(No Model.) 2 Sheets—Sheet 1.

H. M. BAKER, Jr. & A. W. FOX.

ELECTRIC ARC LAMP.

No. 594,928. Patented Dec. 7, 1897.

Fig. 1

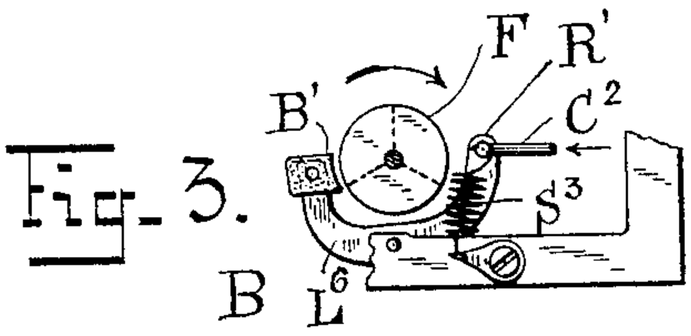

Fig. 3.

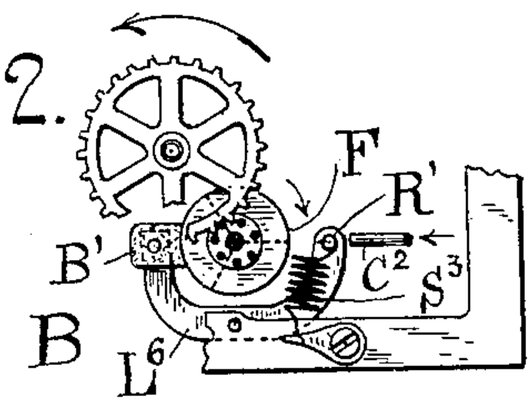

Fig. 2.

Witnesses
Chas. Hanimann
Edward Skrine Berrall.

Inventors
Haydn Imgart Baker, Jr.
Arthur Woodward Fox.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

