

No. 626,361.

**Patented June 6, 1899.**

**A. A. BLACKMAN.**

## METHOD OF AND APPARATUS FOR ELECTROPLATING.

(Application filed Sept. 27, 1898.)

(No Model.)

**2 Sheets—Sheet 1.**

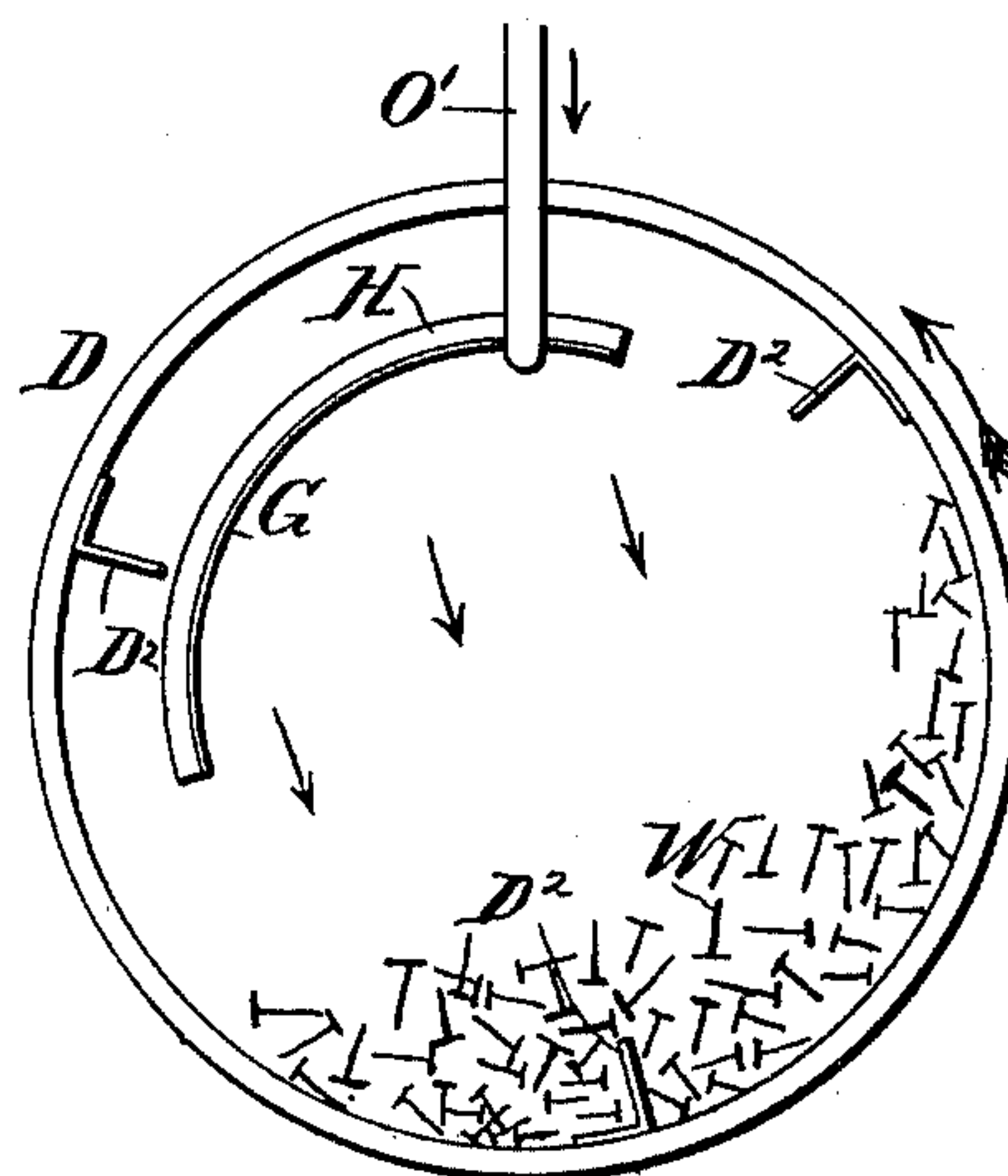
