

(No Model.)

2 Sheets—Sheet 1.

E. C. SMITH.  
PULVERIZING AND FEEDING FUEL TO FURNACES.

No. 587,127.

Patented July 27, 1897.

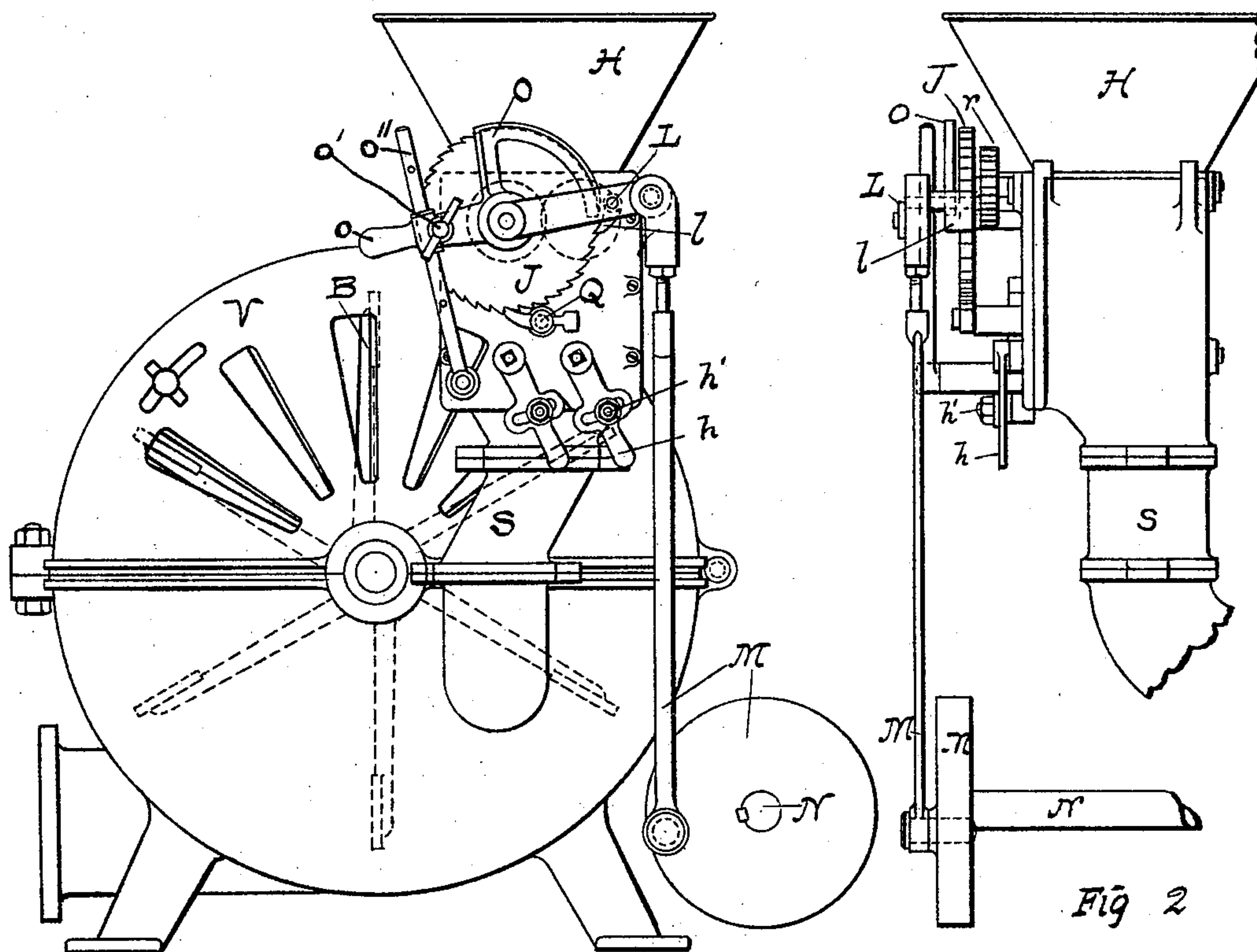


Fig. 1.

