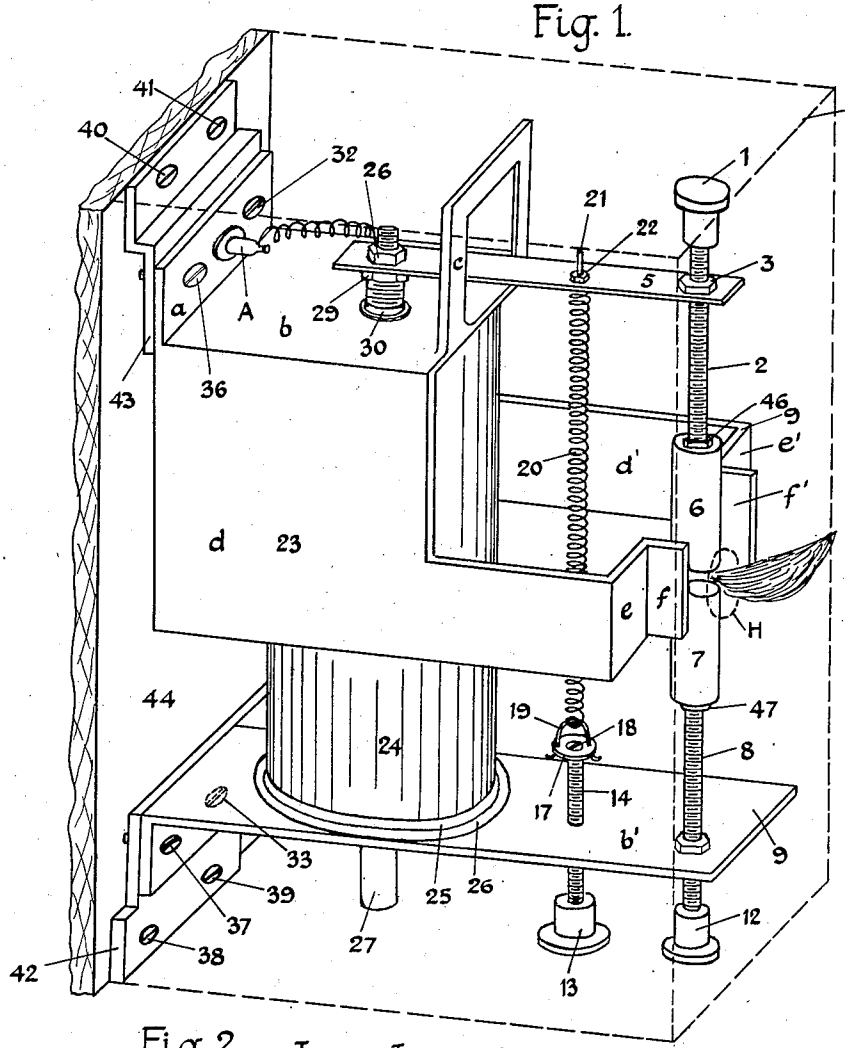



Fig. 2.

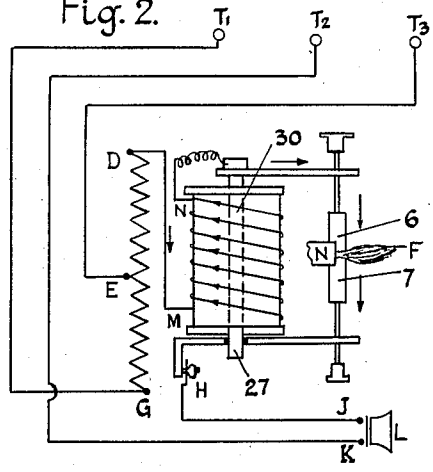
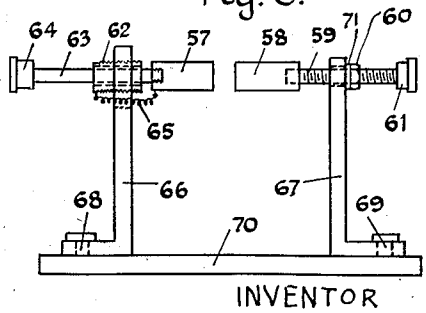



Fig. 9.




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Fig. 3.

