

(No Model.)

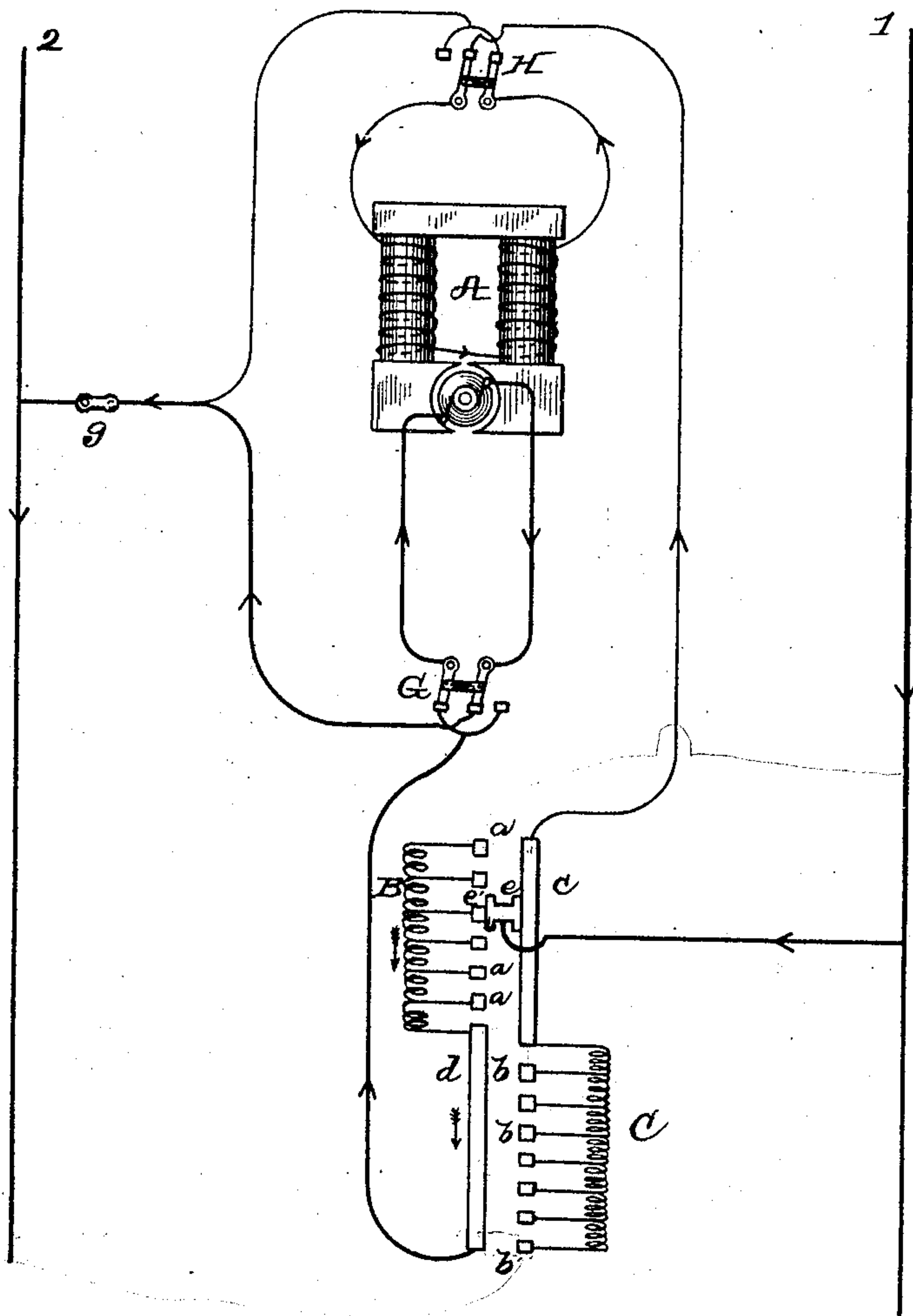
2 Sheets—Sheet 1.

F. J. SPRAGUE.  
ELECTRO DYNAMIC MOTOR.

No. 321,148.

Patented June 30, 1885.

Fig. 1.