Fig. 2

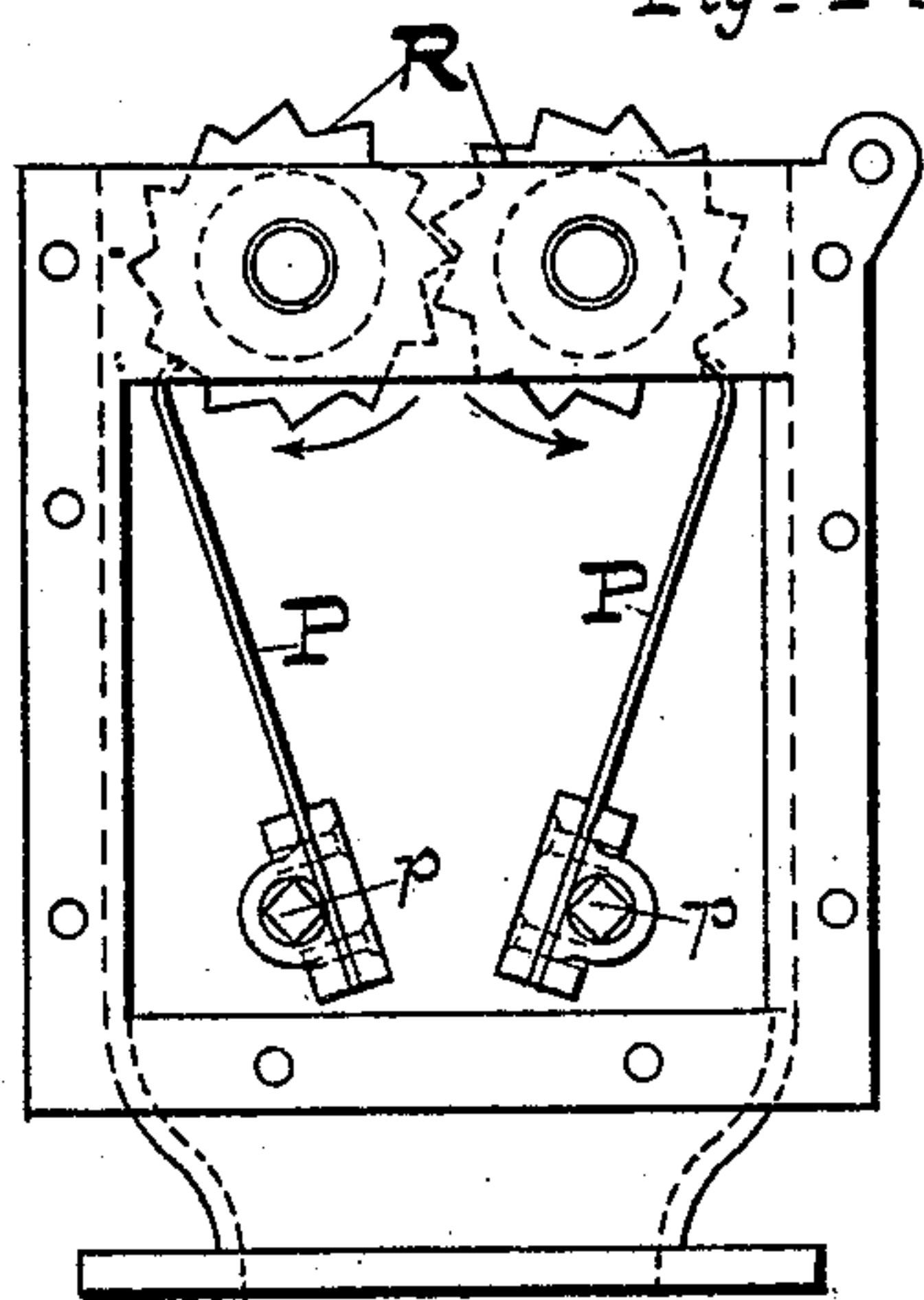


Fig. 3.

