(No Model.)

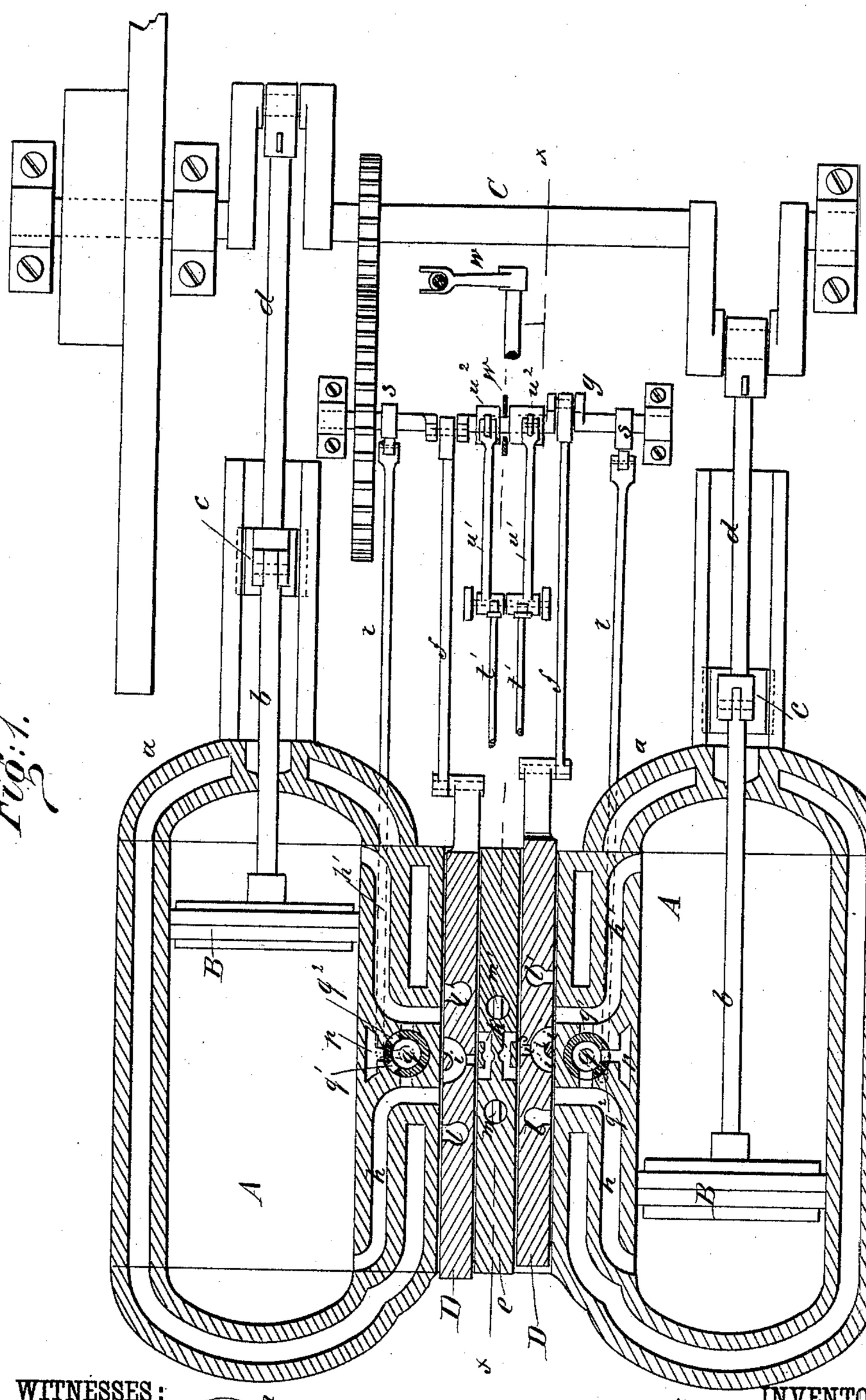
4 Sheets—Sheet 1.

C. SHELBURNE.

GAS ENGINE.

No. 277,618. Patented May 15, 1883.

Fig. 1.



