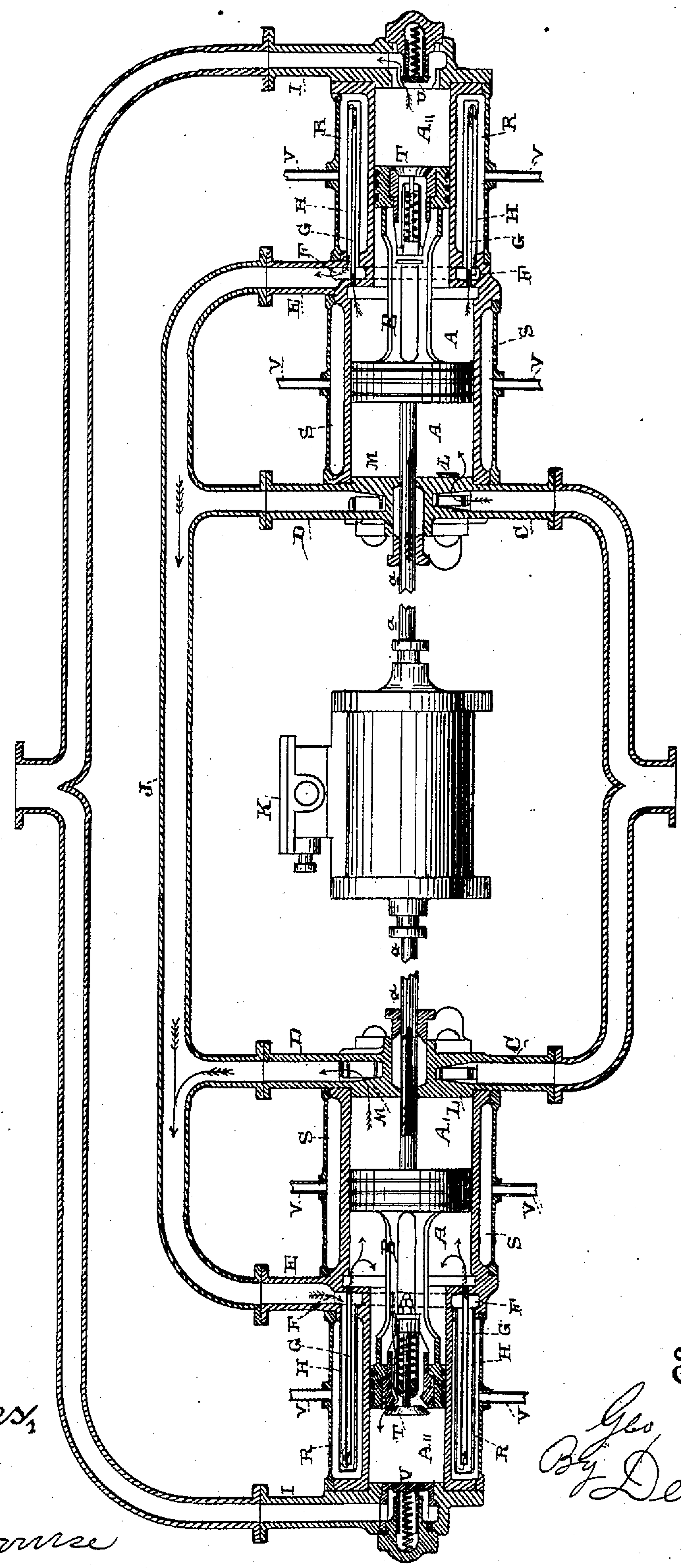
(No Model.) 5 Sheets—Sheet 1.

G. E. DOW.

AIR COMPRESSOR.

No. 341,099. Patented May 4, 1886.