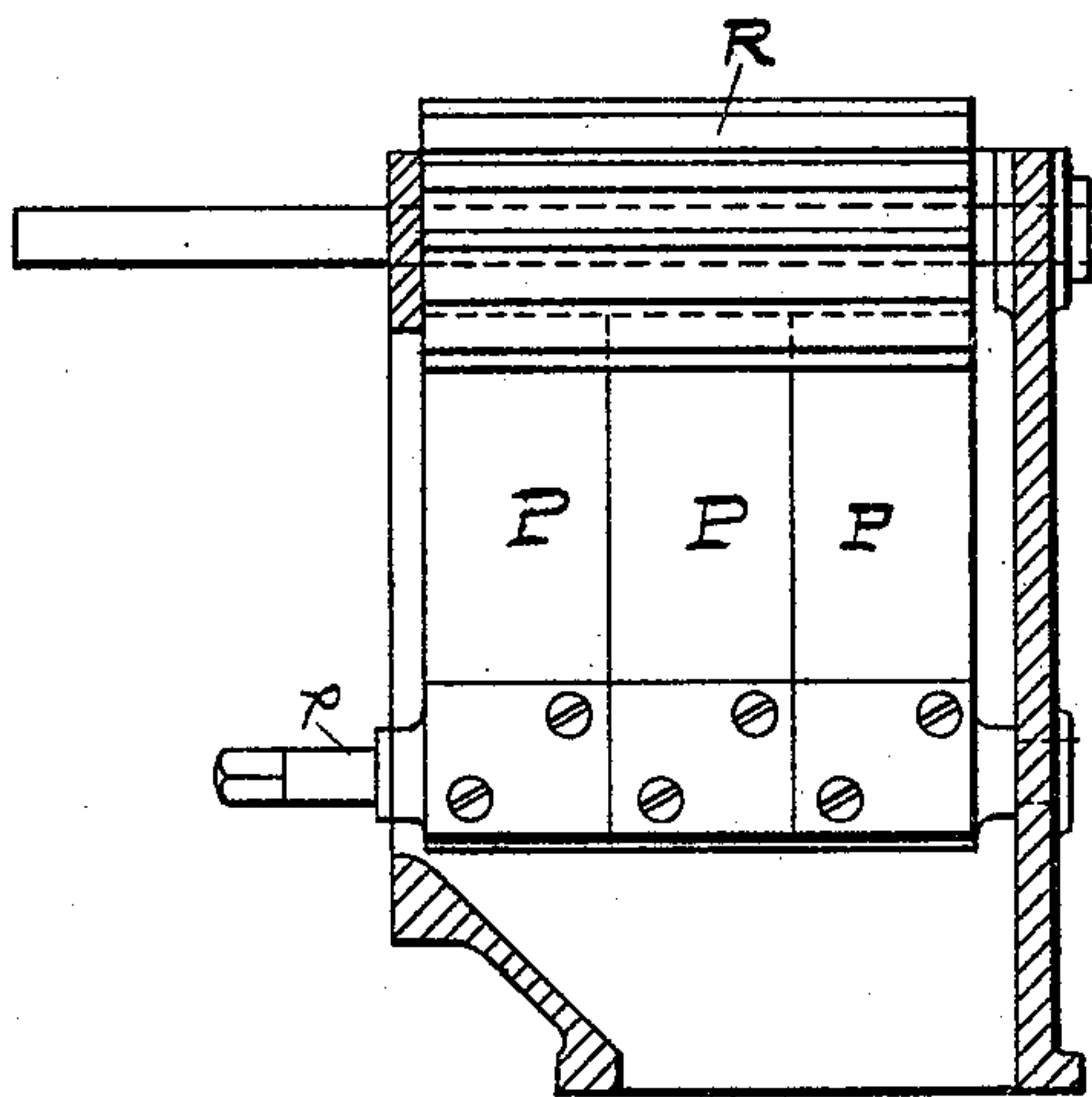


Fig. 4.

