(No Model.) 2 Sheets—Sheet 1.

E. J. BAGNALL & G. ARNOLD.

ELECTRIC ARC LAMP.

No. 553,637. Patented Jan. 28, 1896.

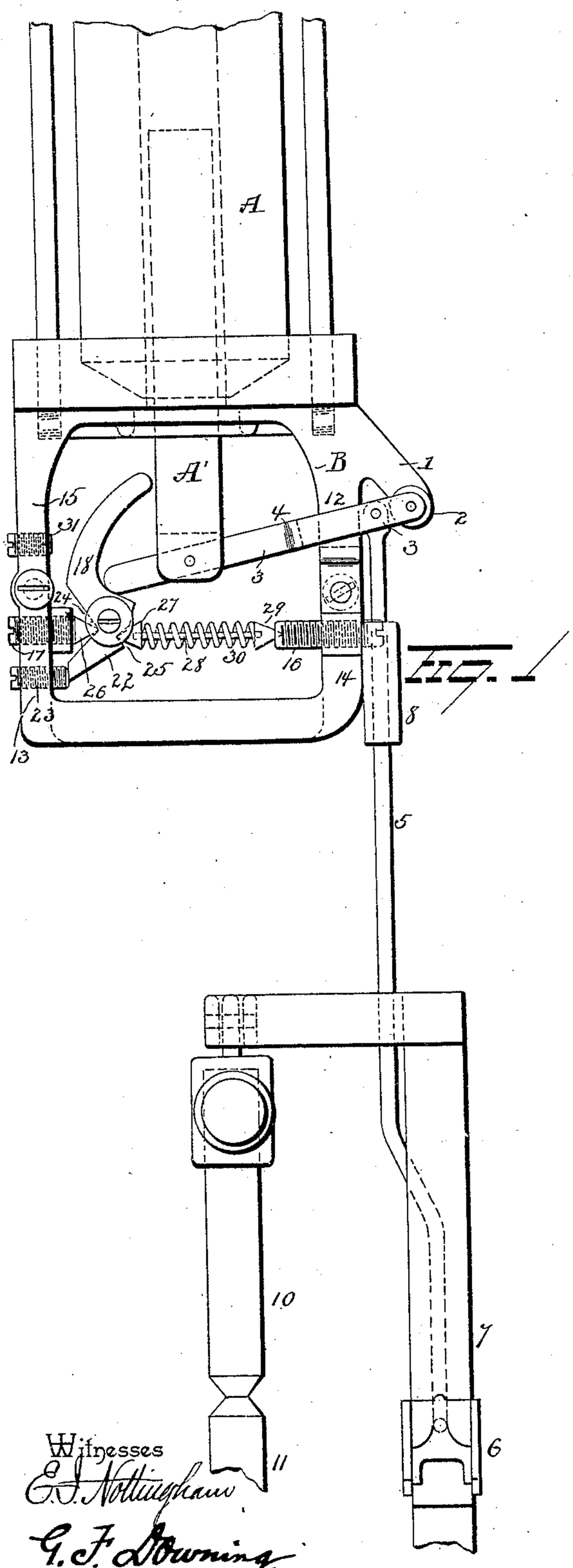

FIG. 1.

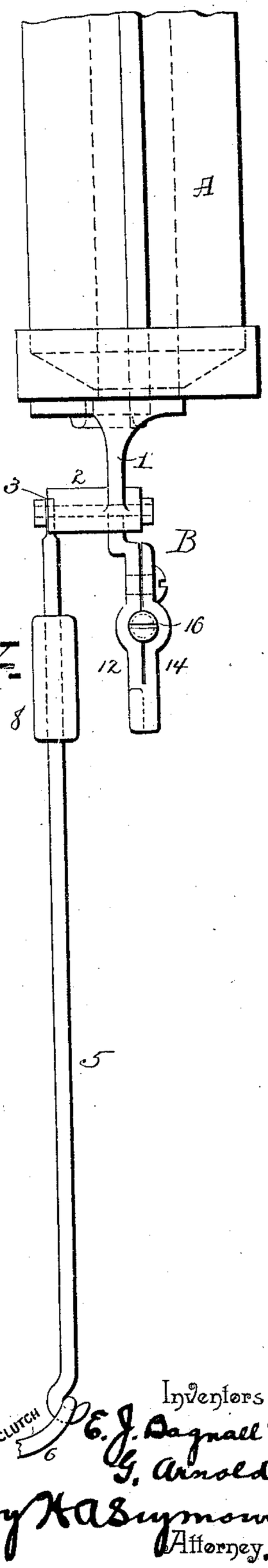

FIG. 4.