FIG. 1



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attys

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

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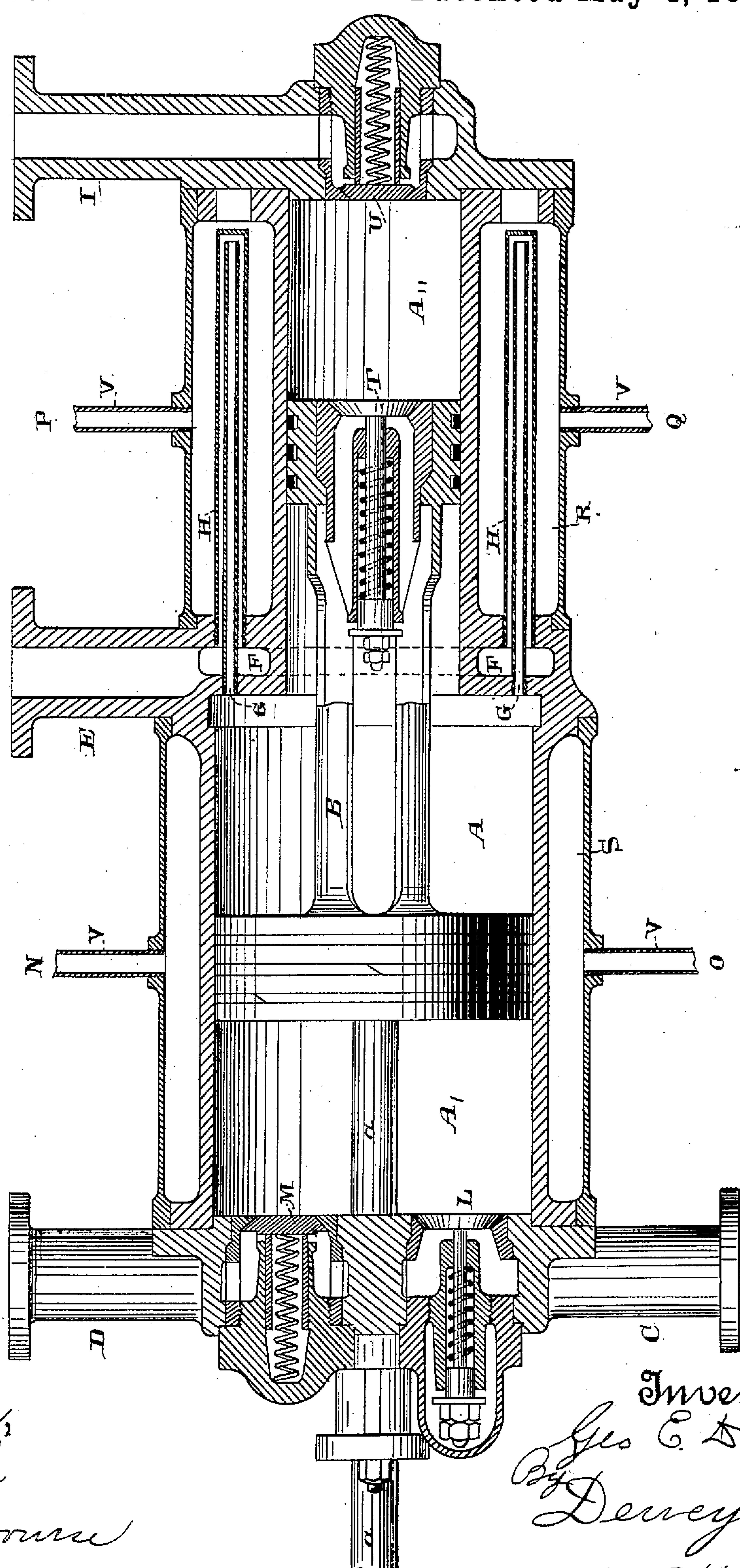

FIG. 2.

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(No Model.)

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FIG. 4.

