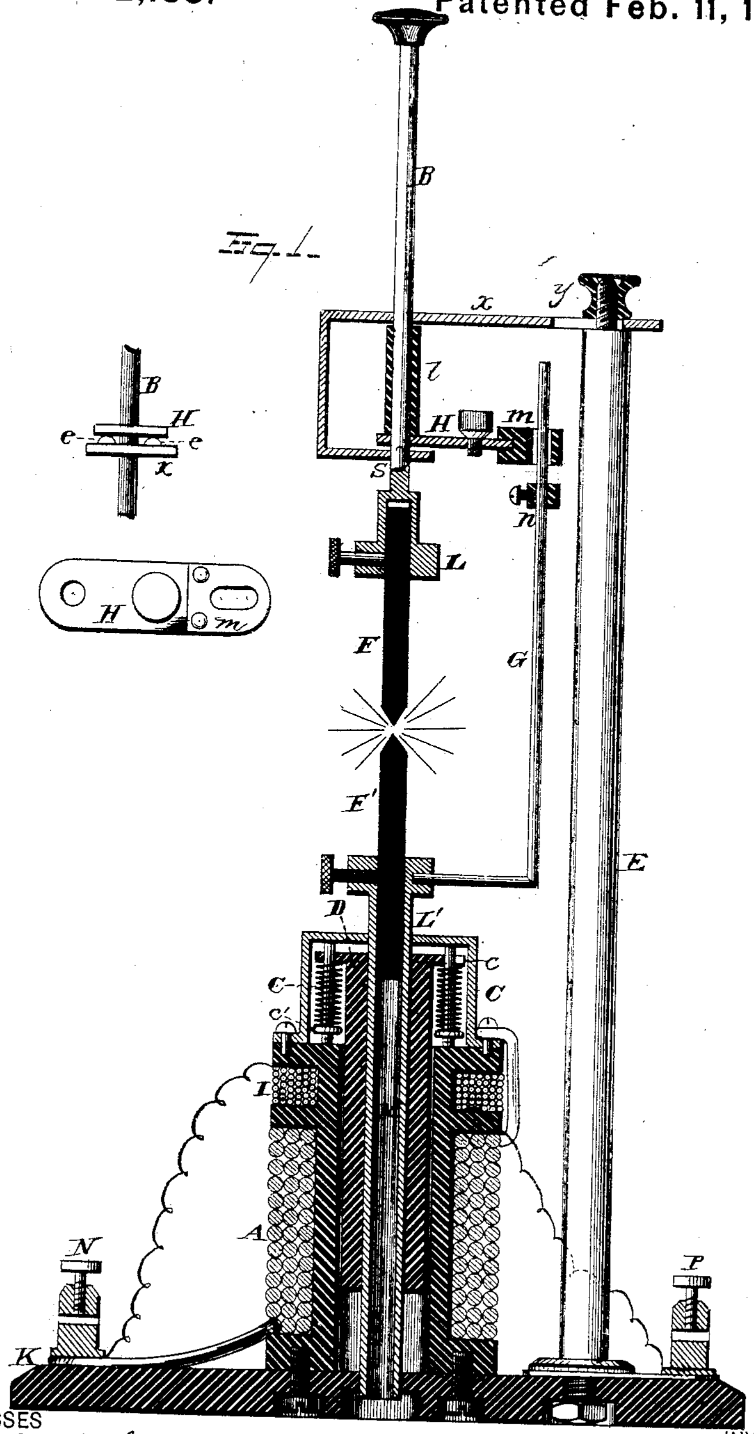
3 Sheets—Sheet 1.

C. F. BRUSH.

Electric Light-Regulator.