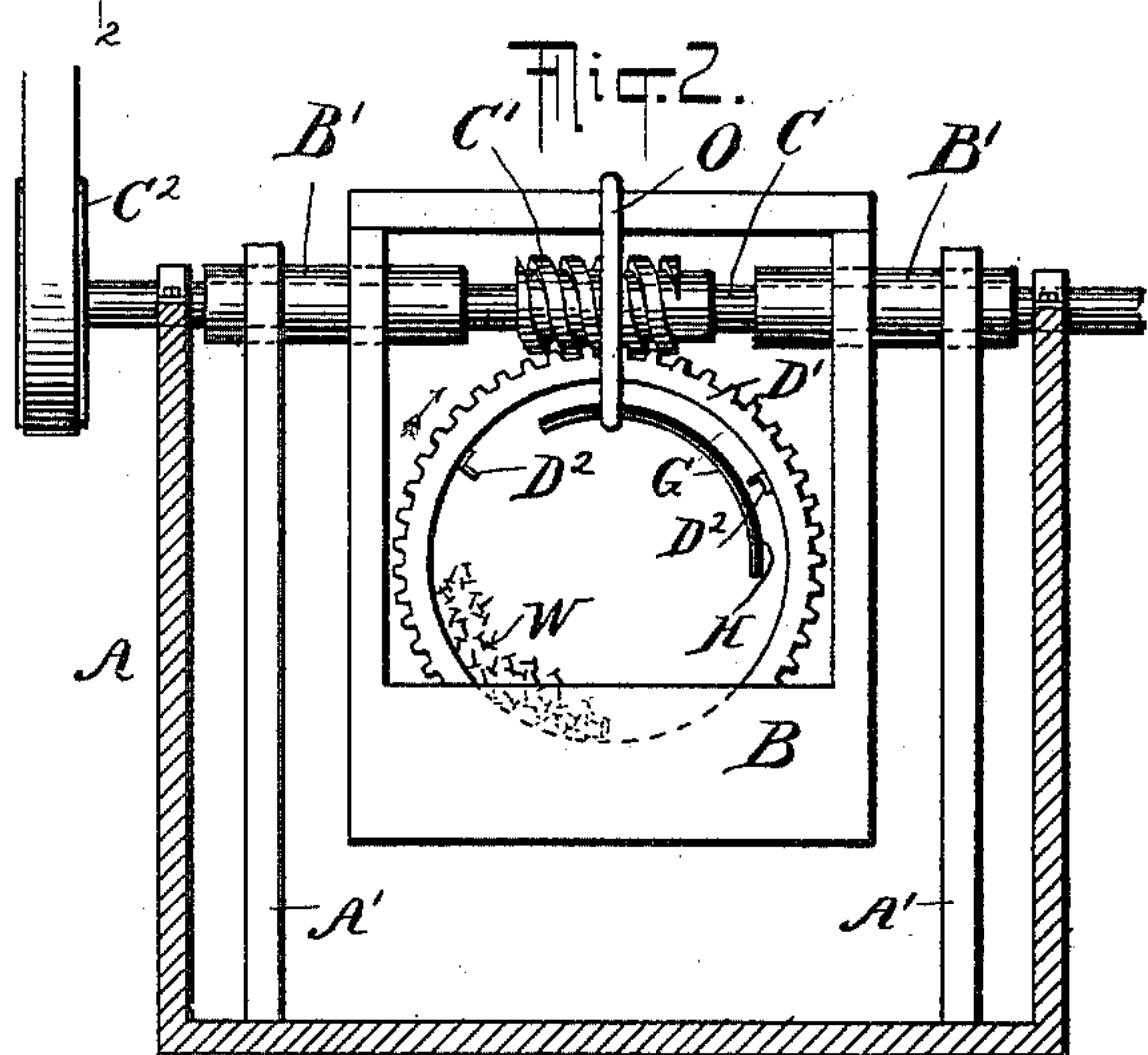
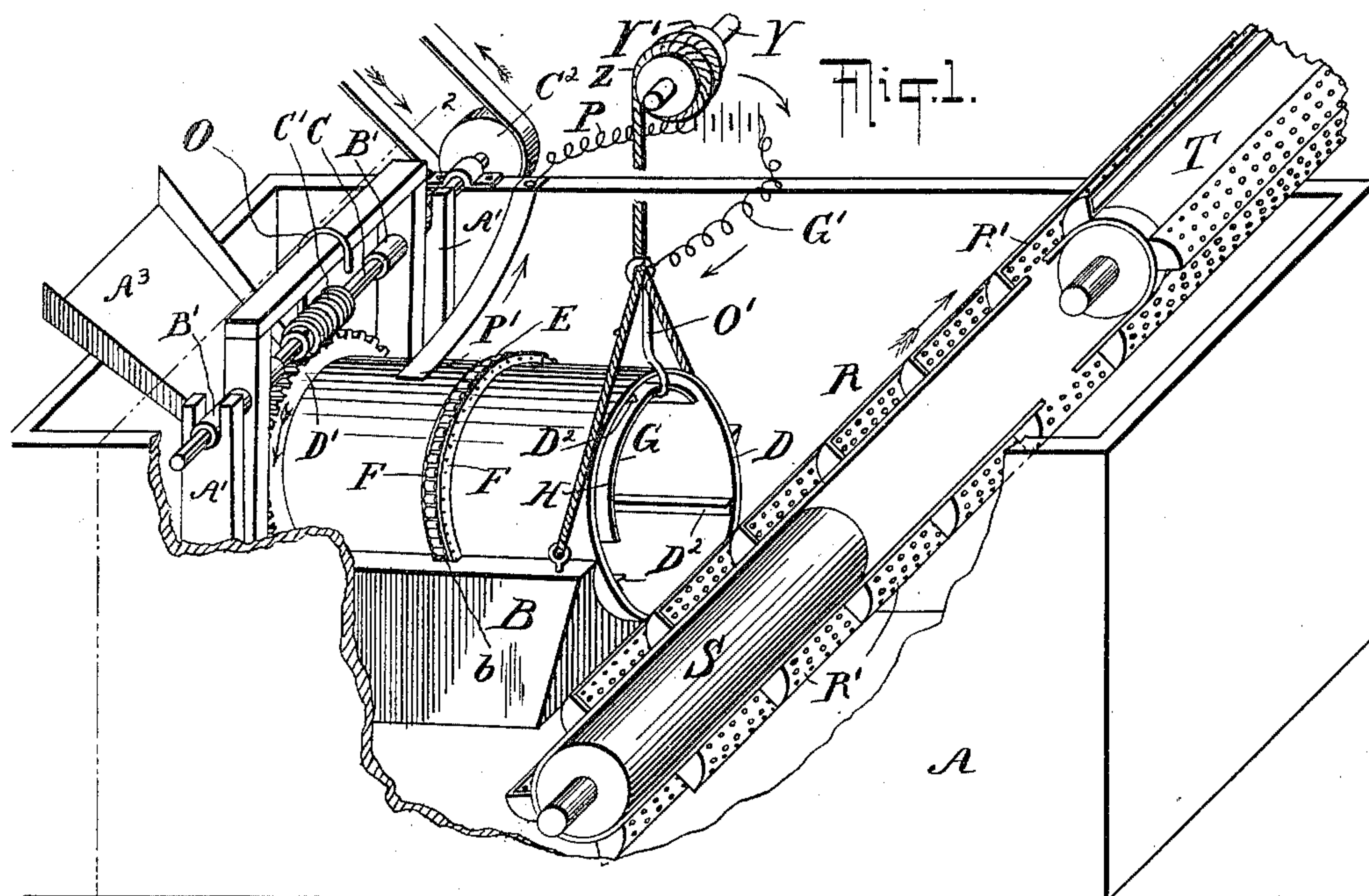