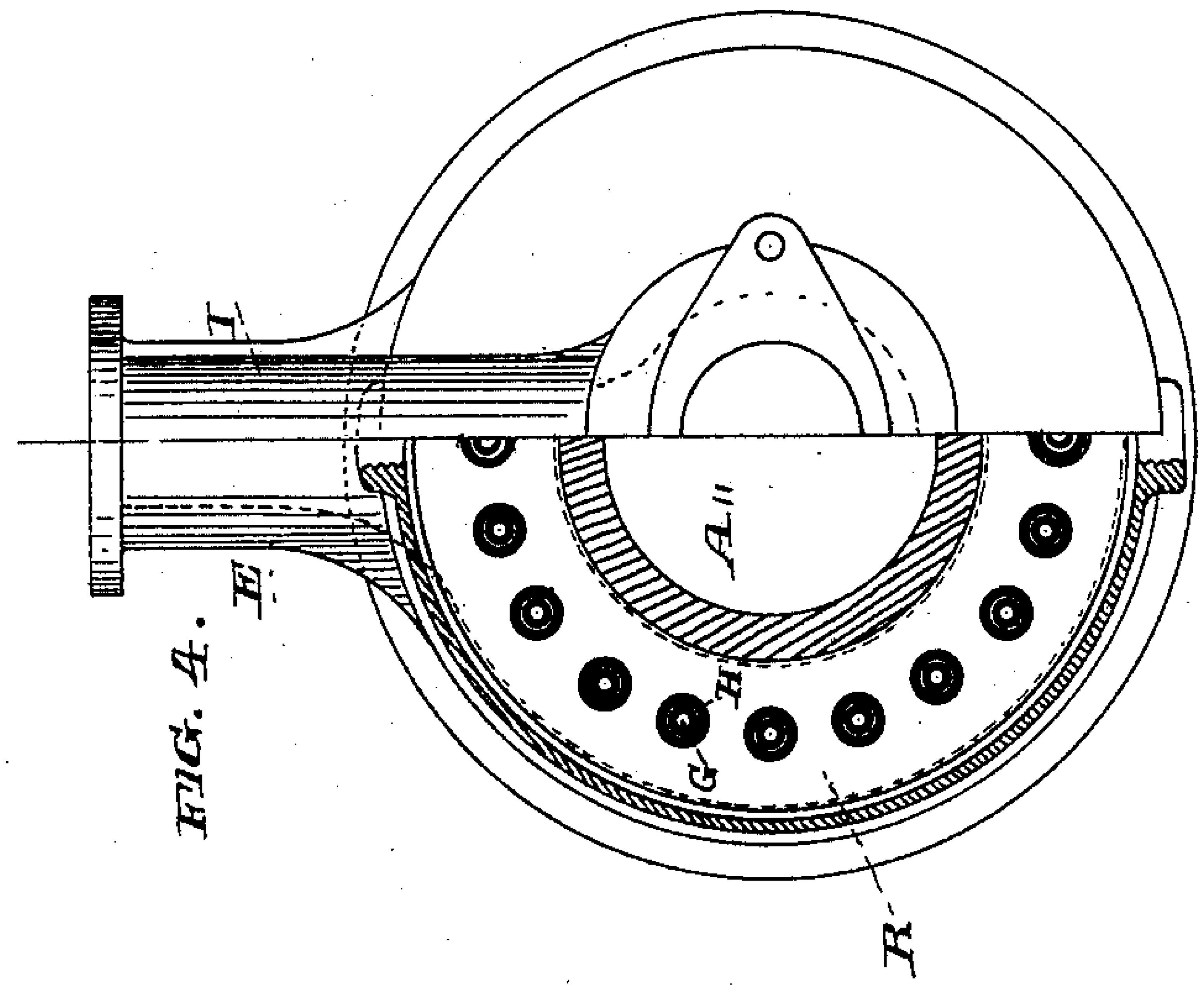

FIG. 3.