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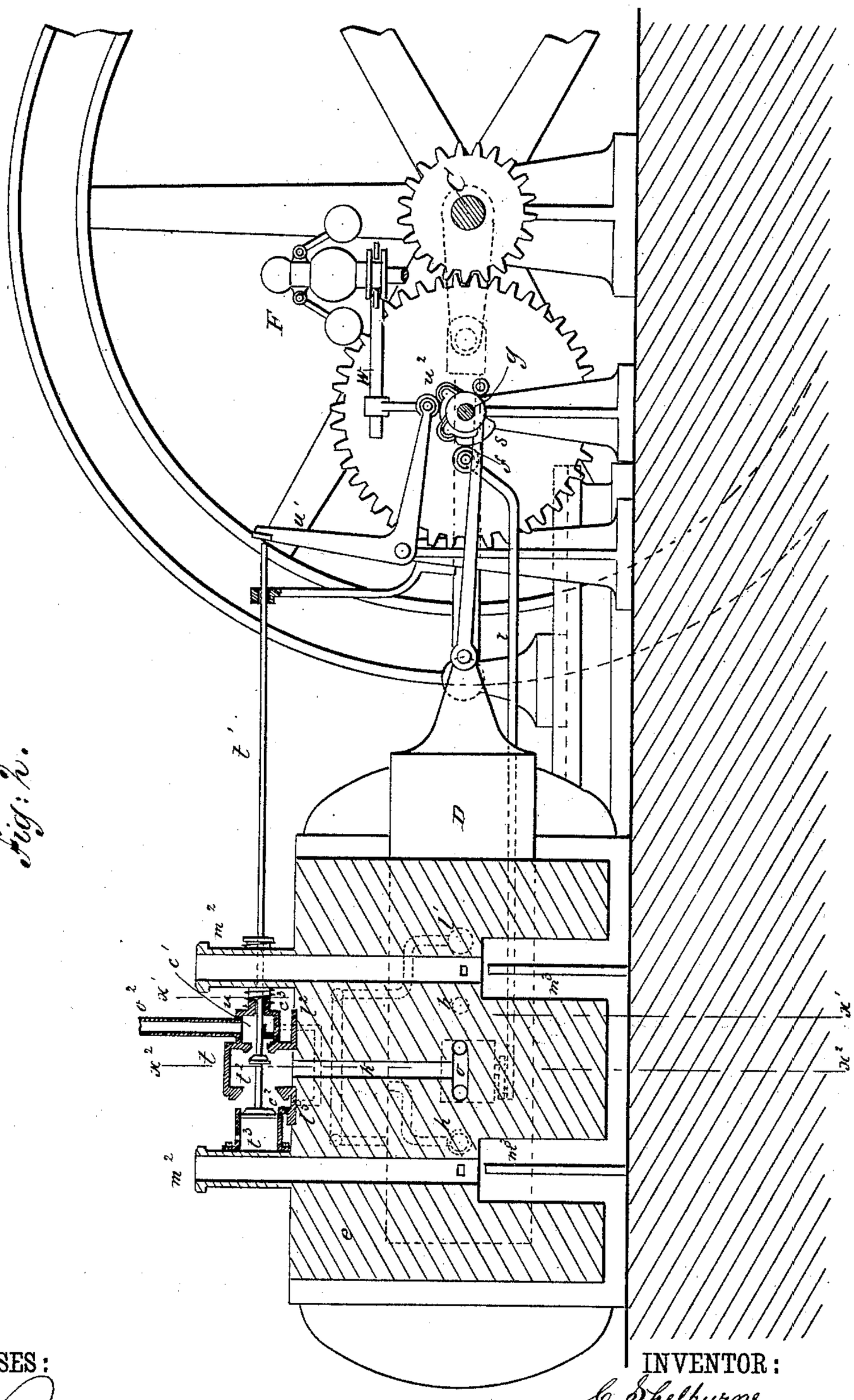

Fig. 2.

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Fig: 3.

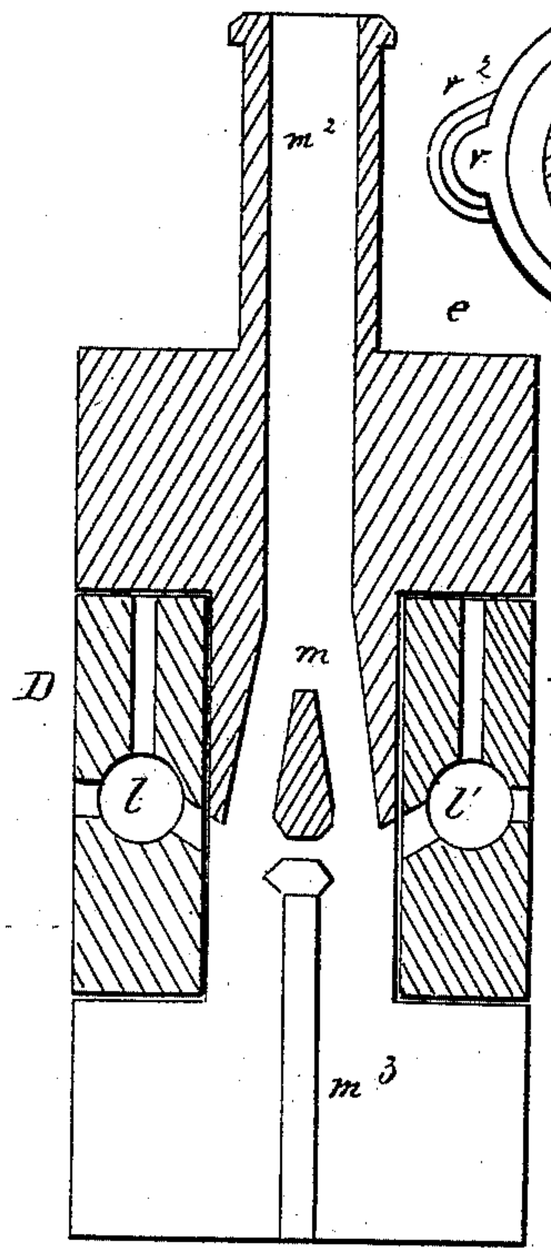

Fig: 7.