No. 212,183. Patented Feb. 11, 1879



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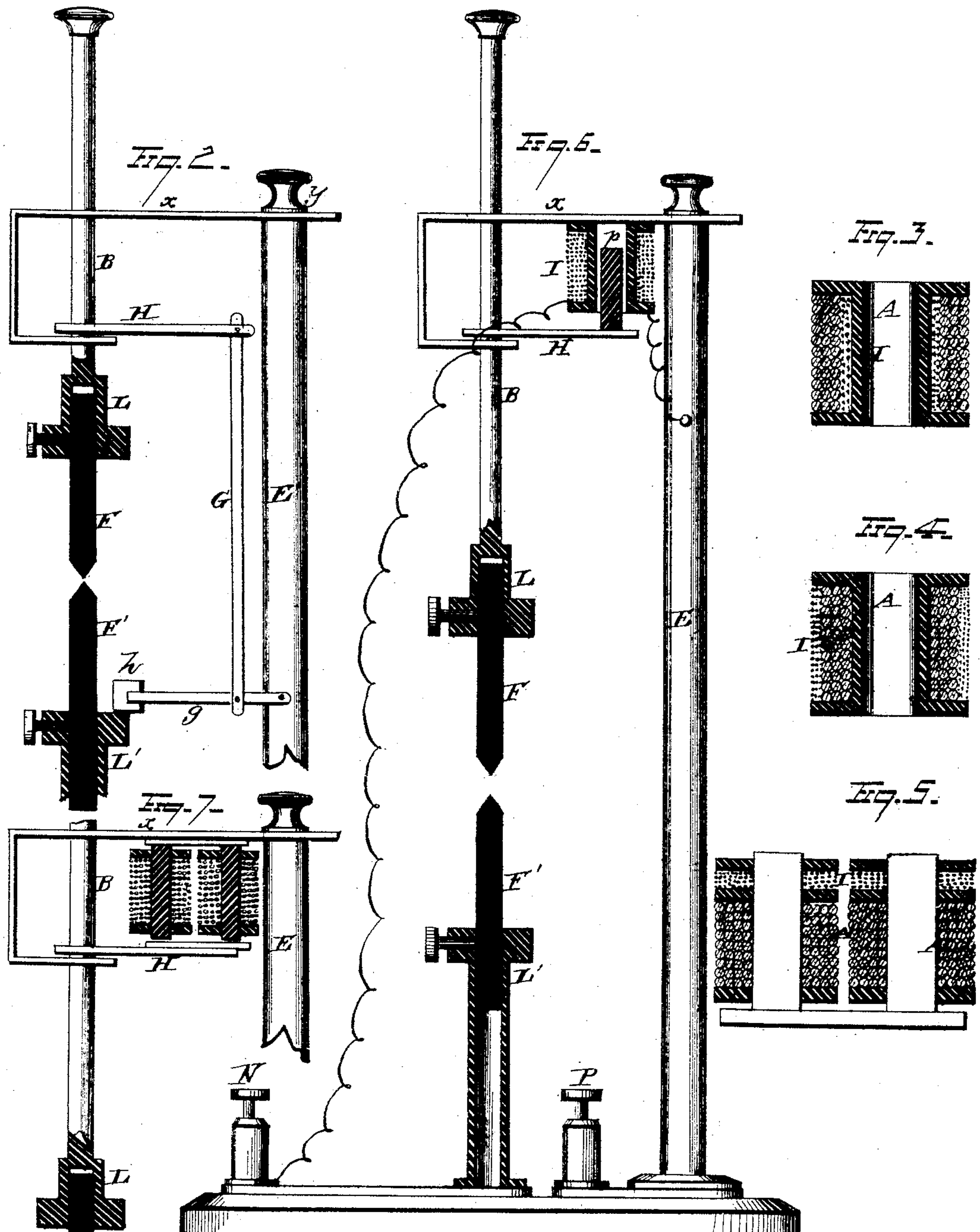