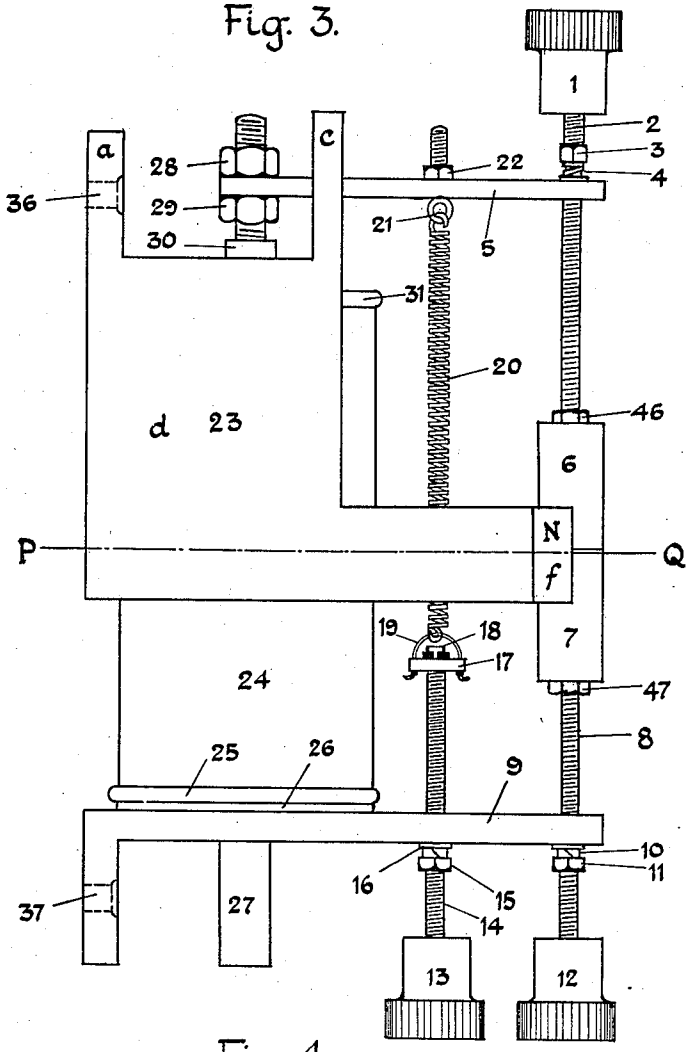
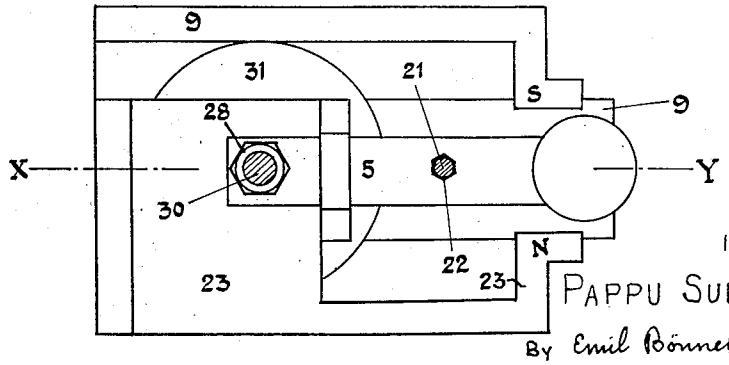



Fig. 4.




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Fig. 5.