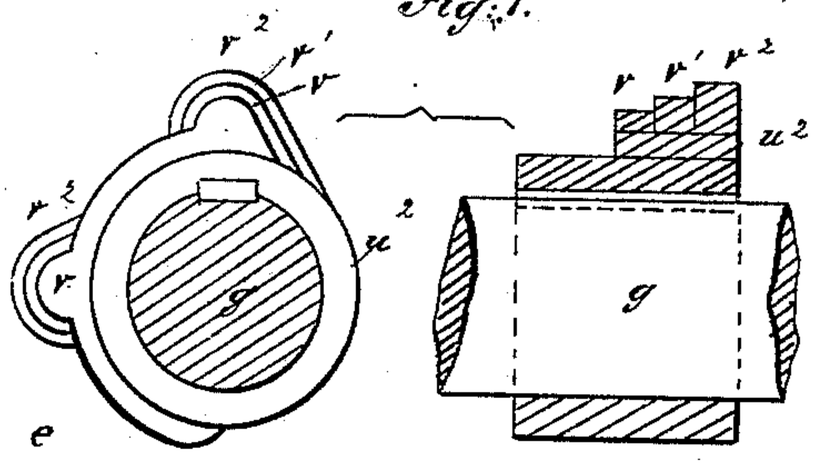

Fig: 8.

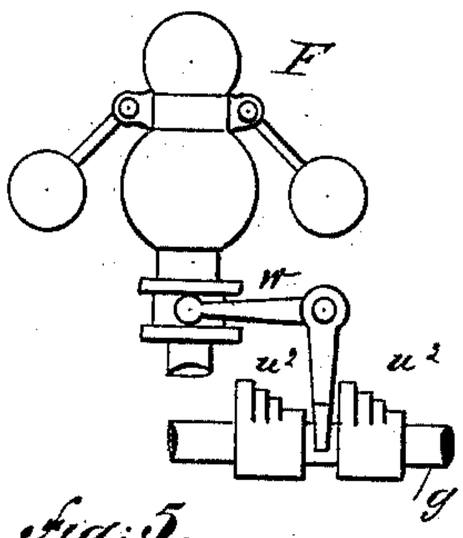

Fig: 4.

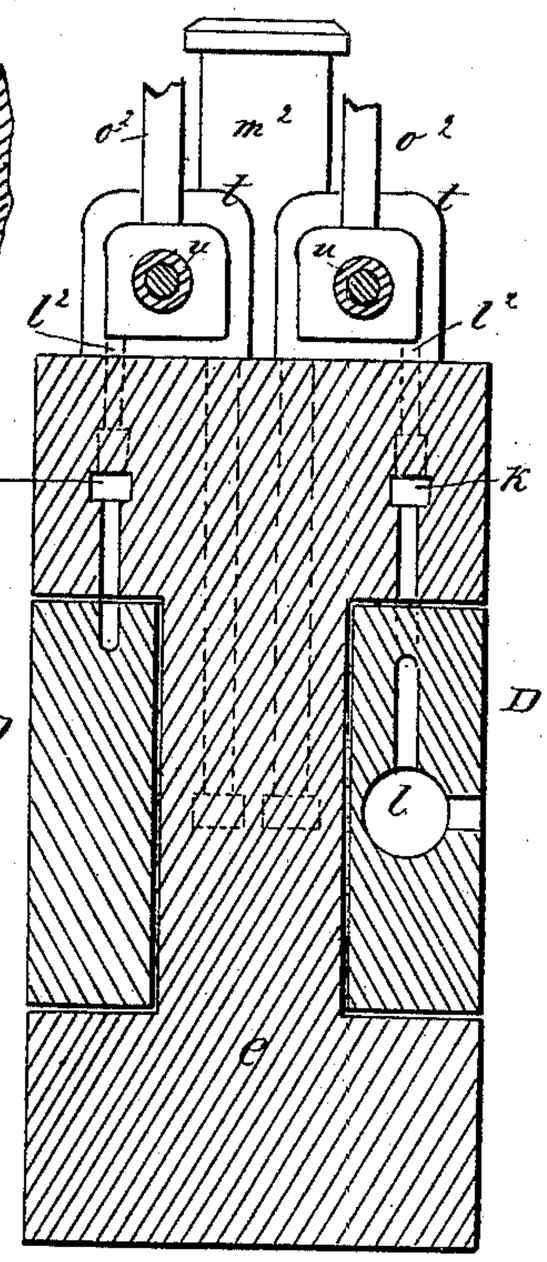

Fig: 5.

