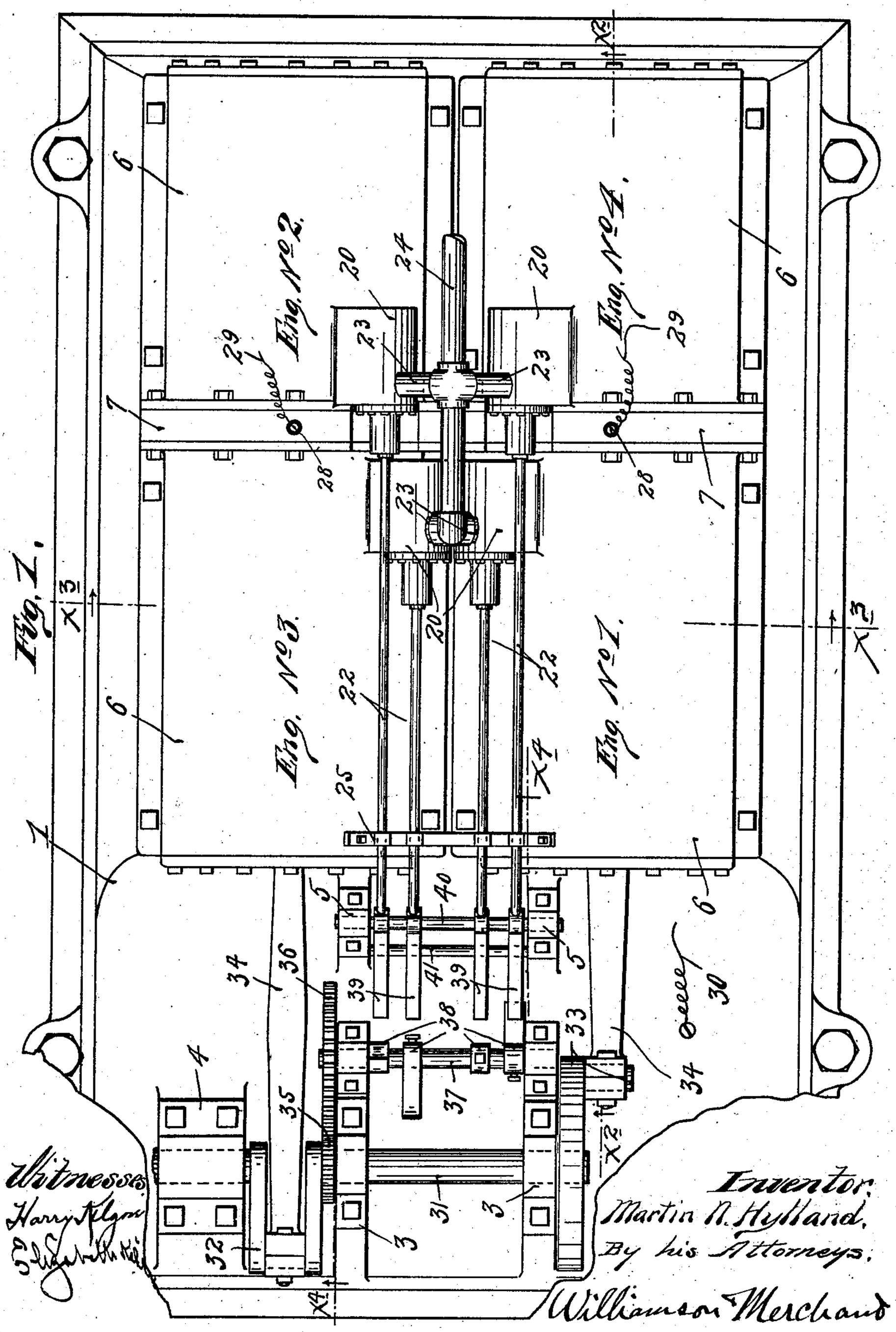
No. 698,285. Patented Apr. 22, 1902.

M. N. HYLLAND.

EXPLOSIVE ENGINE.

(Application filed May 18, 1901.)

(No Model.) 3 Sheets—Sheet 1.