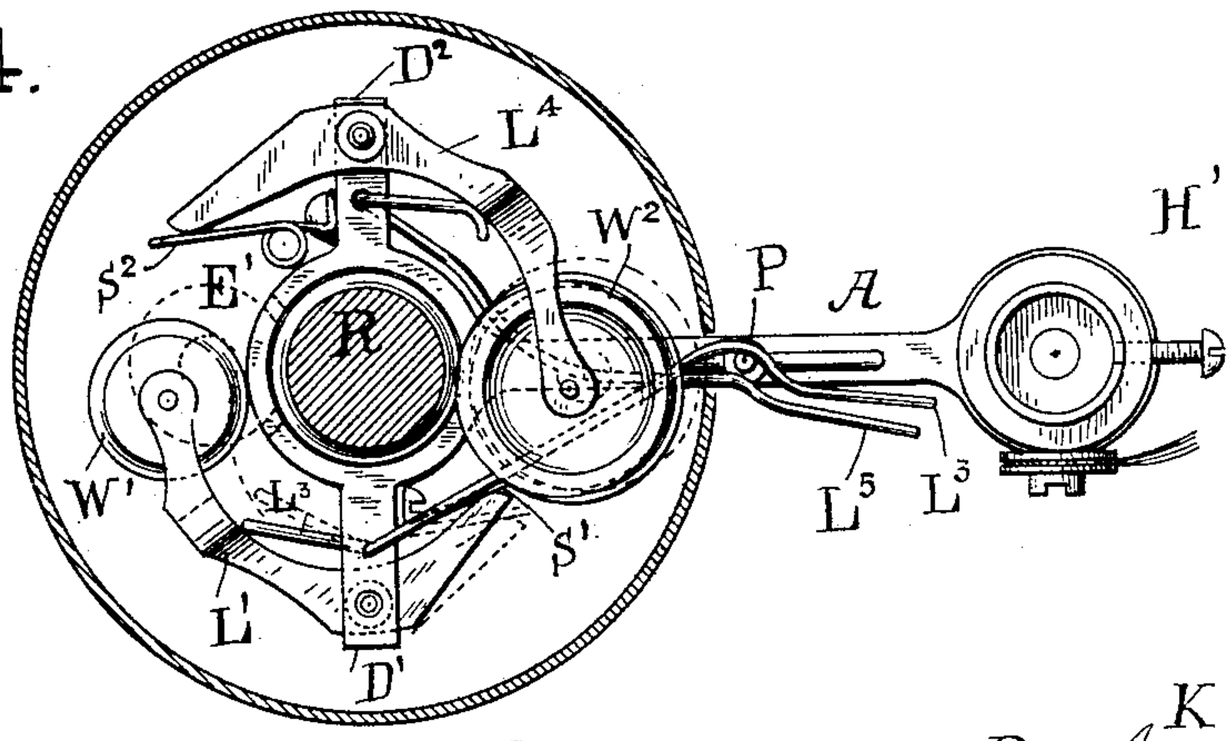


Fig. 5.

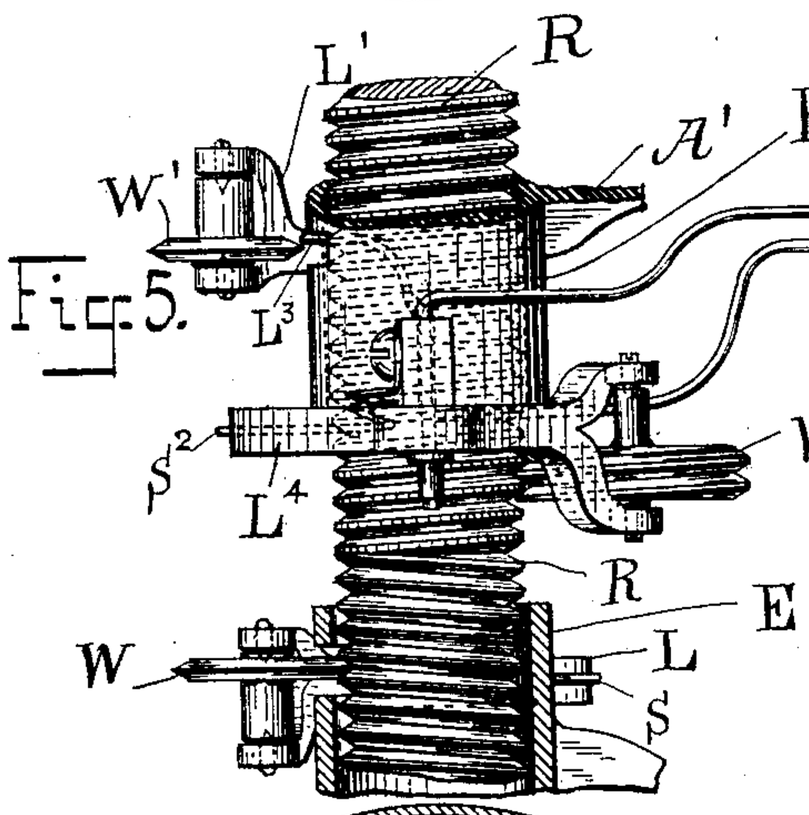


Fig. 7.

