No. 863,734. PATENTED AUG. 20, 1907.

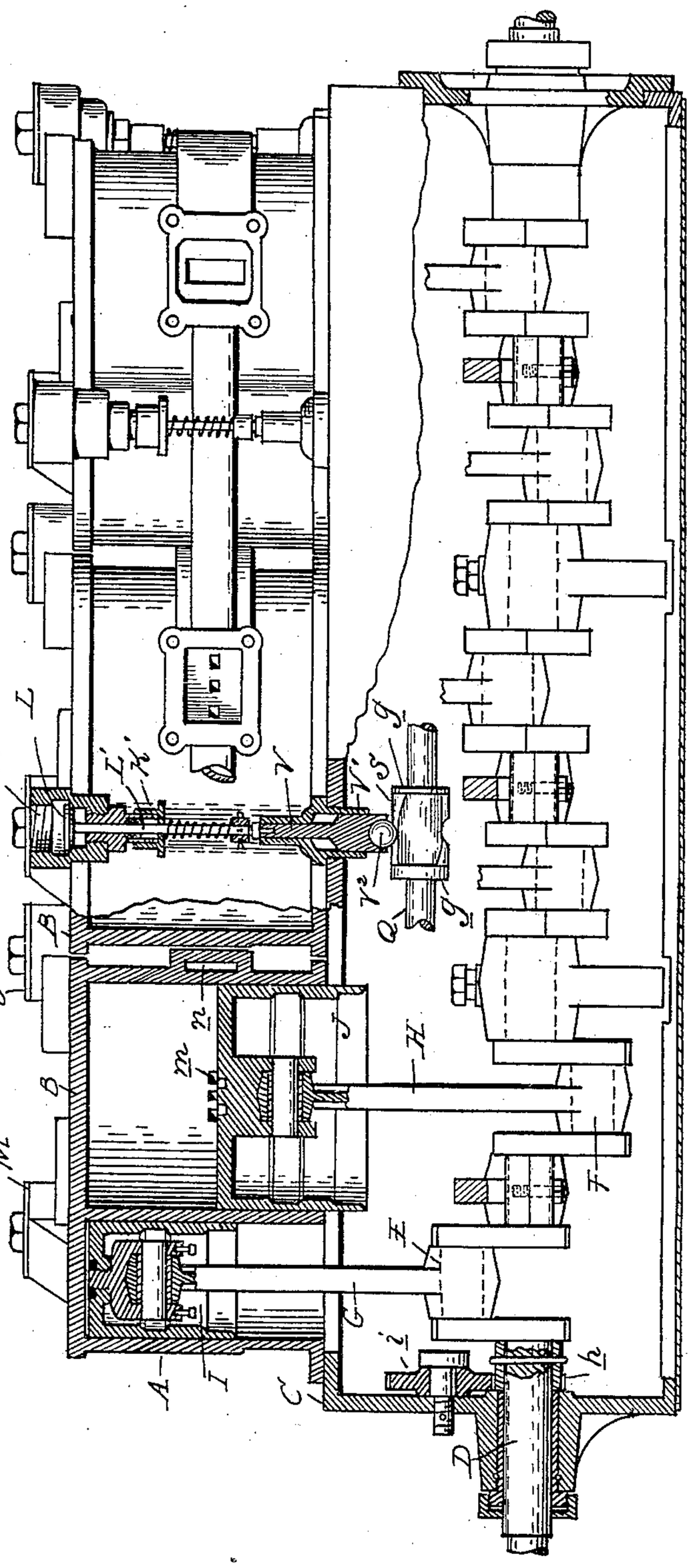
J. D. MacLACHLAN.

STEAM ENGINE.

APPLICATION FILED FEB. 10, 1906.

3 SHEETS—SHEET 1.

Fig. 1.