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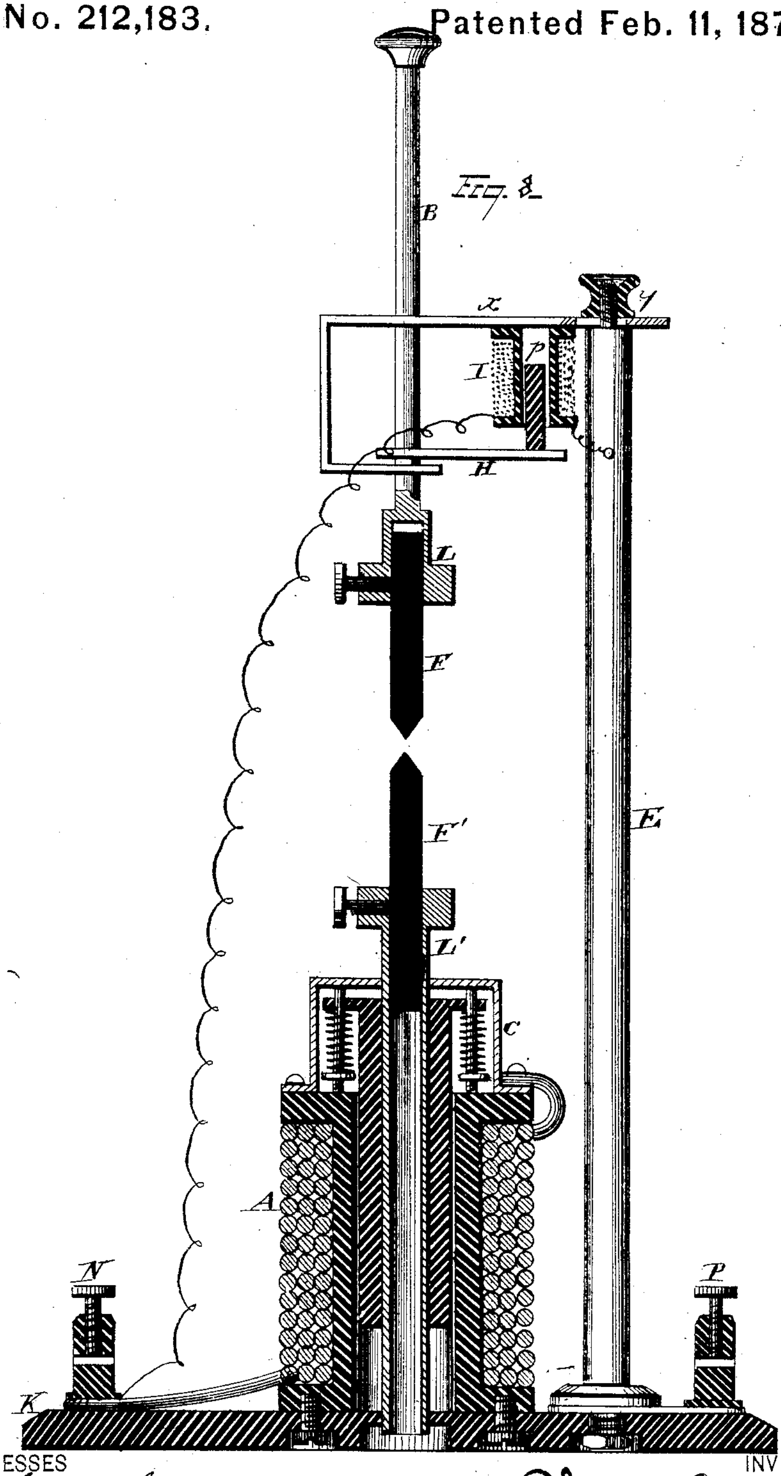

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UNITED STATES PATENT OFFICE.

CHARLES F. BRUSH, OF CLEVELAND, OHIO.

IMPROVEMENT IN ELECTRIC-LIGHT REGULATORS.

Specification forming part of Letters Patent No. **212,183**, dated February 11, 1879; application filed May 7, 1878.

To all whom it may concern:

Be it known that I, CHARLES F. BRUSH, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Electric-Light Regulators; and I 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 pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to improvements in electric-light regulators; and consists in the devices and appliances hereinafter set forth and claimed.

In the drawings, Figure 1 represents a vertical section of an electric-light regulator embodying my several improvements. Fig. 2 shows a modified arrangement of releasing mechanism and clutch G H. Fig. 3 shows a modified arrangement of principal helix A and adjusting-helix I. Fig. 4 shows another modification of the same. Fig. 5 shows one method of applying the adjusting-helix I to an ordinary magnet, such as is involved in many regulators in common use. Fig. 6 shows the adjusting-helix I as used without a principal helix. Fig. 7 shows a modification of the same. Fig. 8 shows the adjusting-helix and principal helix operating different cores or magnets.