Fig. 3.

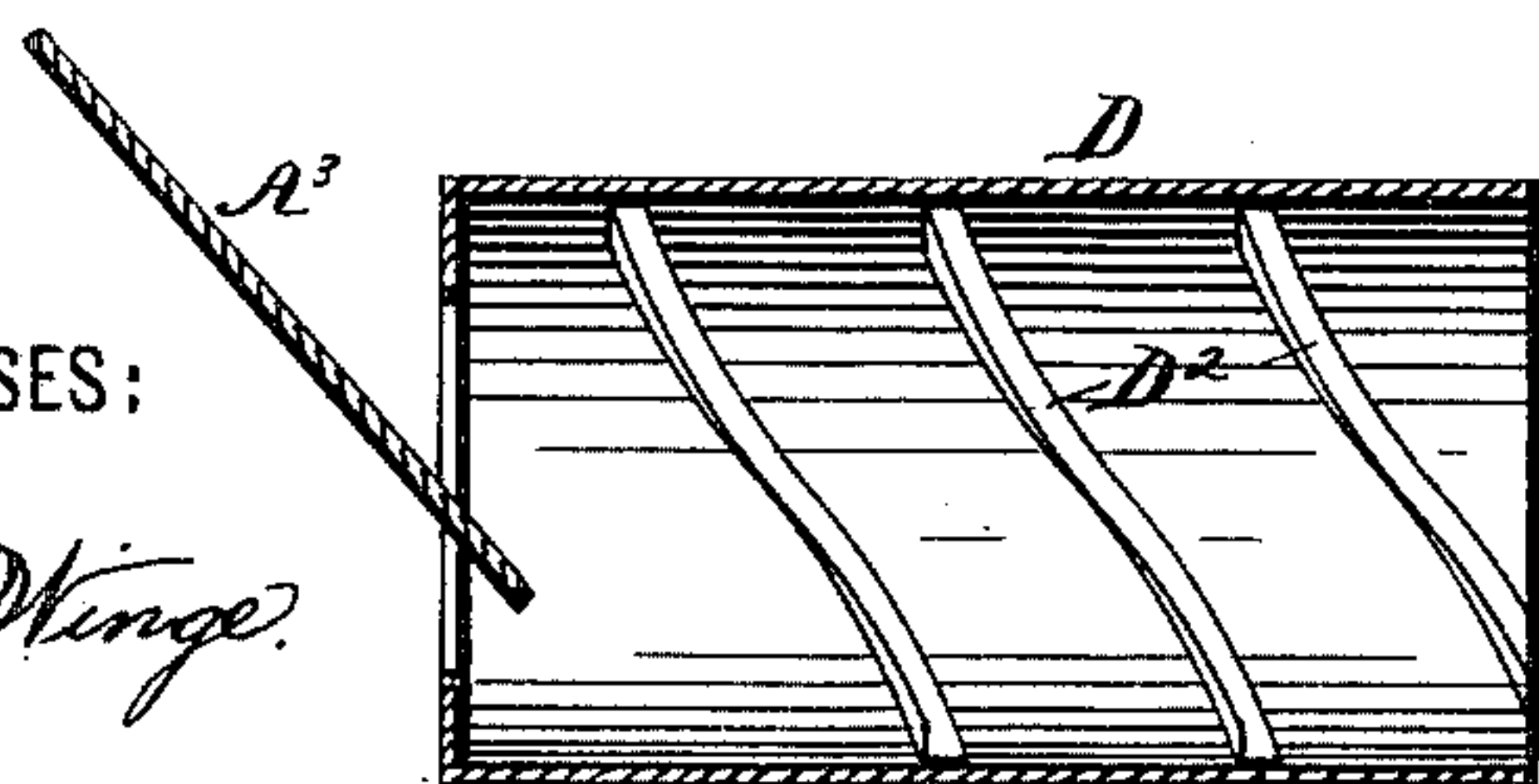


Fig. 4.