Witnesses

*James B. Pinner*  
*Fredrick H. Davis*

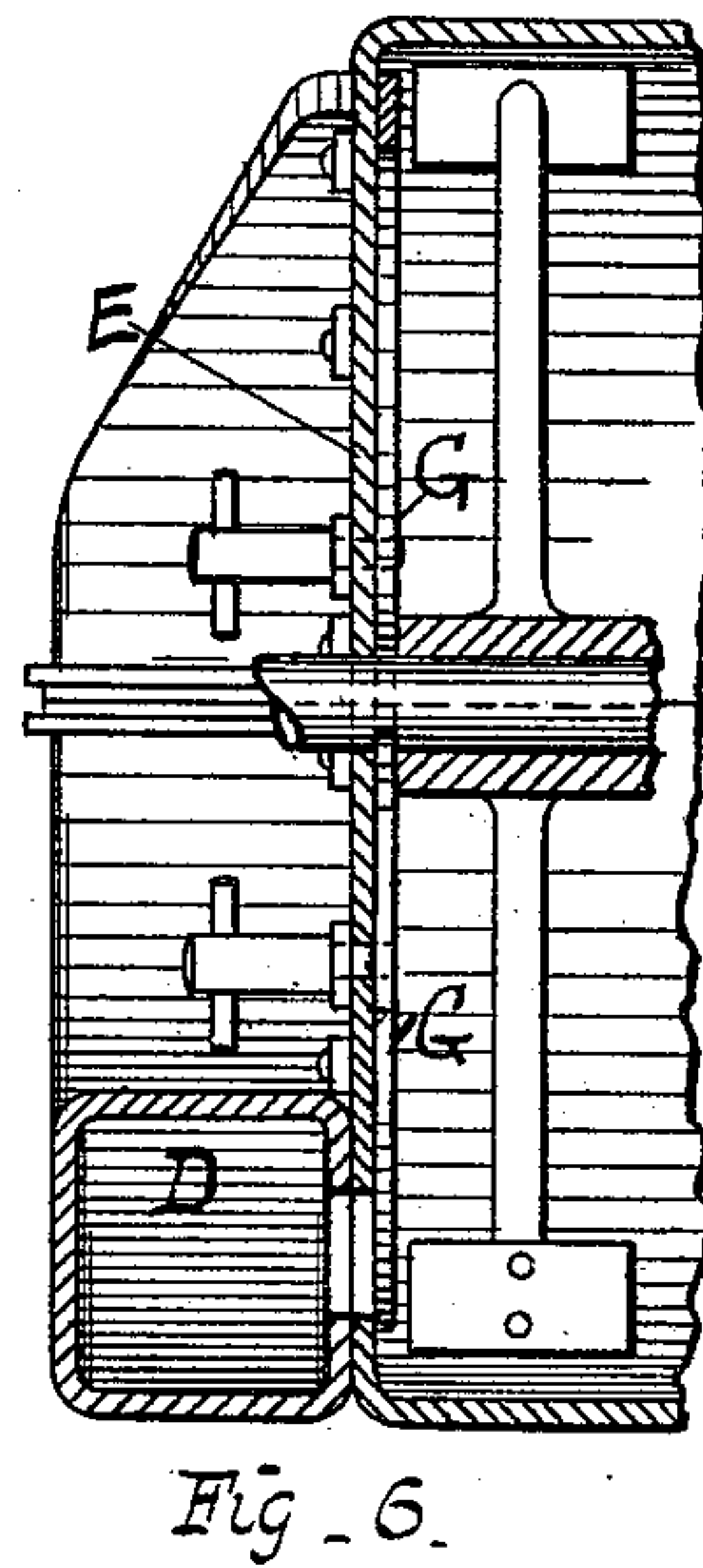