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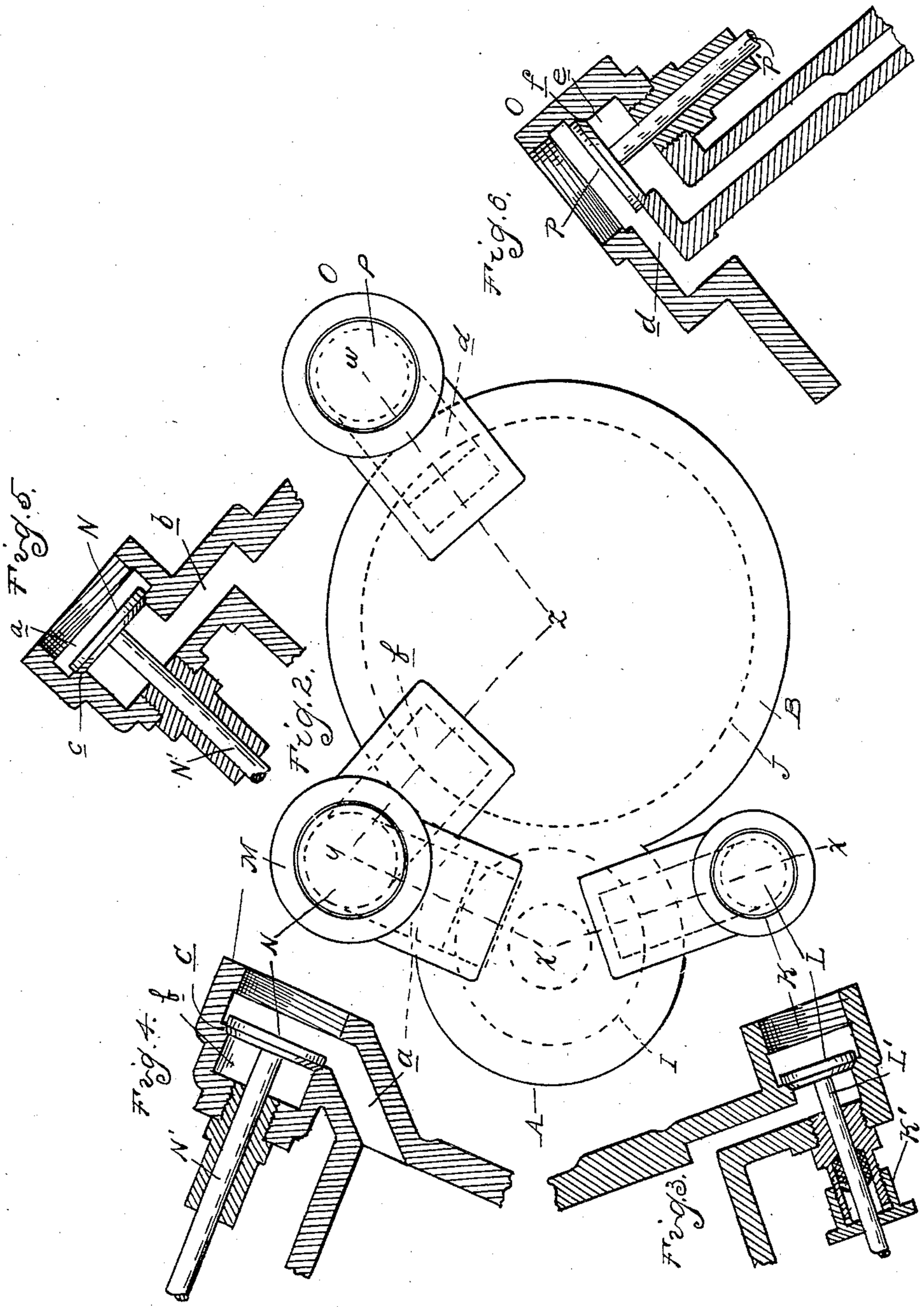