ATTEST:

*E. A. Rowland*  
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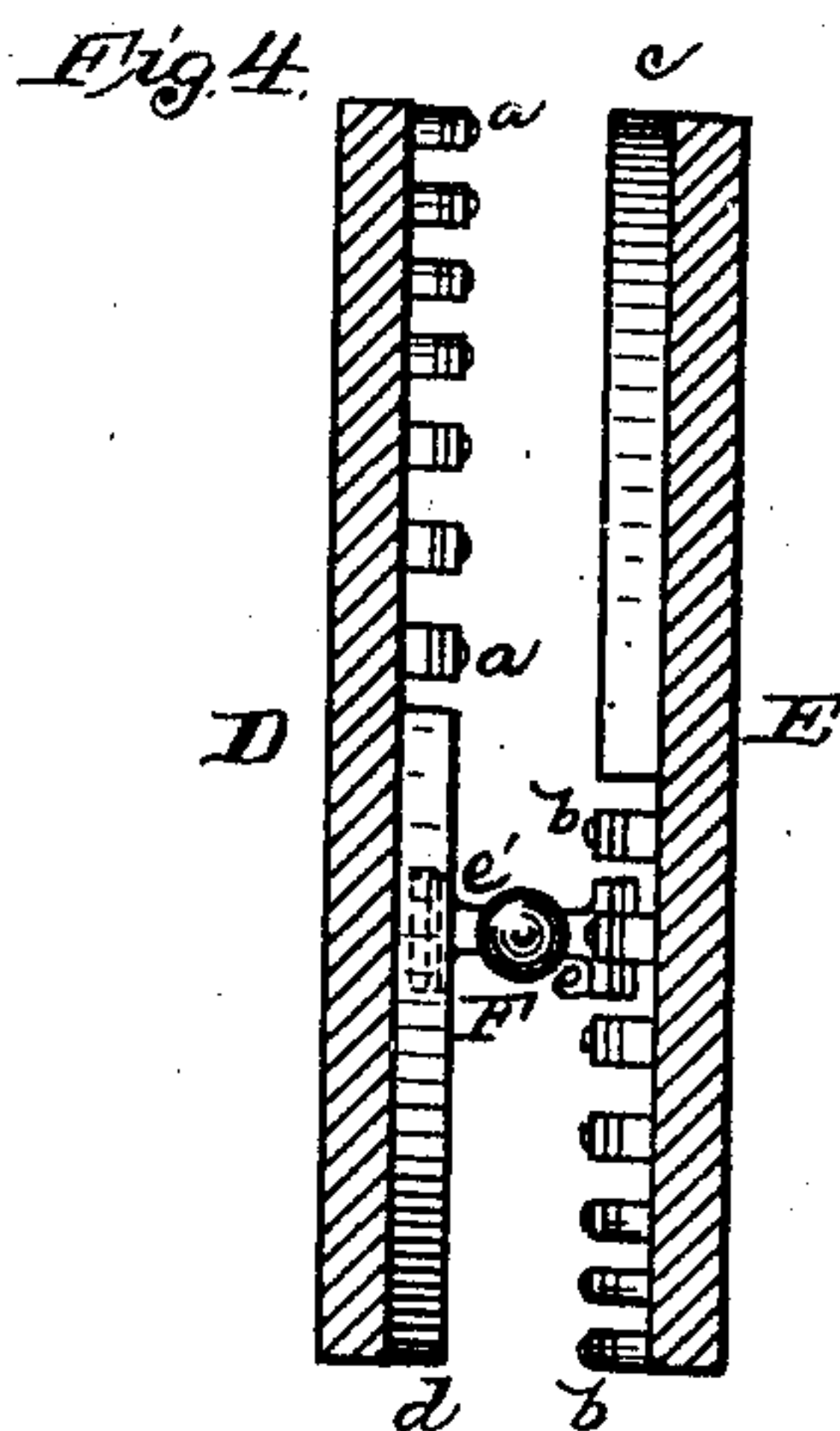
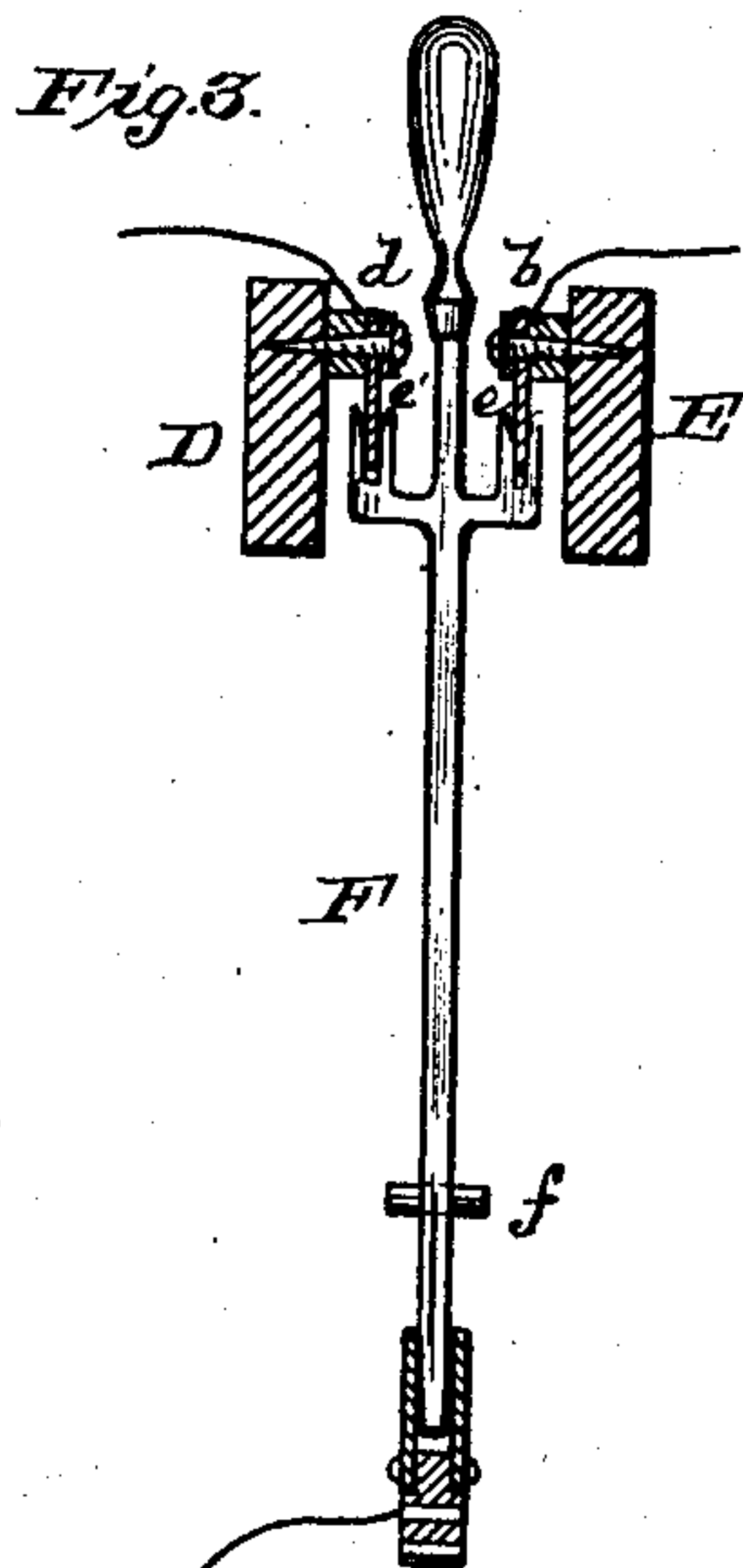
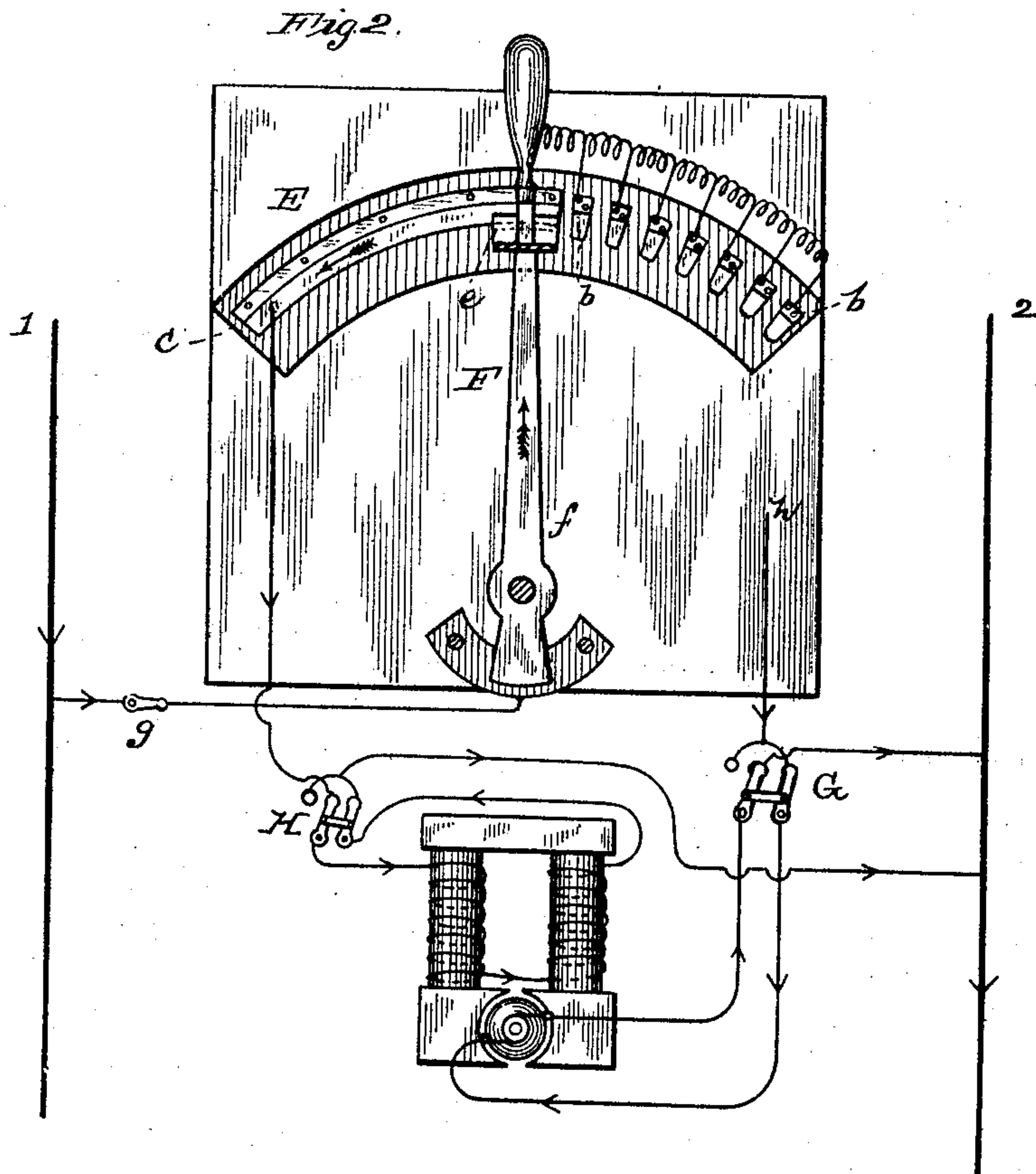
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E. C. Rowland  
J. H. Mudd

