

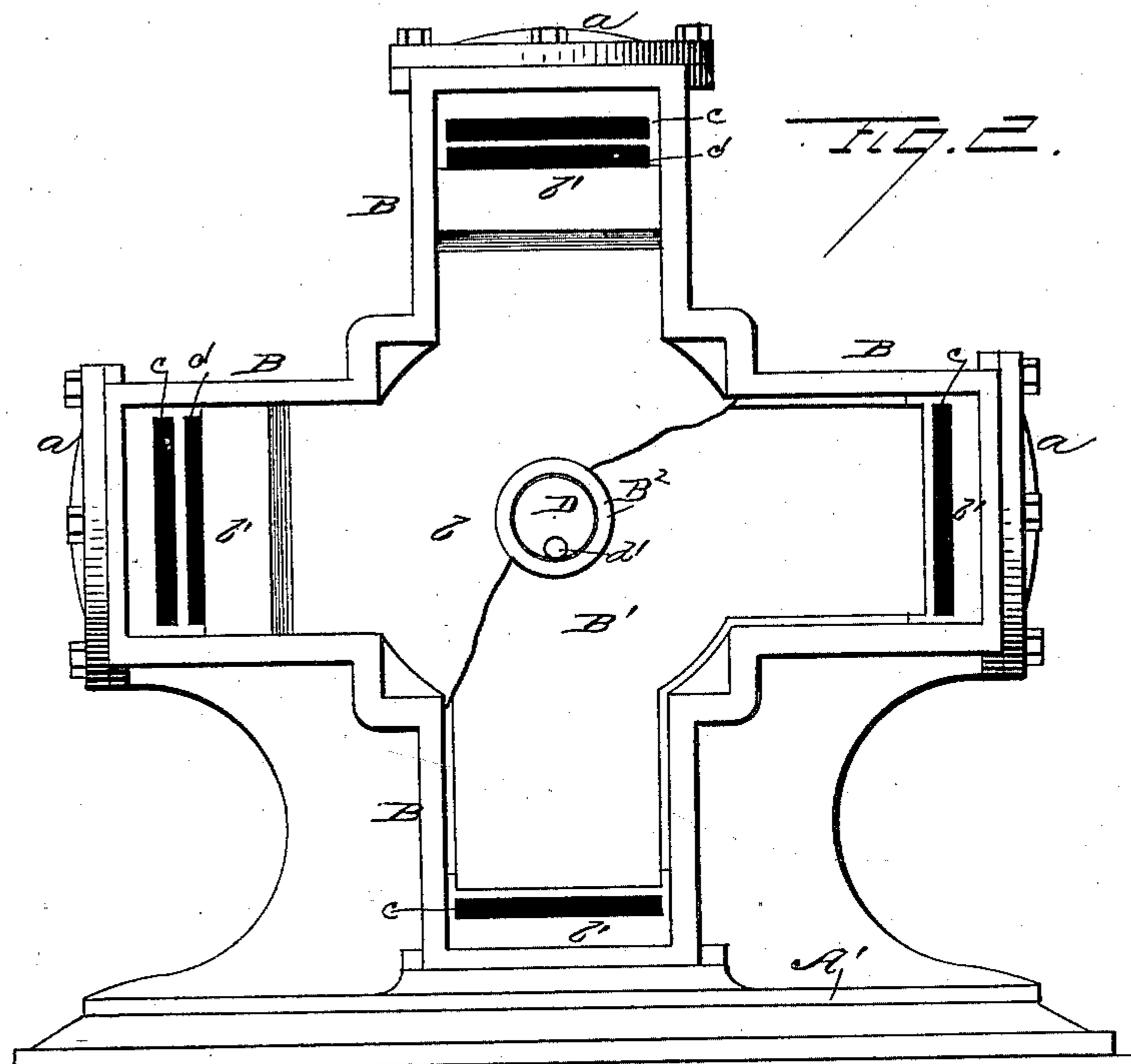
