No. 832,184. PATENTED OCT. 2, 1906.

J. F. DURYEA & W. M. REMINGTON.

CARBURETER.

APPLICATION FILED JUNE 19, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

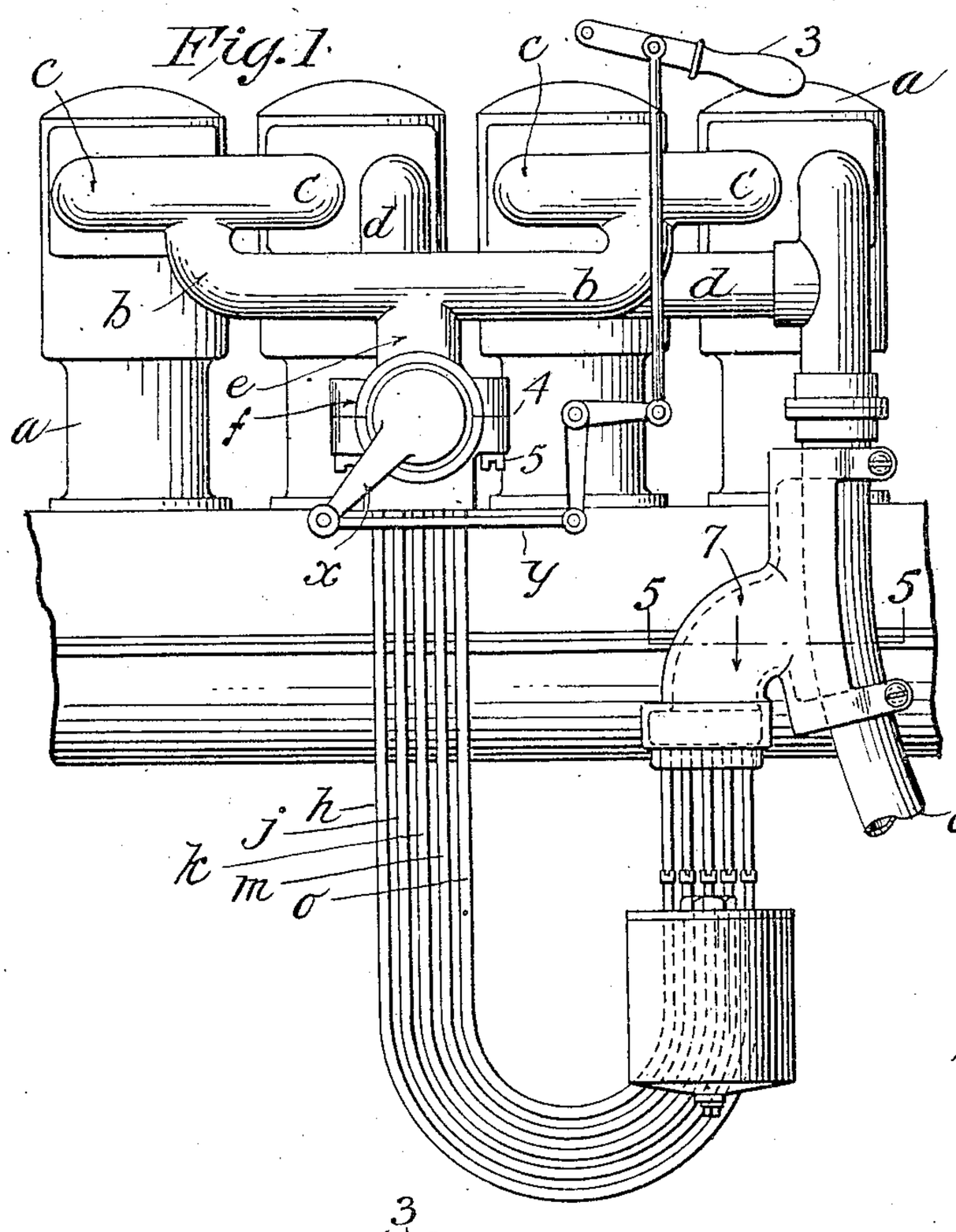


Fig. 5

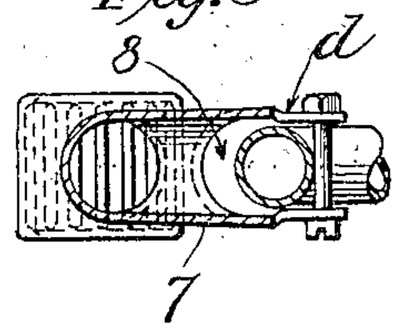


Fig. 4.

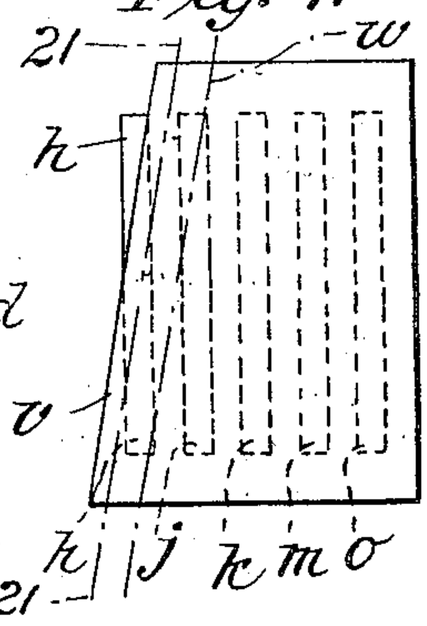


Fig. 2.