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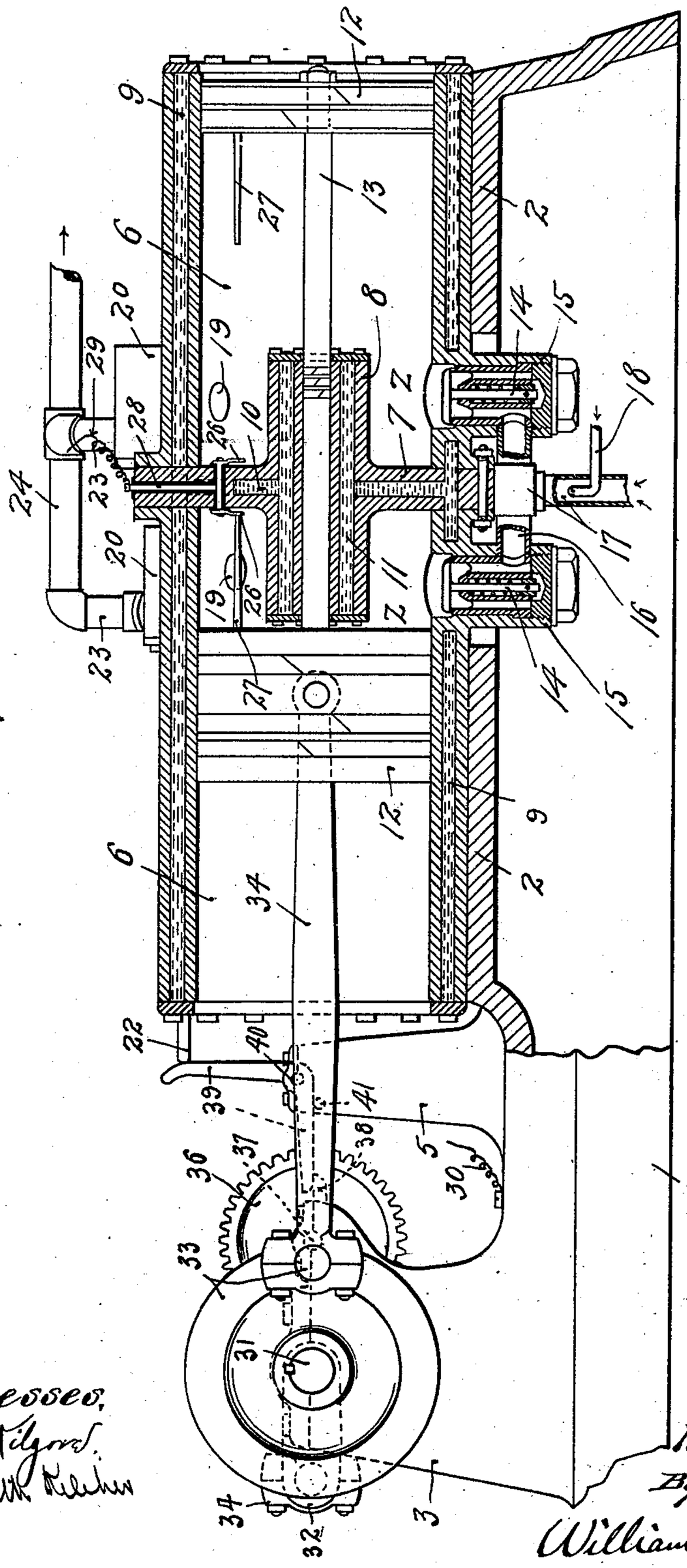

Fig. 2.

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Fig. 3.