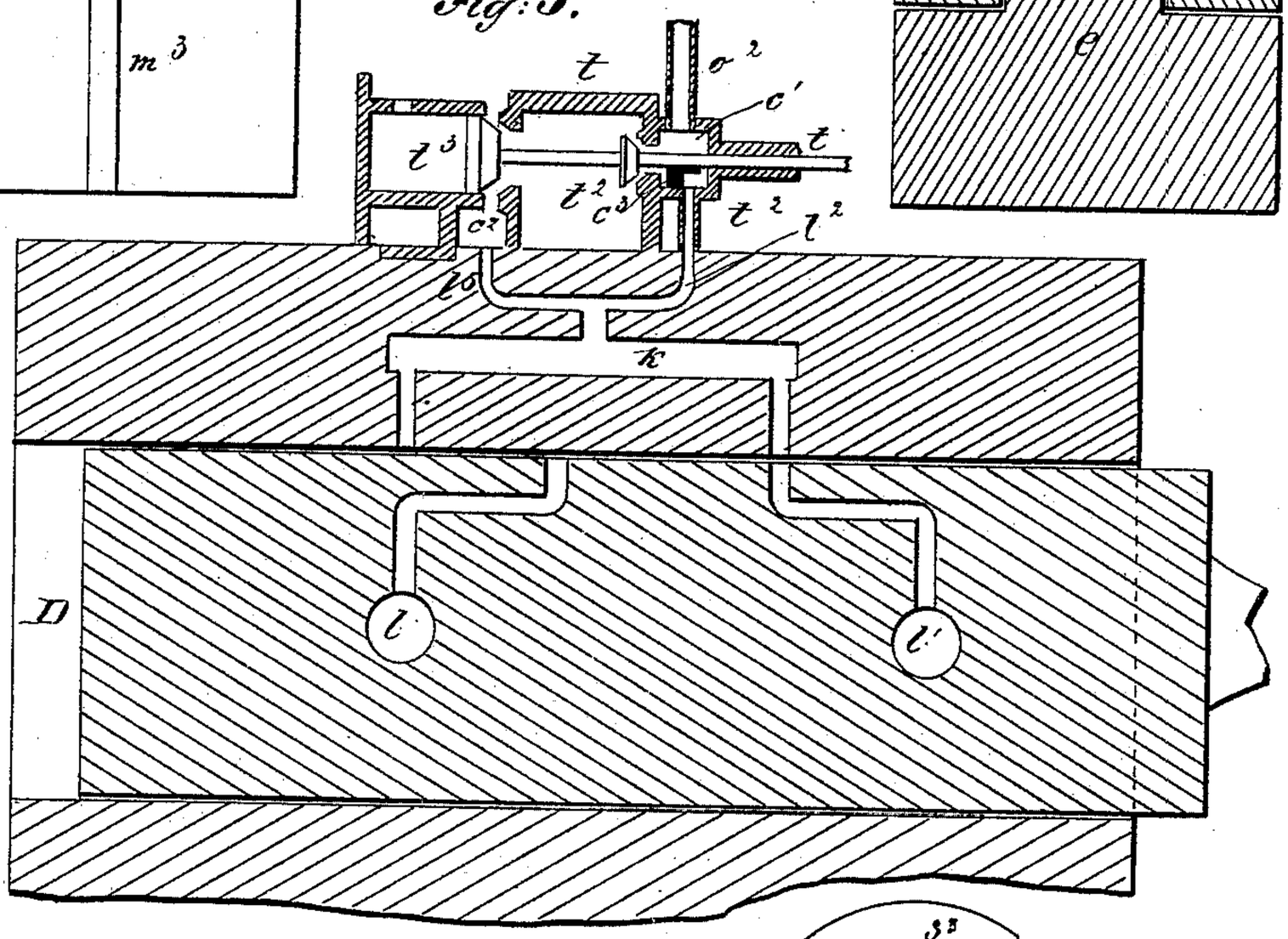

Fig: 6.