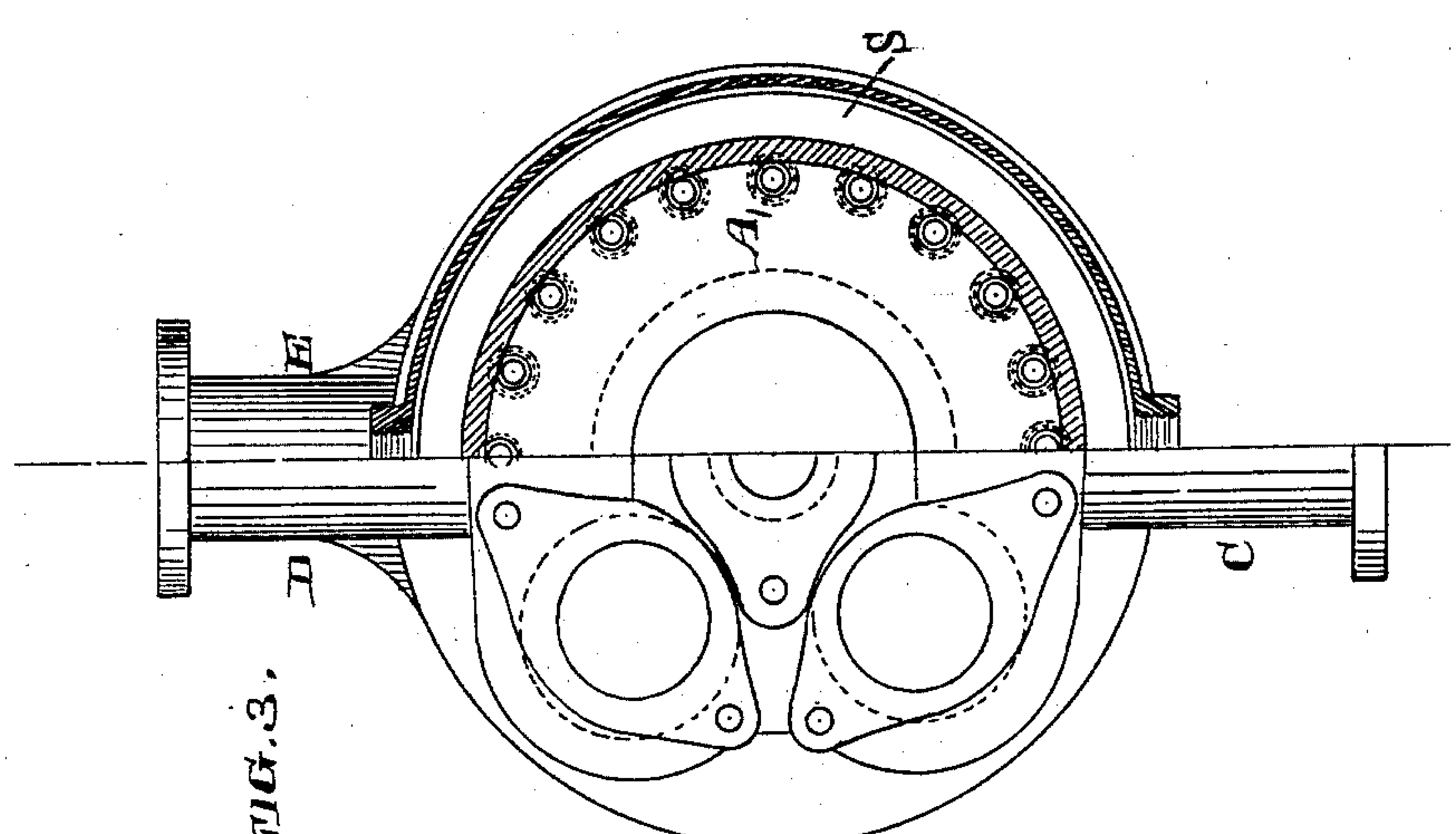

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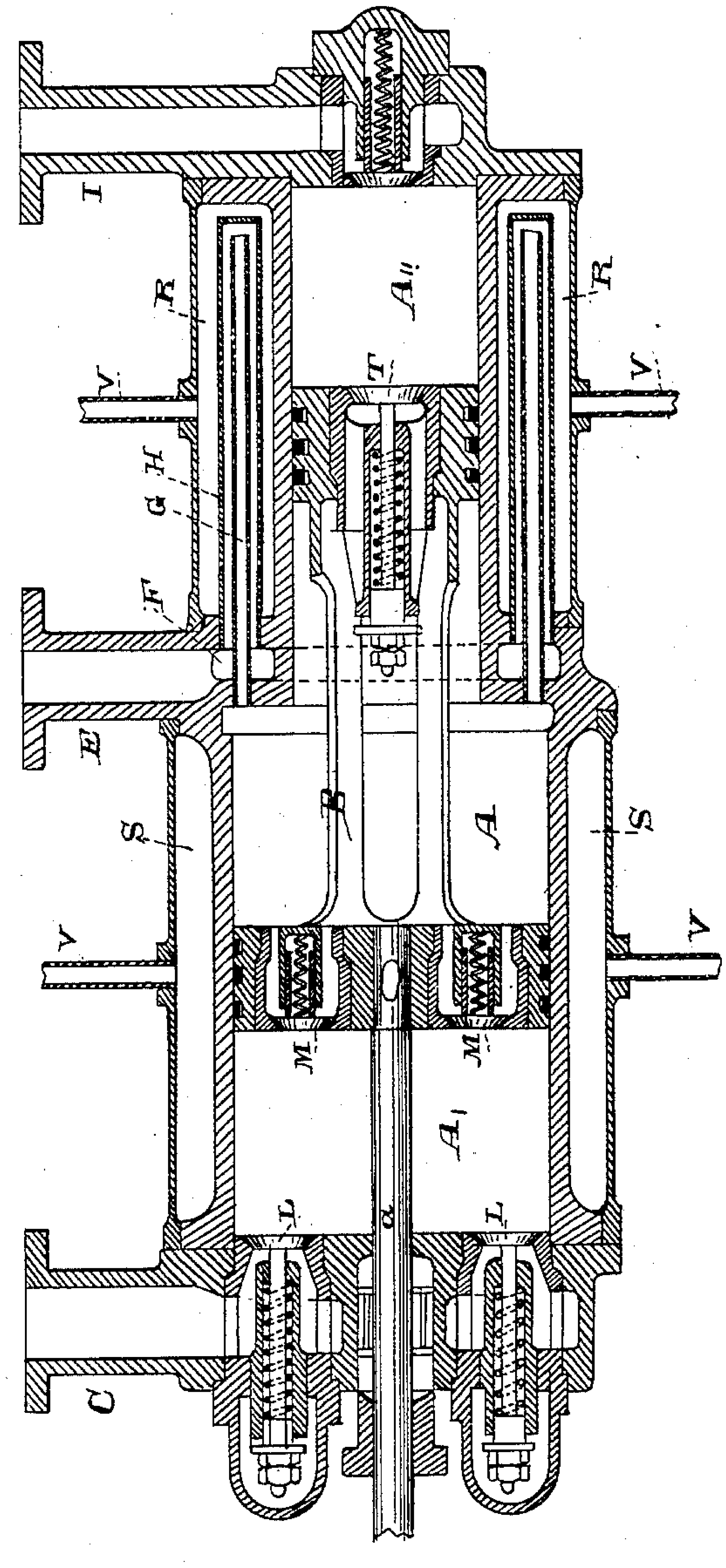
FIG. 5.



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