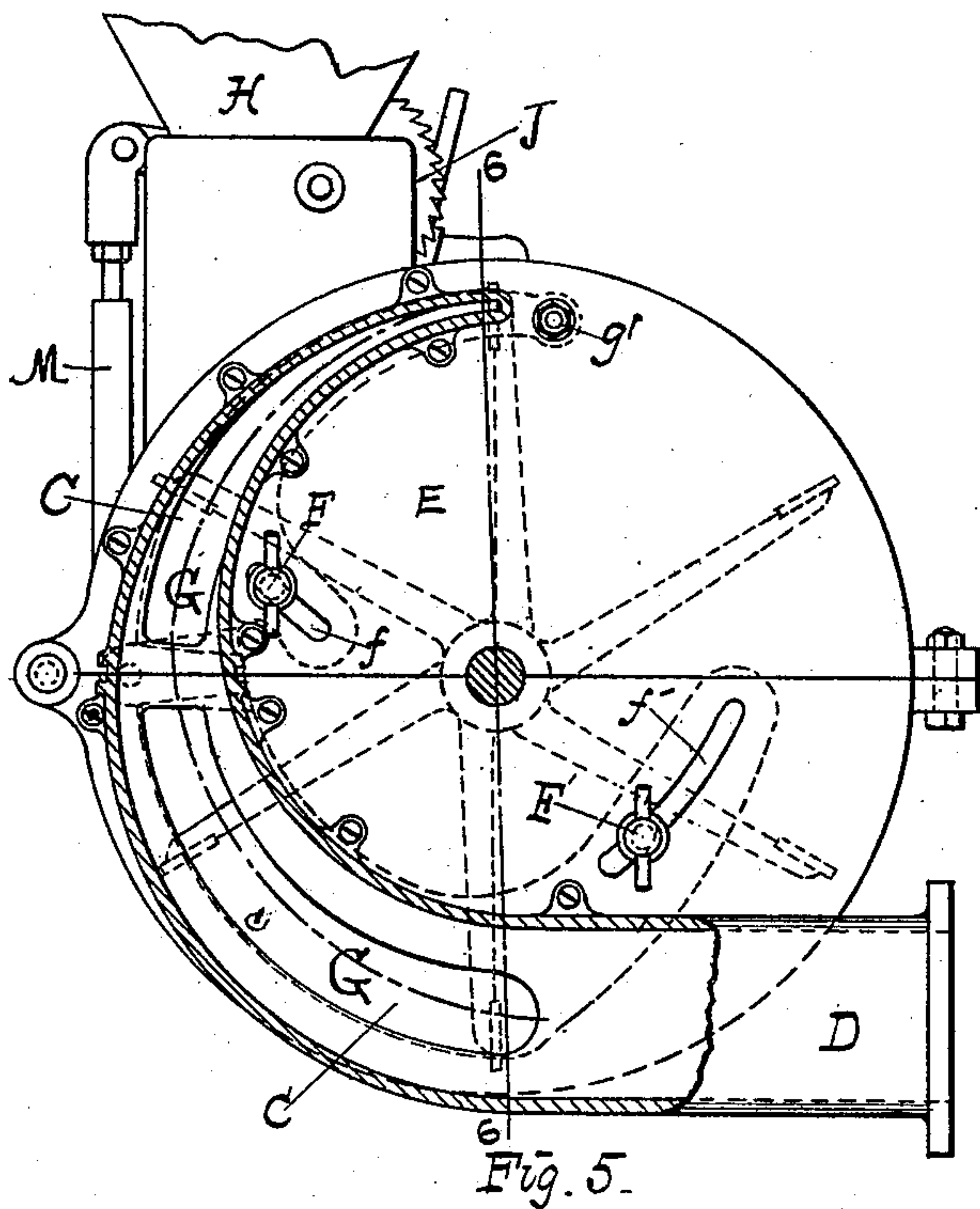
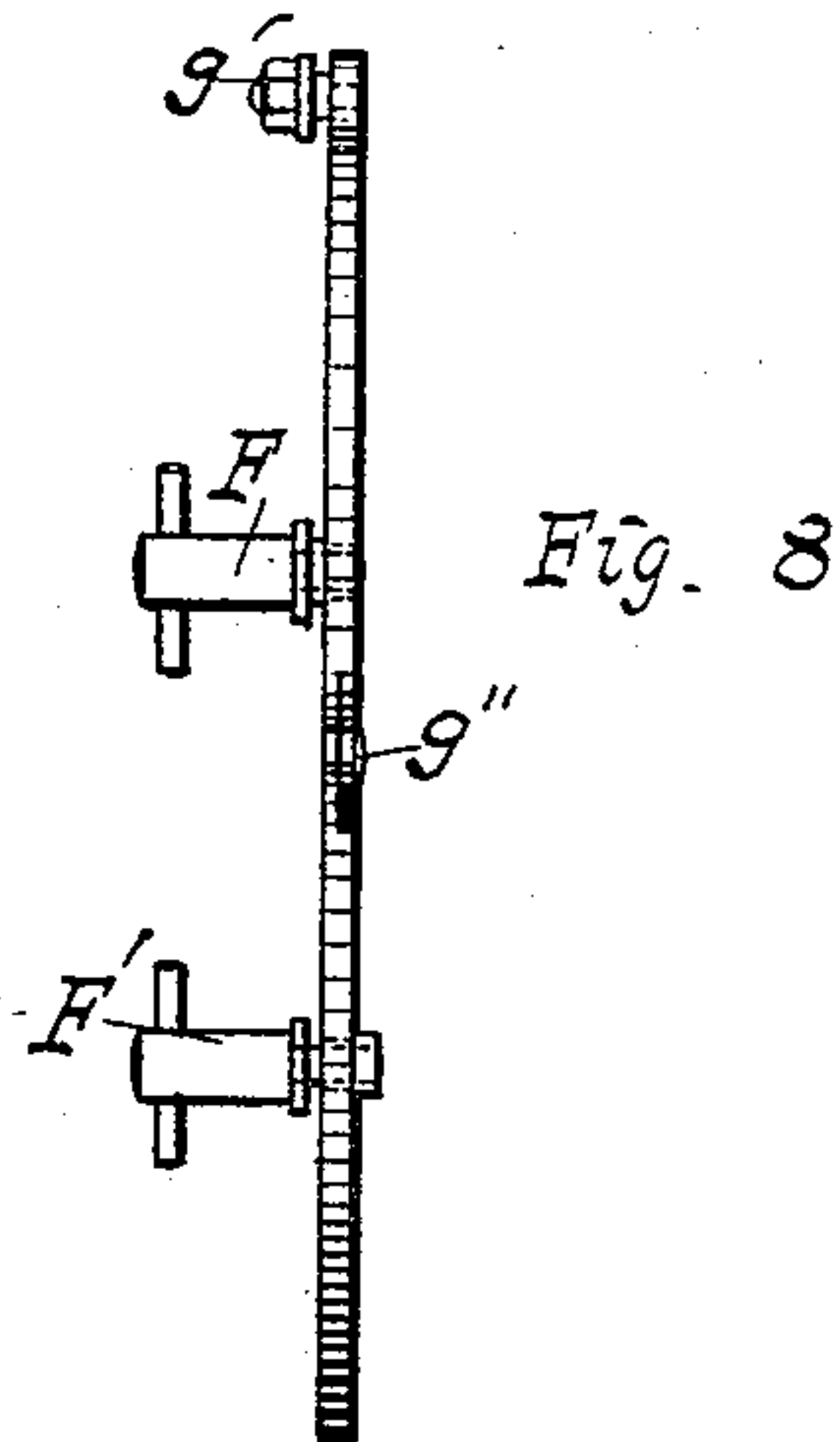
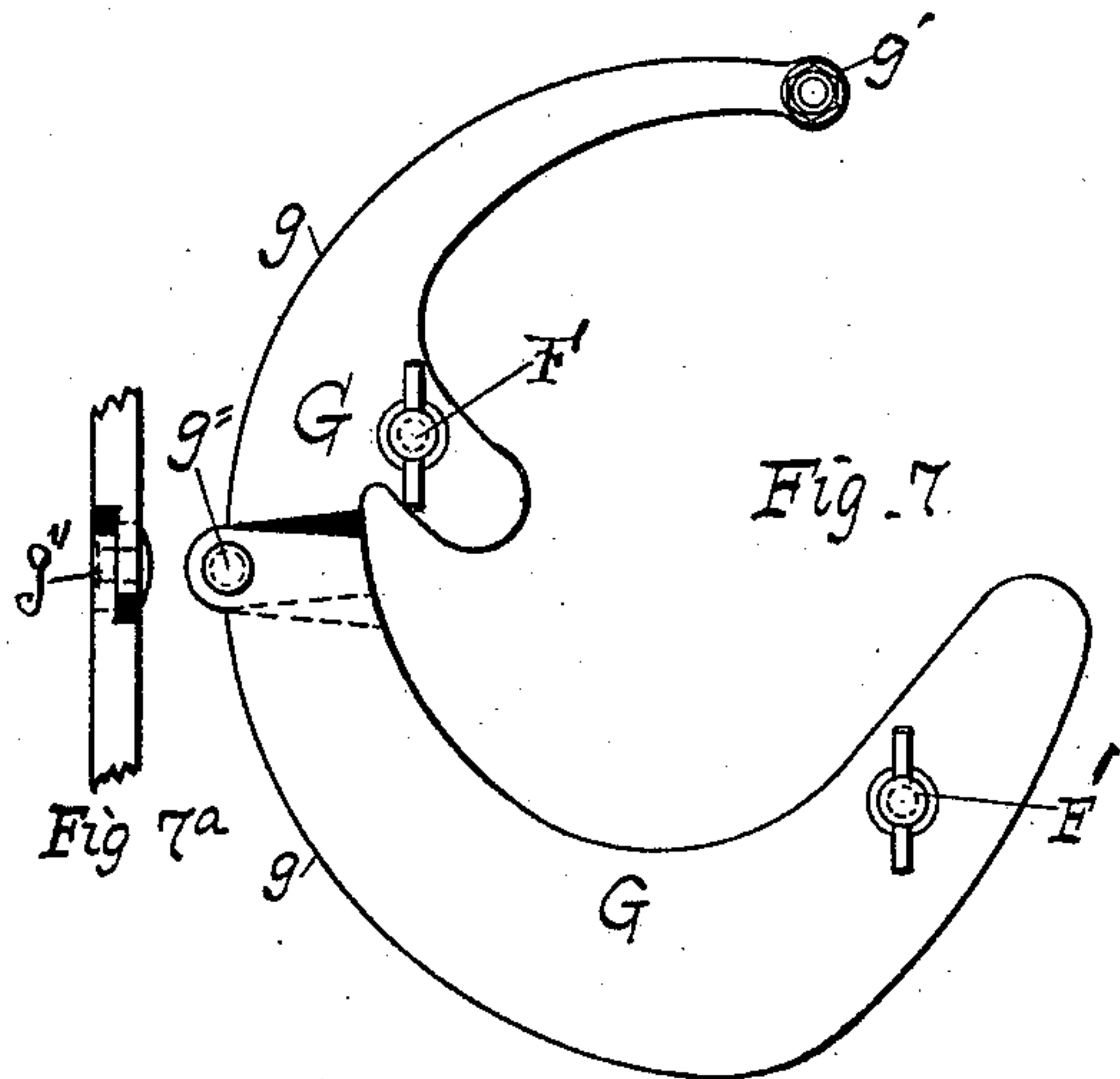
Inventor