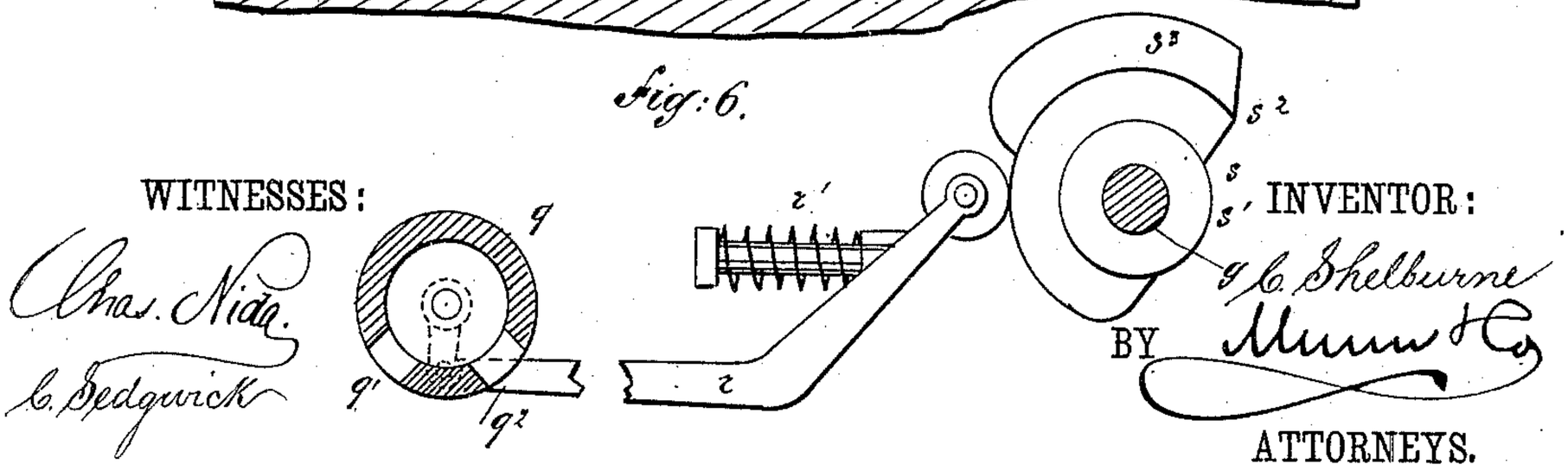

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Fig: 10.

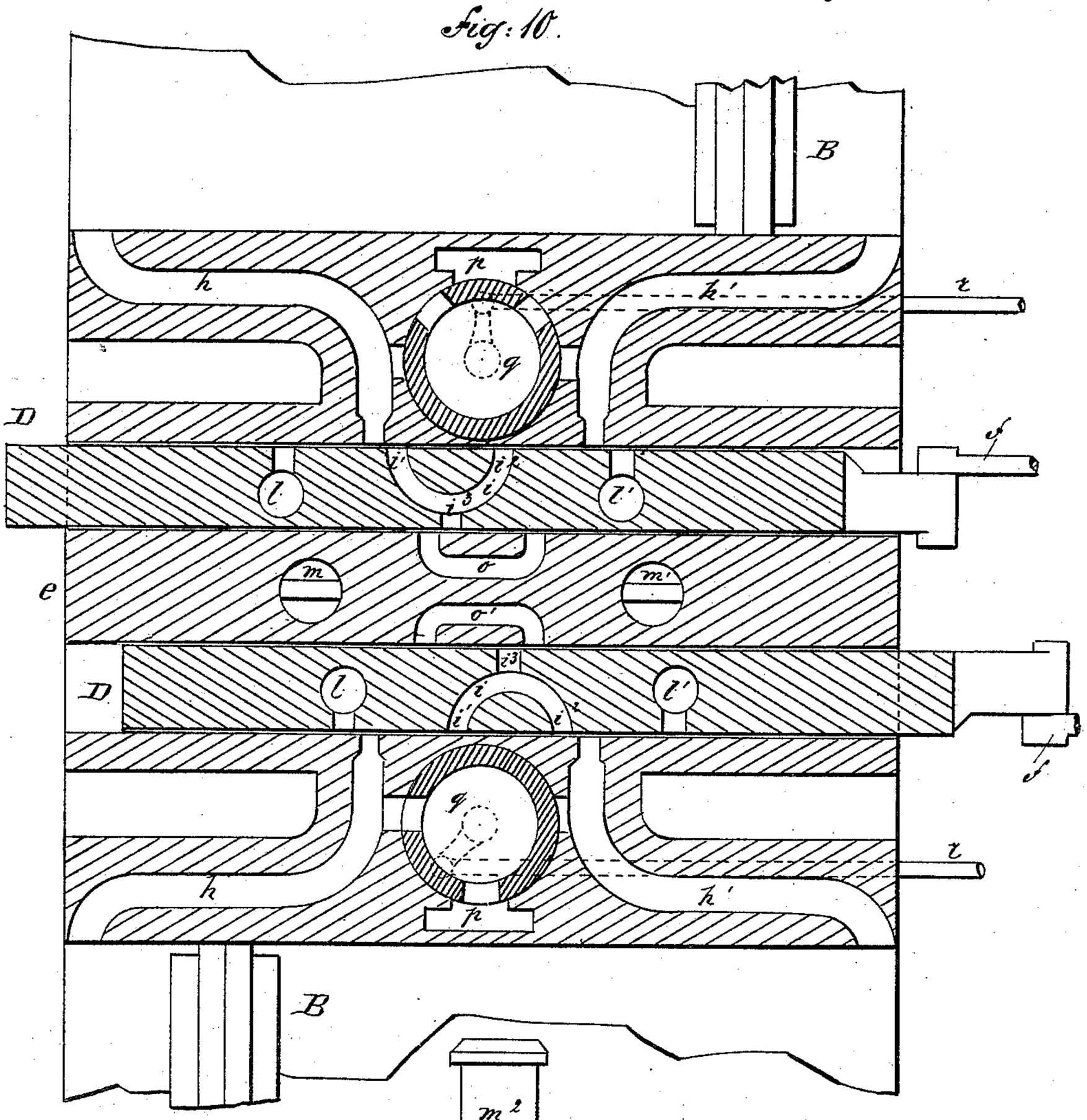
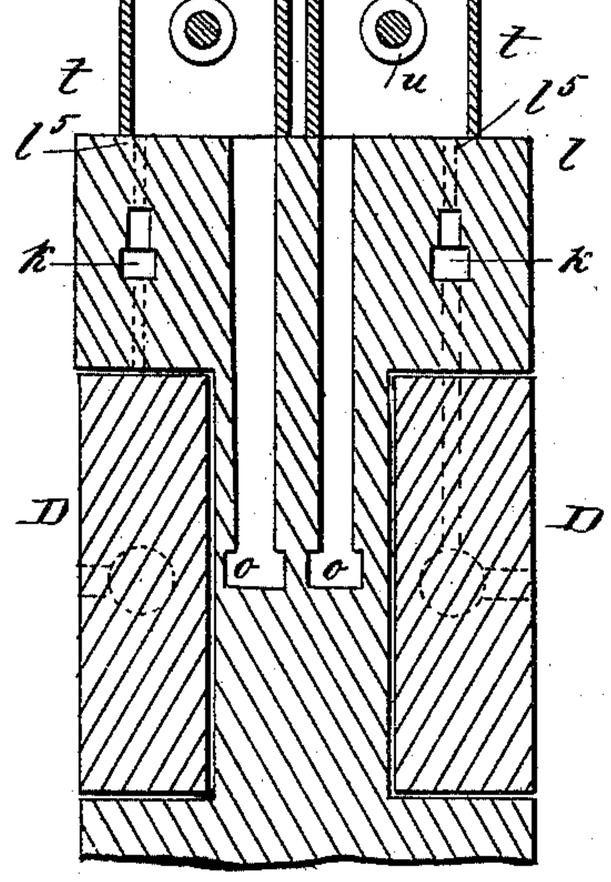