In Fig. 1, K is a base, of suitable material, to which is attached a metallic post, E, supporting the arm X, which carries the rod B. This rod moves through holes in the arm X, and has at its lower end a carbon-holder, which clamps the carbon F firmly in position, so that it is carried up and down with the rod.

H is a ring-clamp surrounding the rod B, and prolonged and weighted at one side, as shown. This clamp is supported on projections *e*, attached to the arm X. *l* is a tube loosely surrounding the rod B, for the purpose of preventing the clamp H being carried up with the rod B when the latter is raised.

D is an iron core rigidly attached to the tube M, which, projecting above and below the core, passes through suitable bearings, as shown, and terminates above in the carbon-holder L′, which clamps the carbon F′, the latter extending down the tube M as far as may be desirable.

c are arms attached to the upper end of the core D, by means of which the spiral springs C support and force upward the core D, and with it the carbon F′. *c′* are adjusting-screws, for regulating the tension of the springs C.

G is an arm carried by the carbon-holder L′, and its upper end passes loosely through a hole in the prolonged end of the clamp H. This clamp is provided at its end with an insulating material, *m*, so that the arm G cannot make electrical contact with it. The arm G is provided with an adjustable collar, *n*, so placed that when the core D is at the limit of its upward movement the end of the clamp H will be slightly raised.

The lower portion of the core D is surrounded by a helix of coarse wire, A, having one of its ends attached to the binding-post N, and the other, in connection with the carbon-holder L′, through the tube M and its upper bearing, as shown. P is a binding-post, connecting with the post E.

When the regulator is not in operation, the springs C will force the core D upward, the collar *n* on the arm G will raise the end of the clamp H, the rod B will be released, and will fall until the carbons F F′ are in contact. The arm X being provided with a slot through which the post E passes, the carbons F F′ may be adjusted in proper apposition by loosening the nut J, which may then be tightened.

The operation of the device as far as described is as follows: The posts P N being attached to a suitable source of electricity, the current passes through the post E, arm X, and rod B to the carbon F; thence through the carbon F′, tube M, and helix A to the other binding-post, N. Under these conditions the core D is drawn down by the axial magnetism of the helix A, carrying with it the carbon F′ and arm G. The weighted end of the clamp H being thus allowed to fall at the beginning of the downward movement, the sides of the hole in the clamp through which the rod B passes impinges against the latter, and prevents its downward movement of carbon F.

The core D, continuing to move downward, separates the carbons F F′, and the voltaic arc is developed between them, thus producing the electric light. The tension of the spring C is so adjusted that the downward movement of the core D will be arrested when the carbons F F′ are sufficiently separated, the magnetism of the helix A being much reduced by the weakening of the electric current, due to the resistance of the arc between the carbons.

Now, as the carbons gradually burn away, their distance from each other is increased, the electric current is weakened, owing to the increased resistance, and the magnetism of the helix A is reduced so as to be overcome by the spring C. This allows the carbon F′ to move upward until sufficiently near its neighbor, when it is stopped by the increased electric current acting on the core D. When the carbons have burned to such an extent that the core D approaches near to the limit of its upward movement, the clamp H is raised, and the rod B, being liberated, falls downward, carrying with it the carbon F, until the downward movement of the core D, caused by the shortening of the voltaic arc, allows the clamp H to again fasten the rod B.

By means of this simple device an electric light may be uniformly maintained for many hours, the only limit to the time being the length of carbon rods employed.

The releasing-arm G, Fig. 1, may be replaced by the arrangement shown in Fig. 2, consisting of a lever, *g*, pivoted at one end to the post E, and connected by a link, G, with the clutch or clamp H. One end of the lever *g* projects over the carbon-holder L′, from which it is insulated by suitable material *h*, as shown. The lever *g* and link G are so arranged that when the carbon-holder L′ is at its upper limit the lever will be raised by it, thus raising the clamp H and liberating the rod B.