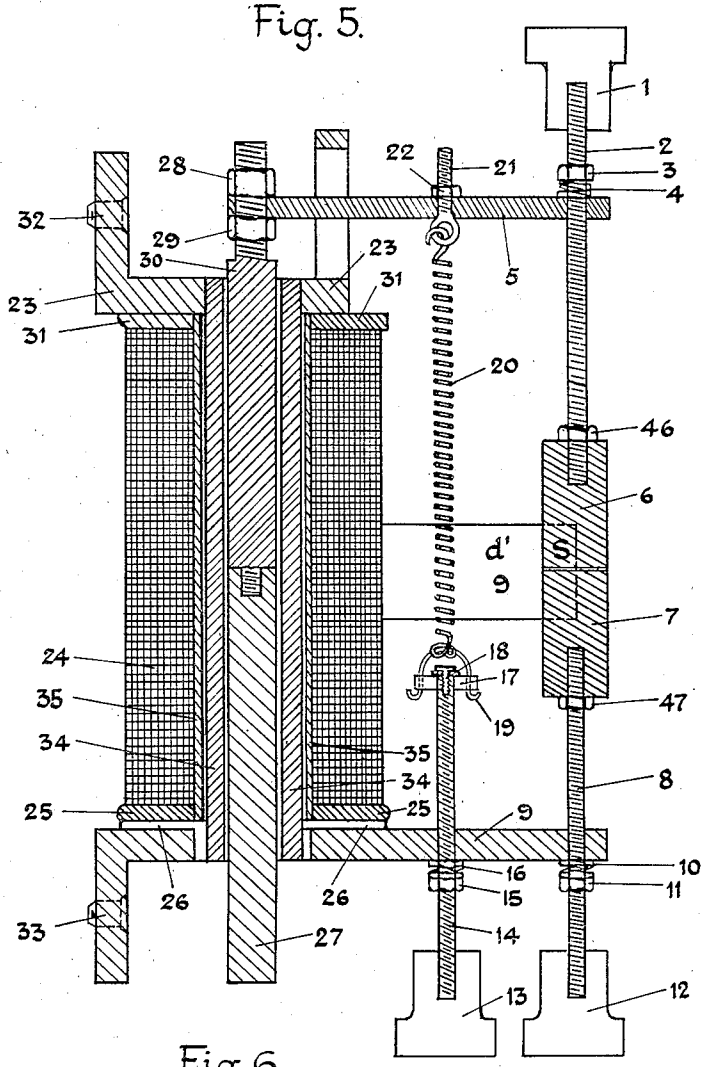
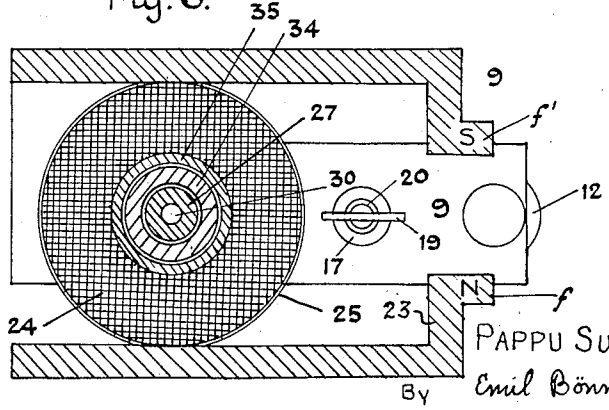



Fig. 6.




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Fig. 7.

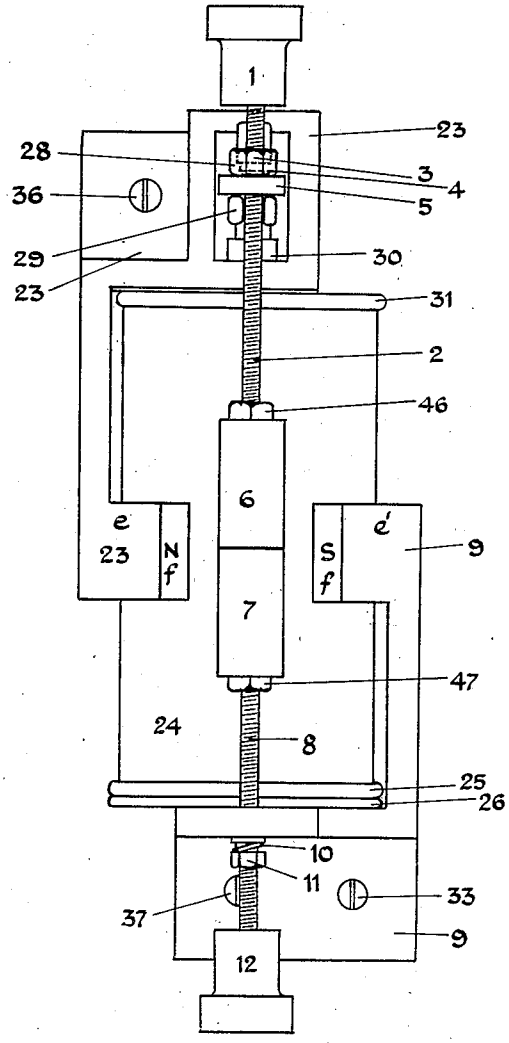
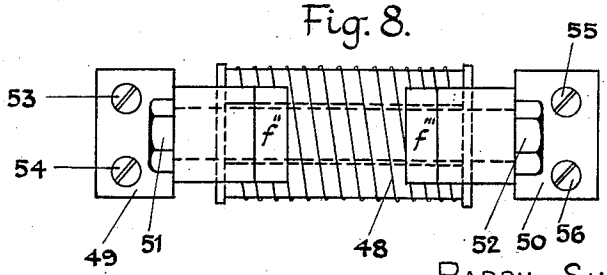



Fig. 8.