(No Model.)

5 Sheets—Sheet 5.

G. E. DOW.

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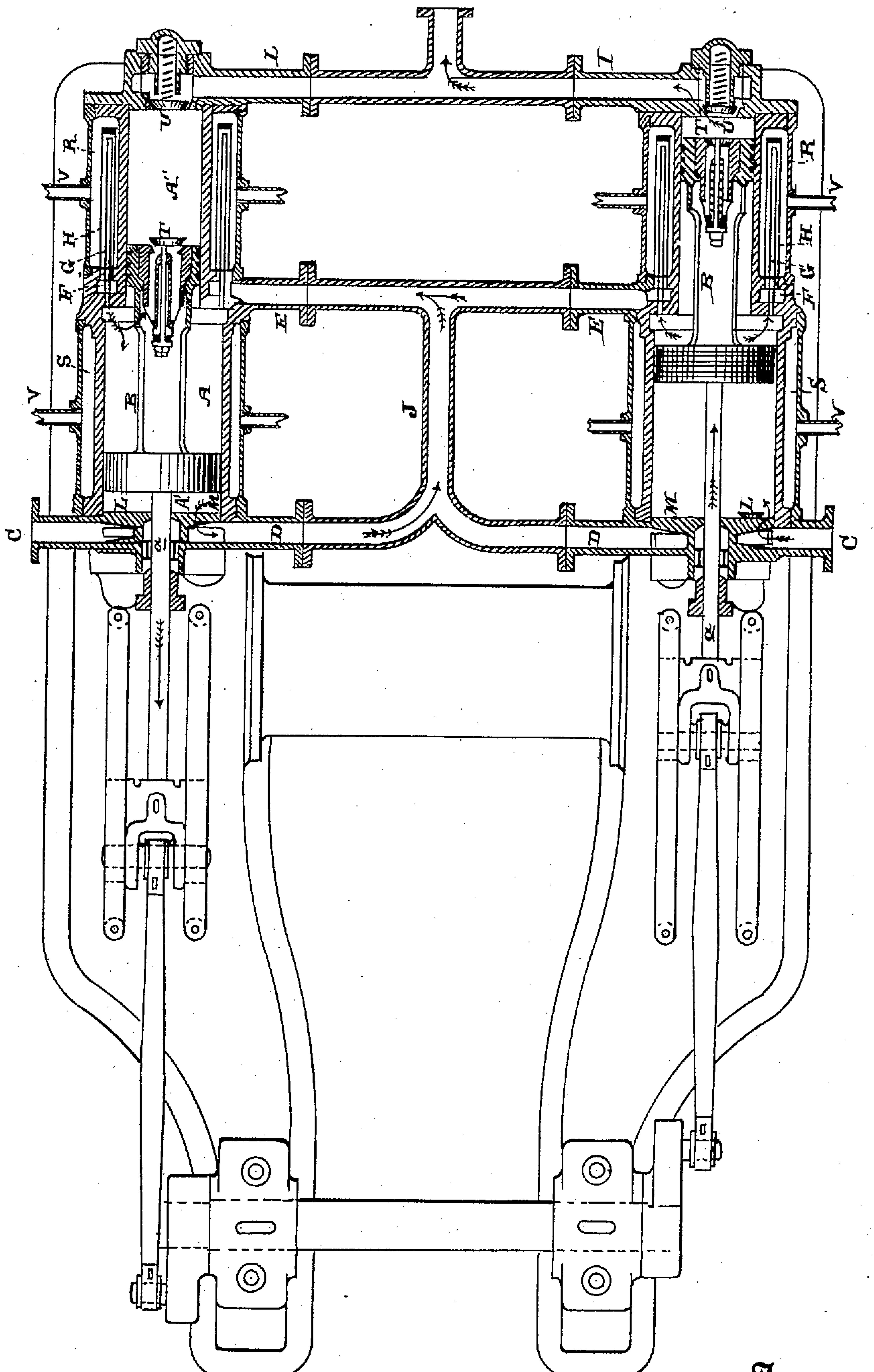
Fig. 6.



