

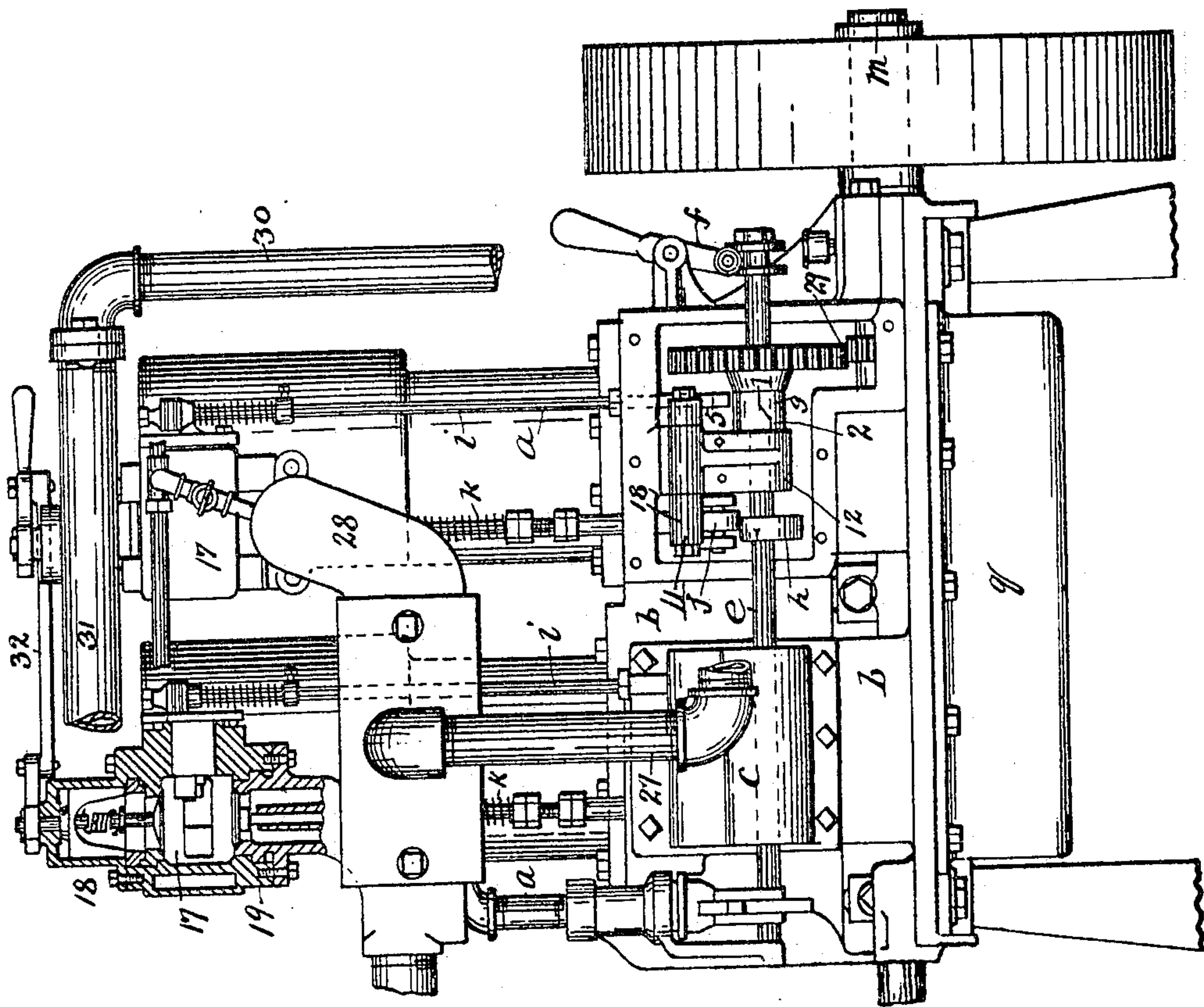
No. 799,029.

PATENTED SEPT. 12, 1905.

A. P. BRUSH.
STARTING MEANS FOR EXPLOSIVE ENGINES.

APPLICATION FILED JULY 29, 1902.

4 SHEETS—SHEET 1.



WITNESSES.