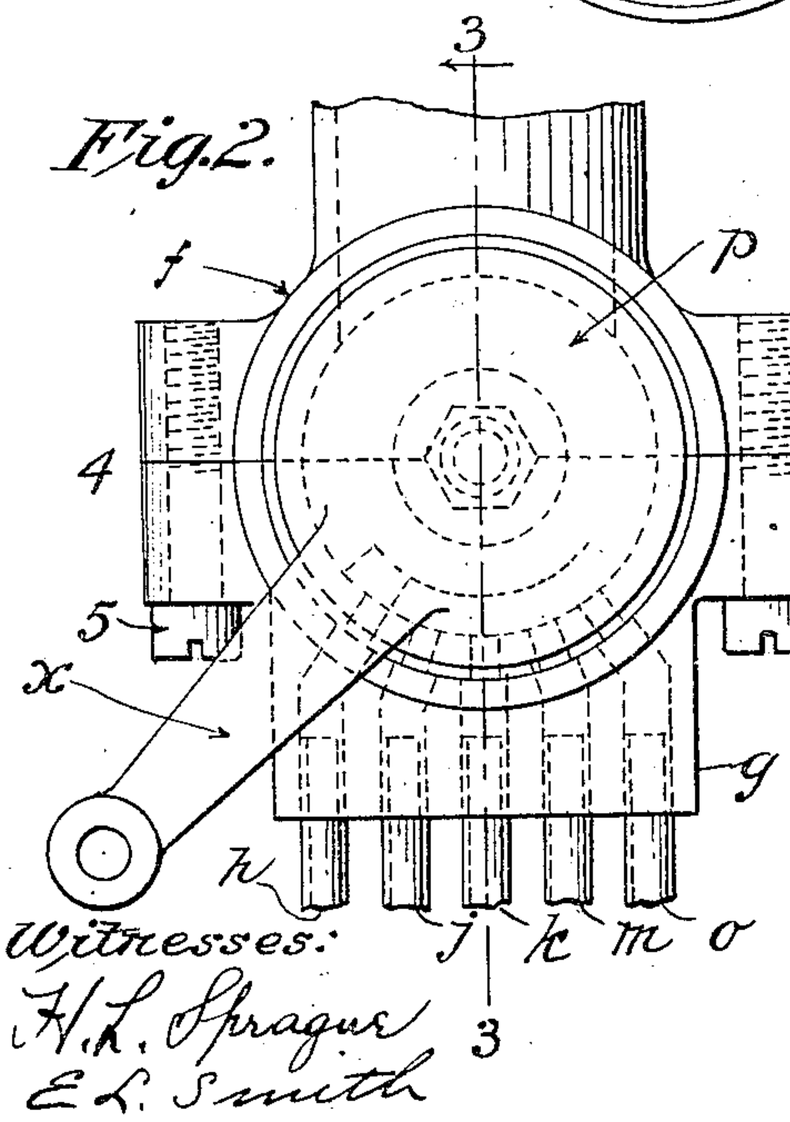
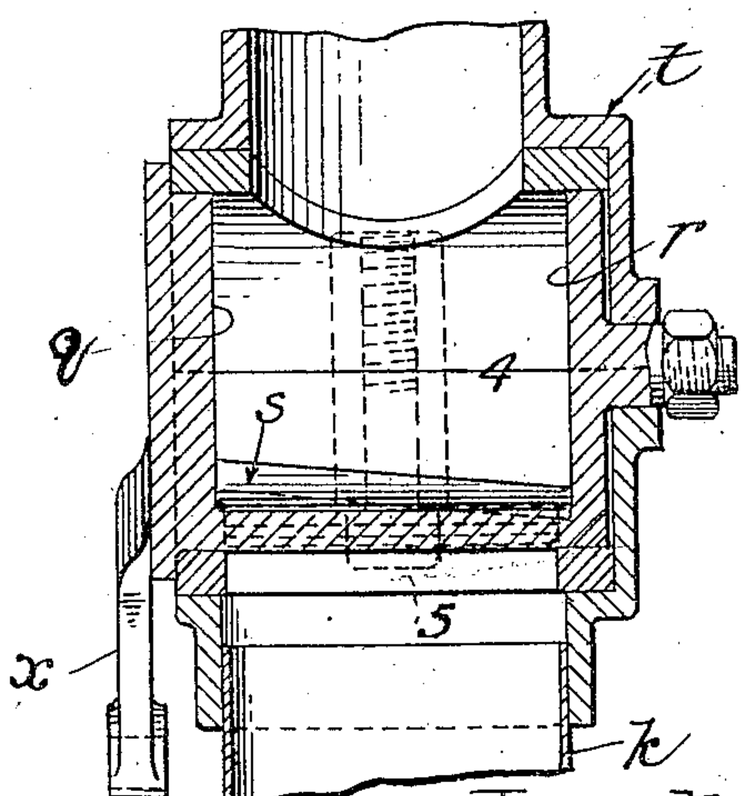


Fig. 3.