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UNITED STATES PATENT OFFICE.

GEORGE EDWIN DOW, OF SAN FRANCISCO, CALIFORNIA.

AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 341,099, dated May 4, 1886.

Application filed November 9, 1885. Serial No. 182,305. (No model.)

To all whom it may concern:

Be it known that I, GEORGE EDWIN DOW, of the city and county of San Francisco, State of California, have invented an Improvement in Air-Compressors; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to certain improvements in compressors for air or gas, and is particularly applicable to that class in which the medium is compressed in two or more stages by means of receiving and delivery cylinders, in each of which the compression is partially performed.

It consists of compressing-cylinders having their axes in the same line and the pistons connected with the piston-rod in such a manner as to be actuated simultaneously, so that no stuffing-boxes are exposed to the heat arising from final compression.

It also consists in an improved means for surface cooling, and in certain details of construction, all of which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a longitudinal section of my improved compressor. Fig. 2 is an enlarged longitudinal section of one cylinder with valves, passages, and water-jacket. Fig. 3 is a view of the receiving end of the cylinder, showing a half-section through line N O, Fig. 2, the piston being removed. Fig. 4 is a view of the delivery end of the cylinder, showing a half-section through P Q, Fig. 2, the piston being removed. Fig. 5 is a modification of the cylinder A, showing the eduction-valves of the receiving-chamber A′ placed in the piston. Fig. 6 is a modification showing the series of cylinders placed side by side, the pistons operated by a rotating shaft having cranks set opposite each other, so that the pistons operate coincidently and in opposite directions.

A A are two cylinders, having ends A′ and A^2, of different diameters, their axes being in the same line, so that their pistons B and B may be connected together and operate simultaneously.

a is the piston-rod, extending through the receiving ends of the cylinders A and connecting with their pistons. In the present case I have shown a steam-engine, K, placed in line between the two cylinders, so that the piston-rod extends into the engine-cylinder and is connected with its piston, thus enabling the single engine to operate both compressing-pistons at once.

C C are the induction-pipes through which air or other medium is admitted to the receiving ends of the cylinders A, passing through the inwardly-opening valve L, when the piston moves toward the opposite end of the cylinder. When the piston returns, the valve L closes and the valve M opens, allowing the air or medium which is being compressed to pass through the pipe D and into the pipe J, and thence through E into the intermediate chamber.