O. B. Baumziger
Kate E. Wells

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Alanson P. Brush
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His Attorney

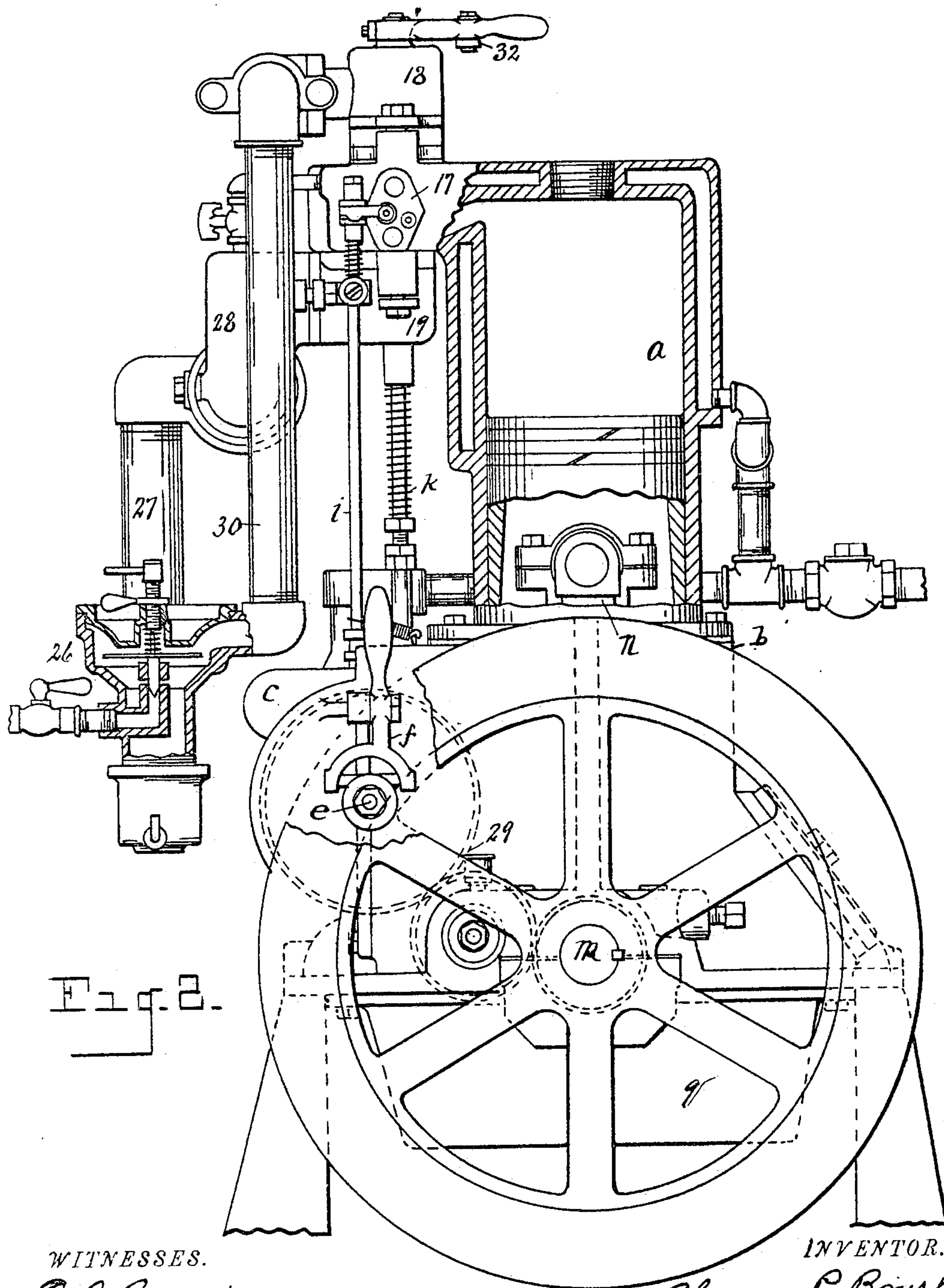
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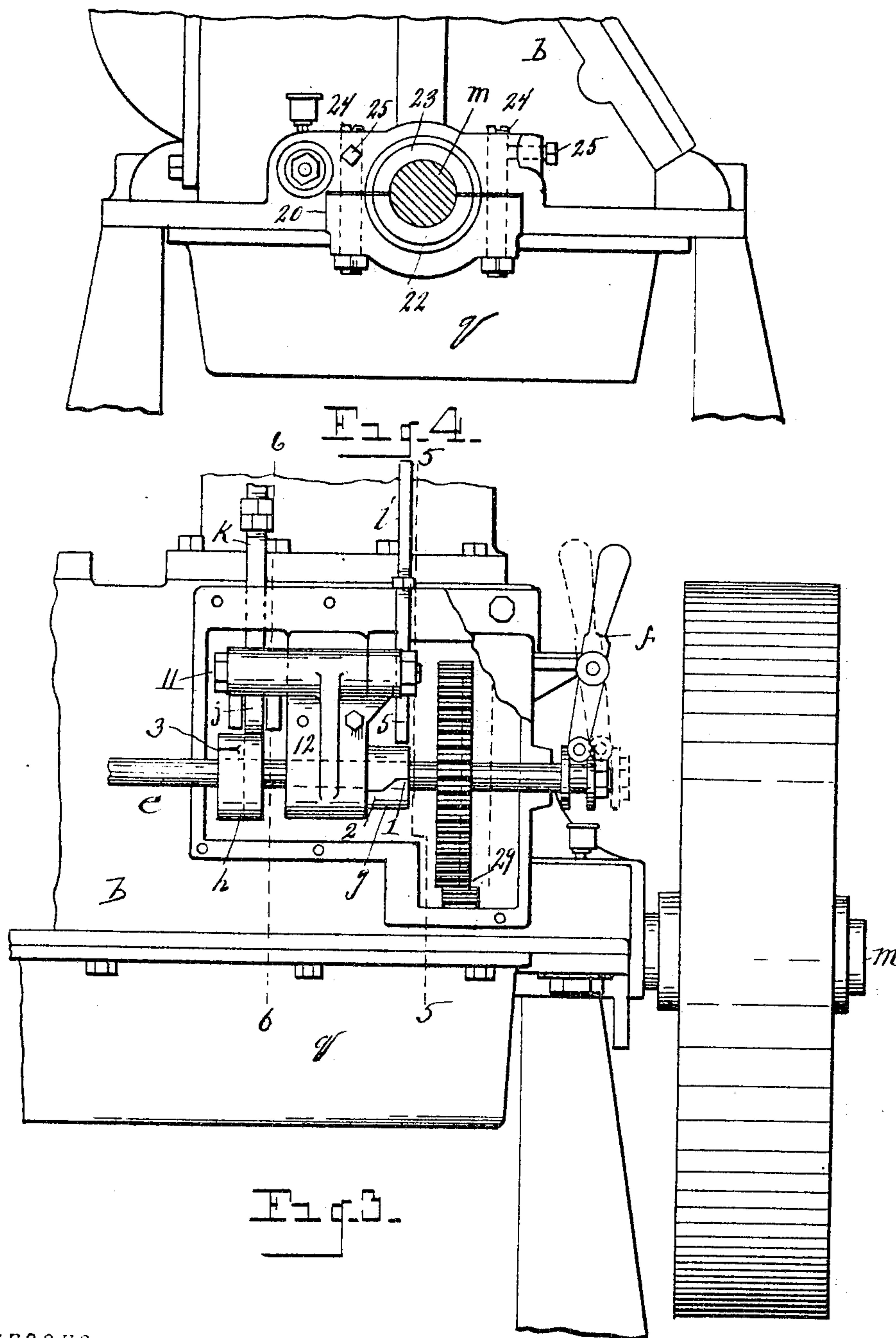
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4 SHEETS—SHEET 3.