Witnesses:
H. L. Sprague
E. L. Smith

Inventors.
James Frank Duryea
William M Remington.
by Chapmans
Attorneys.

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2 SHEETS—SHEET 2.

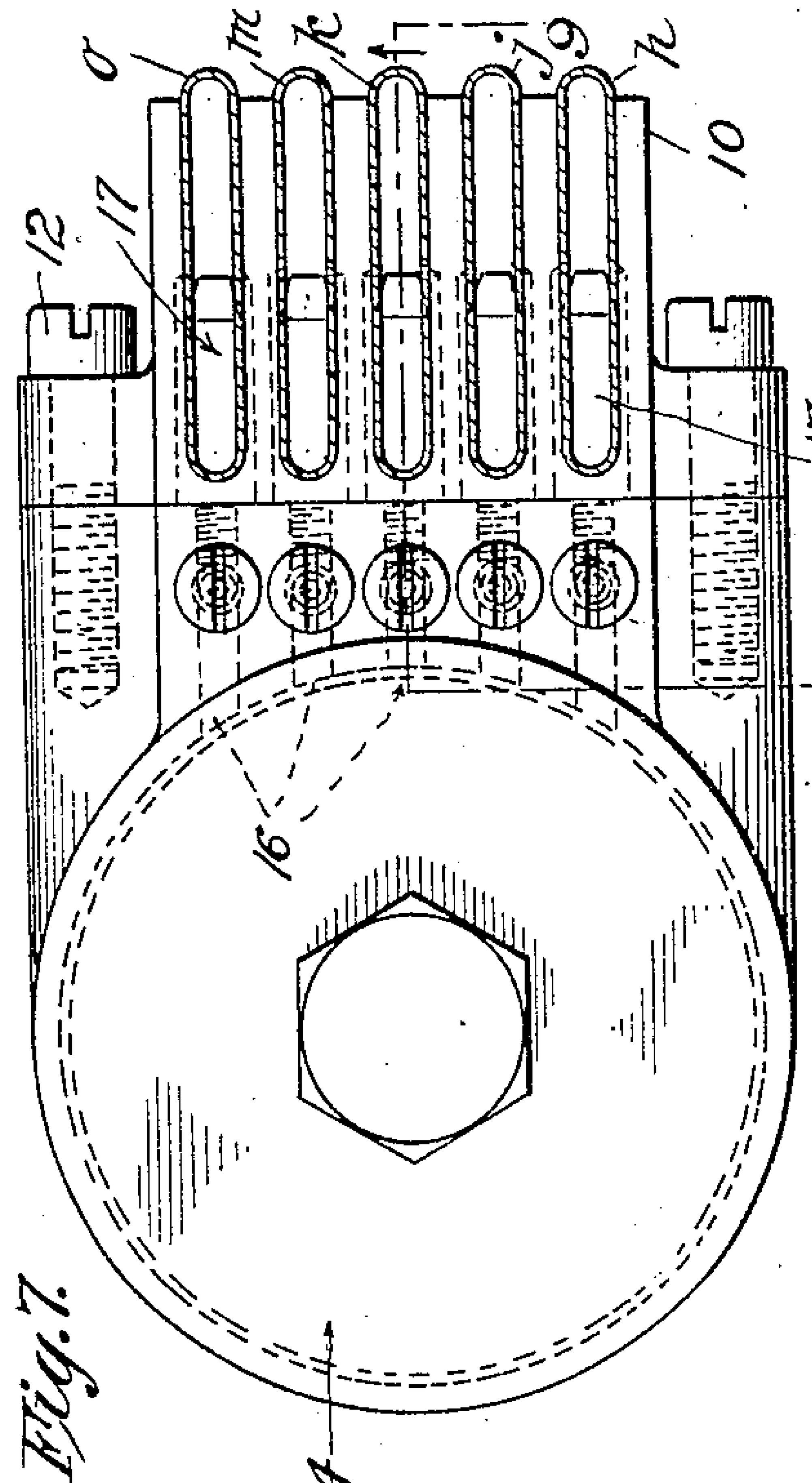

Fig. 7.