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(No Model.) 2 Sheets—Sheet 2.

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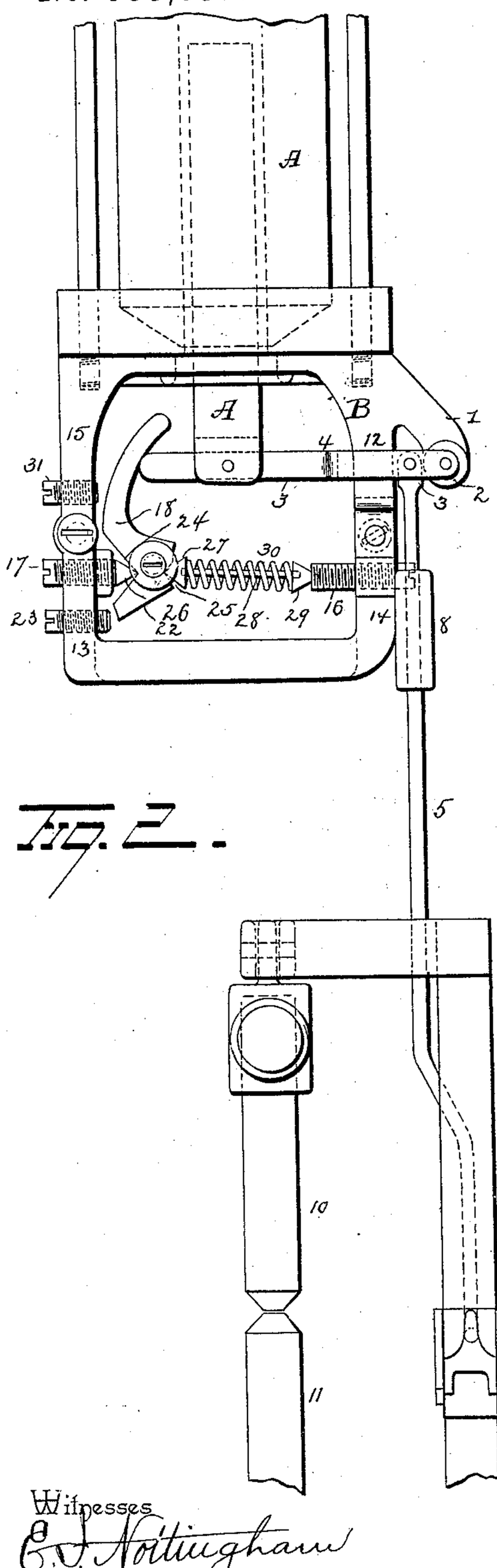

FIG. 2.