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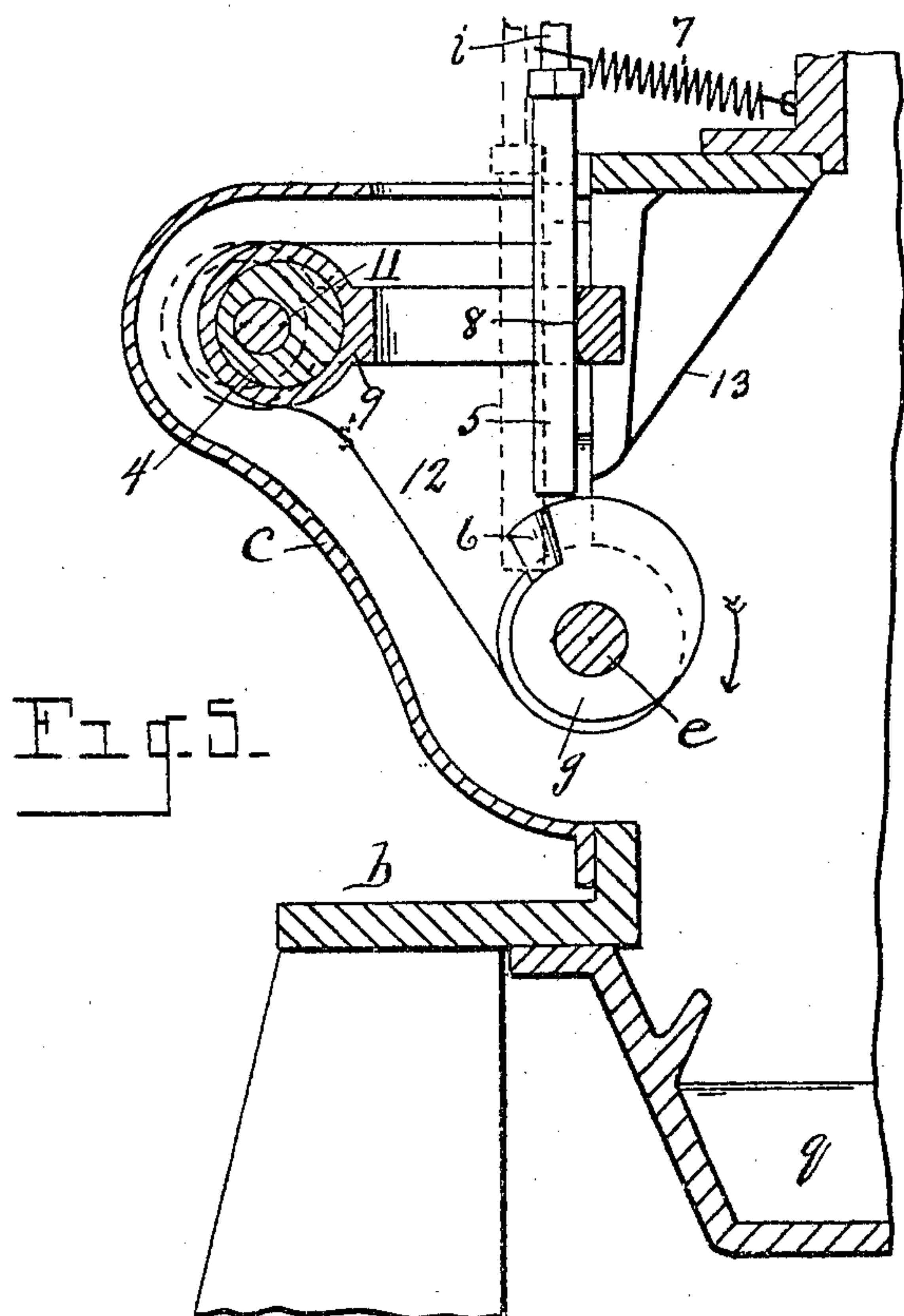