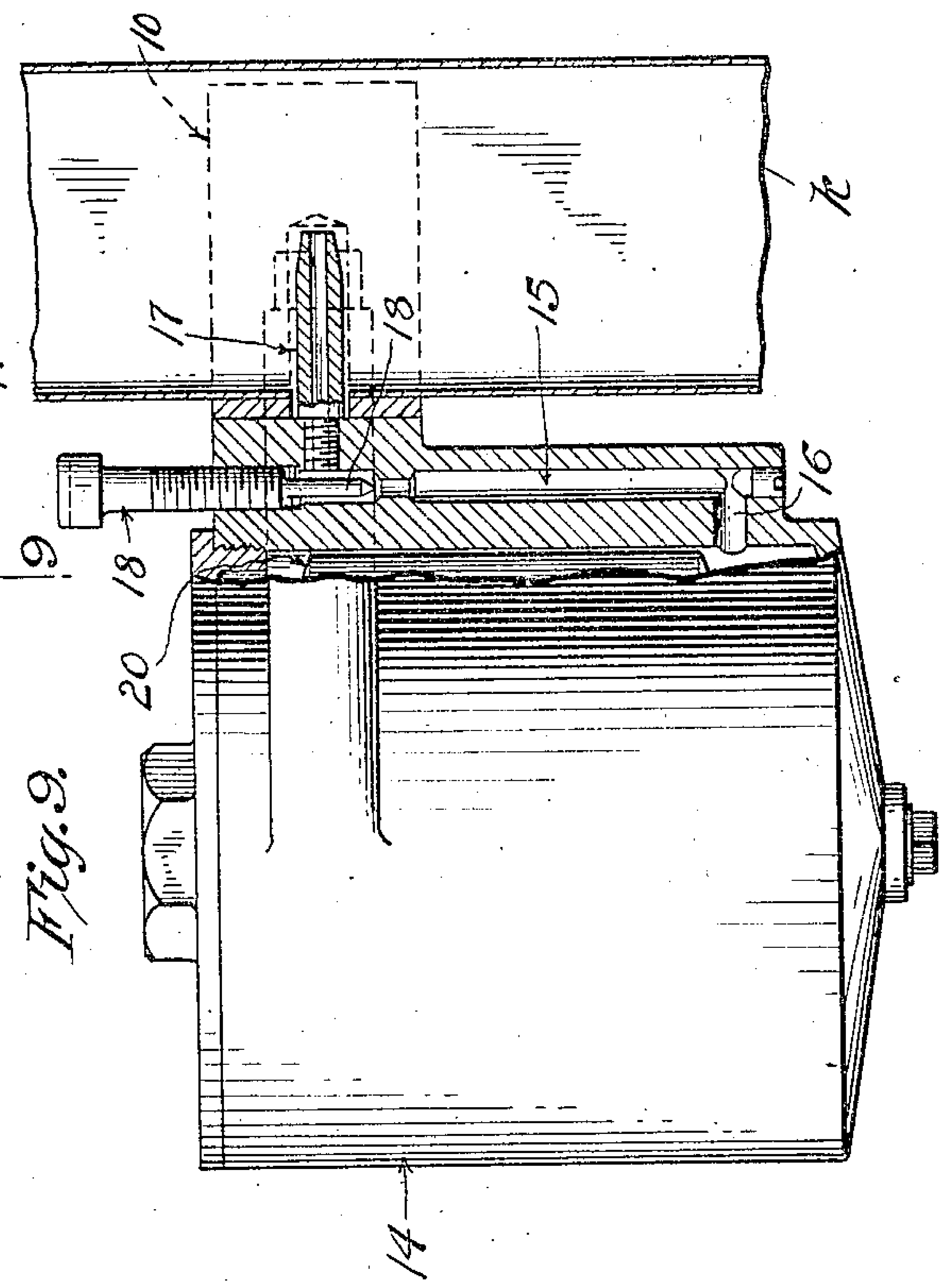

Fig. 9.