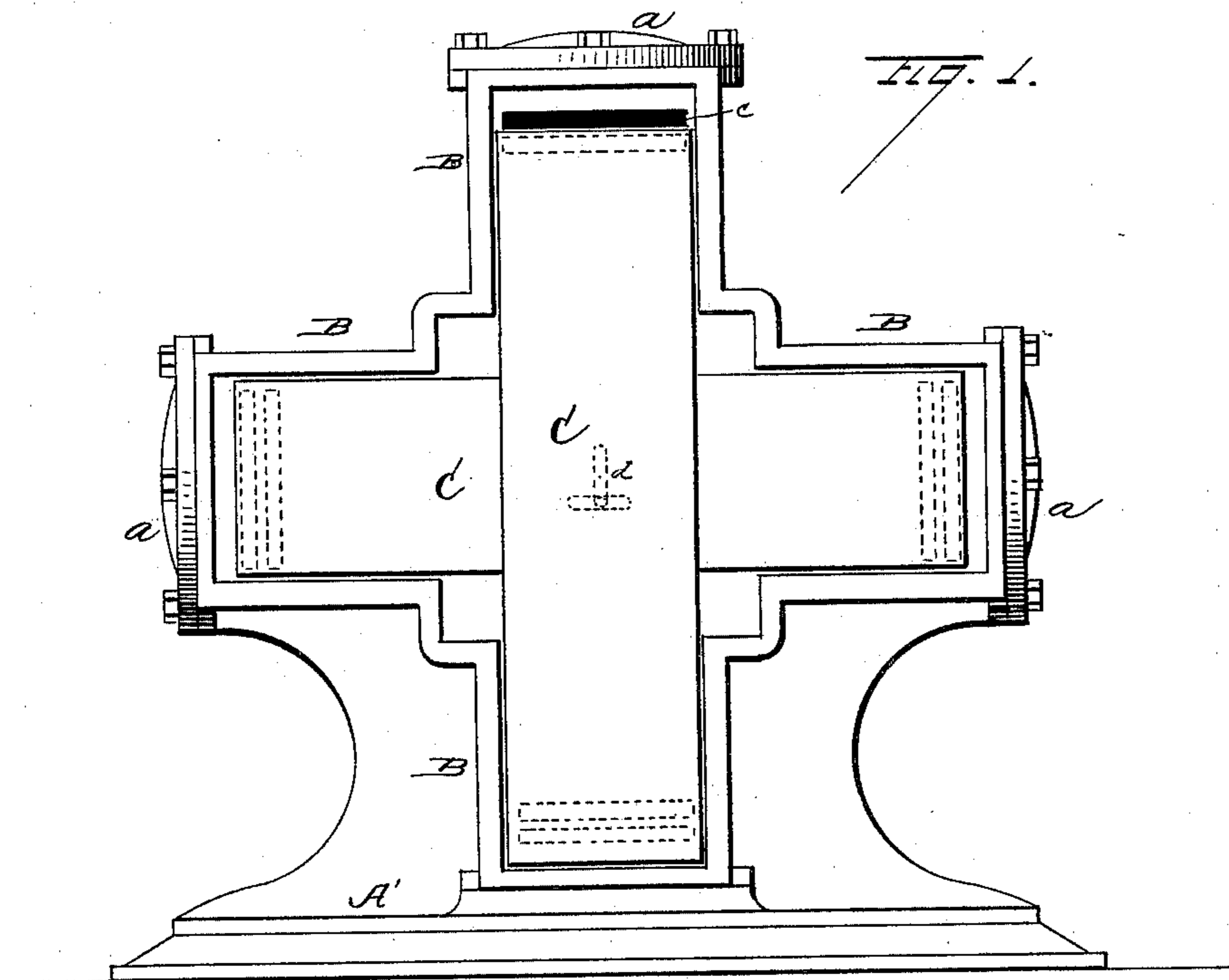
(No Model.)