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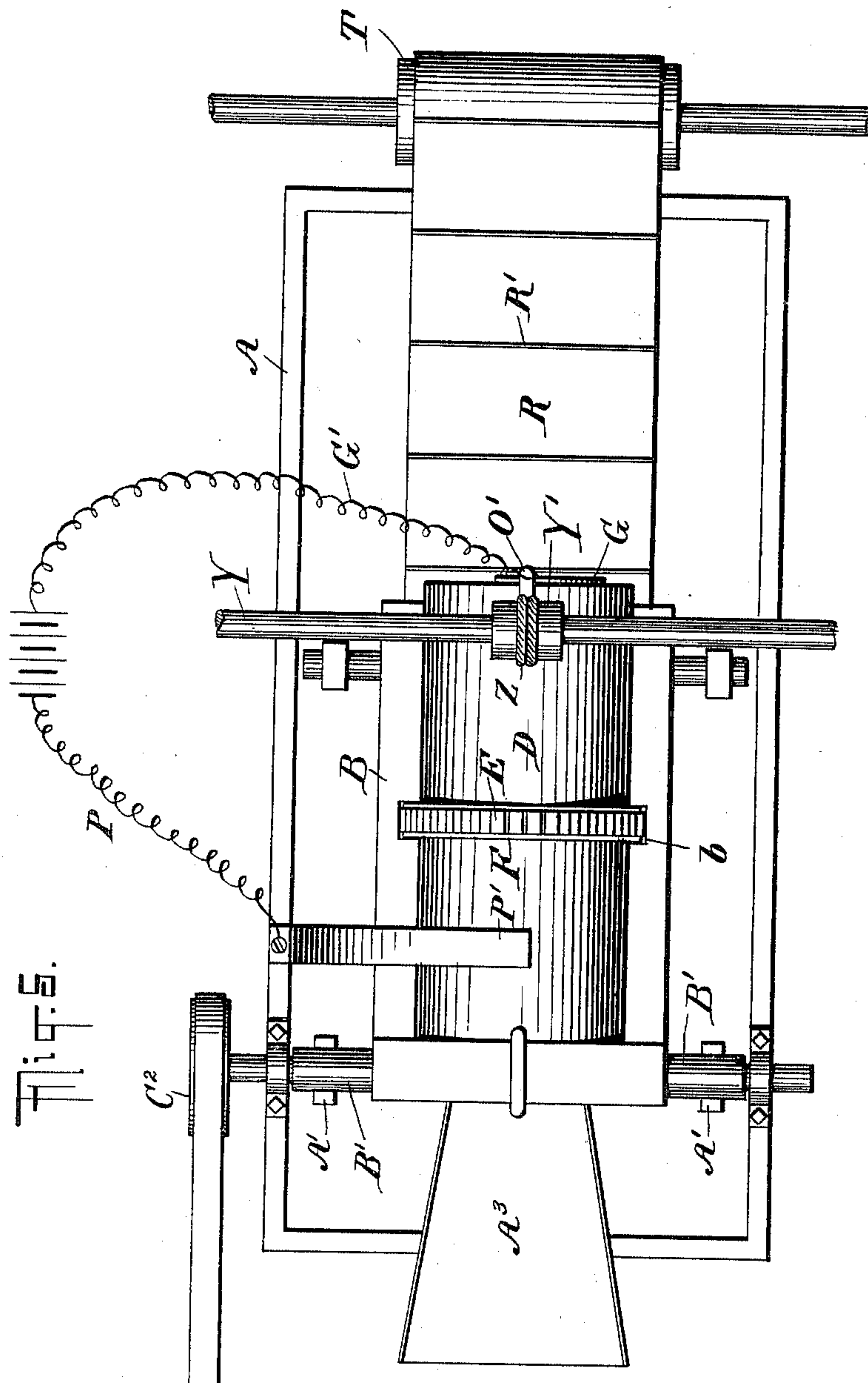
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2 Sheets—Sheet 2.