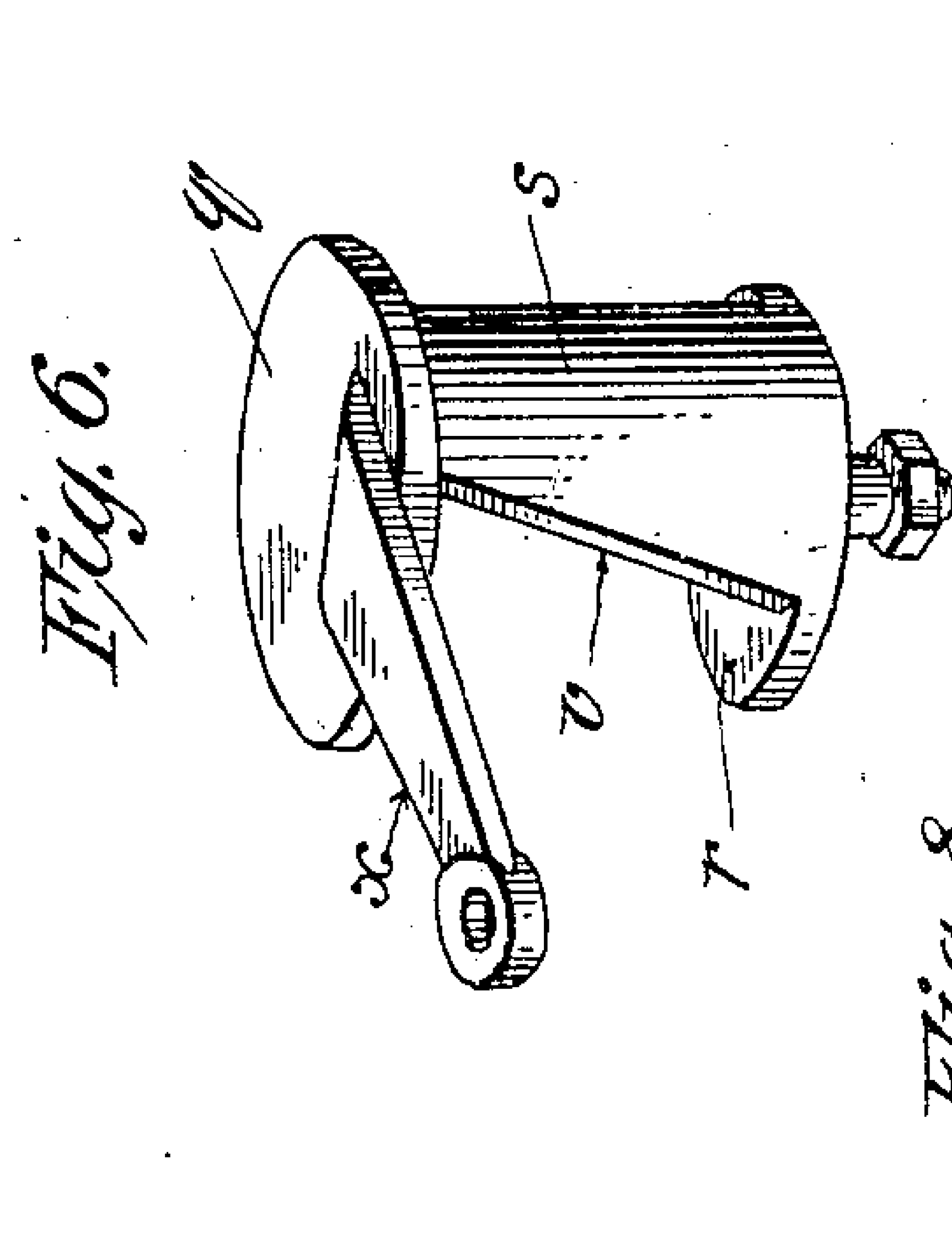

Fig. 6.

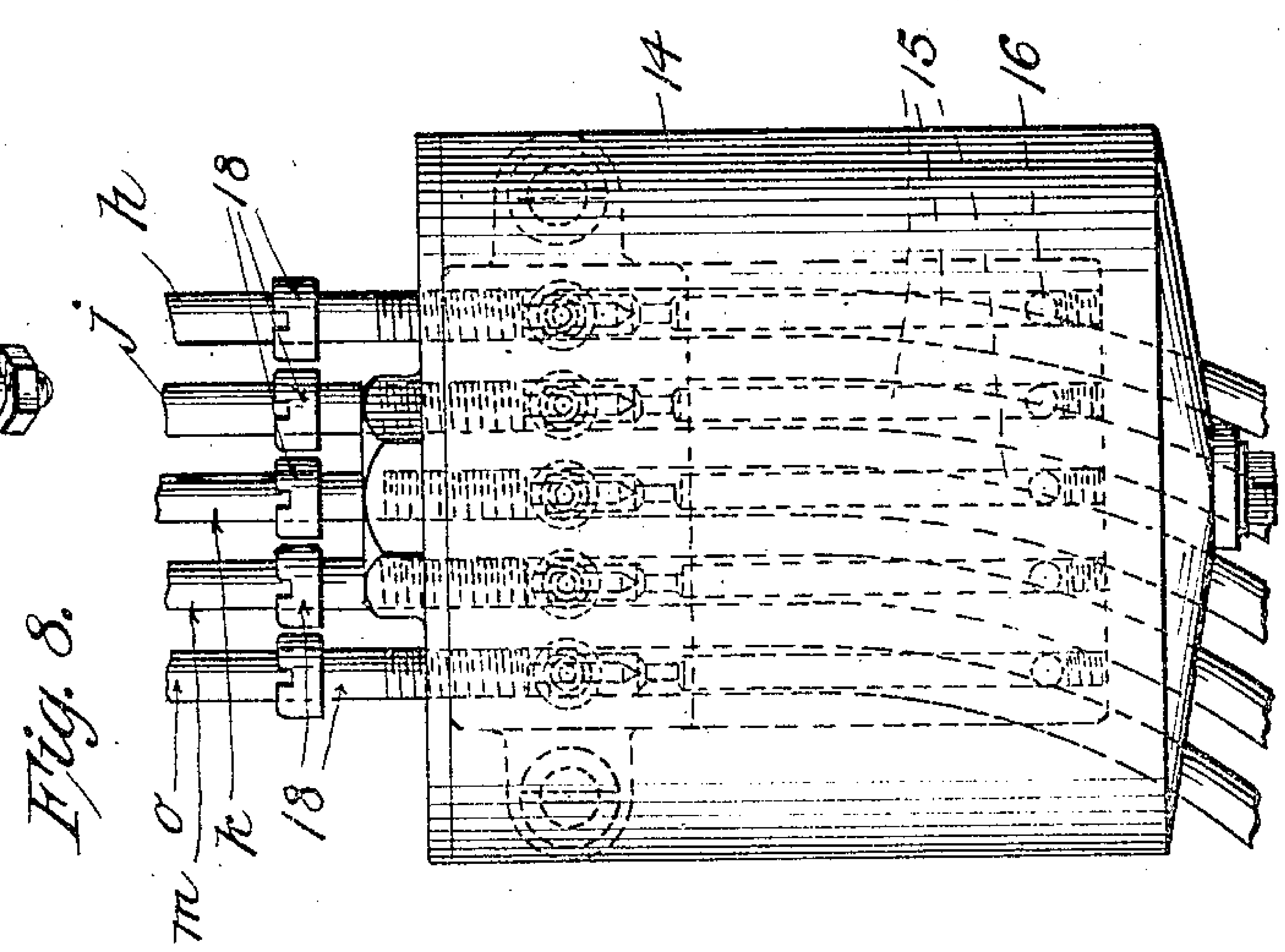

Fig. 8.