Fig: 9.



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UNITED STATES PATENT OFFICE.

CEPHAS SHELBURNE, OF JOHNSON CITY, TENNESSEE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 277,618, dated May 15, 1883.

Application filed February 27, 1883. (No model.)

To all whom it may concern:

Be it known that I, CEPHAS SHELBURNE, of Johnson City, in the county of Washington and State of Tennessee, have invented a new and Improved Gas-Engine, of which the following is a full, clear, and exact description.

My improvements relate to the class of gas-engines in which gaseous pressure within the cylinder, resulting from the combustion of a mixture of inflammable gas or vapor and air, causes the piston to perform its stroke, the products of the combustion being expelled by the return-stroke of the piston.

The objects of the invention are to obtain greater speed and power in proportion to the size of the cylinder, and also uniformity in running; further, to simplify the construction of the engine both in respect to the number of parts and arrangement of the mechanism.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional plan view of a gas-engine of my improved construction. Fig. 2 is a vertical longitudinal section on the line *x x*, Fig. 1. Fig. 3 is a detail section, showing the arrangement of the gas-flame and the passages for firing the charges. Fig. 4 is a transverse section on line *x' x'*, Fig. 2. Fig. 5 is a detail section, showing the arrangement of the firing-passages in the slide-cover. Fig. 6 is a detail view, showing the mechanism for operating the exhaust-valves. Fig. 7 represents the cam used for admitting the explosive mixture of gas and air into the cylinders. Fig. 8 is an elevation of the governor. Fig. 9 is a detail section on line x^2 x^2, Fig. 2. Fig. 10 is a sectional plan view, showing passages in slide and slide-cover for the admission of the explosive mixture of gas and air into the cylinders.

A A are two jacketed cylinders, provided with heads *a* of concave form.

B B are pistons connected by their rods *b* to cross-heads and slides at *c*, the slides being connected by rods *d* to the crank-shaft C. The cylinders are placed side by side, and between the side of each cylinder and a fixed plate, *e*, is a slide, D. The two slides are connected by rods *f* to a crank-shaft, *g*, having cranks placed one hundred and eighty degrees apart, the shaft *g* being geared to the main shaft C in such a manner that the main shaft makes two revolutions to one of the secondary shaft, and consequently the slides are given one backward and one forward motion for every two revolutions of the main shaft. The cylinders A are formed with passages *h h'*, extending from the outer surfaces next to the slide D to the opposite ends of the cylinders, so as to admit the explosive mixture at both ends of the cylinders, as hereinafter described.