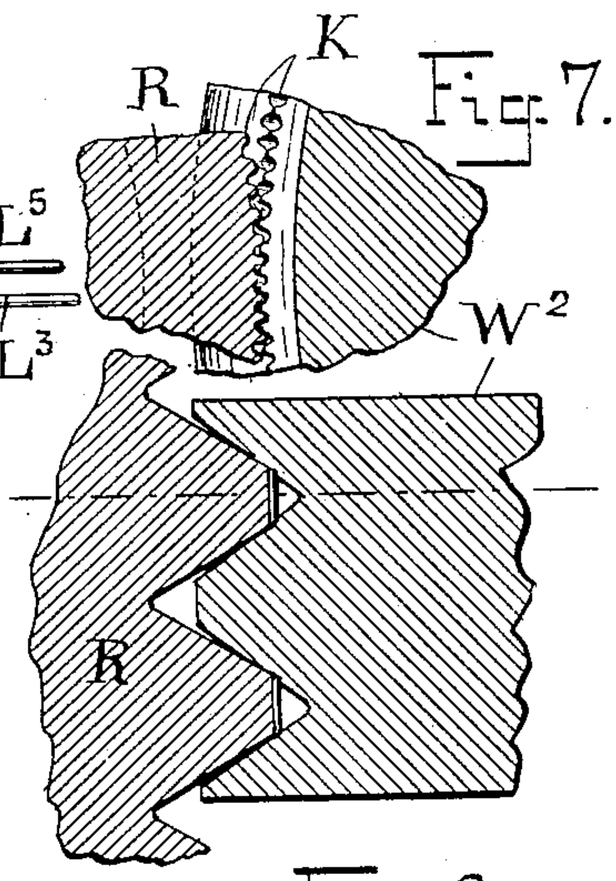
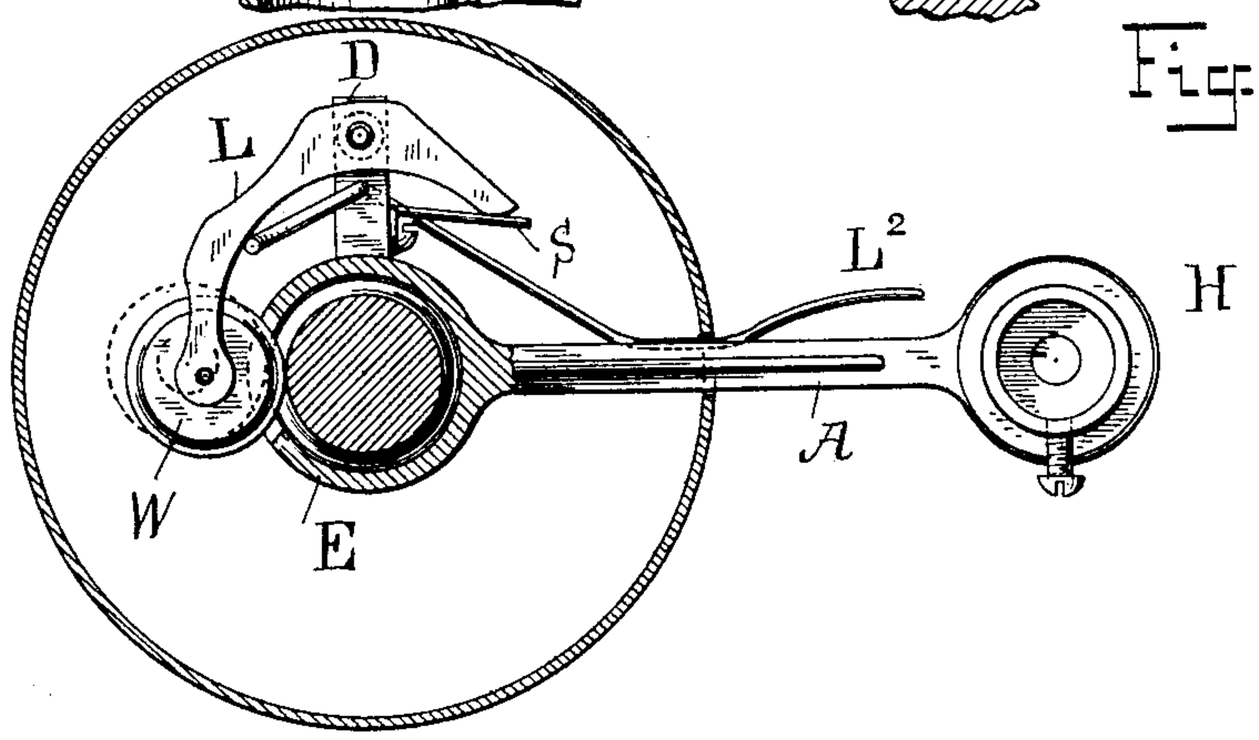


Fig. 8.