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Attorney

(No Model.)

2 Sheets—Sheet 2.

E. C. SMITH.  
PULVERIZING AND FEEDING FUEL TO FURNACES.  
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Witnesses  
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Attorney



# UNITED STATES PATENT OFFICE.

EDWARD C. SMITH, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE SMOKELESS COMBUSTION COMPANY, OF WEST VIRGINIA.

## PULVERIZING AND FEEDING FUEL TO FURNACES.

SPECIFICATION forming part of Letters Patent No. 587,127, dated July 27, 1897.

Application filed August 14, 1895. Serial No. 559,221. (No model.)

*To all whom it may concern:*

Be it known that I, EDWARD C. SMITH, of New York, N. Y., have invented a new and useful Improvement in Apparatus for Pulverizing and Feeding Fuel to Furnaces, of which the following is a description, referring to the accompanying drawings, which form a part of this specification.

In two applications filed on the 14th day of August, 1894, and serially numbered 520,306 and 520,307, I have set forth certain improved apparatus for feeding fine fuel to furnaces in which the coal-dust, culm, or other fuel is fed into a pulverizer through a pair of feed-rolls and is reduced in the pulverizer to an impalpable powder. From the pulverizer the fuel, after being sufficiently pulverized, is blown with a blast of air into the furnace and there burned like a gas. In the use of such apparatus several difficulties are encountered. When the coal is wet or contains an appreciable amount of moisture, it sticks to the feeding or grinding rolls and materially interferes with the proper feeding of coal to the pulverizer. To overcome this difficulty is one of the chief objects of the invention which forms the subject-matter of this application. Another difficulty which has been met with is the proper regulation of air-supply and coal-supply. With a given feed of coal and a given speed of rotation of the pulverizer the passage of more air through the pulverizer draws with it so much more pulverized coal that each particle of coal remains in the pulverizer a much shorter time and is consequently not properly pulverized. To overcome this difficulty and to make the coal-supply and the air-supply more independent is a second object of the present invention. In addition to these objects the invention contemplates a more simple construction of the various parts of the apparatus and a more complete control and regulation of the various functions. To these and certain other incidental ends, which will be more fully understood from a description of the accompanying drawings, the invention is embodied in the apparatus and its several parts, all constructed, arranged, combined, and used substantially in the manner hereinafter described, illustrated, and claimed.

In the drawings, Figure 1 is a front end view of the complete pulverizing apparatus. Fig. 2 is a side view, partly broken away, of the feed-roll, attachments, and regulation for grinding and feeding the coal to the pulverizer. Figs. 3 and 4 are detail views of the device for freeing the feed-rolls from moist or adhesive fuel. Fig. 5 is a rear end view of the pulverizer, on a slightly reduced scale, showing the regulation of discharge from the pulverizer. Fig. 6 is a section on the plane 6 6 of Fig. 5, and Figs. 7 and 8 are face and edge views of the jointed plate or gate by which the discharge is controlled.

Throughout the figures like letters of reference indicate like parts.

Briefly stated, the improved process which forms the subject of certain claims of this patent consists in supplying fuel to the pulverizer at a rate proportional to the amount of steam to be produced; in separately regulating the admission of air so that it may be proportional to the quantity and quality of the fuel used in order to give the best results with the least waste and smoke; in regulating the time which each portion of the fuel occupies in passing through the pulverizer, and thereby regulating the pulverization of the fuel, and, finally, in regulating the speed of the pulverizer, and thereby simultaneously varying the draft, feed, and pulverization at will.