At *q* are the exhaust-valves.

The arrangement of the ports and passages for the admission of the firing-charge and of the igniting-flame and the operation of the exhaust-valves are the same in connection with each cylinder, and also when a single cylinder is used, and the following description applies to either cylinder shown.

In the slide D is a passage, *i*, open at one side of the slide by two outlets, i' and i^2, and at the other side, or against the plate or cover *e*, by a passage, i^3. In the plate or cover *e* is a U-shaped passage, O, the ends of which open upon the face of the slide D, and which is connected by a channel to the chamber *t*, Fig. 5, by which the mixture of gas and air is supplied.

m m' are passages formed in the cover *e*, fitted, as shown in Fig. 3, with a gas-burner, m^3, at the base of a chimney, m^2. *l l'*, Figs. 1, 3, and 4, are firing-passages in the slide D, open at both sides of the slide at one side for communication with the passage *m* and at the other side for communication with the passages *h h'* for firing the charge in the cylinders. The exhaust-valves *q* are of tubular form, and are made with side slots or openings, q' q^2, which, when the valve is rocked, connect the passages *h h'* of the cylinder with the main exhaust-passage *p*, which discharges to the open air. The exhaust-valve is operated or controlled by a rod, *r*, which is acted upon by a cam, *s*, on the secondary shaft *q*. As shown in Fig. 6, the cam *s* is made with three elevations, s', s^2, and s^3, of different heights, the intermediate surface or cam, s^2, closing or retaining the valve in its middle or closed position, and the other two cams causing the mo-

tion first in one direction and then in the other, so as to connect the passages *h h'* alternately with the exhaust. The rod *r* is provided with a roller that is pressed against the cam by means of a spiral spring, *r'*, suitably arranged.

k is a channel, to which air enters from an air-chamber, c^2, by a passage, l^5, and gas from gas-chamber *c'* by the pipe and passage l^2, before mentioned. The air and gas are thoroughly mixed before entering a small channel of chamber *k*, from where it leads, by suitable channels, to the igniting-chambers *l l'*. The igniting-chambers *l l l' l'* being filled at the same time as the cylinders, when the air and gas valves t^3 t^2 are opened by action of the cam U^3 air enters a passage, c^2, and is led by suitable channel to chamber *k*, and gas from chamber *c'* enters pipe l^3 and channel to chamber *k*, where they are thoroughly mixed before entering the ignition-chambers *l l'*. The air-passage c^2 is kept closed by the value t^3, and the gas pipe or channel l^2 is kept closed by a small valve, c^3, carried on the rod *t'*. These channels to the chamber *k* being kept closed only at the given time for filling ignition-chambers, no air or gas can enter ignition-chambers while the engine is doing its work before filling a second time. The gas-burners m^3 are formed to burn two jets—one at each side—for communication with the separate chambers *l l'*, and these jets are so situated that if the flame of one is blown out by the charge rushing back the flame of the opposite side cannot be blown out, and the one extinguished will be relighted before the ignition-chamber at that side returns with a second charge to be fired.

The operation, in connection with the two cylinders, is as follows: The passage *i* in the slide of one cylinder being moved into connection with the passage *h'* of the cylinder and chamber *k* of the slide-cover, the combustible charge goes from the passage *k* to that end of the cylinder. At the same time the passage *l'* in the same slide is connected to the chamber *k*, as in Figs. 4 and 5, and is thereby charged with the combustible mixture from the chamber *k*. The piston, then moving forward, compresses the charge, and the slide moving back the opening *i* is brought opposite the passage *h* for filling the opposite end of the cylinder while the passage *l'* is being filled with the mixture from chamber *k*. At the same time the other end of the cylinder is filling with the gas and air from chamber *o* through passages *i h*, and chamber *l* is filling from chamber *k*. The piston is then moved back by the explosion of the first charge. During this latter movement the exhaust-valve *q* has been moved to connect the passage *h'* and the exhaust *p*, and the previously-fired charge is exhausted to the open air. During these operations of the slide in connection with one cylinder the other slide is being moved, but in the reverse direction, and the other cylinder being filled and the charge fired in the same manner, but not at the same time, as the arrangement is such that while the charge is firing in the end of one cylinder the opposite end of the same cylinder is being charged. At the same time in the other cylinder one end is working, while at the opposite end the products of combustion are being expelled, and the pistons are thus placed under pressure in alternate order, and each cylinder being double-acting there is a continuous pressure being exerted for rotating the main shaft C. The crank-shafts are so arranged that the pistons B B have completed their stroke while the slides D D have not quite completed their full stroke, as shown in Fig. 10, so that the piston moves slightly forward before the cylinder-charge is fired. This is for a purpose, as will be noticed. In the working of the slide one of the passages *l l'* comes over the passage *h h'* just as the last products of combustion are being expelled. In this arrangement of cranks the piston has completed its stroke and the products of combustion quite expelled, and the exhaust-valve *q* closes just before the chamber *l* comes over *h*, so that none of the products of combustion can enter *l*. Again, the fired charge has propelled the piston its full stroke before the passage *i'* comes over *h*. Should any of the products of combustion enter *i'*, they are thoroughly mixed with the second charge on entering the cylinder.