Fig. 6.



Witnesses
Chas. Hanimann
Edward Skrine Berrall.

Inventors
Hayden Mozart Baker, Jr.
Arthur Woodward Fox.

UNITED STATES PATENT OFFICE.

HAYDN MOZART BAKER, JR., AND ARTHUR WOODWARD FOX, OF BROOKLYN, NEW YORK.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 594,928, dated December 7, 1897.

Application filed February 24, 1897. Serial No. 624,873. (No model.)

To all whom it may concern:

Be it known that we, HAYDN MOZART BAKER, Jr., and ARTHUR WOODWARD FOX, citizens of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented a new and useful Mechanical Movement and a Self-Centering Arc-Lamp, of which the following is a specification.

Our invention relates to improvements in mechanical movements and in mechanism of arc-lamps for automatic feeding of the carbons as required by their consumption; and the objects of our improvements are to provide either equal or differentiated and automatic feed for the carbons and holders at will and also differentiated feed at any desired rate by a combination of screw, wheel, and worm feeding devices automatically operated by and in circuit.

A further and incidental object is to provide a lamp that may be used with either an alternating or a direct current circuit at will.

We attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a part sectional view and part elevation. Figs. 2 and 3 represent details of the feeding mechanism. Fig. 4 is a sectional view cut on line 4 4, Fig. 1. Fig. 5 is a part sectional and part side view of the feeding-screw and associated parts. Fig. 6 is a horizontal sectional view cut on line 6 6, Fig. 1; and Figs. 7 and 8 are enlarged views of the opposite screw-threads and surfaces of the main feeding-screw and associated parts.

Similar letters refer to similar parts throughout the several views.

The screw-rod R is a compound screw provided with right and left screw-threads of equal pitch by which to make and control the approach of the carbon-holders and carbons.

The holders H and H′ each consist of a sleeve E or E′, respectively bored smooth or made without threads, fitting not too snugly, but easily, the outside diameter of the screw-rod R and provided each with an arm A or A′, respectively, and the arms each carry a carbon and necessary attachments for holding and operating the same, the upper one being provided with the proper coil, as usual, as shown, or in any other usual way. Each of these holders H and H′ is held in position, and they are moved toward each other on the screw-rod R by means of a revolving device W or W′, held in a pivoted arm or lever L or L′, secured to the sleeve E or E′, preferably by being pivoted to a projecting stud D or D′, as shown. We provide in each case a spring S or S′, secured to the sleeve or to a stud thereof and bearing upon the outer arm of the lever L or L′, so as to throw the revolving device W or W′ into engagement with the threads of the screw-rod R, which engagement secures each holder in position on the screw-rod R.

The revolving devices W and W′, provided for the holders H and H′, respectively, consist of a complete plain wheel the periphery of which describes a complete circle properly shaped to take in the threads of the screw-rod R. The screw-rod R is connected with and operated by clockwork or a set of wheels controlled and moved by a spring or otherwise, and when the screw-rod is turned by the driving mechanism the wheels W and W′, being plain, revolve in and through contact with the screw-threads, and, whatever the diameters of the plain wheels, they carry the holders H and H′ toward each other for an equal distance, corresponding to or controlled by the number of turns made by the screw-rod R and the pitch of the screw-threads or the number of threads to the inch on the screw-rod R. In this way both carbons are advanced by the clockwork mechanism simultaneously and equally as they are consumed, and also automatically by the clockwork in the manner to be described hereinafter and at any desired and provided rate.