Fig. 5.

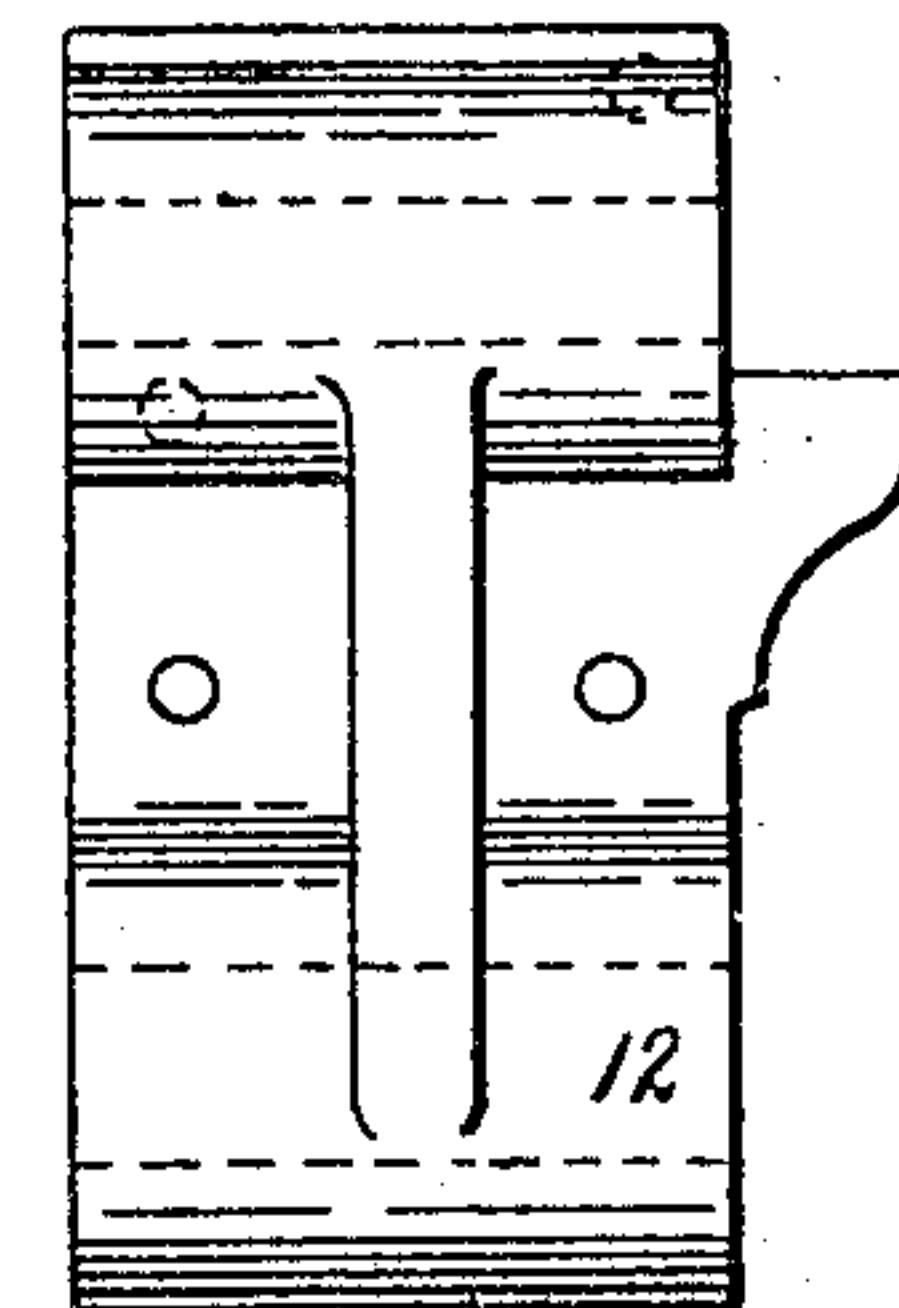


Fig. 7.