Referring to the drawings, I will first describe the apparatus and then explain the manner in which I employ it in order to cause it to carry out my method.

In Figs. 1, 2, 3, and 4 are shown the apparatus for separately admitting the fuel and the air into the pulverizer. In addition the pulverizer blades and arms B are shown; but these, while they form part of my combination, are in no respect novel in themselves, being substantially well known in the art. At H is the hopper which receives the coarse coal. The toothed feed-rolls R, of the form clearly shown in Figs. 3 and 4, are mounted beneath the hopper H and serve to grind the coal and feed it between the rolls R into the supply-pipe S, through which the ground coal passes to the pulverizer. In using moist fuel great difficulty has been encountered by



reason of the adhesion and packing of the moist coal-dust against the feed-rolls. For this purpose the spring scraper-plates P are employed. These are mounted upon the shafts *p* and bear against the faces of the rolls R, so that they scrape and clean the rolls of all coal or other fuel that has adhered to the teeth. Each of these scraper-plates P preferably consists of three or more divisions, as clearly indicated in Fig. 4, so that slight irregularities in the surface of the rolls may be more readily followed. The shafts *p* project through the wall of the box which contains the rolls and are provided with levers or handles *h*, by which they may be turned and the plates P thereby pressed with more or less force against the rolls R. Each of these handles *h* is provided with a slot through which the fixed screw-stud *h'* projects. By means of nuts threaded onto these studs *h'* the handles *h* may be set firmly at any position. As the rolls R rotate the spring scraper-plates P follow the toothed surface of the rolls, the spring of the plates being sufficient to allow them to yield in passing from tooth to tooth. The shafts of the rolls R are geared together by means of the spur-gears *r*, so that the two rolls turn together in opposite directions. The ratchet J, mounted upon one of these roll-shafts, is driven by means of the vibrating lever L and the pawl *l*. The lever L receives its motion from the crank-disk and rod M, driven from the shaft N. The crank-disk M gives to the lever L and pawl *l* a vibration equal to several teeth of the ratchet J. The pawl *l* is, however, screened for part of this motion by means of the adjustable sector O, which may be adjusted at will by the handle *o*, so as to screen the pawl from engaging with one, two, three, or more teeth in each stroke, and so regulate the feed for each stroke and cause the ratchet J to turn a greater or less amount accordingly. A rod and set-screw *o' o''* or any other equivalent may be employed to lock the sector O when properly adjusted and prevent its accidental displacement by the jarring of the apparatus. A pawl Q engages with the ratchet J to prevent back motion. This pawl, as shown, is so balanced that it will engage by gravity, though, if preferred, a spring may be employed. The rolls R are turned by the driving mechanism just described through a certain angle at each revolution of the shaft N, and this angle is adjustable by means of the sector O, as described, so that by moving the handle *o* the amount of coal fed to the pulverizer may be regulated at will. The rolls rotate in the direction indicated by the arrows in Fig. 3, and the coal is therefore fed through the rolls and drops down into the supply-pipe S, whence it passes into the pulverizer and is beaten by the blades of the pulverizer B until it is reduced to an impalpable powder. Through the adjustable air-damper V air is admitted to the pulverizer at the same end through which the pipe S enters. At the other end

of the pulverizer, as shown in Figs. 5 and 6 and as fully described and claimed in the applications above referred to, is located a spiral discharge D. This spiral discharge instead of passing tangentially from the side of the pulverizer opens from the end plate of the pulverizer in such a manner that only the finely-pulverized coal passes into it, whereas if the opening is in the side wall of the pulverizer such coarser particles as have partially escaped the action of the beater-blades are necessarily driven into the discharge-passage and so delivered without complete pulverization. The function and purpose of this spiral discharge-passage from the end of the pulverizer do not in themselves form the subject-matter of the claims of this application; but with this discharge I have combined a hinged diaphragm or gate-valve by which the opening into the discharge D may be more or less enlarged or closed at will. The opening through the end wall of the pulverizer is of the circular and tapered or gradually-decreased shape shown at C in Fig. 5. The gate G so operates that as it closes the opening C is gradually diminished in width throughout its whole length.

In Fig. 5 the whole gate is shown in dotted lines in its closed position, and a second dotted line *c* indicates the position of the edge of the gate when half-open. The gate is shown in full in Figs. 7 and 8. The edge *g* conforms closely to the curved edges of the opening C. One end of the gate G is secured at *g'* to the inner surface of the end wall of the pulverizer, as clearly indicated in Figs. 5 and 6. The screw-stud or set-screw F extends through and slides in a slot *f* in the end wall E of the pulverizer. By means of this set-screw F the upper portion of the gate G may be adjusted to open, more or less, the upper part of the discharge-opening C. The lower portion of the gate G is jointed to the upper portion at *g''*. The cross-section of this joint is shown in the view marked 7<sup>a</sup>, which forms a part of Fig. 7. A set-screw or stud F', working in a slot *f'*, controls the position of the lower portion of the gate G. The slot *f'* is so located that by loosening both set-screws F F' the whole gate may be opened or closed by the set-screw F'. The set-screw F necessarily follows its slot *f*, and the edge *g* of the gate remains throughout its entire length substantially parallel with the edges of the discharge-opening C.