When the carbons are consumed or for any reason it is desired to return the holders H or H′ to the starting positions at top and bottom, it is only necessary to overcome the springs S or S′ by the movement of the levers L^2 or L^3, respectively, the inner arm of each of which makes contact with that arm of the lever that holds the wheel W or W′, thereby lifting the wheel so held out of contact with the screw-rod and its threads, whereupon the holders may be dropped or raised, as required,

by sliding on the right-and-left screw-rod to any point or position desired, and on releasing the spring and the lever that holds the wheel out of action it (the wheel) will reën-gage the screw-rod at an adjacent thread thereof and thereby retain the holder in position thereon at the point of such engagement.

As so far described, the arrangement and operation is that found, used, desired, or necessary where the lamp is to be located in a circuit having an alternating current, in which case it is necessary, because of the equal alternating consumption of them, to have both the carbons move toward each other at the same rate. This object is accomplished by providing both holders H and H′ with similar plain wheels similarly held upon the sleeves E and E′ and similarly operated, as shown, but of course engaging the right or left threads of the upper and lower parts of the compound right-and-left screw-rod, and thereby causing the two holders to move toward each other with equal speed whatever may be the size of the plain wheel used, W or W′. Where two plain wheels are used, as shown, in combination with a compound screw-rod of the same diameter, but with right and left threads of the same pitch and number to the inch, the feed of the two holders will be the same whatever the diameters or sizes of the two plain wheels, because the movement is entirely and alone caused by the screw-threads on the compound screw-rod R.

When, however, the lamp is to be used in connection with a direct current, the feed of the two holders and carbons must be differentiated to suit the increased combustion of the positive carbon, and in that case the plain wheel attached to the holder H′ is to be thrown and held out of engagement and out of action, and it may be so held by the engagement of the lever L^3 with a lock-pin or stop P, while the worm W^2, held in a lever L^4, pivoted to the stud D^2, is to be tripped into engagement with the threads of the upper part of the rod R, as shown. The worm W^2 is also provided with a spring S^2 and lever L^5 for throwing the worm W^2 into and out of engagement with the threads of the screw-rod R and for engaging the lock-pin or stop P.

The screw-rod and the worm are two revolving screws, one long and the other short, making peripheral contact, the last having endwise motion and the first not having any such motion.

In order to move the holder H′ as related to the holder H with the required differentiated speed, say the speed of twenty to ten, we provide the worm W^2, held in the pivoted lever L^4, the pitch of the thread on the worm preferably, but not necessarily accurately, yet sufficiently, corresponding with the pitch on the adjacent part of the screw-rod. The worm W^2 being provided with screw-threads on its periphery and the diameter of the worm being the same as that of the rod, when the rod R is turned the holder H′ will be moved on the rod R for a distance equal to the sum of the movements generated by the two screws—to wit, the screw-rod R and the worm W^2. The sum of these movements will be twice that generated by the screw-rod, or, in other words, the worm W^2 will double the movement of the arm H′ and make it as twenty to ten to that of the holder H. This is the result obtained when the rod and the worm are of the same diameter and pitch. The worm W^2 is a differential worm and produces differential motion not only between the holder H′, to which it is attached, and the holder H, but also between the worm W^2 and the screw-rod R. Where, however, it is desired to move the holder H′ and its carbon at any other rate or ratio in reference to the holder H, the pitch of the reversed screw-threads on the screw-rod R being the same, the diameter of the worm W^2 must be varied accordingly to produce a ratio of movement of, say, twenty to eleven, or any other ratio.

The primary principle involved is that as the diameter of the worm is diminished or made less than that of the rod R the resulting speed or movement of the holder H′ downward will be increased, and as it is enlarged it will be diminished.