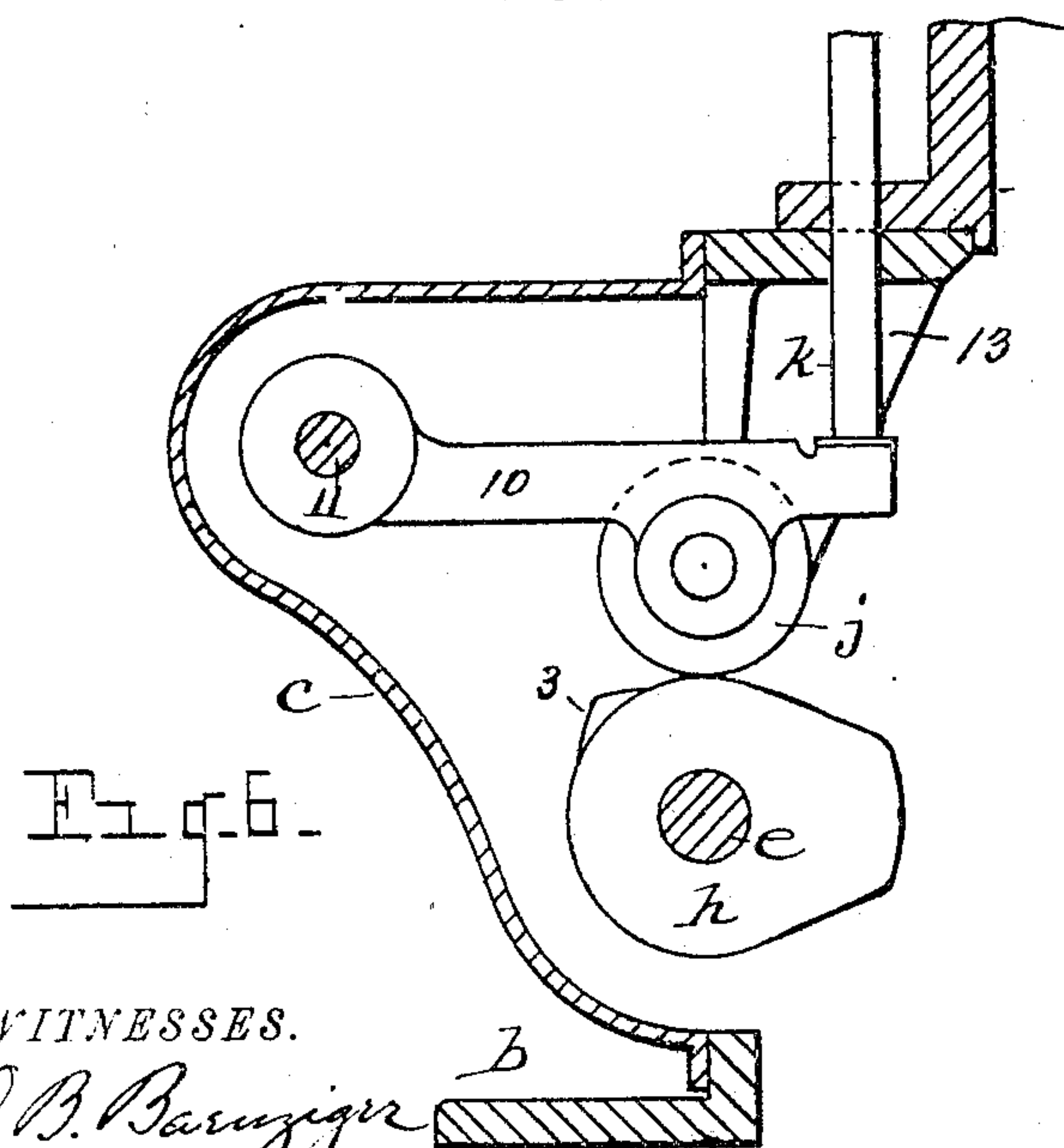


Fig. 6.

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UNITED STATES PATENT OFFICE.

ALANSON P. BRUSH, OF DETROIT, MICHIGAN.

STARTING MEANS FOR EXPLOSIVE-ENGINES.

No. 799,029

Specification of Letters Patent.

Patented Sept. 12, 1905.

Application filed July 29, 1902. Serial No. 117,453.

To all whom it may concern:

Be it known that I, ALANSON P. BRUSH, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Starting Means for Explosive-Engines, of which the following is a specification, reference being had to the accompanying drawings, which form a part of this specification.

My invention has for its object certain new and useful improvements in starting means for explosive-engines; and it consists of the construction, combination, and arrangement of devices hereinafter described and claimed and illustrated in the accompanying drawings, in which—

Figure 1 is a view in front elevation illustrating features of my invention, parts being in vertical section and one of the gear-cases being removed. Fig. 2 is a view in end elevation and vertical section. Fig. 3 is an enlarged view illustrating portions of the igniting and exhaust mechanism. Fig. 4 is a detail view of the front end of the engine-frame with the fly-wheel removed, showing the arrangement of the shaft-bearings. Fig. 5 is a view in section on the line 5 5, Fig. 3. Fig. 6 is a view in section on the line 6 6, Fig. 3. Fig. 7 is an enlarged detail view of the cam-shaft bracket.

The drawings herewith submitted show more particularly my improvements as embodied in a marine engine, although I do not limit my invention thereto.

Features of my invention apply either to a single or to a multiple-cylinder engine, while other features relate more especially to a multiple-cylinder engine whether two or more cylinders are employed.

Among the objects of my invention are, first, simplicity, economy, utility, and durability of construction; second, accessibility to the various parts of the engine; third, convenience of operation; fourth, perfect lubrication.

My invention also includes the general construction and arrangement of the engine.

The general and special purposes of my invention are attained in the following manner:

In carrying out my invention as illustrated in the drawings submitted herewith I have shown a double-cylinder engine in which the cylinders are shown at *a a* mounted upon a supporting-base *b*, with which is also connected a gear-case or oil-shield *c* for each

cylinder. Each gear-case is removable without disturbing the inclosed mechanism, the several gear-cases being in vertical alinement.

Running through the several gear-cases is a cam-shaft *e*, made adjustable longitudinally thereof in any suitable manner, as by an actuating-lever *f*. Upon said shaft and adjustable therewith in each gear-case are cams *g* and *h*, the one, as the cam *g*, being an igniter-cam actuating an igniter-rod *i*, forming a part of the ignition or sparking device, the igniter-cam *g* being rigidly engaged to the shaft in a desired relation and constructed to give an earlier or later spark, according to the position in which it is adjusted relative to said rod. This cam *g* is constructed with plural cam-surfaces (indicated by the numerals 1 and 2) on its periphery to cause the rod *i* to drop earlier or later, as may be required to cause an earlier or later spark. The other cam, as the cam *h*, is an exhaust-cam, upon the periphery of which rides the exhaust-cam roll *j*, actuating the exhaust-rod *k*. The bearing for the cam-shaft and the roller for the exhaust-cam are carried by a bracket in each gear-case, (indicated at 12,) the various brackets being secured to the frame of the engine. The gear-cases also serve as shields to prevent the lubricating-oil escaping. The cam-shaft can be taken off the engine without disturbing the cams or any of the adjustments of related parts by removing the several brackets. The lever *f* may be fulcrumed to the adjacent portion of the gear-case, as shown, and is required only upon one of said cases where multiple-cylinders are used.