Both cylinders A are surrounded by chambers S and R, through which water is caused to circulate by means of pipes V, so as to convey away the heat developed by the compression of the air or other medium. Within the chamber R, which surrounds the cylinder A^2, are concentric pipes G and H, arranged in rows, as shown in Fig. 4, so that the water circulates around them. The air or gas passing from the intermediate chamber into the smaller or discharge end of the opposite cylinder is conducted through cooling-tubes G and H, so that the heat resulting from the first compression will be taken up and conveyed away by the passing water.

The pistons in each of the cylinders A A are formed with a large and a small end, the large end fitting the larger portion of the cylinder and the smaller end fitting the smaller portion. These two are united by a web or hollow and open connecting portion, so that they operate together, and the valve T opens through the smaller end of the piston into the discharge end of the chamber A^2.

The pipe J connects the two pipes D, which lead from the valves M into the receiving ends of the cylinders, and also, extending beyond these pipes, connects with the pipes E, which open into an annular space, F, surrounding each cylinder between the larger and smaller portion thereof.

The exterior pipes, H, of the cooling system are secured into holes in the side of the annular chamber F nearest the surrounding space R of the smaller portion of the cylinder, and they extend nearly to the end of this space, and themselves have their outer ends closed, as shown.

The smaller and inner pipes, G, pass through the chamber F, screwing into the opposite wall and opening into the intermediate chamber or space between the larger and smaller ends of the piston. These smaller pipes extend concentrically within the larger ones, H, and nearly to their closed ends, so that when the piston in the larger portion of the cylinder is moving toward the rear end it forces the air behind it through the inner tubes, G, thence back between the tubes G and H and into the annular space F, from which it escapes through the pipe E. As water is freely admitted into the chamber R, within which these numerous tubes are situated, it will be seen that the heat developed in the compression of the air will be nearly or quite all conveyed away by the water.

The operation of the apparatus will then be as follows: Supposing the pistons to be moving toward the right in the direction shown by the arrows, Fig. 1, the larger portion of the right-hand cylinder will be receiving air upon one side of the piston through the valve L and the pipe C. The air which is upon the opposite side of this larger portion of the piston will be forced through the tubes G and H, and thence into the pipe E and the pipe J, as before described, passing along the pipe J until it meets the air which is being forced through the pipe D of the left-hand cylinder by its piston, which is also moving toward the right and discharging air through the valve M, as shown. These two bodies of air, uniting, continue on through the pipe E, and through the pipes H and G in the chamber R of the left-hand cylinder, entering the space behind the larger portion of the piston of the cylinder. As this amount of air is more than is necessary to fill the larger portion of the cylinder, the surplus escapes through the valve T in the smaller end of the piston into the discharging end A^2 of the left-hand cylinder. At the same time the air contained in the discharge end of the right-hand cylinder is being compressed and forced outward through the valve U and the pipe I to the receiver or point of consumption. When the movements of the pistons are reversed, the same action takes place in the reverse manner—that is, the air is admitted into the receiving end of the left-hand cylinder, and is forced from the intermediate chamber through the cooling-pipes and the pipes E and J into the intermediate chamber and the discharge-chamber of the right-hand cylinder, this operation being continued at each reciprocation of the pistons. As a quantity of air equal to the contents of the chamber A′ must be compressed into the chamber A^2 of the opposite cylinder from the intermediate chamber with each displacement, it will be seen that the compression created in the receiving-chamber is a fixed quantity, and is governed by the relative volume of the two chambers A′ A^2. The intermediate chambers of the cylinders being maintained in communication with each other by means of the pipe or conduit J, the air or gas, in passing into the latter on its way from one chamber to the other, is conducted through the cooling-tubes G and H, as before described, so that the heat resulting from the first compression is taken up by the surrounding water.

The apparatus here described is simple in construction, not liable to derangement or excessive wear, and high speeds may safely be employed without injury to the machine, as no liquids are used in the cylinders to take up the heat of compression, as in other machines. The perfect cooling of the air or gas by the means shown and described and subdividing the work into two or more stages gives ample time to take up the heat in the jackets, and greatly reduces the amount of resistance offered to the compression, and consequently takes less power to run the machine.