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Patented Dec. 22, 1936 2,065,023

# UNITED STATES PATENT OFFICE

2,065,023

## ELECTRIC FLAME PRODUCING DEVICE

Pappu Subba Rao, Mylapore, Madras, British India

Application June 3, 1936, Serial No. 83,331
In British India April 23, 1935

2 Claims. (Cl. 219—14)

This invention relates in general to an electric flame producer and more particularly has reference to an apparatus for striking an arc and magnetically converting the same into an elongated flame.

An object of this invention is to provide an apparatus having a fixed electrode, a movable electrode, and electromagnetic means for moving the electrodes apart to strike an arc and for displacing the arc to form an elongated flame.

Another object of this invention is to provide an arc striking and modifying apparatus comprising a solenoid having an armature displaceable therein, a pair of electrodes mounted in axial alignment with their axes parallel to the axis of the solenoid, one of the electrodes being stationary and the other mounted for movement with said armature, and pole pieces extending from the ends of said solenoid, one to a position on one side of the gap formed upon separation of the electrodes and the other to a position on the opposite side of the gap.

The device according to the invention comprises a pair of electrodes collinearly arranged and adapted to be separated to strike an arc therebetween, and an electro-magnet arranged with its pole pieces one on either side of the axis of the electrodes at their point of separation, and adapted to be energized on or after striking of the arc.

The electrodes may be arranged for separation manually to strike the arc, in which case the manually operated means may be arranged to close the circuit including the electrodes before striking the arc, and simultaneously or immediately thereafter to close the energizing circuit for the electro-magnet.

Alternately the electrodes may be adapted for separation to strike the arc by electro-magnetic means comprising for example, an armature attached to one of the electrodes, and associated with a solenoid energized from a suitable current supply to move the electrode against a biasing force. In such an arrangement, the energizing circuit of the armature actuating solenoid may be connected in parallel or in series with the circuit for energizing the solenoid of the flame-deflecting electro-magnet, and in a preferred form of construction of the device, the solenoid which energizes the armature operating electro-magnet, serves also to energize the flame-deflecting electro-magnet, and this single solenoid is energized by the current passing between the electrodes. The circuit is preferably closed by means of a press button switch so that the arc-flame persists while the switch is held closed, but on releasing of the pressure of the thumb, the flame becomes extinguished.

The electro-magnet armature may be rigidly connected with the moving electrode, but preferably a small amount of lost motion is provided between these parts, particularly when a single solenoid coil is provided, as the striking of the arc is thereby facilitated. This lost motion may be arranged to be taken up on movement of the armature by resilient means such for example as a spring washer.

The electrodes may conveniently be constructed of copper when the device is to be actuated from direct-current mains, but where alternating-current only is available, carbon electrodes are more advantageously provided. The solenoid energizing circuit or circuits preferably include a resistance, which may be suitably tapped in accordance with the voltage of the current supply available. The resistance may be further tapped, preferably at its mid-point, for connection to one terminal of an alternating current supply, so that only one half of the resistance is effective when alternating current is used.

In order to increase the strength of the magnetic field across the arc, one or more auxiliary electro-magnets may be provided, and arranged with their pole pieces in place of the pole pieces of the main electro-magnet, which latter is then only used to actuate the armature.