Obviously, many forms of clamps H and releasing mechanism G may be employed, the essential element being such as will release the rod B when the core D approaches near to its upward limit, and clamp it when the core moves in the opposite direction. In case it becomes desirable to operate this regulator in other positions than the vertical one shown, it will only be necessary to so arrange matters that gravity or suitable springs, or both, may produce the same movements of the several parts which gravity and the springs C produce in the vertical position described.

We have now to consider the second important element of my invention, which consists in the introduction of the second helix, I, used alone or in combination with the principal helix A. I have styled this second helix the "adjusting-helix," and will so refer to it in my description. It is employed for the purpose of governing the automatic adjustments of the regulator, its value for this purpose being more apparent when two or more are used in a single electric circuit.

It is well known that when an attempt is made to use two or more regulators of ordinary forms in a single electric circuit they work very irregularly, some allowing their carbons to come and remain in contact, while others have their carbons widely separated. The cause of this irregularity may be explained as follows: Supposing two regulators are being used, at the commencement of the operation the regulators may start evenly, especially if a limit is fixed to the separation of their carbons. When, however, the carbons burn away, so that the weakened current allows them to move toward each other, this movement will commence in one regulator before it does in the other, as it is impossible to adjust the regulators so nicely that their automatic adjustments will take place simultaneously; but as soon as one pair of carbons approach each other, the electric current is strengthened, and the other pair of carbons, which were about to move forward, will be retained in their old position. When another adjustment becomes necessary, the same regulator which proved the more sensitive in the first instance may again advance its carbon first. These operations are liable to continue until the more sensitive regulator has its carbons in contact and ceases to afford light, while the other monopolized the whole voltaic arc, which was at first divided between the two. Hence it appears that no more than one regulator of the ordinary form can be successfully operated by a single current. If, however, a device can be applied to the regulators above considered which shall automatically tend to force the carbons together with a constantly-increasing pressure as their distance increases, then the two regulators, or as many more as the current is capable of operating, will work uniformly, each maintaining its due portion of the voltaic arc. This important result I attain by means of the adjusting-helix I. This helix consists of wire very much finer than that of the helix A, and consequently the wire is much longer and makes more convolutions than the latter. The ends of the fine wire are connected with the binding-posts P and N, but in such a manner that the electric current shall pass through it in a direction opposite to that in the helix A.

It will now be seen that the electric current has two passages provided for it—one of high resistance through the adjusting-helix I, and the other of comparatively low resistance through the helix A, carbons F F′, and the voltaic arc between them.

It is well known that when an electric current has two channels for its passage it will divide itself between them, the relative amounts passing through them being inversely as their resistance. Hence, any increase in the resistance of one conductor produces a corresponding increase of current in the other. It follows, from the difference in direction of the current in the two helices, that the helix I will constantly tend to neutralize the magnetism produced by the helix A in the core D, and thus diminish the force which draws the latter downward. The number of convolutions of the helix I and its resistance are so proportioned to the number of convolutions in the helix A and its resistance, together with that of the normal voltaic arc, that the magnetizing power of the latter helix shall be much greater than that of the former. The magnetizing power of the former is, however, very considerable, notwithstanding the small amount of current which passes through it, owing to its great number of convolutions.

Suppose, now, that two or more regulators, provided with adjusting-helices, are introduced into a single suitable electric circuit. The preponderant magnetism of the helices A will operate to separate the carbons in the several regulators, as before explained, and the neutralizing effect of the adjusting-helices I will be equal in all, thus performing no function as long as the regulators work uniformly; but when any irregularity of action commences by which one pair of carbons are separated more than their normal distance, then, owing to the increased resistance of the main circuit in this particular regulator, the current in its adjusting-helix is increased, thus further neutralizing the effect of the principal helix, and allowing the springs C to push the carbons back to their normal position.

If the carbons in any instance approach too near together, the diminished resistance of the main circuit in this instance weakens the current through the adjusting-helix, allowing the principal helix to separate the carbons to their normal distance. Thus it may be seen that the use of this simple device obviates all the difficulties hitherto experienced in multiplying electric lights from a single source of electricity.