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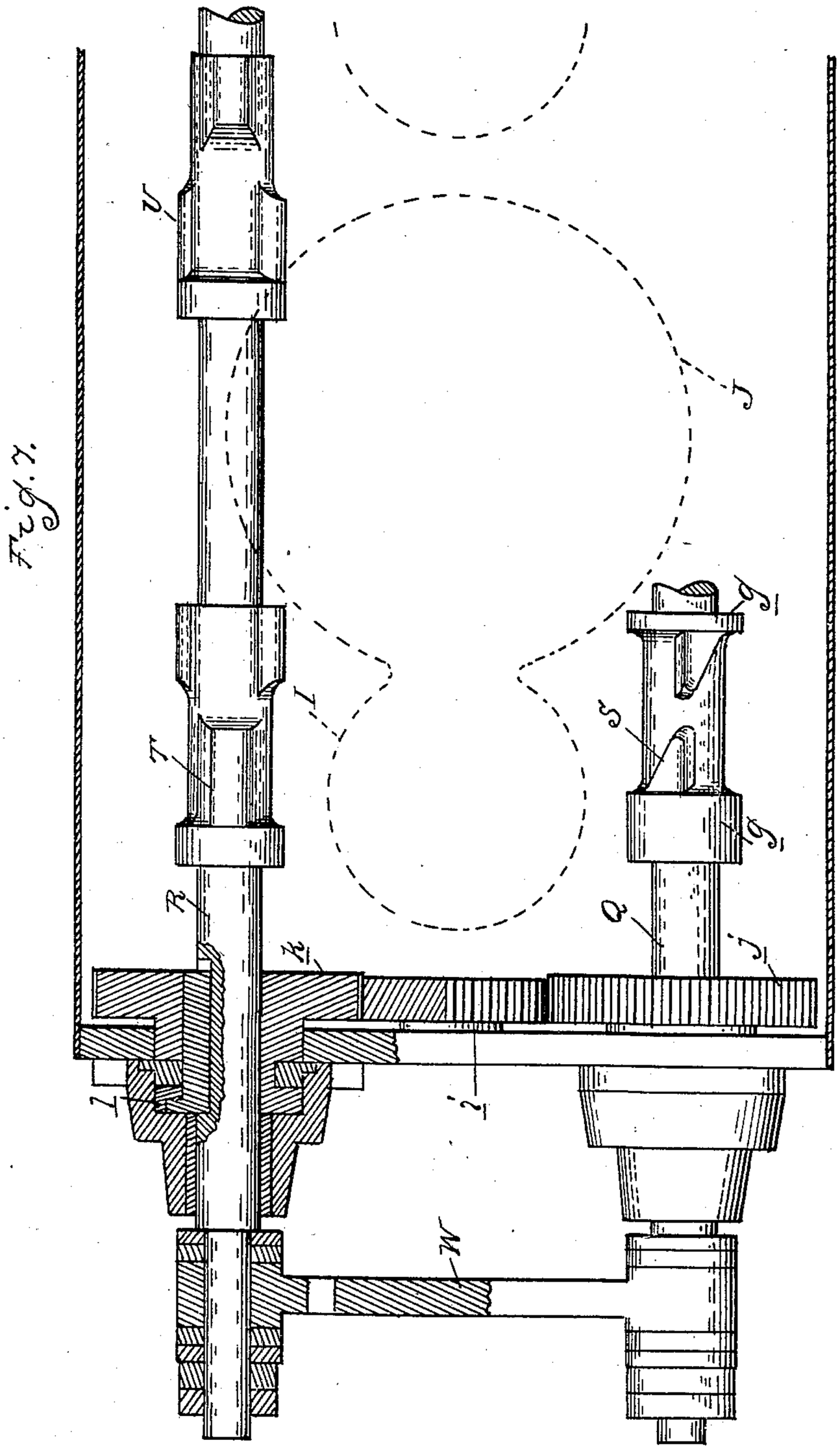

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UNITED STATES PATENT OFFICE.

JOHN D. MacLACHLAN, OF DETROIT, MICHIGAN, ASSIGNOR TO DETROIT STEAM ENGINE COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

STEAM-ENGINE.

No. 863,734. Specification of Letters Patent. Patented Aug. 20, 1907.

Application filed February 10, 1906. Serial No. 300,443.

To all whom it may concern:

Be it known that I, JOHN D. MacLACHLAN, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention relates to steam engines and is more particularly designed for use in connection with motor vehicles and in other places where it is desirable to have a wide range of adjustment, both as to speed and power.

The invention consists in the peculiar construction as hereinafter set forth.

In the drawings, Figure 1 is a longitudinal section broken away into various planes to illustrate the different parts of the machine; Fig. 2 is a plan view of one of the cylinders of the engine; Figs. 3, 4, 5 and 6 are sections respectively on the section lines *x*—*x*, *x*—*y*, *y*—*z* and *z*—*w* of Fig. 2, the said sections being drawn in projection with their respective section lines; Fig. 7 is a plan illustrating the adjustable cams controlling the valves.

The engine may be of the compound type comprising cylinders of different sizes, the steam from the smaller cylinder being expanded into the larger, but means is also provided for admitting the high-pressure steam through the smaller cylinder to the large cylinder, when greater power is needed. The engine is further provided with controlling means by which the point of cut-off may be varied, and the arrangement is preferably such that by the movement of a single lever or controlling device, the cut-off may be varied in length until steam is admitted throughout the entire working stroke of the piston in the small cylinder, while a further movement will cause the admission of a high-pressure steam into the small cylinder from whence it enters the large cylinder, thereby progressively increasing the power of the engine.