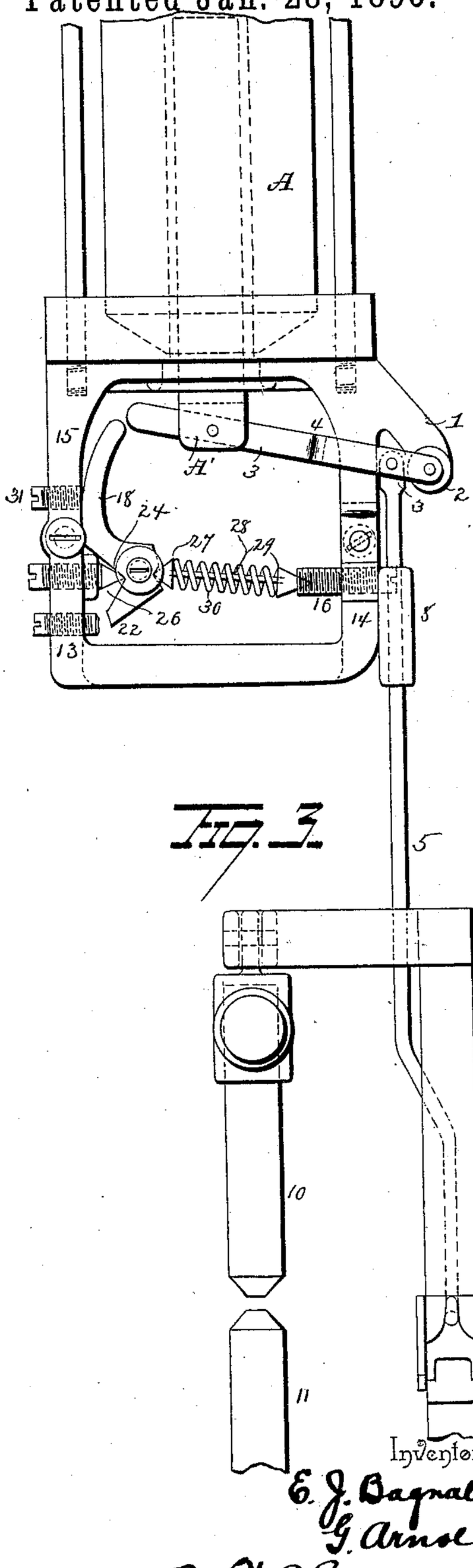

FIG. 3.

Witnesses
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UNITED STATES PATENT OFFICE.

ERNEST J. BAGNALL AND GEORGE ARNOLD, OF CLEVELAND, OHIO, ASSIGNORS TO THE ADAMS-BAGNALL ELECTRIC COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 553,637, dated January 28, 1896.

Application filed October 2, 1895. Serial No. 564,454. (No model.)

To all whom it may concern:

Be it known that we, ERNEST J. BAGNALL and GEORGE ARNOLD, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Arc Lamps; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to an improvement in electric-arc lamps, and more particularly to such as are adapted to be operated with alternating electric currents.

In alternating-current arc lamps as heretofore constructed the carbons are arranged in series with the separating and feeding coil and are normally in contact when no current is passing through the lamp. The coil is provided with a movable core or armature, to which the clutch devices or other mechanical feeding mechanism is attached. It is obvious that when current first enters the lamp it will flow through the coil and carbons. The carbons being normally in contact, the resistance to the current will be at the minimum, and consequently a heavy current will flow through the coil. This heavy current actuates the magnet violently, giving it such power that it pulls the carbons apart so suddenly as to rupture the arc. The strength of the magnet will, of course, be destroyed when the arc is thus ruptured and the carbons will fall together again, closing a circuit of low resistance through the coil and causing the above operation to be repeated. Thus a violent and annoying chattering takes place until the carbon points shall have become sufficiently heated so that an arc can be formed and maintained between them.

It is the object of our invention to provide means whereby to prevent the repeated separations of the carbons, rupturing of the arc, and consequent violent chattering in an alternating-current arc lamp.

A further object is to provide means for causing the carbons to be so disposed for a brief period before the normal arc is struck as to form a very small arc between them, whereby to raise the temperature of the carbon points to a sufficient degree of heat to cause them to throw off a proper amount of volatilized carbon to maintain the normal arc.

With these objects in view the invention consists in the combination, with the separating-magnet and carbons of an electric-arc lamp, of arc-starting devices constructed and arranged to cause the carbon points to be sufficiently heated prior to the formation of the normal arc to insure the maintenance of the normal arc when formed.

The invenion also consists in the combination, with the separating-magnet and carbons of an arc lamp, of arc-starting devices constructed and arranged to cause the carbons to be slightly separated for a short period before they are separated sufficiently to form the normal arc.