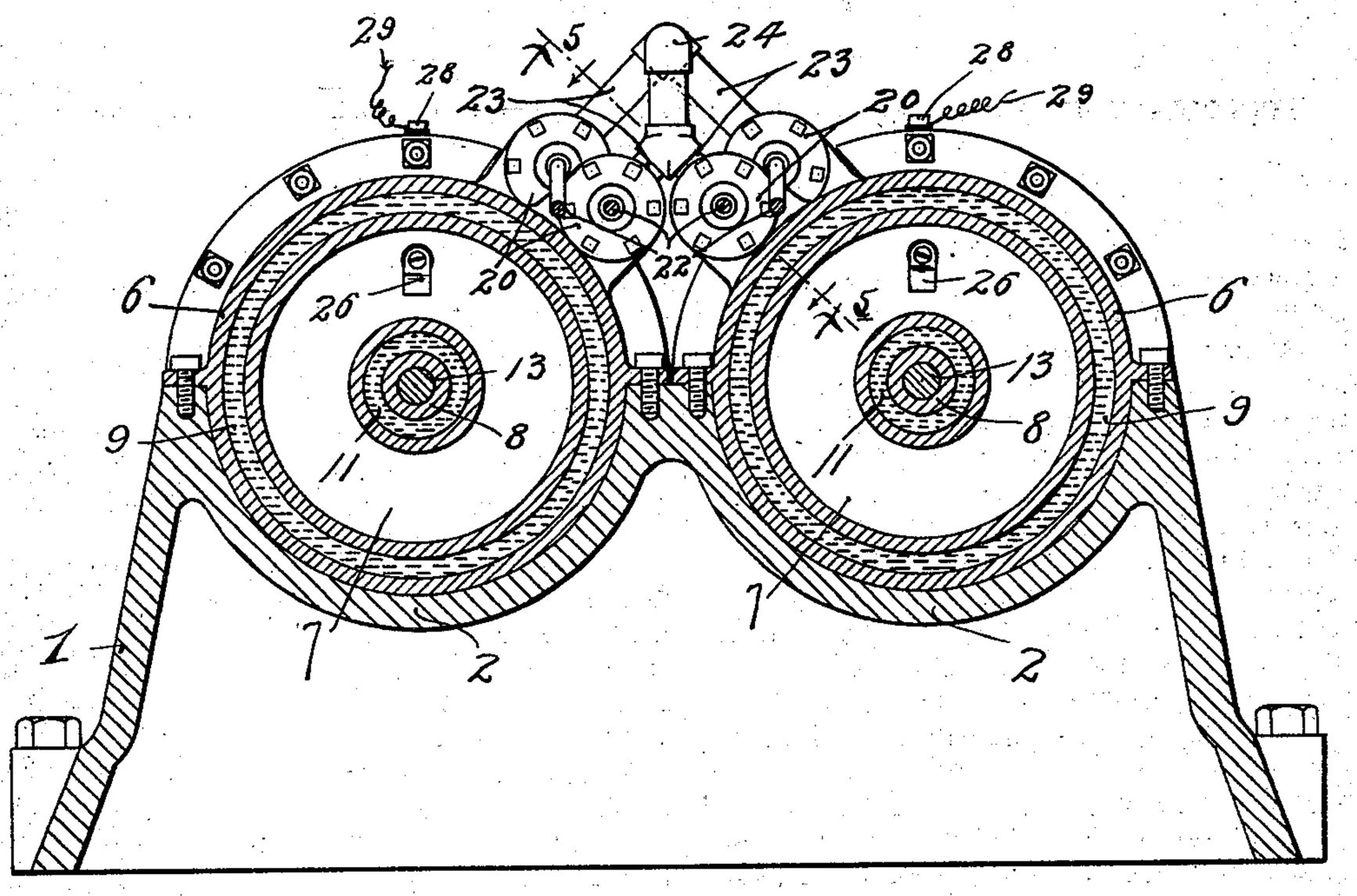


Fig. 4.

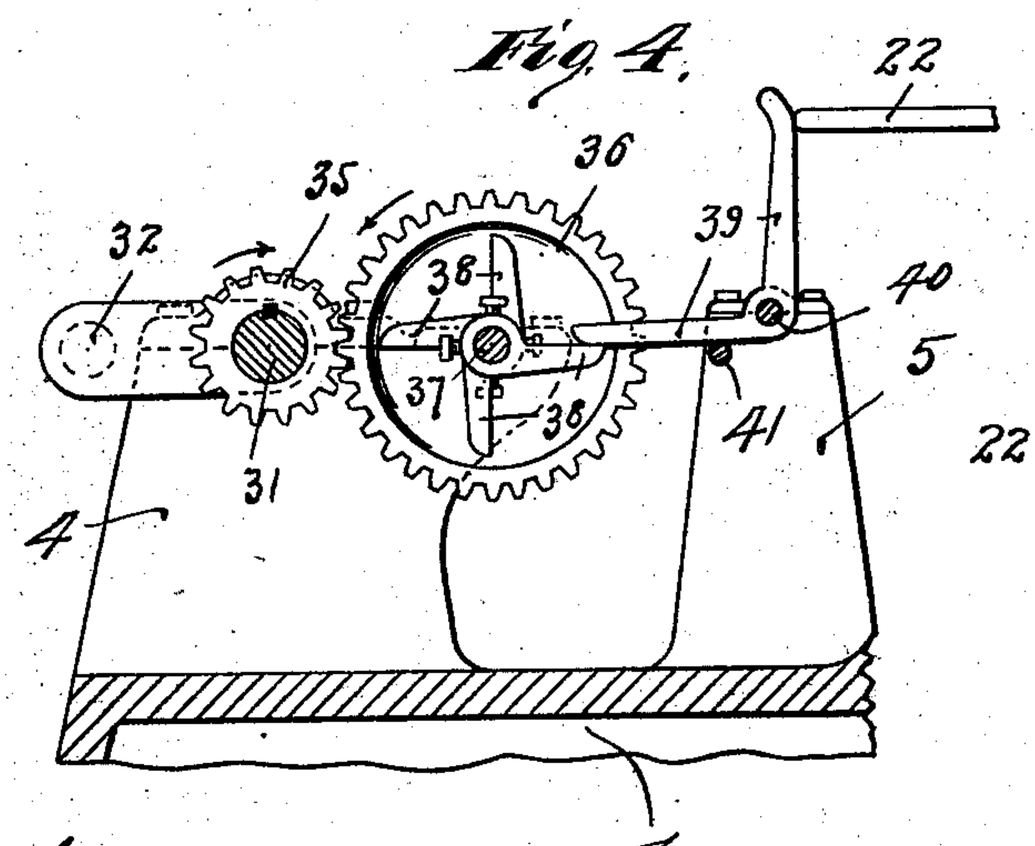
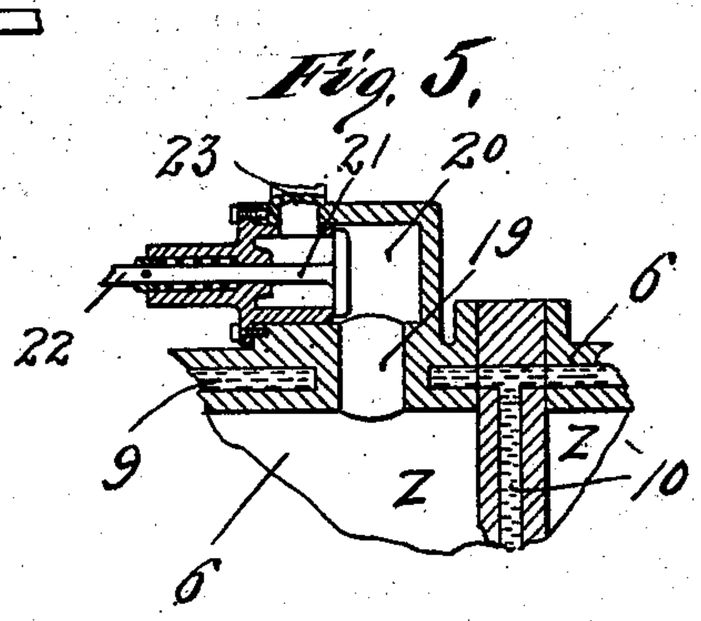