The igniter-cam *g* to close the electric circuit must be arranged to cause the sparks before the piston reaches the center. The normal position of the cam-shaft is to the left. Drawing the shaft to the right gives a later ignition, owing to the shape of the cam. The right-hand cam-surface 1 is made, as shown, to actuate the rod *i* quicker and earlier than the portion 2.

The right-hand portion of the exhaust-cam *h* is circular in form except for the cam portion for raising the exhaust-valve in its proper time, while the left-hand portion of the cam in addition thereto has on its periphery a relief-cam 3. It will be evident from the drawings, especially from Fig. 3, that with the cam-shaft and actuating-lever in position shown by the full lines the relief-cam 3 and the late-spark cam 2 are not in operation, thus giving the full compression and early ignition

necessary to develop the maximum power of the engine. When, however, the cam-shaft and actuating-lever are shifted into position shown by the dotted lines as is necessary in starting, the relief-cam 3 being so placed on the exhaust-cam will raise the exhaust-valve during a part of the compression-stroke, thus allowing a part of the charge to escape into the exhaust-passage of the engine, thus making the engine easier to rotate by hand. It will also be seen that in this position the early-spark cam 1 will not be in operation, but that the late-spark cam 2 will be substituted therefor, causing the igniter-rod to drop and the spark to take place after the crank has passed the upper or central position, timing the explosion so that the impulse will be in the direction of rotation.

It is well known that in explosive-motors of the four-cycle type the charge must be ignited before the piston reaches the point of maximum compression to allow the pressure in the cylinder to reach the maximum point on or very near the center. It is also well known that in engines of any considerable size the compression of a full charge and the ignition before the center when the engine is being turned slowly or is being started renders a reduction of the compression and a later ignition absolutely necessary when an engine is to be started easily. The arrangement of the cams, cam-shaft, igniter, and exhaust-valve mechanism permit the later ignition and lighter compression simultaneously, by means of the movement of the lever *f* and this for any number of cylinders. It is also evident that the surface to which the gear-case and cam-shaft bracket are attached may be produced on the proper portion of an engine-frame for any number of cylinders at a single operation, thus insuring the alinement of the cam-shaft and making it possible for the cam-shaft brackets and gear-cases in duplicate. My invention is also so constructed that the cams, brackets, cylinders and valves, with their cases and igniters, are preferably made in duplicate, rendering their assemblage for multiple-cylinder engines an easy and convenient matter. It will be observed that when any gear-case is removed the igniter and exhaust mechanism are entirely exposed, thus giving great accessibility thereto. It will also be evident that a cam-shaft with any number of cylinders, with its related parts, may be assembled separately and attached or removed from an engine-frame without disturbing the cams and their several adjustments on the shaft or the adjustment of parts related thereto, as the exhaust-cam-roll arm 10 or the igniter-timing device illustrated in Fig. 5, these parts being attached simply to the cam-shaft bracket. My invention contemplates any suitable igniter mechanism 17 other than as herein described, also any suitable inlet-valve mechanism

18 and exhaust-valve mechanism 19. It will be observed in Fig. 5 that the igniter for the cylinder to which that particular cam-shaft bracket belongs may be timed independently of the other cylinders by rotating the eccentric washer 4, thus changing the position of the igniter-rod foot 5, causing it to drop off the step 6 of the igniter-cam earlier or later, as may be desired. This of course does not interfere with the simultaneous timing of the igniters on all of the cylinders for starting and is intended simply to give an accurate separate adjustment for each cylinder necessary in order to obtain the best results when running under normal conditions. It will be seen, moreover, that the igniter-rod foot 5 by means of the spring 7 and also owing to the direction of the rotation of the cam is held against the limiting end of the slot 8 in the igniter-adjusting arm 9; but in case the cam should be accidentally revolved in the reverse direction the igniter-rod foot 5 by the extension of the spring 7 will be allowed to move away from the end of the slot 8, thus preventing damage to the parts. The exhaust-cam-roll arm 10, as shown more particularly in Fig. 6, is loosely revolvable upon the bolt 11, which also rocks the igniter-timing eccentric 4, said bolt passing through the cam-shaft bracket and at the other end rocking the igniter-timing eccentric 4.