The devices for controlling the proportion of gas and air are shown in Fig. 2. o^2 o^2 are the gas-supply pipes, connecting with chambers *t t*, that open to the passage leading to the channels *o o'* in the slide-cover *c*, as above mentioned. *t'* is a rod fitted with a valve, t^2, for closing the opening between the pipe o^2 and chamber *t*, and also fitted with a valve, t^3, outside the chamber *t*, for closing an air-inlet in the said chamber. The valves are kept closed by a spring, *u*, and are opened at the proper time by means of a bent lever, *u'*, acting upon the end of the rod *t'* and operated upon by a cam, u^2. The cam u^2, as shown most clearly in Fig. 7, has projections *v*, *v'*, and v^2 extending from its surface u^3. There are two of these cams u^2 for each cylinder, carried by a sleeve upon the shaft *g*, that is capable of endwise movement on the shaft. To these sleeves of the cams is connected the arm *w* from an ordinary centrifugal governor, F, as shown most clearly in Fig. 8. In the operation of these parts the sleeve is positioned with its cam-surfaces u^3, *v*, *v'*, and v^2 with reference to the lever *u'*, according to the rise and fall of the governor-balls. The roller of the lever *u'* turning upon the cam u^2, the air and gas valves t^2 t^3 are opened sufficiently wide to let in a suitable quantity of the explosive mixture of gas and air for filling the cylinders. The gas and air, meeting at right angles, are thoroughly mixed in the chamber *t* before entering the cylinders. At this juncture the air-valve t^3 has been opened sufficiently wide to let in all the air that can be admitted between the cham-

ber *t* and the cup, which are placed in such positions to each other as to let in sufficient air for forming the mixture of sufficient strength for forming the combustible charge for filling the cylinders, when by the action of the projections *v v' v²*, controlled by the governor, the valve t^2 is opened to a greater extent to let in a greater proportion of gas than was admitted to the cylinder, while the air-valve t^3 enters a cup suitably arranged to receive it, thus admitting a greater proportion of gas than air, making a stronger charge of the mixture for filling the passages *h h h' h'* and the concave ends of the cylinders. This stronger charge, being fired, is projected with some force into the cylinders, thus causing a more complete ignition of the cylinder-charge. When one end of the cylinder has been filled by action of the cam w^4, Fig. 7, and the piston is moving forward to compress the charge, the opposite end of the cylinder is filled by action of the second cam, w^2. Should the engine be running beyond its normal speed, the governor-balls rise, and, carrying with them the cams w^2 w^4, throw the roller of the lever *w'* on one of the lower steps, *v v'*, thus causing the valve t^2 to open wider, thereby diminishing the strength of the charge and lessening the speed of the engine. The rounded or concave heads *a* of the cylinders serve the purpose of insuring a more complete combustion of the charge in the cylinder, and also insuring the products of combustion left from a previous explosion becoming intimately mixed with the fresh charge entering the cylinder. When less power is required the supply of gas and air may be cut off from one cylinder; or should the cylinder become overheated, as is frequently the case in gas-engines, the gas-supply may be cut off from one cylinder while air is still admitted for cooling, and this being done with the cylinders alternately they will be cooled without stopping the engine.

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

1. The combination, with the cylinders having passages *h h'*, of the slides D, each having a passage, *i*, with two lateral outlets, *i' i²*, and fire-passages *l l'*, and the cover *e*, having U-shaped passage *o*, connecting with chamber *t*, whereby the mixture of gas and air may be supplied, as described.

2. The combination, with the gas-chamber *c'* and the air-chamber c^2, of the passages l^2 l^5, chamber *k*, ignition-chambers *l l'*, valves t^2 t^3, and cam w^2, the latter having suitable connections with said valves, as and for the purpose specified.

3. In gas-engines, the combination, with a cylinder, of a slide formed with firing-passages *l l'*, the slide-cover *e*, formed with two passages, *m m'*, and the separate gas-burners m^3, substantially as shown and described.

4. In gas-engines, the combination, with the cylinder and the two slides D D, formed with firing-passages *l l'*, and slide-cover *e*, formed with passages *m m'*, of the gas-burner m^3, formed to burn-jets at opposite sides for connection with the firing-passages of the separate slides, substantially as shown and described.

5. In gas-engines, the combination, with the gas-supply pipe l^2, of the chamber *t*, valves t^2 t^3, and rod *t'*, the lever *w'*, cam w^2, and centrifugal governor F, substantially as described, for operation as set forth.

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Witnesses:
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T. H. R. CHRISTIE.