The compressor requires but two piston-rod stuffing-boxes, each one of which is easily maintained, as the piston-rod passes into the receiving-chamber only, where the pressure and heat is low, no matter how high the final pressure may be, and the packing is not exposed to the numerous difficulties arising from exposure to high pressure and temperature, as in dry compressors of the ordinary construction.

Although I prefer the general arrangement of parts and method of operation herein shown, I do not wish to limit myself to this precise construction, as other arrangements of cylinders, valves, or passages may be easily substituted without departing from the essential features of the invention. Thus the cylinders might be set side by side and the pistons operated by a rotating shaft having cranks set opposite to each other, so that the pistons may move coincidently and in opposite directions.

A modification of the cylinder is shown in Fig. 5, in which the eduction-valves M of the receiving end of the cylinder are placed in the large end of the piston, thus dispensing with the passage D.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, in an air-compressor, of two or more sets of cylinders, each set comprising two cylinders of unequal size placed in line and having their pistons united so as to move simultaneously, piston-rods extending through the outer heads of the larger cylinders and connected with a driving mechanism, valves through which air may be admitted and discharged at this end of the larger cylinder, and pipes connecting the spaces upon opposite sides of the larger pistons with each other, and also with those of the corresponding series, substantially as herein described.

2. The combination, in an air-compressor, of two or more sets of cylinders, each set comprising two cylinders of unequal size placed in line, and communicating freely with each

other at their adjacent ends, pistons fitting the two cylinders and connecting with each other, so as to move simultaneously, the piston-rods connecting with the larger pistons and extending through the outer heads of the same, so as to be actuated by a suitable motor, induction and eduction valves within the outer head, through which air is admitted to and discharged from the outer side of the larger piston, pipes connecting the discharge-valves with the spaces between the larger and the smaller pistons of two corresponding sets of cylinders, and valves by which the air may pass from this space through the smaller pistons to the outer ends of the cylinders, in combination with discharge or eduction valves connecting the outer ends of the smaller cylinders with the storage-reservoir, substantially as herein described.

3. The combination, in an air-compressor, of cylinders arranged in sets of two or more, each set comprising two cylinders of unequal diameter placed in line, having their adjacent ends open to communicate freely, pistons fitting these cylinders and united, so that they move simultaneously, induction and eduction valves in the outer head of the larger cylinder, pipes connecting the eduction-valves of each of the larger cylinders with the space at the rear of its piston, also with the rear of the corresponding piston of its series in the other cylinder, in combination with a series of concentric pipes, through which the air passes before entering these interior chambers, said pipes being surrounded by a chamber through which water circulates, substantially as herein described.

4. The combination, in an air-compressor, of the cylinders connected together in series, each set comprising two cylinders of unequal diameter standing in line, with their adjacent ends opening into each other, having pistons connected together, so as to operate simultaneously, with induction and eduction valves and connecting-pipes, as shown, in combination with a chamber concentric with and exterior to the smaller cylinder, a series of concentric pipes extending into this chamber, and connected with the air-conducting pipes and passages, so that the air must pass through these cooling-pipes, substantially as herein described.

5. The combination, in an air-compressor, of cylinders arranged in sets of two or more, acting in unison, each set comprising two cylinders of unequal diameter placed in line, having their adjacent ends open to communicate freely, pistons fitting these cylinders and united to move simultaneously, induction and eduction valves in the outer head of the larger cylinder, pipes connecting the eduction-valves of each of the larger cylinders with the space between the larger and smaller pistons of both sets of cylinders, valves opening through the smaller pistons into the outer ends of their cylinders, and eduction-valves through the ends of these cylinders for the discharge of the compressed air, substantially as herein described.

6. The sets of air-compressing cylinders acting in unison, each set comprising two cylinders of unequal diameter placed in line, with their adjacent ends open to communicate freely, and with pistons united to move simultaneously, chambers surrounding these cylinders at their junction, into which the air-conveying pipes open, water-chambers surrounding the smaller cylinders adjacent to the air-chambers, and pipes extending from the air-chambers into these water-chambers, and other smaller pipes passing through the air-chambers into the larger pipes, and connecting with the larger cylinders in the rear of their pistons, substantially as herein described.

In witness whereof I have hereunto set my hand.

GEORGE EDWIN DOW.

Witnesses:
C. D. COLE,
J. H. BLOOD.