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# UNITED STATES PATENT OFFICE.

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## METHOD OF AND APPARATUS FOR ELECTROPLATING.

SPECIFICATION forming part of Letters Patent No. 626,361, dated June 6, 1899.

Application filed September 27, 1898. Serial No. 691,989. (No model.)

*To all whom it may concern:*

Be it known that I, ALFRED A. BLACKMAN, a citizen of the United States, residing in the borough of Manhattan, in the city and State of New York, have invented a certain new and useful Improvement in Electroplating Methods and Apparatus, of which the following is a specification.

My invention makes it practicable to deposit a thin coating of metal upon small articles with economy, rapidity, and perfection. I have discovered that it is practicable to electroplate by continuously moving the articles to be coated through a solution and changing frequently the points of support.

I have carried out the invention by the aid of a tumbling-cylinder immersed in a solution composed of alum and chlorid of zinc of the proper strength, the cylinder being open at each end and revolved in a slightly-inclined position, and treating thoroughly-cleaned iron articles to be electroplated, feeding them in at the high end and allowing them to be delivered automatically at the other end. I provide for varying the inclination, and thereby varying the rate at which the articles will be moved, and consequently the time during which the deposit is applied. I have so far mainly coated iron with zinc by this means. The immensity of the possibilities in this line and the difficulties experienced in the ordinary methods may make this its most important development, and I will describe the invention as thus applied. The articles to be plated may be nails, and I will so describe them.

The accompanying drawings form a part of this specification and represent what I consider the best means of carrying out the invention.

Figure 1 is a general perspective view with a portion of the tank broken away to show the interior. Fig. 2 is a cross-section on the line 2 2 in Fig. 1. Fig. 3 is a section through the tumbling-cylinder on a larger scale. Fig. 4 is a longitudinal section through the tumbling-cylinder and adjacent parts, showing a modification. Fig. 5 is a plan view of the apparatus illustrated in Fig. 1.

Similar letters of reference indicate corresponding parts in all the figures where they appear.

A is a tank, of wood or other suitable material, containing water with alum and chlorid of zinc, making a solution of ordinary strength—say about three ounces of the salt of zinc to a gallon of the solution.

A' A' are posts standing in the tank in the positions represented.

B is a frame, of hard wood or other suitable material, capable of turning to a small extent on hollow trunnions B', supported on the posts A'. C is a worm-shaft carried in bearings on the tank and extending through the hollow trunnions, presenting a worm C' in the space between these posts.

D is a tumbling-cylinder mounted in the frame B and running on antifriction-rollers E, carried in revolving rings F, the series of rollers running in properly-curved ways b, formed in the frame B, so as to allow the cylinder to be revolved with ease in the framing. The cylinder D may be conveniently made of hard wood in longitudinal strips or staves, held firmly together by hoops, with a lining of copper or other good metallic conductor which will remain unaffected by the solution. The metallic lining of the cylinder D is always in contact with the nails or other articles W which are to be treated, and is kept in electrical connection with the negative pole of the battery or with a dynamo (not shown) by means of the conducting-wire P, making an electrical contact with the cylinder at P'.