In a preferred construction of the invention, the electric circuit including the electrodes is connected in series with a solenoid coil which serves to energize an electro-magnet for creating a magnetic field across the arc, and also to actuate the armature for separating the electrodes. The armature which is disposed axially within the coil, is arranged parallel to the electrodes, and the pole pieces at the opposite ends of the electro-magnet are provided with extensions, which terminate one on either side of the electrodes at their point of separation, so that a magnetic field is set up across the arc when the latter is struck, and the electro-magnet is energized. This results in the arc being blown transversely of the axis of the electrodes, and by adjusting the strength of the magnetic field in accordance with the strength of the arc, a flame is obtained of about an inch to two inches in length, which may be utilized for any purposes such as an ordinary match, petrol lighter or other pyrophoric appliance as at present used. The circuit may be established from the ordinary

supply mains, by means of a plug included in the circuit and attached to the device by means of a flexible lead. Portability of the device is thus obtained, as by the provision of plug sockets at suitable places, the device may be plugged in when required at any of the places. The device may be made of a conveniently small size so that it is readily adapted for ordinary domestic use such as for lighting fires, lamps, cigarettes and the like.

Two constructional embodiments of the device according to the invention are illustrated by way of example in the accompanying drawings, in which:—

Fig. 1 is a perspective view of one form of the device.

Fig. 2 is a diagrammatic representation of the electrical connections of this device.

Fig. 3 is a side elevation of the device.

Fig. 4 is a plan view.

Fig. 5 is a sectional elevation on the line X—Y of Fig. 4.

Fig. 6 is a sectional plan view on the line P—Q of Fig. 3.

Fig. 7 is a front elevation.

Fig. 8 is a front elevation of an auxiliary magnet which may be used, and

Fig. 9 is a front elevation of a somewhat modified and manually operated device.

Referring to Figs. 1 or 7 of the drawings, the device comprises essentially two electrodes 6 and 7 included in an electric circuit, which are adapted to be separated to strike an arc therebetween. The electrode 7 is secured in position while the electrode 6 is mounted so as to be movable away therefrom to strike and maintain the arc. The electrode 7 is secured by means of a locknut 47 at one end of a threaded rod 8 which engages a threaded hole in a soft iron bracket 9. The other end of the brass rod 8 which protrudes beyond the bracket 9 has secured thereto an insulated knob 12, whereby the electrode 7 may be rotated and also be moved towards and away from the electrode 6 for adjustment purposes. The rod 8 is secured in position by means of a nut 11 which is tightened up against the bracket 9 with the intervention of a spring washer 10. The electrode 6 is secured in a similar manner by a nut 46 to a threaded brass rod 2 which passes through a threaded hole in a brass bracket bar or electrode carrier 5, to which it is secured by a nut 3 and a spring washer 4. The outer end of the rod 2 has secured thereto an insulated knob 1 whereby the electrode 6 may be rotated and moved axially towards or away from the bracket bar 5 for adjustment purposes.

The bracket bar 5 is provided with an eyelet bolt 21 which is adjustably secured to the bar by a nut 22, and the eyelet serves as an anchor for one end of a spiral spring 20, the other end of which is secured to a U-shape shackle 19 which is connected to an insulated disc 17. The disc 17 is freely mounted for rotation at the end of a threaded brass rod 14, and is retained in position by means of an axially inserted screw 18. The threaded rod 14 engages a threaded hole in the bracket 9, and is equipped at its other end with an insulated knob 13 whereby the rod 14 may be rotated to adjust the tension of the spring 20. The rod 14 may be locked in position by means of a nut 15 and a spring washer 16.

The bracket bar 5 is formed at its free end with an apertured boss, through which is passed the threaded end of a brass rod 30, and the bar is adjustably secured to the rod 30 by means of nuts 28 and 29. The rod 30 extends parallel to the electrodes 6 and 7, and at its free end is formed with a screwed stud, which engages a threaded axial recess at the end of a cylindrical soft iron armature rod 27. The rod assembly 27 and 30 is slidably disposed within a brass tubular member 34, and the intervening space between these rods may be lubricated with a suitable lubricant to permit easy sliding of the rods 27 and 30. The brass tube 34 is secured at one end to a bracket 23 of soft iron which is fixed by screws 32 and 36 to an ebonite or like insulating plate 43 which in turn is secured to a wooden or like insulating base 44 by means of two screws 40 and 41. The other end of the brass tube 34 is retained in the cylindrical flange of a flanged annular disc 26 of asbestonite, or other insulating material, which in turn is supported in the bracket 9. This bracket is secured by means of screws 33 and 37 to an ebonite or like plate 42 which is secured to the wooden base 44 by screws 38 and 39.