As shown, A is the small or high-pressure cylinder and B is the large or low-pressure cylinder, being preferably cast integral.

C is a crank case to which the cylinders A and B are secured, and D is the crank shaft provided with the diametrically-opposite cranks E and F connected by the rods G and H with the pistons I and J of the cylinders A and B. Thus, the pistons I and J move oppositely in the cylinders A and B. The steam for driving said pistons is admitted to the cylinders at one end only and is controlled by valve-controlled passages arranged as follows:

K is the steam admission passage for the small or high-pressure cylinder, preferably formed in a nipple cast integral with the cylinders.

L is a valve seated within the passage K having the downwardly-extending valve stem L′ which passes out through the stuffing box K′.

M is a ported lug preferably cast integral with the cylinders and having formed therein the passage *a* leading to the high-pressure cylinder and the passage *b* leading to the low-pressure cylinder. Between these passages *a* and *b* is a valve-seat *c* for the valve N. This valve, when seated, cuts off communication between the two cylinders and is operated by a depending stem N′. O is another ported lug preferably formed integral with the cylinder B and containing the passage *d* which communicates with said cylinder and the passage *e* which leads to an exhaust connection. Between these passages is the valve-seat *f* for the valve P, which also is provided with a depending stem P′.

The valves L, N and P are operated by adjustable means, as for instance, the cams which are preferably arranged on two cam shafts Q and R on opposite sides of the crank shaft. Upon the shaft Q are mounted the cams S for operating the valves L and upon the shaft R the cams T and U for respectively operating the valves N and P. These cams, as illustrated in Fig. 7, are so formed as to vertically reciprocate the stems of the various valves, each of which is preferably provided with an extension V sliding in a guide V′ and provided at its lower end with a rounded hardened bearing V^2.

Each cam is provided with two oppositely arranged portions between which is a neutral point which will communicate no movement to the valve stems. To throw either of the cam portions into action, the shafts Q and R are moved longitudinally, and to this end, the said shafts are preferably cross-connected by a yoke-sleeve W which is operated by any suitable controlling connection (not shown). The cam S is provided at its opposite ends with annular portions *g* which are adapted, when in registration with the valve stem L′, to hold the valve L continuously open.

The valve shafts Q and R are driven by suitable gear trains connecting with the crank shaft of the engine which, as illustrated, comprise the gear *h* upon the crank shaft, meshing with a gear wheel *i* which is intermediate the gears *j* and *k*, respectively on the shafts Q and R. To permit of the longitudinal adjust-

ment of the shafts Q and R, the gear wheels *j* and *k* are feathered thereon and are held from displacement during the movement of the shafts by collars *l*.

With the parts constructed as described, in operation steam is admitted to the nipple K, and whenever the valve L is open, will enter the upper end of the cylinder A, causing the downward movement of the piston I and the turning of the crank. This, through the gear connection described, will rotate the shaft Q and the cam S thereon which will close the valve at various points in the stroke of the piston according to the longitudinal adjustment of the shaft Q. Thus, if the shaft is so adjusted as to register the central portion of the cam with the valve stem, the valve L will remain closed constantly, but an adjustment of the shaft in either direction from this neutral point will cause the opening and closing of the valve, the period between varying with the adjustment until a point is reached where the valve remains open during the entire stroke.

Upon the completion of the down stroke of the piston I, the cam T upon the shaft R will operate to open the valve N which will permit the steam in the cylinder A to pass into the cylinder B. The piston J in this cylinder will be at the upper end thereof and, as the steam is admitted, will be driven downward, the steam expanding in the larger cylinder while at the same time the movement of the crank shaft will return the piston I in the small cylinder. Upon the completion of the down stroke of the piston J, the steam in the cylinder B is exhausted, preferably through direct exhaust ports *m* which are uncovered by the final movement of the piston and which communicate with the annular exhaust channel *n* surrounding the cylinder B. In the meantime, the cam S is turned to again open the valve L, admitting the high-pressure steam to the cylinder A, which again drives downward the piston I and during the return stroke of the piston J, the exhaust valve P is opened by the cam U to permit of the expulsion of the remaining steam in the cylinder B.