The invention also consists in the combination, with the separating-magnet and carbons of an arc lamp, of arc-starting devices constructed and arranged to retard the separation of the carbons after the current enters the lamp and the carbons have begun to separate; and the invention further consists in certain novel features of construction and combinations and arrangements of parts, as hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a view showing portions of an arc lamp with the parts in normal positions when no current is passing through the lamp. Fig. 2 is a similar view showing the positions of the parts when the current enters the lamp and before the normal arc is formed. Fig. 3 is a similar view showing the positions of the parts after the normal arc has been formed. Fig. 4 is a view at right angles to Figs. 1, 2, and 3.

A represents a solenoid which can be supported in the lamp-casing in any suitable manner and preferably disposed in a vertical position, so that its core A′ will project into a frame B arranged in a fixed position immediately below the solenoid. The frame B is made with a lateral arm 1, having a boss 2, with which one end of a lever 3 is pivotally connected, said lever being bent at 4 and made to project within the frame B immediately under the core A′ of the solenoid, to

which core the lever 3 is pivotally connected at a point between the ends of the latter. A clutch-rod 5 is pivotally connected to the lever 3 at a point in proximity to the pivotal point of the latter with the bars 2. The rod 5 depends from its connection with the lever 3 and at its lower end is connected with a clutch 6 of any preferred form of construction, or a clutch-blade 7, said rod 5 preferably being made in two parts connected together by means of a turnbuckle 8, by which latter the length of the rod can be adjusted. The holder 9 for the upper carbon 10 is connected with the clutch-blade 7 and the lower carbon 11 is carried by any suitable devices. (Not shown.)

The lower half of the frame B is made thicker than the upper portion and split to form arms 12 13, disposed parallel with the arms 14 15 of the frame. The arms 12 14 are made with screw-threaded recesses which constitute bearings for a horizontally-disposed screw 16. A screw 17 is mounted in a similar manner between the arms 13 15 and slightly above a line passing through the screw 16. A lever 18 is disposed within the frame B and made with a V-shaped recess 24, in which the conical end 26 of the screw 17 has a bearing, said conical end 26 thus forming the end of the lever. Opposite the recess 24 another V-shaped recess 25 is made in the lever 18 for the reception of a conical head 27, which is loosely connected at one end of a rod 28. A similar head 29 is loosely connected to the other end of the rod 28 and has a bearing in the inner end of the screw 16. A spring 30 encircles the rod 28 and bears at its respective ends against the heads 27 29. The lever 18 is prevented from escape from its bearings by means of disks or nuts 21. The lever 18 is made with an upwardly-extending curved arm 19, which terminates at its lower end in a flat seat 20 to one side of the fulcrum of the lever, and with this curved arm and seat the free end of the lever 3 is adapted to engage in a manner hereinafter more fully explained. The short arm of the lever 18 projects downwardly and slightly laterally from the pivotal point of the lever and constitutes a foot 22, adapted, when the parts are in their normal positions, (with no current passing through the lamp,) to engage an adjustable stop 23, as shown in Fig. 1.

From this construction and arrangement it will be seen that when the parts are in their normal positions, with no current passing through the lamp, the axis of the spring 30 will be out of line with the axis of the screw 17 and below the fulcrum of lever 18, so that the force of said spring will be exerted on said lever to cause the foot 22 to bear against the adjustable stop 23. When the parts are in this position, the curved arm 19 of lever 18 will project toward the core A′ of the solenoid, the said core will be in its lowest position, and the free end of the lever 3 will rest on the seat 20 of lever 18, as shown in Fig. 1. It is evident that when the core of the solenoid rises, carrying the lever 3 with it, the engagement of the free end of said lever with the curved arm 19 of lever 18 will cause the latter to turn on its fulcrum, and that when the lever 18 has been moved to a sufficient extent to cause the head 27 at the end of the spring 30 to pass above the fulcrum of said lever and the axis of the screw 17 said spring will exert a pressure on the lever 18 to cause the arm 19 to complete its rearward movement, pass out of line with the free end of the lever 3 and rest against an adjustable stop 31. The stop 31 should be so adjusted that when the curved arm 19 is resting against it the free end of said curved arm will be just out of line with the free end of the lever 3. When the core of the solenoid moves down, (as when the lamp is cut in and out of circuit and the solenoid de-energized,) the free end of the lever 3 will pass the free end of the curved arm 19 and strike the seat 20, thus causing the lever 18 to turn sufficiently to bring the head 27 on spring 30 to pass below the fulcrum of the lever 18, when said spring will cause said lever 18 to return to its normal position, as shown in Fig. 1. The above description explains the mechanical operation of our improvements. Their electrical operation and importance in the successful operation of an arc lamp for use with an alternating electrical current will next be explained.