Witnesses:
H. L. Sprague
E. L. Smith

Inventors.
James Frank Duryea.
William M. Remington.

by Chapin & Co
Attorneys.

UNITED STATES PATENT OFFICE.

JAMES FRANK DURYEA AND WILLIAM M. REMINGTON, OF SPRINGFIELD, MASSACHUSETTS; SAID REMINGTON ASSIGNOR TO SAID DURYEA.

CARBURETER.

No. 832,184. Specification of Letters Patent. Patented Oct. 2, 1906.

Application filed June 19, 1905. Serial No. 266,024.

To all whom it may concern:

Be it known that we, JAMES FRANK DURYEA and WILLIAM MERRIAM REMINGTON, citizens of the United States of America, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented new and useful Improvements in Carbureters, of which the following is a specification.

This invention relates to carbureters such as are used for the atomization or volatilization of liquid fuels and the proper mixing therewith of the required volume of air to produce a combustible mixture, the carbureters being of that type in which, as is well known, the principle of operation involves means for drawing air through a passage into which a regulated quantity of liquid hydrocarbon is drawn through a suitable inlet by the aspirating effect of the movement of the air through the passage past said inlet-opening, whereby the liquid may be volatilized or atomized and, mingling with the air, constitute the agent whose combustion within the cylinder of the engine actuates the piston of the latter.

It has been shown in practice that in many kinds of work to which internal-combustion engines are especially adapted far more difficulty is experienced in controlling the engine at points of varying efficiency than is the case with steam—for example, where a substantially constant pressure is used. For example, when the engines are used in driving motor-vehicles the speed and load requirements might vary, say, from one hundred revolutions per minute with practically no load to fifteen hundred revolutions per minute with a full load, and under this wide variation great difficulty has been experienced in providing a carbureter having sufficient "flexibility," as it is termed, to supply to the engines a combustible mixture in which the proportions of the combustible and air will not materially vary. This difficulty arises from the fact that if the area of the passage through the carbureter is great enough to supply the engine with a combustible of the proper proportions and volume to run the engine at its maximum efficiency this passage is then so large that when the engine demands but the minimum supply the air will move through the carbureter on the suction-stroke of the engine at such a reduced velocity as to result in the very imperfect vaporization or atomization of the combustible, and consequently the resulting mixture will be relatively poor in combustible. Therefore as the engine is throttled down the proportion of the volatilized fuel to air diminishes and eventually reaches the point where its ignition is uncertain or impossible.

The object of the present invention is to overcome these disadvantages by the provision of means whereby the capacity of the conduit for the combustible extending between the carbureter and the engine and whereby the quantity of the combustible which may enter said conduit to be mixed with the air may be regulated; and having these ends in view the invention consists in making the conduit between the atomizer and the engine of a number of separate pipes whose aggregate areas are sufficient to supply the maximum volume of combustible the engine may require, means being provided in the form of a suitable valve to effect the closure of as many of these separate pipes as desired, each pipe being provided with a suitable inlet-pipe for the combustible and regulating means therefor. By means of this construction the suction-stroke of the piston will only be effective to produce the atomization of the combustible in such of the pipe units making up the conduit as are left open by the position of the valve.

The invention is fully illustrated in the accompanying drawings, in which—

Figure 1 shows in side elevation the application of the invention to an internal-combustion engine of the ordinary four-cylinder type. Fig. 2 is an enlarged plan view of the valve which controls the various pipes which unitedly constitute the conduit between the carbureter and the engine. Fig. 3 is a sectional elevation in the plane of line 3 3, Fig. 2, showing the construction of the interior of the valve. Fig. 4 is a diagram illustrating the position of the valve relative to the apertures leading into the valve-casing and into which the various pipes of the conduit are connected. Fig. 5 is a sectional view in the plane of line 5 5, Fig. 1, which shows the general construction, taken in connection with said Fig. 1, of the intake end of the air-pipe leading to the carbureter. Fig. 6 is a perspective view of the movable element of the valve shown in Figs. 2 and 3. Fig. 7 is a

plan view of the reservoir of the carbureter, showing the relation of the separate pipes of the conduit thereto and the separate connections between said pipes and the reservoir. Fig. 8 is an end elevation of the construction shown in Fig. 7 viewed from the left-hand end of the latter figure; and Fig. 9 is a side elevation of Fig. 7, partly in section, in the plane of line 9 9 to show the means of connection between each of the pipes of the conduit and the reservoir and the regulating means therefor.

Referring now to the drawings, *a* may indicate the engine as a whole; *b*, a trunk inlet-pipe provided with branches *c*, extending to each cylinder of the engine, *d* indicating the exhaust-pipe branching to each cylinder.