2 Sheets—Sheet 1.

D. D. HARDY.
MULTIPLE CYLINDER ENGINE.

No. 313,730.

Patented Mar. 10, 1885.



WITNESSES:

H. C. Smith
A. Pare

INVENTOR.

D. D. Hardy

per

H. Harrison
ATTORNEY.

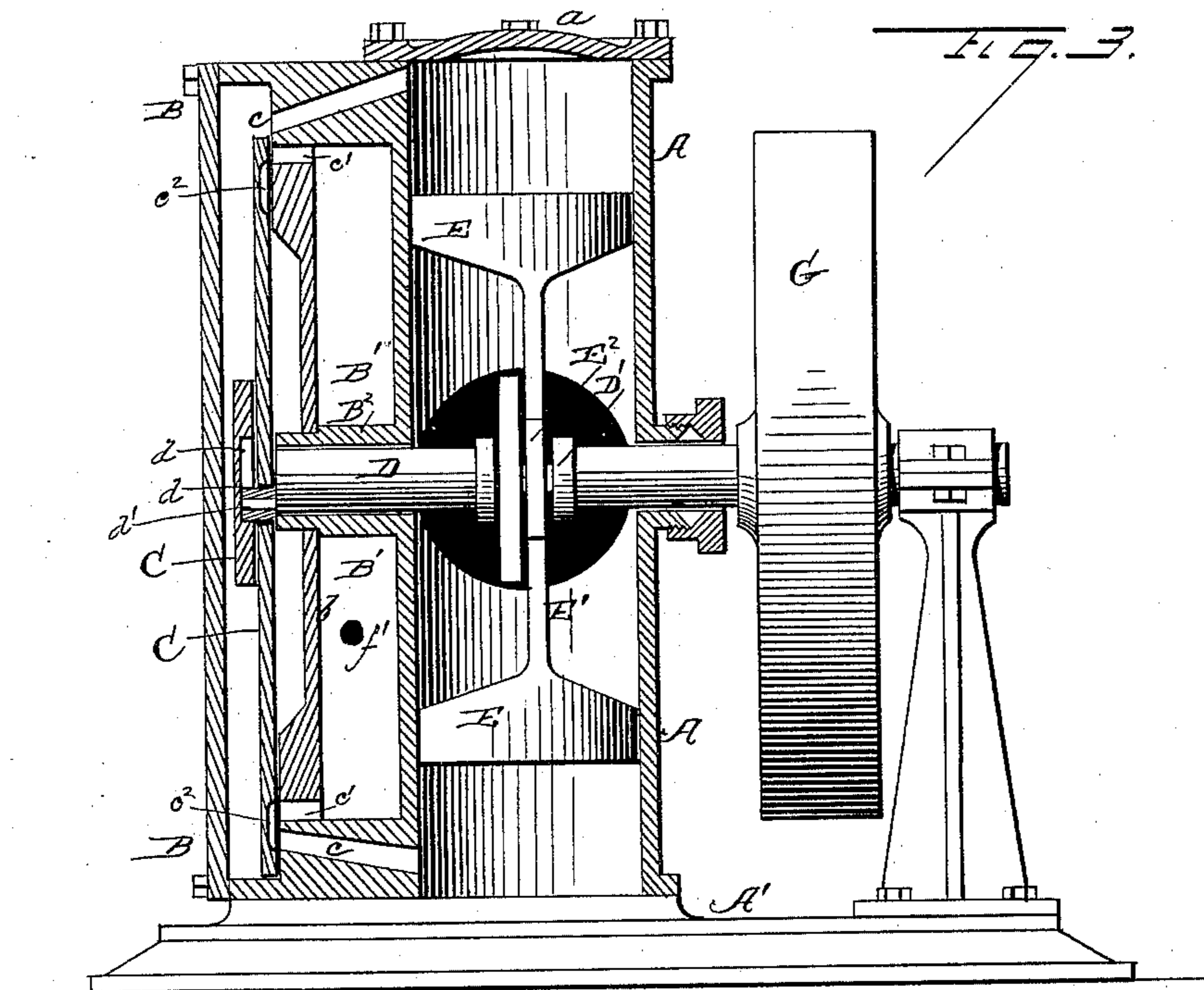
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H. L. M. & Arthur

A. Pare

INVENTOR.
Lester D. Hardy
per *H. Harrison*
ATTORNEY.

UNITED STATES PATENT OFFICE.

DEXTER D. HARDY, OF CHICAGO, ILLINOIS.

MULTIPLE-CYLINDER ENGINE.

SPECIFICATION forming part of Letters Patent No. 313,730, dated March 10, 1885.

Application filed August 21, 1884. (No model)

To all whom it may concern:

Be it known that I, DEXTER D. HARDY, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Multiple-Cylinder Engines, of which the following is a specification; to wit:

This invention relates to an improvement in steam-engines; and it consists in certain novel points of the construction and arrangement of the valves of that class of engines commonly known as "four-cylinder" engines, substantially as will be hereinafter more fully set forth and claimed.

In order to enable others skilled in the art to which my invention appertains to make and use the same, I will now proceed to describe its construction and operation, referring to the accompanying drawings, in which—

Figure 1 is an end elevation of the engine with the face of the steam-chests removed to show the valves. Fig. 2 is a similar view with the valves removed and part of the division-wall broken away to show the exhaust-chamber. Fig. 3 is a longitudinal vertical section of the engine, and Fig. 4 is a side elevation of the same.