As above mentioned, one of the most objectionable features in the operation of an arc lamp with an alternating current is the annoying chattering caused when the lamp is started, and this chattering is largely due to the repeated breaking and making of the circuit between the carbons during the time the points of the carbons are becoming sufficiently heated to insure the maintenance of the normal arc. It is known that before the normal arc can be maintained when an alternating current is employed the carbon points must be sufficiently heated to throw off a certain amount of volatilized carbon. In alternating-current arc lamps the separating solenoid or magnet is included in series in a normally-closed circuit with the carbons, so that when the current first enters the lamp the resistance is so low that a heavy current passes through the solenoid or magnet and causes it to become so strong as to violently separate the carbons to their full extent for a normal arc and before the points of the carbons can have possibly become sufficiently heated to cause the maintenance of the normal arc. The arc is therefore ruptured and the circuit instantly broken, thus depriving the solenoid of its energy and permitting the carbons to again come together and close the circuit through the solenoid, the result of which is to again violently separate the carbons. These operations, with the consequent annoying chatter, will continue until the temperature of the points of the carbons shall have reached such a degree as will cause them to throw off sufficient volatilized carbon to insure the main-

tenance of the normal arc. By means of my improvements I avoid these continuous violent separations of the carbons and consequent breaking of the circuit with accompanying chatter, and this result I accomplish by causing a small preliminary arc to be formed and maintained for a sufficient length of time to properly heat the carbon points to insure the maintenance of the subsequently-formed normal arc. The action of the parts in the performance of these functions is as follows:

The parts, when no current is passing through the lamp, assume the positions shown in Fig. 1, with the carbons in contact with each other. Current being now made to pass through the lamp, the coil or solenoid will be energized and its core will begin to rise, causing the clutch to grip the clutch-blade and begin to separate the carbons. The core A′ will rise only a very short distance, however, when its further ascent will be arrested by the engagement of the lever 3 with the curved arm 19 of lever 18; but the carbons have been slightly separated (see Fig. 2) sufficiently to permit the formation of a small arc between them. The core continues to move upwardly against the resistance offered by the spring 30 and maintain the small arc for a sufficient length of time to permit the carbon points to become properly heated to maintain a normal arc, at which time the head 27 at the end of spring 30 will have moved past a line common to the axis of the screw 17 and above the fulcrum of lever 18, whereby to cause the lever 18 to complete its movement, Fig. 3, and set free the lever 3 and core A′, when the latter will complete its upward movement within the coil A and effect a separation of the carbons sufficient to form a normal arc which will be maintained. Sufficient range of movement of the lever 3, without engaging the lever 18, will be permitted to allow a proper feeding of the carbons; but when the lamp is cut out of circuit the core will drop and engage the seat 20 of lever 18, causing said lever to assume its normal position, Fig. 1, as above explained, ready to be operated when the lamp is again started.

Various slight changes might be made in the details of construction of our invention without departing from the spirit thereof or limiting its scope, and hence we do not wish to limit ourselves to the precise details herein set forth; but,

Having fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. The combination with the separating magnet and the carbons of an arc lamp, of arc starting devices so constructed and arranged as to cause the carbons to be sufficiently heated before the formation of the normal arc to insure the maintenance of said normal arc when formed, substantially as set forth.

2. The combination with the separating magnet and carbons of an arc lamp, of arc starting devices constructed and arranged to cause the carbons to be slightly separated for a short period before they are separated sufficiently to form the normal arc, substantially as set forth.