Fig. 5.



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UNITED STATES PATENT OFFICE.

MARTIN N. HYLLAND, OF FEDORA, SOUTH DAKOTA.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 698,285, dated April 22, 1902.

Application filed May 18, 1901. Serial No. 60,804. (No model.)

To all whom it may concern:

Be it known that I, MARTIN N. HYLLAND, a citizen of the United States, residing at Fedora, in the county of Miner and State of South Dakota, have invented certain new and useful Improvements in Explosive-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to explosive-engines, and has for its object to improve the same with a view to obtaining a maximum efficiency and of reducing to a minimum the size of the fly-wheel required.

To the above ends my invention consists of the novel devices and combinations of devices hereinafter described, and defined in the claim.

The invention is illustrated in the accompanying drawings, wherein like characters indicate like parts throughout the several views.

Figure 1 is a plan view with some parts broken away, illustrating a multicylinder engine designed in accordance with my invention. Fig. 2 is a longitudinal vertical section taken on the line x^2 x^2 of Fig. 1. Fig. 3 is a transverse vertical section taken approximately on the line x^4 x^4 of Fig. 1. Fig. 4 is a section on line x^4 x^4, Fig. 1; and Fig. 5 is a detail in section on the line x^5 x^5 of Fig. 3.

The numeral 1 indicates the bed-casting, shown as having cylinder-seats 2 and bearing-pedestals 3, 4, and 5. Four cylinders 6, located in axially-alined pairs, each pair constituting a so-called "tandem" cylinder, are rigidly secured in the seats 2 of the base-casting 1. At their outer ends cylinders 6 are open and the axially-alined cylinders are rigidly secured to abutments or dividing-heads 7, formed with the piston-rod bearings 8. The cylinders 6, abutments 7, and bearings 8 are provided, respectively, with water-jacketing chambers 9, 10, and 11. The circulating connections for said chambers 9, 10, and 11 are not shown. Working within each tandem cylinder, with one cylinder-head located on each side of the abutment 7, is a tandem piston 12, the head of which is rigidly connected by a piston-rod 13, that works through the bearings 8. Opening into each explosion-chamber *z* thus formed within the cylinders adjacent to the abutments 7 is a spring-seated intake-valve 14, suitably mounted in the sleeve-like extension 15 of the corresponding cylinder. The sleeve-like seats 15, as shown, are connected by short branch pipes 16 with a common air-supply pipe 17, into which the oil-supply pipe 18 opens. The air and oil are commingled and introduced into the explosion-chambers of the cylinders in the ordinary manner. Exhaust-ports 19 open from the explosion-chambers *z* of these cylinders through the valve-boxes 20, the passages in which are normally closed by spring and pressure seated exhaust-valves 21, having long projecting stems 22. As shown, the said valve-boxes 20, outward of the exhaust-valves 21, are connected through branch pipes 23 with a common exhaust-pipe 24. The exhaust-valve stems 22 project toward the left with respect to Figs. 1 and 2 and work loosely through a guide-plate 25, fixed on the adjacent cylinders. Also within the explosion-chamber *z* of each cylinder is an insulated electrode 24, which coöperates with a movable electrode 27 in the form of a metal finger carried by the corresponding piston-head, as best shown in Fig. 2. As shown, the several insulated electrodes 26 are connected by insulated metal stems 28 to a lead-wire 29. The other lead-wire may be connected to any suitable portion of the engine—as, for instance, to the bed-plate 1, as indicated at 30 in Fig. 2.