At some suitable point, as *e*, a valve-casing *f* is attached to the trunk-pipe *b*, and into a boss *g* on the lower side of this valve-casing the separate pipes *h*, *j*, *k*, *m*, and *o* are connected with suitable passages which extend through the wall of the casing and are controlled by the rotatable valve *p*. This valve is shown in detail in Figs. 3 and 6, and it consists, essentially, of the parallel cylindrical heads *q* and *r*, united by the portion *s*, which is that part of the valve which bears against the interior surface of a bushing *t* in the casing and is arranged to move over the passages into which the pipes *h*, *j*, *k*, *m*, and *o* are connected, which passages constitute continuations of these pipes and are radially disposed relative to the axis of the valve *p* and the bushing *t* referred to. The forward or throttling edge of the portion *s* of the valve (which edge is indicated by *v*) is inclined relative to the axis of the valve, whereby the various passages leading to the pipes *h*, *j*, *k*, *m*, and *o* will be gradually covered or uncovered by the movement of this inclined edge *v* of the valve thereof from one end to the other as the valve is rotated. The purpose of this construction may be clearly seen by referring to Fig. 4, in which this inclined edge *v* of the valve is shown as it begins to uncover the passage *h*, (these various passages being referred to by the same letter of reference that indicates the various pipes connected with them,) the dotted line *w* showing the position of the throttling edge *v* after the passage *h* has been fully uncovered, which shows that before the total uncovering of one passage is effected the edge *v* will pass into the area of the next, whereby the successive opening of these various passages will be effected without any break. The valve *p* has attached thereto or forming part thereof an arm *x*, which, as shown in Fig. 1, may by a system of rods and levers *y* be connected with an operating-handle 3 or with any other device as a governor, whereby the valve may be actuated to regulate the supply of combustible mixture to the engine.

While the valve described and shown herein is considered to be best adapted to the end in view, any other having the same characteristics may be substituted therefor. The shell or casing *f* of this valve is made in the form of a cylinder with one closed end, being preferably divided into two parts on the line 4 4, as shown in Fig. 2, these being put together with screws 5, by the loosening of which the valve may be removed or the connection between the carbureter and the engine broken for the purpose of examining or removing the carbureter. The pipes *h*, *j*, *k*, *m*, and *o* are, as shown in the various figures of the drawings, flattened, to the end that they may be placed side by side and occupy relatively little room. Preferably they would be arranged as shown in Fig. 1, the ends thereof opposite the ends which enter the valve-casing *f* being in a similar manner entered in a sort of tubular head 7, adapted to be clamped to the exhaust-pipe *d* in such manner as to leave an air-passage 8 (shown in Fig. 5) contiguous to the pipe *d*, whereby when upon the suction-stroke of the engine air is drawn through the conduit-pipes to the engine it will pass into the head 7 in contact with the hot exhaust-pipe, and thus become more or less heated. No part of the invention, however, is involved in the idea of heating the air which is used in the carbureter; but there is advantage in heating it, which fact is utilized in the construction shown.

At some point between the two ends of the conduit-pipes *h*, *j*, *k*, *m*, and *o* they pass through a rectangular boss, (shown in Figs. 7 and 8 and indicated by 10,) which is slotted to receive the aforementioned conduit-pipes, these preferably being brazed or otherwise secured therein. This boss 10 is provided with lugs on the opposite ends thereof through which screws 12 may pass to secure the liquid-fuel reservoir 14 in operative relation to these conduit-pipes. This reservoir is of cast metal, and one wall thereof, as shown in section in Fig. 9, is made thick enough to have drilled therein the usual passages 15 and 16 for the liquid fuel. The passage 15 extends vertically through this wall of the reservoir and is intercepted by the fuel-supply nozzle 17, screwed into the wall of the reservoir at right angles to said passage, and at some point between the nozzle 17 and the reservoir is located the usual needle-valve 18, whereby the quantity of liquid fuel which may pass into the atomizing-pipe from the reservoir may be regulated.

As shown in Figs. 7 and 8, separate atomizing-pipes 17 for the conduit-pipes *h*, *j*, *k*, *m*, and *o* are provided, and separate passages 15 and 16 are provided for each of the pipes 17 and separate adjusting-valves 18 also.

The reservoir 14 is hermetically closed and provided with a pipe (not shown) which extends to some suitable larger reservoir for liquid fuel, the usual float 20, as shown in

Fig. 9, being located in the reservoir to maintain the liquid fuel therein at a constant level near the level of the atomizing-pipes whereby on the suction-stroke of the piston a certain amount of the liquid fuel will be drawn from the reservoir through the fuel-supply nozzle 17 into the conduit-pipes *h*, *j*, *k*, *m*, and *o*, or such of them as are open, and mingling therein with the volume of air passing through said nozzle constitute the explosive mixture required for the operation of the engine.

The salient feature of this invention lies in the provision of a group of pipes of relatively small area, each provided with an atomizing-pipe connected with the liquid-fuel reservoir, the aggregate areas of the pipes constituting said group being sufficient to supply the engine with the required volume of combustible mixture to run it at its maximum efficiency, provision being made for cutting off certain pipes of said group as the demand on the engine for power decreases, this cutting off of these pipes effecting the diminution of the area of the conduit extending to the engine and proportionately cutting off the supply of fuel, and attention is especially called to this simultaneous adjustment of the air and fuel supply as distinguished from the method now in common use of throttling the intake-port of the carbureter when it is desired to reduce the volume of the combustible.