Surrounding the tube 34 and extending between the brackets 23 and 9 is a solenoid coil 24 which is wound on to a bobbin comprising a thin brass tube 35 having flanges 25 and 31 arranged one at either end.

The soft iron bracket 23 as shown in Fig. 1, in addition to comprising the portions shown as *a* and *b*, also includes a portion *d*, which extends parallel to the coil 24 along the outside thereof, and has a further extending portion which is bent at its end as shown at *e* and *f* so that the portion *f* is closely adjacent to the electrodes 6 and 7 and is parallel thereto. The bracket 9 is provided on the other side of the coil 24 with similarly extending portions *d'*, *e'*, and *f'*, the portion *f'* being parallel to the portion *f* and disposed diametrally opposite thereto with respect to the electrodes 6 and 7. The portion *f* comprises a North pole piece, and the portion *f'* a South pole piece of an electro-magnet which may be energized by current passing through the solenoid 24.

As shown in Fig. 2, one end of the solenoid coil 24 is connected to the bracket bar 5, whereas the other end is connected to one end of a resistance D G. This resistance may be of the order of 70 ohms. The other end G of the resistance is connected to a terminal T1, while the coil is tapped intermediately at E where it is connected to a terminal T3. The circuit which passes from the bracket bar 5 through the electrodes 6 and 7 and to the bracket 9 is connected from terminal H to one terminal J of a push button switch L. The other terminal K of the push button switch is connected to a terminal T2.

When the device is adapted to be operated by direct current, the terminals T1 and T2 are connected to the supply mains, but when the device is intended to be operated by alternating current, the terminals T1 and T3 are connected to the supply mains so that the resistance D G in the circuit is halved.

In operation, when the push button switch L is closed, a circuit is established through the coil 24 and between the electrodes 6 and 7. The energizing of the magnet, thus causes the armature 27 to be drawn further into the tube 34, the distance being regulated by the tension of the spring 20. As the armature 27 moves into the brass tube 24 the electrode 6 is moved away from the electrode 7, and an arc is struck therebetween. The tension of the spring 20 is adjusted so that the electrode 6 is held sufficiently far away from

the electrode 7 as to provide a continuous arc of sufficient length between the electrodes, without rupturing. The energizing of the magnet simultaneously sets up a magnetic field across the arc, which owing to its position, causes the arc to be deflected transversely of the electrodes. The magnet poles are arranged so that the deflections of the arc in accordance with "Fleming's left hand rule" is away from the solenoid 24. By suitable adjustment of the spring 20, this flame can be arranged to be of any desired size, from about 1 to 2 inches. When the press button switch L is released, the current supply is switched off, and the electrode 6 is restored to its position in contact with the electrode 7 by means of the spring 20 which simultaneously moves the armature 27 outwards from the tube 34. The outward movement of the electrode 6 may be limited by means of a stop *c* (Fig. 1) secured to the bracket 23.

The device may be housed within a suitable container which completely encloses the device with the exception of the press button of the switch L, a convenient hole H being provided in the container opposite the meeting faces of the electrodes 6 and 7 through which hole the flame may protrude when the button L is pushed. The container may be constructed in any desired manner as for example in the form of a table pedestal, or adapted to be suspended from a hook and the portion of the container through which the flame protrudes is constructed of some noninflammable material such as asbestonite.

In the modified arrangement shown in Fig. 9, the fixed electrode 58 is secured on the end of a threaded rod 59 which engages a threaded hole in a bracket 67 secured by screws 69 in an insulated base 70. A knob 61 is provided at the outer end of the rod 59 whereby the electrode 58 may be rotated and moved axially. A nut 60 and a spring washer 71 serve to lock the electrode carrying rod 59 in position. The electrode 57 is secured on the end of the rod 63 which passes slidably through a bush 62 which is threaded externally and engages a threaded hole in a bracket 66 which is secured to the base 70 by a screw 68. The electrode 57 is biased away from the electrode 58 by means of a spring 65, but its movement away from the electrode 58 is limited by the inner end of the bush 62 which is adjustable with respect to the bracket 66. The outer end of the rod 63 is provided with an insulated operating knob 64.