INVENTOR:  
Frank J. Sprague  
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# UNITED STATES PATENT OFFICE.

FRANK J. SPRAGUE, OF NEW YORK, N. Y., ASSIGNOR TO THE SPRAGUE  
ELECTRIC RAILWAY AND MOTOR COMPANY.

## ELECTRO-DYNAMIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 321,148, dated June 30, 1885.

Application filed March 3, 1885. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK J. SPRAGUE, of New York, in the county and State of New York, have invented a certain new and useful  
5 Improvement in Electro-Dynamic Motors, of which the following is a specification.

This invention relates to a method of operation for electro-dynamic motors on circuits of constant difference of potential. Such method  
10 consists in first introducing the motor into circuit with a very strong field and with a small difference of potential at the terminals of the armature-circuit, so that the motor starts slowly; then progressively raising the  
15 armature-circuit potential until that circuit is brought up to full potential, and then, to still further increase the speed, weakening the field-magnet strength. I have devised an apparatus in which all these operations affecting  
20 the armature and field circuits are performed by a single commutator-arm, which apparatus I have found to be a convenient one for carrying the above-described method into effect. This apparatus is illustrated in the accompanying  
25 drawings, in which—

Figure 1 is a diagram of a motor with its connections and of the apparatus embodying my invention; Fig. 2, a vertical longitudinal  
30 section of the commutator which I employ, with a diagram of the connections; Fig. 3, a vertical transverse section of the commutator, and Fig. 4 a top view of the commutator.

A is a shunt-wound electro-dynamic motor. 1 2 are the line-conductors from which said  
35 motor derives current.

B is a series of resistance-coils for the armature-circuit, the terminals of which are brought to contact-blocks *a a*, and C is a similar series of resistances for the field-circuit  
40 connected with contacts *b b*.

Situated opposite the contacts *a a* in a line with contacts *b b* is a long contact-block, *c*, connected in the field-circuit, and opposite the  
45 contacts *b b* in line with contacts *a a* is a similar long contact-block, *d*, in the armature-circuit.

The contacts *a a* and *d* are mounted in the form of an arc on an insulating-strip, D, and contacts *b b* and *c* are similarly mounted on  
50 strip E. The contacts are preferably of the

form shown, being supported off from the strip, so as to enter between the jaws of forked contacts *e* and *e'*, which are carried by a metal arm, F, pivoted at *f* and working back and forth between the two series of contacts. To  
55 this arm F is permanently connected one of the terminals of the supplying-circuit. When the contacts *e e'* are at the highest position in the diagram Fig. 1, it will be seen that all the resistance-coils *a a* are in the armature-circuit; but there are none in the field-circuit. Consequently there is a strong field-magnet and weak armature when the motor is started by throwing in switch *g*. On then moving  
60 the contacts *e e'* down resistance is cut out of the armature-circuit, while as contact *e'* is moving on the long block *d* there is no change in the field-circuit. Thus the armature-circuit is gradually raised to the full potential, which is reached when the contact *e'* reaches  
70 the lowest of the contacts *a*. Then to weaken the field, and still further increase the speed or power, or both, of the motor, the contacts *e e'* are moved further down, and as they pass from one contact *b* to another resistance-coils  
75 C are placed in circuit and the field is gradually weakened, while the armature-circuit is not affected, because contact *e* is moving on the long block *c*. The ends of the two long blocks extend opposite each other, so that  
80 circuit is maintained in passing from the armature-resistance contacts to the field-resistance contacts. In practice these effects are produced by moving the pivoted arm F along the two series of contacts. The motor is thus  
85 made to start slowly, and then to gradually increase its speed up to the maximum. While the motor is running its field-magnet may be regulated without affecting the armature-current by changing the position of the moving  
90 contacts between contact *d* and contacts *b b*.

It will be understood that in the section Fig. 2 only the field-circuit resistance contacts can be seen; hence the wire which leads to the armature-resistance contact is  
95 broken off in this figure at *h*.

G is a switch for reversing the armature-circuit, and H a similar switch for reversing the field-circuit.

I do not claim herein the apparatus de- 100

scribed, this application being confined to the method of regulation. The apparatus will form the subject of a separate application for Letters Patent, such division into two applications having been required by the Commissioner of Patents.

What I claim is—

10 1. The method of operating an electro-dynamic motor, which consists in starting the motor with low potential at the armature terminals and strong field-magnet, gradually increasing the armature-circuit potential, and then gradually decreasing the strength of the field-magnet, substantially as set forth.

2. The method of operating an electro-dynamic motor, which consists in starting the motor with resistance in its armature-circuit and little or no resistance in its field-circuit, gradually cutting out resistance from the armature-circuit, and then gradually increasing the resistance of the field-circuit, substantially as set forth.

This specification signed and witnessed this 16th day of February, 1885.

FRANK J. SPRAGUE.

Witnesses:

A. W. KIDDLE,  
E. C. ROWLAND.