By means of the present invention it is possible to reduce the supply of fuel to the very lowest point or to increase it to the maximum without changing the quality of the mixtures as regards the relative proportion of air and fuel compared with those proportions when the engine is running at its normal rate.

To adjust the carbureter, the valve *p* should be set (see Fig. 4) with its throttling edge *v* about on the dotted line 21, which will uncover, say, a little more than half of the first pipe *h* of the group leading to the engine. At this point the needle-valve 18 of this pipe may be adjusted to give a correct mixture of air and fuel. When this has been attained, the edge of the valve may be moved to gradually close the pipe *h* or in the opposite direction to gradually open it, and this movement may take place within certain limits without so increasing or decreasing the relative proportions of fuel to the volume of air passing through the pipe as to make the mixture either too poor or too rich in fuel, and this is a sufficiently flexible point to permit the valve to travel, we will say, toward the open position far enough to begin to open the next pipe *j*. If, however, the volume of air which could pass through this pipe were added to the correctly-proportioned mixture in the pipe *h*, the mixture would be too highly diluted. Therefore as the valve *p* is moved to uncover the pipe *j* the needle-valve 18 of this pipe is also adjusted to provide a correctly-proportioned mixture as this pipe is gradually uncovered, and in this way the adjustment of the valve 18 of each of the pipes *h*, *j*, *k*, *m*, and *o* is effected, the combined output of them all being sufficient to supply the engine with the required volume of mixture to run it at its maximum capacity. This adjustment being properly made for each of the pipes, it is obvious that when the valve is moved to gradually cover the ends of these pipes there will be no change in the quality of the mixture, as each open pipe will yield that mixture in the proportion of air and fuel to which it is individually adjusted, and it will therefore be possible to throttle down the engine to the lowest point and yet obtain a correctly-proportioned mixture, and the same is true of the opposite extreme.

Obviously the number of the pipes *h*, *j*, *k*, *m*, and *o* constituting the conduit between the carbureter and the engine may be more or less numerous, as demanded by the conditions of the service to which it is to be adapted, and of course the cross-sectional form of these pipes is immaterial, the essential feature of the invention being in the use of a conduit between the carbureter and the engine subdivided into a plurality of relatively small conduits each provided with its own fuel-supply pipe or atomizing-nozzle and each provided with means to regulate that supply, means being provided to open or close at will any desired number of the separate units of the conduit to increase or diminish the total volume of the combustible mixture delivered to the engine.

Having thus described our invention, what we claim, and desire to secure by Letters Patent of the United States, is—

1. A carbureter comprising a suitable reservoir for the fuel, a plurality of separate conduits extending therefrom, means to supply fuel to each conduit separately, and means to open or close said conduits in succession to vary the total volume of fuel, said means consisting of a casting having two disk-shaped pieces and connected by a curved-shaped part one edge of which stands at an angle to said disk-shaped pieces.

2. A carbureter consisting of a plurality of conduits, a valve for the outlet ends thereof, a casing for the outlet ends the opposite ends being open; a fuel-reservoir connected with the conduits between their ends, separate fuel-supply pipes extending from the reservoir into each conduit, and a regulating-valve for each supply-pipe, said valve having an edge that is normally inclined to the conduit-openings in said casing.

3. A carbureter of the character described having an inlet and outlet opening supply-reservoir, the latter being operatively connected with an engine-cylinder, a plurality of conduits extending between said openings, a

pipe to supply combustible to each of said conduits separately from said supply-reservoir, and a valve to control the outlet end of said conduits said valve having an edge inclined to said outlet-openings whereby a greater or a less number of the latter may be placed in operative communication with said engine-cylinder.

4. The combination with an internal-combustion engine, of a carbureter, a suitable conduit between the latter and the engine consisting of a plurality of separate passages each being provided with separate means for supplying a combustible thereto, and a valve in said conduit to control said separate passages, said valve being rotatably mounted and having a disk-shaped part at its opposite ends, a part connecting said disk-shaped part, one edge of said connecting part being straight and the other edge inclined, whereby a greater or less number of the latter may be placed in operative communication with said engine.

5. The combination with an internal-combustion engine and a carbureter consisting of a suitable reservoir for fuel, a plurality of conduits extending therefrom to the engine, means to supply fuel to each conduit separately, and means to open or close said conduits in succession to regulate the volume of fuel, said regulating means comprising a rotary valve, one edge of which is inclined to said conduits, whereby a gradual opening and closing of the plurality of the conduits is effected.

6. A carbureter comprising a fuel-reservoir, a plurality of conduits and separate fuel-supplying means extending from each conduit to the reservoir, a valve-casing having a plurality of narrow, parallel slits in its wall with each of which one of said conduits is connected, a valve in said casing to move over said slits to open or close the same, the throttling edge of said valve being inclined relative to said parallel slits whereby the advancing or receding movement of said edge will effect the uncovering or the covering of said slits in a direction extending from one end thereof to the other.

JAMES FRANK DURYEA.
WILLIAM M. REMINGTON.

Witnesses:
WM. H. CHAPIN,
K. I. CLEMONS.