The arcing circuit is connected respectively to the brackets 66 and 67, and an arc is struck by pushing the knob 64 towards the electrode 58 until the electrodes 57 and 58 abut, and then allowing the electrode 57 to move away from the electrode 58. This arc may then be deflected to provide the requisite flame by means of an electro-magnet similar to that illustrated in Figs. 1 to 7, the pole pieces of which are arranged one on either side of the electrodes 57 and 58.

If desired, an electro-magnet as shown in Fig. 8 may be provided for this purpose. This magnet may also be used as an auxiliary magnet in addition to the magnet 9, 23, 24 in the arrangement shown in Figs. 1 to 7.

Referring to Fig. 8, this magnet comprises a pair of pole pieces *f''* and *f'''*, which are bolted together by means of a soft iron bolt 51 and a nut 52, to brackets 49 and 50 respectively which may be secured to the base board 44 by means of screws 53, 54, and 55, 56 respectively.

A solenoid coil 48 is wound on a bobbin which surrounds the bolt 51, and when the magnet is used as an auxiliary to the main electro-magnet, the coil is connected in series with the solenoid coil 24. This auxiliary magnet may be disposed transversely of the axis of the coil 24 and the pole pieces *f''* and *f'''* may be arranged to substitute the pole pieces *f* and *f'* respectively. The use of the auxiliary magnet serves to increase the length of the flame.

The device illustrated in Fig. 9 may be used with either alternating current or with direct current, but as in the case of alternating current, it is necessary for the arc to be struck when the current is at a maximum value, in this latter case, it may be necessary to break the current several times before the actual movement of the electrode 57 coincides with maximum current. For this reason, the form of device shown in Figs. 1 to 7 is more suitable for use with alternating current, since the initial movement of the armature will coincide with maximum current through the coil 24 and then the electrode 6 will be moved when maximum current is flowing between the electrodes 6 and 7.

When the electrodes become pitted due to long use, they may be rotated slightly relatively to one another by the knobs 1 and 12, so that fresh contact surfaces are provided.

It will be seen that the invention provides a device which is simple in construction, and owing to the very low current consumption, is very economical in use. Using current at the rate of 10 cents per unit, the device can be used to light a kerosene lamp for example, at a cost of .00015 of a cent, and compared with the use of matches at the rate of 0.6 cent per box of 40 match sticks, the use of the device according to the invention is one hundred times cheaper than a match. Moreover, owing to the low consumption of current, there is no danger of blowing fuses or damaging existing installations such as lamps.

If desired, the device may be arranged for providing a continuous flame, and is then particularly adapted for use in gold-smithies, laboratories and the like. With such devices, carbon electrodes may be employed, and provision may be made for cooling the electrodes and also the solenoid coil.

It will be evident that the construction, arrangement and operation of the device may be modified considerably within the scope of the invention.

I claim:—

1. An apparatus for striking an electric arc and converting it into an elongated flame, comprising a tube, a solenoid winding on said tube, a bracket of ferro-magnetic metal extending laterally from one end of said tube, a fixed electrode carried by said bracket and extending in a direction parallel to the axis of said tube, a ferro-magnetic armature movably mounted in said tube, a non-ferrous rod extending from one end of said armature, an electrode carrier mounted on the free end of said rod and extending laterally therefrom, an electrode mounted on said carrier in axial alignment with said fixed electrode for movement with said armature toward and away from said fixed electrode, resilient means urging the movable electrode toward the fixed electrode, said bracket having a portion extending to a position on one side of the electrodes at the gap formed on separation of the electrodes, and a member formed of ferro-magnetic material extending from the other end of the tube

to a position on the opposite side of the electrodes at the gap.

2. An apparatus for striking an electric arc and converting it into an elongated flame, comprising a tube, a solenoid winding on said tube, a bracket of ferro-magnetic metal extending laterally from one end of said tube, a fixed electrode carried by said bracket and extending in a direction parallel to the axis of said tube, a ferro-magnetic armature movably mounted in said tube, an electrode carrier mounted on said armature and movable therewith, an electrode mounted on said carrier in axial alignment with said fixed electrode for movement with said armature toward and away from said fixed electrode, resilient means urging the movable electrode toward the fixed electrode, said bracket having a portion extending to a position on one side of the electrodes at the gap formed on separation of the electrodes, and a member formed of ferro-magnetic material extending from the other end of the tube to a position on the opposite side of the electrodes at the gap.

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