As shown, the compound screw-rod has right and left screw-threads of the same or equal pitch; but we do not desire to limit our invention to or to combinations with a rod made precisely like that shown in the drawings and so far described. The right or the left screw-threads, either of them, and also the rod itself, may be made different in most if not in all other properly characteristic respects, and particularly as to pitch, length, number of threads per inch, &c. The coöperating worm W^2 may also be varied much in the same way, and when varied in diameter and circumference very and characteristically different effects may be produced. Where the worm is made of a smaller diameter than the screw-rod on and with which it operates, the movement of the sleeve or holder on the line of the axis of the rod is made greater than that produced initially by the threads of the screw-rod, say, carrying a screw-sleeve, and to ascertain the total movement of the holder the total of such movement must be added to that due initially to the threads of the screw-rod, and this total movement will be more than double the said initial movement. Where, however, the worm W^2 is made of larger diameter than the right-and-left screw-rod or the part on which it operates, the additional movement developed is made less instead of greater than the initial screw-rod movement or for a shorter distance on or in the direction of the axis-line of the right-and-left screw-rod. In order, therefore, to be able to produce any desired rate of movement on the axial line or any desired rates of relative or differentiated movements, it becomes necessary to find and apply a rule for ascertaining the proper diameter

of the worm W^2 as related or to be related to the rod R. This rule may be stated as follows: Given the distance, measured on the axial line of the screw-rod, over which the worm is to travel, the number of revolutions of the screw-rod, its diameter, and the pitch of the threads of the screw-rod and worm, to find the proper size of the worm. The distance, measured on the axial line of the screw-rod, over which the worm is to travel in one revolution of the screw-rod, less the pitch of the threads of the screw-rod, equals or gives the distance on the axial line of the screw-rod that the worm travels of itself and alone, which divided by the pitch of the threads of the worm equals or gives the number of revolutions of the worm in making such travel. The length of one thread on the pitch-line of the screw-rod divided by the number of revolutions of the worm equals or gives the length of one thread on the pitch-line of the worm. The square root of the length of one thread of the worm, squared, minus the pitch, squared, equals or gives the circumference of the worm on the pitch-line. This circumference divided by π equals the diameter of the worm on the pitch-line.

The turning or feed movement of the screw-rod R is under the control and action of the clockwork shown altogether in Fig. 1 and in some of the detail parts in Figs. 2 and 3. The movements of the rod R and its operating clockwork are subject to the control of the brake B, which consists, as shown, of the pivoted U-shaped lever L^6, provided with the bearing-block B', which engages a friction or brake wheel F. Associated with the clockwork is the shunt-coil C, provided with an armature C', which has a bent-arm extension C^2. The spring S^3 holds the bearing-block B' of the brake B in contact with the brake-wheel F at all times unless the tension of the spring S^3 is overcome, and when the brake is on the clockwork machinery and the screw-rod are held stationary thereby. As the consumption of the carbons proceeds and the distance between their adjacent ends increases the amount of electrical energy passing between them diminishes, and as the shunt-coil is in the shunt-circuit the armature C' is presently drawn into contact with the core of the coil, under control of the coil, and as it is being moved into contact with the core of the coil the arm C^2 makes contact with the rod or arm R' on the brake-lever L^6, thereby crowding the brake-lever over and the bearing-block B' away from the wheel F, whereupon the clockwork under the control of the spring being set free and in motion the screw-rod is turned in the ordinary way. The brake-wheel F is provided with the usual fly or fans for steadying the movement of the parts.

As the movement of the screw-rod proceeds and the adjacent ends of the carbons in the two holders H and H' approach each other the electrical energy transmitted from one carbon to the other increases, and as it increases the portion transmitted through the shunt-coil and circuit diminishes until, under control of the spring S^4, the armature C' is released, carrying with it its arm or extension C^2, thereby surrendering the brake-lever L^6 into the control of the spring S^3, whereupon the bearing-block B' will again make contact with the wheel F and stop the clockwork movement by overcoming the energy of the clock-spring, thereby arresting and preventing the further movement of the screw-rod R and holding the positive and negative carbons in position for the time being and until the increasing gap between the adjacent ends of the two carbons causes a repetition of the increased current-flow through the shunt-coil, whereupon the operations mentioned will be repeated with the same results as before described.