Y is a shaft carrying a pulley Y', around which is wound a cord Z, which is branched and attached to the frame B at the delivery end. It will be understood that the tumbling-cylinder D is longer relatively to its diameter than is indicated in Fig. 1. When the shaft Y is turned to lower the free end of this cylinder, the nails or other articles being plated will move through it faster, and when it is turned the other way the pulley Y' winds up the cord Z and raises the delivery end of the frame B, thus making the cylinder D nearly level, and the traversing through is then very slow. There are provisions, as a toothed wheel and a spring-dog or a series of such wheels and dogs, (not shown,) for turning and holding the shaft Y, so that by liberating and turning the shaft Y one way or the other the inclination of the frame B, and conse-



quently of the tumbling-cylinder D, may be varied with great nicety. As the free end of the frame is raised and lowered by adjusting the wheel (not shown) the tumbling-cylinder D is inclined more or less, so that the nails or other articles being plated will be hastened or retarded in their tumbling passage through it.

D' is a worm-wheel fixed on the tumbling-cylinder D and engaged with the worm C'. This cylinder is shown as entirely of copper or other metal, and the arrangement is such that the frame B and the parts carried thereon may be raised and lowered at the free end—the delivery end—without changing the engagement of the worm with the worm-wheel. In other words, at any inclination of the tumbling-cylinder the revolutions of the worm C', derived through a belt from the motor, (not represented,) running on a pulley C<sup>2</sup> on the shaft C, by its action on the worm-wheel D' slowly revolves the tumbling-cylinder D. This cylinder is provided with longitudinal strips D<sup>2</sup> in its interior, which, as the cylinder D slowly revolves, insure the desired tumbling action of the nails or other articles W being traversed through it.

G is a curved plate of zinc having its outer face coated with an insulating-covering, as a thin coating of gutta-percha H, and having its inner face exposed to the solution. It is mounted in the upper portion of the interior of the tumbling-cylinder D, being set concentric thereto and considerably to one side in the upper portion thereof. It is supported at the receiving end by a sling O and is electrically connected by a stout copper wire G', leading from the positive pole of a battery or dynamo, connected through a sling O' at the other end.

The loose material which is to be plated is fed into the upper end of the tumbling-cylinder through an inclined chute A<sup>3</sup>, into which it is fed by hand or by any suitable machinery. The slow revolution of the tumbling-cylinder D agitates the nails, carrying them up on one side and causing them to tumble in an indefinite variety of attitudes relatively to each other and to the cylinder. During this operation they move slowly by gravity from the higher to the lower end of the cylinder. The action presents all the surfaces very uniformly to the solution while agitated and to the electric current which moves into them from the extended anode G. The one-sided position of the latter in the cylinder is required by the fact that the nails are, by the friction of the cylinder and the direct lifting action of the strips D<sup>2</sup>, carried up in one side of the interior of the cylinder, and it is necessary in order to present a large surface of the anode G and keep it out of possible contact with the nails to locate it on the opposite side of the center line.

It will be understood that the strength and temperature of the solution will require attention at intervals; also, that the tumbling-

cylinder may be taken out and the plating of zinc which is uselessly deposited on it may be removed from time to time. It is well to have one or more spare cylinders D ready to be substituted when required.

Various methods may be employed for conveniently removing the nails after their delivery from the lower end of the tumbling-cylinder D. I have shown an endless apron R, traveling around drums S T in the direction indicated by the arrow and provided with transverse cleats or perforated flights R', adapted to insure the retention of the nails, so that they will be carried up and delivered outside of the tank A. Other subsequent treatment, rinsing, brushing, and drying, and their storage for use may be effected by hand or by suitable machinery in any ordinary or suitable manner.

I attach importance to the continuity of the tumbling action because it insures an approximate uniformity of the coating on all parts of the irregular-shaped articles being treated. I also attach importance to the fact that the articles being treated are carried through in so liberal a stream as to superimpose them, because the tumbling under these conditions by alternately subjecting the articles to different degrees of exposure causes them to become plated at the different points with alternations rapid and slow, and they thus attain a more uniform deposition of the plating metal thereon.