The crank-shaft 31 of the engine is suitably journaled in the bearing-pedestals 3 and 4. This shaft is provided with a pair of cranks 32 and 33, the latter of which, as shown, is in the form of a disk and serves as a small fly-wheel. The said cranks project in diametrically opposite directions and are connected by crank-rods 34, one to each of the tandem pistons 12, as best shown in Fig. 2.

35 indicates a pinion on the crank-shaft 31, which meshes with a gear 36 of twice its diameter carried by a shaft 37, loosely journaled in the pedestal 3 and provided with four tappets 38, offset laterally and projecting at an angle of ninety degrees the one from the other. Each tappet 38 coöperates with one of a series of four bell-crank levers 39, pivoted on a

shaft 40, supported by the pedestals 5. A stop-rod 41, supported by the pedestals 5, limits the downward movements of the horizontal arms of the bell-cranks 39. Each bell-crank 39 engages the outer end of one of the stems 22 of the exhaust-valves 28 and when acted upon by the corresponding tappet 38 forces open the said corresponding exhaust-valve. It is evident since the tappets are set ninety degrees apart and as the shaft 37 is given two rotations to one of the crank-shaft 31 that the exhaust-valves will be opened with a properly-timed action for a four-cycle engine. Fig. 4 shows one of the tappets as having just engaged with its coöperating bell-crank 39, and this contact, as it will be noted, takes place while the crank-shaft is approximately on its dead-center. By giving the tappet the proper overlap with its bell-crank 39 the exhaust-valves actuated thereby may be held open any desired length of time.

To more clearly demonstrate the relative timed action of the engine, the cylinders of the several engines are in Fig. 1 marked engine No. 1, engine No. 2, engine No. 3, and engine No. 4. With reference to Figs. 1 and 2, it will be seen that the engine No. 1, having compressed its charge, is on the point of exploding the same, while engine No. 4 is just commencing to exhaust. Engine No. 3 is just commencing to take in its charge, while engine No. 2 is just commencing to compress its charge. Bearing these relations in mind it is evident that when the crank-shaft 31 has made a one-half rotation from the position shown in the drawings engine No. 2 will have compressed its charge and the charge will be exploded. When the said shaft has completed its first rotation and is back in the position indicated in the drawings, engine No. 3 will have received, compressed, and exploded its charge. When the said shaft has made a one-and-one-half rotation, engine No. 4 will have compressed and exploded its charge. It is further evident that when the said crank-shaft has completed its second rotation engine No. 1 will again be ready to have its charge exploded.

Under the above action of the several engines the application of power to the crank-shaft is almost continuous, and a maximum resultant efficiency of the several engines is thereby obtained. Furthermore, with the above arrangement a very small fly-wheel may be employed, and in many cases the fly-wheel may be dispensed with.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

In an explosive-engine of the four-cycle type, the combination with two tandem cylinders having intermediate abutments, of a pair of coöperating tandem pistons the heads of which work in said cylinders on opposite sides of the coöperating abutments and the stems of which work through said abutments, intake-valves and exhaust-valves opening, respectively, into and from said cylinders, between said abutments and said piston-heads, a crank-shaft having cranks set one one hundred and eighty degrees in advance of the other and connected one to each of said tandem pistons, and a one-to-two valve-gear for operating said four exhaust-valves in succession involving a series of four rotary tappets driven from said crank-shaft and set ninety degrees apart, whereby an explosion is obtained for each half-rotation of the crank-shaft and for each stroke of the pistons, substantially as described.

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

MARTIN N. HYLLAND.

Witnesses:
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WM. STIER, Jr.