The adjusting-helix I may occupy various positions in relation to the principal helix A without interfering with its peculiar function. Thus, for instance, it may be placed within the principal helix instead of at either end, or it may be placed outside of the latter. These modifications are shown, respectively, in Figs. 3 and 4.

The adjusting-helix is equally applicable to those regulators in which an ordinary electro-magnet is employed, having its helix or helices rigidly attached to its core or cores. One method of so applying it is shown in Fig. 5. Or it may be applied to those regulators having two principal helices, like the well-known "Browning" and similar regulators. It is, of course, equally applicable to single principal-helix regulators other than that represented in Fig. 1—such, for example, as that described in a former application of my own.

When a single regulator is used in an electric circuit the adjusting-helix acts as a valuable governor, preventing sudden changes of position in the carbons, and insuring great uniformity of working.

We have yet to consider the application of the adjusting-helix to those regulators in which it may replace the principal helix entirely, while still performing its peculiar function. Such a regulator is shown in Fig. 6, in which the carbon F′ is stationary, being connected directly with the binding-post N. The adjusting-helix I here acts on an iron core, *p*, attached to the outer end of the clamp H, and taking the place of the weight similarly placed in Fig. 1. One end of the adjusting-helix is attached to the binding-post B through the post E, while the other is attached to the binding-post N.

The operation of the device is as follows: The electric current being supplied to the binding-posts P N, the carbons are properly separated by raising the rod B. The electric current then divides itself between the main circuit of the regulator, including the carbons F F′, and that of the adjusting-helix, as before explained. When, now, the carbons burn away so that their separation becomes too great, the increased resistance of the main circuit strengthens the current in the adjusting-helix, so as to enable it to lift the core *p*, and with it the clamp H, thus allowing the rod B to move downward until the decreasing resistance of the main circuit again allows the core *p* to fall and clamp the rod B.

Fig. 7 shows a modified application of the adjusting-helix as applied to the regulator just described. Here the helix I and the core *p*, Fig. 6, are replaced by an ordinary electro-magnet wound with the adjusting helix or helices, and acting on an armature of iron attached to the clamp H, as shown.

Fig. 8 shows a modification or development of the regulator represented in Fig. 6. In this case the lower carbon, F′, is operated by a principal helix, A, in the manner described in connection with Fig. 1, while the mechanism for releasing the rod B is operated by the adjusting-helix I, as described in connection with Fig. 6.

We have here the principal helix A and the adjusting-helix I performing their several characteristic functions, although separated from each other and operating upon different cores or magnets.

What I claim is—

1. The combination, in a single circuit, of two or more electric lights, each of which is provided with an upper carbon point, having mechanism connected therewith for releasing the carbon-holder and allowing it to be fed by gravity, and a lower carbon, the position of which is regulated by the resultant force of axial magnetism caused by the passage of electricity through a helix on the main circuit and a helix on a shunt circuit, substantially as set forth.

2. In an electric-light regulator, the combination, with a carbon-holder, of a magnet surrounded by two helices, one helix located in the main circuit, and the other in a shunt-circuit, the main and subsidiary currents passing through said helices in opposite directions, substantially as set forth.

3. In an electric light, the combination, with

a movable core supporting a carbon point and upheld by suitable springs, of a helix surrounding the core and connected with the main circuit, and a superposed subsidiary helix, also surrounding the movable core and connected with a shunt-circuit, substantially as set forth.

4. In an electric light, the combination, with a movable core supporting one of the carbon points, and a main and subsidiary helix surrounding said core, and respectively connected with main and shunt circuits, of the upper carbon point and suitable intervening mechanism, whereby the upper carbon point is fed downward by the action of the lower carbon point, substantially as set forth.

5. In an electric light, the combination, with the upper and lower carbon points thereof, of a helix in the main circuit and a helix in a shunt-circuit, both of said helices surrounding a movable core, with which one of the carbon points is connected, and clamping mechanism connected with the upper and lower carbon points, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES F. BRUSH.

Witnesses:
F. TOUMEY,
F. M. FABER.