A represents the cylinders of my engine, which are four in number, arranged as herein shown, and cast with or supported upon a suitable base, A'. The cylinders are all cast together in the form of a cross, thus +, and are covered by suitable caps, a, in the manner usual in steam-engines. Each cylinder is cast with or has secured to it a steam-chest, B, the four chests also being preferably formed in one piece in order that they may always align and give free action to the valves. The chests are cut away at their centers to form a chamber, B', which receives the exhaust from each cylinder, and this chamber is divided from the outer portion of the chests by a plate or partition, b. Each chest B has at its outer end the usual flat valve-seat, b', connected with its steam-cylinder by an inlet-port, c, and with the exhaust-chamber by an outlet-port, c', as shown in the drawings.

I use in the steam-chests two slide-valves, C C, lying one upon the other at right angles, and formed at each end, as usual in slide-valves, with a cored recess, c², to connect the supply and exhaust ports c c' at proper times

in the stroke of the valves. The longitudinal center of each valve is formed with a transverse slot, d, as in Figs. 1 and 3, in which moves a wrist-pin, d', upon the end of the driving-shaft D, to give motion to the valves. Each steam-cylinder opens at its inner end into a central chamber, and each is provided with a piston-head, E, connected by a rod, E', with a yoke, E², upon a cranked portion, D', of the shaft in said central chamber, as shown in Fig. 3. The driving-shaft passes through the center of the engine, and its inner end is journaled in a hollow tube or bearing, B², which passes entirely through the exhaust-chamber B', and the end of the shaft is covered by the under slide-valve. This prevents any steam from either the outer portion of the steam-chest or its inner exhaust-chamber from being admitted to the shaft or the central portion of the engine behind the pistons, which would interfere with its perfect lubrication. This result is insured by the fact that the slot d in the outer valve does not pass entirely through it, as in Fig. 3, and thus covers and protects the wrist-pin. The outer end of the shaft is supported in a bearing of the main frame, and carries a belt-wheel, G, or other means of giving motion to machinery. The steam-chests B are provided with supply-pipes f, and a single exhaust-pipe, f', connects with the chamber B'.

The action of this engine is obvious. Steam being turned on enters one of the cylinders and forces its piston down, the motion being communicated by the rod and yoke to the driving-shaft, as will be obvious. By reference to Fig. 1 it will be noted that only one of the inlet-ports is open at any given time. In this figure this port in the upper cylinder is open and the exhaust closed while the opposite end of the valve is making connection with the two ports of the lower cylinder for exhausting it. The other valve, as will be noted, is at a moment of rest covering the supply and exhaust ports of both the horizontal cylinders. The continuous action of the upper piston-head drives around the crank, and the wrist-pin beginning to lift closes the upper supply, and cuts off the steam to this cylinder at about one-half the stroke, thus allowing for the use of the expansion of the vapor to the best advantage. The crank having

now just passed the center line of the horizontal cylinders, the wrist-pin moves the second valve to open the supply and exhaust of the other pair of cylinders, and the shaft is thus
5 subjected to the continuous action of live steam in one cylinder and expanding steam in a second, gaining great power and an even action with the greatest economy of steam. The machines so constructed has no dead-points,
10 and the point of cutting off for expansion can be made to suit the work to be performed by varying in making it the relative positions of the supply-ports and the relation of the crank and wrist-pin, together with the sweep of the
15 latter in its revolutions, while the small number of parts and their extreme simplicity make the operation positive and the expense of construction and repairs small.

The engine may be reversed by simply admitting steam to the exhaust-chamber and exhausting it through the supply-pipes in exactly the opposite direction from that already described, and it will be evident that it is applicable to all uses requiring high speed, even-
25 ness of action, direct connections, and economy of space.

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

1. In a multi-cylinder engine, a series of 30 valves lying one across the other and formed with transverse slots at their centers, in combination with the main shaft having a crank-pin working in said slots, substantially as and for the purpose set forth.

2. The radiating cylinders A, having steam-chests B, formed with an exhaust-chamber, B', having a journal, B², passing through it, in combination with the cranked shaft D, passing through the axial centers of the cylinders and 40 the journal B², and provided with the crank-pin *d'* upon its end, and the valves C, each formed with a transverse slot, *d*, at its center, the outer of which does not pass entirely through the valves, substantially as and for the 45 purpose set forth.

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

DEXTER D. HARDY.

Witnesses:

W. C. MCARTHUR,
CHAS. KRESSMANN.