It will be understood from the description above given that the quantity of high pressure steam admitted to the cylinder A and expanded therein and subsequently in the cylinder B is determined by the adjustment of the cam shafts Q and R. Thus, by limiting the volume of steam so admitted, it may be expanded until atmospheric pressure is reached. On the other hand, if power rather than efficiency is desired, by adjusting the cam shafts the cut-off may be lengthened until steam is admitted during the entire working stroke of the piston I. If still greater power is required, by further adjustment of the cam shafts the cam S will register its annular portion *g* with the valve stem, with the result that the valve L will be held open after the completion of the down stroke of the piston I and during its return stroke. This will result in admitting steam at high pressure into the cylinder B by way of the cylinder A and the large area of the piston J is thereby operated upon by a high-pressure steam.

It is to be noted that when the adjustment last described is made, the steam in the cylinder A is operated against the piston I during its return stroke. This will diminish the power, but inasmuch as the piston J is very much larger than the piston I, the resistance of the latter is overcome. In the opposite stroke, the steam in the cylinder A will be effective in driving the engine, and the total effect, therefore, is the power which would be generated by the piston J in the cylinder B alone, the other cylinder being cut out of action.

In order to maintain the balance of the engine, I preferably construct the same with a plurality of pairs of cylinders A and B and, as shown, three pairs are used, the cranks of which are equidistant from each other and distributed around the crank shaft.

What I claim as my invention is:—

1. An engine comprising two cylinders connected in compound for the successive utilization of a volume of steam and a variable cut-off for the first cylinder adapted to extend the period of steam-admission thereto into that of the second cylinder, whereby the steam in said cylinders may be variously expanded or used at a maximum pressure.

2. In a compound single-acting engine, the combination of a valve controlling the admission of steam to the high pressure cylinder, means for holding said valve open continuously for constantly admitting live steam to the high pressure cylinder, and a valve for intermittently admitting live steam to the low pressure cylinder from the high pressure cylinder.

3. In a compound single-acting engine, the combination of a valve controlling the admission of steam to the high pressure cylinder, means adjustable relative to the inlet valve for operating the same, such means adapted when at one point of its adjustment to hold the valve open continuously for constantly admitting live steam to the high pressure cylinder and means for intermittently admitting live steam to the low pressure cylinder directly from the high pressure cylinder.

4. A compound single-acting piston engine comprising high and low pressure cylinders, means for admitting live steam to the high pressure cylinder, a second means for admitting steam from the high pressure to the low pressure cylinder, adjustable mechanisms for controlling the admission of steam to the high and low pressure cylinders, one of said mechanisms capable of an adjustment to cause the admission of a continuous supply of live steam to the high pressure cylinder.

5. In a compound single-acting piston engine, the combination with communicating high and low pressure cylinders, of a valve controlling such communication, means for intermittently actuating the valve, a suitable inlet to the high pressure cylinder, a valve controlling the inlet, an adjustable cam for operating the valve, the cam provided with a continuous annular portion adapted to hold the valve open continuously to admit a constant flow of live steam into the high pressure cylinder.

6. In a compound single-acting piston engine, the combination with communicating high and low pressure cylinders, of a valve controlling the communication between the cylinders, means operated from the crank shaft for intermittently actuating the valve, the high pressure cylinder provided with a steam inlet, a second valve controlling such inlet, means adjustable relative to the inlet valve for operating the same, such means capable at one point in its adjustment of retaining the inlet valve open throughout the length of one or more strokes of the engine to admit a continuous supply of live steam to the high pressure cylinder.

7. In a compound single-acting piston engine, an inlet valve controlling the admission of steam to the high pressure cylinder, a low pressure cylinder in communication with the high pressure cylinder, an intermittently actuated valve controlling the admission of steam from the high to the low pressure cylinder, a valve actuating cam for the inlet valve, the cam capable of longitudinal ad-

justment, and an annular disk at one end of the cam, adapted when in engagement with the valve stem to hold the inlet valve continuously open to admit a continuous supply of live steam to the high pressure cylinder.

8. In a compound single-acting piston engine, an inlet valve controlling the admission of steam to the high pressure cylinder, a low pressure cylinder in communication with the high pressure cylinder, an intermittently actuated valve controlling the admission of steam from the high to the low pressure cylinder, a valve actuating cam for the inlet valve, the cam capable of longitudinal adjustment, and an annular portion at each end of the cam, each of said annular portions adapted when in registration with the valve stem to hold the valve continuously open.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN D. MacLACHLAN.

Witnesses:
JAMES P. BARRY,
AMELIA WILLIAMS.