In Figs. 5 and 6 it is clearly seen that the opening C is not at the extreme outer edge of the end plate E of the pulverizer-shell, but is set in a short distance, so that such coarser particles of the coal as may find their way to this end of the pulverizer will not be carried by the draft of air through the opening C, but will be beaten by the blades until reduced to such an extent that the draft of air may draw them through the opening C. It is also clear that if the gate G be entirely closed, as indicated in Fig. 6, there would be no discharge



of coal from the pulverizer. If the gate G is opened but slightly, the coal fed at the uniform rate by the feed-rolls R is not so freely drawn through the pulverizer and is therefore pulverized to a much greater extent and accumulates to a larger amount within the pulverizer before being drawn out with the draft through the opening C. On the other hand, if the gate G be opened wide a much freer escape for the pulverized fuel is afforded, and therefore each particle of coal passes through the pulverizer more quickly and is not pulverized to as great a degree. By this means, therefore, the amount of pulverization may be regulated independently of the amount of coal which is fed to the pulverizer, and by means of the adjustment of the speed of the feed-rolls already described the amount of coal which is fed may be varied independently of the amount of air received.

Heretofore I have sought to properly regulate the discharge of coal from the pulverizer by means of dampers in the discharge-pipes; but the closing of these dampers does not prevent the feeding of the coal into the pipe, and therefore does not cause it to remain in the body of the pulverizer to be more thoroughly pulverized, as described above. The adjustable gate G, however, in effect opens or closes the end wall of the pulverizer and so keeps the fuel for a greater or less time within the body or shell of the pulverizer and within the action of the beaters B.

The operation of my pulverizer apparatus is as follows: The speed of the beater-blades and of the feed-shaft N may be somewhat proportioned to the amount of horse-power to be produced. After the fire has been started and the pulverizer is delivering pulverized fuel to the furnaces the amount of fuel introduced is regulated at will by means of the sector-screen O, controlled by the handle o. The admission of commingled air and fuel is then properly adjusted to produce the best combustion by means of the adjustable gate G and the air-damper V. In the applications already referred to I have set forth means of regulating the air-supply and the fuel-supply automatically and controlling them by means of the boiler-pressure; but the addition of such automatic means does not in any way form the subject-matter of this application, as the automatic attachments may be applied to the means shown in this patent without material modification of such means.

Having in the foregoing described my invention and the preferred form of apparatus for utilizing the same, I claim, together with all such modifications as may be made by mere skill in the art and with such limitations only as are expressed or by law implied in view of the related arts, as follows:

1. In combination in an apparatus for pulverizing and feeding fuel, the beater-blades and casing therefor, the adjustable feed-rolls for introducing a determinate quantity of

fuel into the pulverizer, a damper for admitting air to the said pulverizer adjacent to the fuel-supply from the said feed-rolls, a discharge-opening leading laterally through the end of the pulverizer-casing, and a gate for the said opening whereby the said opening in the rear end of the pulverizer may be more or less closed, substantially as set forth.

2. In combination in an apparatus for pulverizing and feeding fuel, the beater-blades and casing therefor, feeding apparatus for supplying fuel at one end of the said casing, a discharge-opening extending through the other end E of the said casing, a discharge-passage D leading therefrom, and a gate, G, for opening or closing the said opening through the end of the said casing, substantially as set forth.

3. In combination in an apparatus for pulverizing fuel or other material, the rotary blades or beaters G, the shell or casing therefor, an outlet or discharge opening C through the end plate E of the said shell or casing of the curved form shown, and a gate adjustable across the said opening whereby the width of the said opening may be altered at will, substantially as set forth.

4. In combination in an apparatus for pulverizing and feeding fuel or other materials, the rotary blades or beaters, the shell or casing therefor, an outlet or discharge opening C through the end plate or wall E of the said shell or casing, the discharge D therefor, and the adjustable gate G working upon the face of the said end plate or wall E and controlling the discharge from the said casing into the said discharge-pipe D, substantially as set forth.

5. In combination in an apparatus for pulverizing fuel, or other material, the rotary blades or beaters G, the shell or casing therefor, an outlet or discharge opening C through the end plate, E, of the said shell or casing, and the adjustable gate G consisting of two or more parts pivotally secured together and provided with an edge, g, substantially conforming to the said opening or discharge, C, as set forth.

6. In combination in an apparatus for pulverizing fuel or other material, the rotary blades or beaters, G, the shell or casing therefor, and an outlet or discharge pipe D extending spirally from the end plate E of the said shell or casing, and an adjustable gate, G, working upon the face of the said end plate E and controlling the discharge from the said casing into the said discharge-pipe, D, substantially as set forth.

In testimony whereof I have hereunto set my hand, at New York, this 12th day of August, A. D. 1895.

EDWARD C. SMITH.

In presence of—

JAMES B. KINNEY,  
HAROLD BINNEY.