In order to prevent slip between the screw-threads of the rod R and the bearing-surfaces of the worm W^2, we knurl both the contact-surfaces, as shown in Figs. 7 and 8 and indicated by the letter K. In the case of larger machinery and mechanisms this kind of mechanical movement may be provided with regular cogs or teeth to insure accuracy.

We have shown a screw-rod of the same diameter and same pitch of thread throughout, but it is evident that both may be varied at will, as well as the number of threads to the inch, and by making similar variations in the worm a great variety, almost an infinite variety, of differentiated movements may be produced. It is evident, too, that by substituting worms of different diameters for the plain wheel W on the holder H a still further series of variations of movements may be produced or differentiated.

By giving the levers L, L', and L^4 greater sweep and their springs sufficient range of action wheels or worms of different diameters may be used in connection with the same rod R and associated mechanisms. So the sleeves E and E' being smooth and not screw-threaded within may be used on any rod of the same diameter whatever may be the pitch of the screw-threads or the number of them per inch.

We claim as our invention—

1. In combination the holder H provided with the plain wheel W, the holder H' provided with the plain wheel W', and the compound right-and-left screw-rod R, the axis of each of the plain wheels being located in lines parallel to the circumferential surface of the screw-rod.

2. In combination, the holder H provided with the plain wheel W, the holder H' provided with the plain wheel W', the compound right-and-left screw-rod R, the axis of which is parallel with the axes of the plain wheels W and W', the shunt-coil C provided with the armature C' and the arm C^2, all in combination with the independent brake-lever B and brake-wheel F.

3. In combination, the holder H provided

with the plain wheel W, the holder H′ provided with the worm W^2, and the compound right-and-left screw-rod R.

4. The holder H′ provided with the differential worm W^2 in combination with the screw-rod R, the worm and the screw-rod coöperating to produce differential motion of the holder, substantially as shown and described.

5. The holder H provided with the plain wheel W, the holder H′ provided with the worm W^2, the compound right-and-left screw-rod R, the axis of which is parallel with the axes of the plain wheel W and the worm W^2, and the shunt-coil C provided with the armature C′ and the arm C^2, all in combination with the independent brake-lever B and brake-wheel F.

6. A screw-rod R and a differential worm W^2, each provided with the knurls K, the screw-rod and the worm coöperating to produce differential motion and the knurls cooperating to prevent slip and to secure accuracy of differential motion.

7. The holder of an arc-lamp provided with a pivoted lever carrying a revolving engaging-wheel, in combination with the feed-screw, and also provided with a lever for tripping the wheel-lever, the axes of the revolving wheel and of the feed-screw being parallel.

8. A feeding-screw of an arc-lamp provided at one end with a right-hand screw and at the other end with a left-hand screw, and two sliding holders, each provided with a trip-wheel, the circumferences of which engage the right and left hand screw-threads, respectively, and guide the holders toward each other, the axes of the feeding-screw and of the two trip-wheels being parallel.

9. A feeding-screw of an arc-lamp provided at one end with a right-hand screw and at the other end with a left-hand screw, and two sliding holders, one provided with a plain trip-wheel and the other provided with a trip-worm, the circumferences of which engage the right and left hand screw-threads, respectively, and guide the holders toward each other.

10. As a mechanical movement, the following elements in combination: a revolving screw without endwise, or axial, motion, and a revolving worm operated by the revolving screw, the threads of both the screw and the worm being held in peripheral engagement with each other, and the worm and its holder being free to move axially.

HAYDN MOZART BAKER, JR.
ARTHUR WOODWARD FOX.

Witnesses:
JAMES A. SKILTON,
EDWARD S. BERRALL.