3. The combination with the separating magnet and carbons of an arc lamp, of arc starting devices constructed and arranged to form a small arc between the carbons before the formation of the normal arc, substantially as set forth.

4. The combination with the carbons of an arc lamp, and a separating magnet, of arc starting devices intermediate of said carbons and the separating magnet so constructed and arranged that when current enters the lamp the carbons will be first slightly separated to form a small arc for heating the carbon points and then separate the carbons to form the normal arc, substantially as set forth.

5. The combination with the separating magnet and carbons of an arc lamp, of arc starting devices constructed and arranged to retard the formation of a normal arc after the carbons have begun to separate, substantially as set forth.

6. In an arc lamp, the combination with the carbons, a magnet and a lever connected with said carbons and the armature of the magnet of devices adapted to engage the lever and retard the formation of a normal arc after the carbons begin to separate, substantially as set forth.

7. In an arc lamp, the combination with a separating magnet, and the carbons, of a pivoted lever connected with the armature of said magnet, a connection between said lever and the carbons, a curved lever normally disposed in the path of the first-mentioned lever and a spring bearing against said curved lever and adapted to control the movements of the same, substantially as and for the purpose set forth.

8. In an arc lamp, the combination with the carbons and a magnet in series with said carbons, of a pivoted lever connected with the armature of said magnet, a connection between said lever and carbons and a spring actuated retarding device adapted to be engaged by said lever and to release said lever, successively, substantially as set forth.

9. In an arc lamp the combination with a magnet and the carbons of a lever connected with the armature of said magnet and with the carbons, of a spring actuated retarding lever adapted to be engaged by said first mentioned lever and adjustable stops constructed and adapted to limit the movements of said retarding lever, substantially as set forth.

10. In an arc lamp, the combination with a magnet, and the carbons of a lever connected with the armature of said magnet and with the carbons, a retarding lever to be engaged by the first mentioned lever, and a spring constructed and adapted to bear against said retarding lever, and retain it in the position to which it may be moved, substantially as set forth.

11. In an arc lamp, the combination with a magnet, and the carbons, of a lever connected with the armature of the magnet and with the carbons, a retarding lever adapted to be engaged by said first-mentioned lever and a spring bearing against said retarding lever normally at one side of its fulcrum, substantially as set forth.

12. In an arc lamp, the combination with a separating magnet, and the carbons of a pivoted lever connected with the carbons and with the armature of the magnet, a retarding lever adapted to be engaged by the first-mentioned lever, a pivotal bearing for said retarding lever, a spring adapted to normally bear against said retarding lever at one side of its fulcrum, a foot on the retarding lever and a stop to be engaged by said foot, substantially as set forth.

13. In an arc lamp, the combination with a separating magnet, and the carbons, of a pivoted lever connected with the armature of the magnet and with the carbons, a retarding lever, adapted to be engaged by said first-mentioned lever, a screw forming a pivotal bearing for said lever, a spring having a bearing at one end against the frame of the lamp and a head at the other end of said spring having a bearing in a recess in the retarding lever at one side of its fulcrum, substantially as set forth.

14. In an arc lamp, the combination with a separating magnet and the carbons, of a pivoted lever connected with the armature of the magnet and with the carbons, screws in diametrically opposite arms of the lamp frame, said springs being out of line with each other, a retarding lever to be engaged by the first mentioned lever and having one of said screws for its fulcrum, a spring, and heads at the ends of said spring, one of said heads having a bearing in one of said screws and the other head having a bearing against the retarding lever normally at one side of the fulcrum thereof, substantially as set forth.

15. In an arc lamp, the combination with a separating magnet and the carbons, of a pivoted lever connected with the armature of the magnet and with the carbons, a retarding lever having a pivotal bearing in the lamp frame, said retarding lever having a curved arm to be engaged by the first mentioned lever, a seat on the retarding lever to one side of its fulcrum to be engaged by the first-mentioned lever and a spring adapted to bear against the retarding lever normally at one side of its fulcrum, substantially as set forth.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

ERNEST J. BAGNALL.
GEORGE ARNOLD.

Witnesses:
B. F. WHITMAN,
ED T. HOLMES.