Modifications may be made without departing from the principle or sacrificing the advantages of the invention. Instead of the strips D<sup>2</sup> straight and extending directly longitudinally of the interior of the cylinder D they may be more or less helical, so as to aid in carrying forward the nails. In cases where it is desired for any reason, as too little depth of the tank, the tumbling-cylinder may be horizontal or even slightly inclined upward, and the nails may be traversed through it entirely by the oblique action of the tumbling-strips D<sup>2</sup>. Fig. 4 shows such a modification with changeable baskets X X to receive and allow of the convenient removal of the nails.

I claim as my invention—

1. The method described of electroplating irregular-shaped articles by moving them continuously in one direction through the solution and changing their individual positions by continuous tumbling while subject to the electroplating-current, substantially as herein specified.

2. The method described of electroplating irregular-shaped articles by moving them continuously in one direction through the solution and changing their individual positions by continuous tumbling in quantities constituting a deep layer and while subject to the electroplating-current, substantially as herein specified.

3. The apparatus described comprising a tank containing the solution, a tumbling ves-



sel open at each end immersed therein having its inner surface of conducting material with a conductor therefrom to the negative pole of a source of electricity so that metallic articles tumbled therein may serve as the cathode, an extended conducting-surface also immersed in the solution with a conductor therefrom to the positive pole so that it may serve as the anode and induce a deposit of the metal in the solution upon the tumbled articles, and provisions for inducing a traverse of the articles through the tumbling-cylinder, combined and arranged to serve substantially as herein specified.

4. The apparatus described comprising a tank containing the solution, a tumbling-cylinder open at each end immersed therein having its inner surface of conducting material with a conductor therefrom to the negative pole of a source of electricity so that the metallic articles tumbled therein may serve as the cathode, means for revolving such cylinder and thereby tumbling such articles, an extended conducting-surface also immersed in the solution with a conductor therefrom to the positive pole so that it may serve as the anode and induce a deposit of the metal in the solution upon the tumbled articles, the movable frame B carrying suitable bearings for such tumbling-cylinder, and provisions operated at will by the attendant for changing the inclination and thereby hastening or retarding the traverse of the articles W to be plated, combined substantially as herein specified.

5. An electroplating-machine comprising a tank, a tumbling-cylinder open at both ends with negative electrical connections, a curved conducting-plate suitably arranged in the upper portion of the interior of such cylinder, with positive electrical connection, a backing of non-conducting character on the outer face of such curved plate, means for revolving said cylinder and means for inducing an axially-progressive movement relatively to the

cylinder and plate, as well as a tumbling movement of properly - prepared articles to be plated, combined and arranged for joint operation substantially as herein specified.

6. The tank A, chute A<sup>3</sup>, for introducing articles, and the endless apron R stretched over the drums S, T, and means for traversing it for removing such articles, in combination with the tumbling-cylinder D open at each end, lying in a nearly horizontal position in the tank between such parts, equipped with longitudinal strips D<sup>2</sup> to insure the tumbling action, and means for slowly revolving the same, in combination with anode and cathode connections, all arranged for joint operation, substantially as herein specified.

7. The apparatus described comprising a tank, a cylinder open at both ends and revolvably supported therein, and having a feed-chute located at its head, in combination with anode and cathode connections, means for rotating said cylinder, and devices for vertically adjusting the lower end of the cylinder to vary its adjustment and consequently the feed of the articles therethrough, all combined and arranged for mutual operation substantially as herein specified.

8. The apparatus described, comprising a tank, a cylinder open at both ends and revolvably supported in a swing-frame and having gearing at its head, and a shaft hung in trunnions and having a wheel engaging said gearing, the arrangement maintaining the engagement irrespective of the inclination of the cylinder, in combination with anode and cathode connections, substantially as herein specified.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

ALFRED A. BLACKMAN.

Witnesses:

O. C. WINGE,  
M. F. BOYLE.