The cam-shaft brackets 12, as seen in Figs. 3 and 5, are attached to a portion 13 of the frame, which is machined at the same operation and, in fact, is a continuation of the surface to which the gear-case or oil-shield is attached. This construction permits the surface for each cylinder for attaching the gear-case and cam-shaft brackets to be machined or finished at one continuous operation regardless of the number of cylinders and insures absolute alinement of the cam-shaft when the brackets are properly attached.

The driving-shaft is shown at *m*, provided with one or more crank-arms with which are connected the corresponding connecting-rods *n*. Each crank turns in an oil-pan *q*. The specific construction of the oil-pan or lubricating mechanism forms the subject-matter of another application filed of even date herewith, the same bearing Serial No. 117,454, July 29, 1902.

The frame of the engine is recessed right through for the bearings of the crank-shaft in one operation, as indicated at 20, and the bearing metal 22 and 23 for the shaft is located in said recesses, the same being arranged so that it shall be centered in the corresponding machined-out recess. The bearings themselves are made to fit so that when the bearings are inserted in the recesses the two semicircular portions of the bearing are in line vertically with each other, and so that any number of said bearings may be in per-

fect alinement with each other regardless of the number of bearings. This makes the alining of the crank-shaft bearings very simple and permits of the renewal of the portions of the bearing and the manufacture of the same in duplicate. Adjusting-screws 24 are threaded into the frame or base *b*, said screws being provided with slots or other suitable means of rotation from above. Set-screws 25 hold the adjusting-screws in place. In this manner the parts of the bearing may be adjusted without access being necessary to the heads of the bolts in the base of the engine. It will be noted also that the adjustment is upward, while in a single-action engine the wear is downward. Thus the adjustment may continually correct the defect of alinement on the wear of the bearings.

It will be understood that there is a bearing between each crank on the crank-shaft *m*.

A mixing-valve is shown at 26, that is illustrated herewith forming the special subject-matter of another application filed by me March 7, 1902, Serial No. 97,107.

27 denotes an air-intake leading to an exhaust connection 28 for the purpose of taking warm air from around the same.

The crank-shaft is geared with the cam-shaft in any suitable manner, as by gears 29.

30 is a portion of the air-passage 27 arranged to take the air after it has passed through the mixing-valve 26 to the distributing portion 31 of the intake.

32 is a connection for operating all of the throttle-valves at once.

What I claim as my invention is—

1. In a multiple-cylinder engine the combination of an engine frame or base, multiple cylinders mounted upon said base, a removable gear-case for each cylinder, a crank-shaft, a cam-shaft bracket in each gear-case, a longitudinally-adjustable cam-shaft in the same plane as the crank-shaft extending through the several gear-cases and carried by said brackets, igniter and exhaust actuating cams upon the cam-shaft, and independently-adjustable igniter devices for each cylinder, said cams simultaneously adjustable with the adjustment of the cam-shaft, the exhaust-cams being each provided with a relief-cam surface, and the igniter-cams being each provided with a late-ignition-cam surface, whereby the time of ignition and of exhaust may be simultaneously controlled, and whereby the ignition devices may be separately and independently adjusted.

2. In a multiple-cylinder engine the combination of an engine frame or base, multiple cylinders mounted upon said base, a removable gear-case for each cylinder, a crank-shaft, removable cam-shaft brackets, a longitudinally-adjustable cam-shaft in the same plane as the crank-shaft extending through the several gear-cases and carried by said brackets, igniter and exhaust actuating cams upon the

cam-shaft in each of said gear-cases, and independently-adjustable igniter devices, said cams simultaneously adjusted with the adjustment of the cam-shaft, the exhaust-cam provided with a relief-cam surface, and the igniter-cam provided with a late-ignition-cam surface, whereby the time of ignition and of exhaust may be simultaneously controlled, and whereby the ignition devices may be separately and independently adjusted, the cam-shaft being removable from the engine without disturbing the cams or adjustments of related parts by removing the gear-cases and the cam-shaft brackets.

3. In a multiple-cylinder engine the combination of an engine frame or base, multiple cylinders mounted upon said base, a removable gear-case for each cylinder, a crank-shaft, removable cam-shaft brackets, a longitudinally-adjustable cam-shaft carried by said brackets in the same plane as the crank-shaft, igniter and exhaust actuating cams upon the cam-shaft, and independently-adjustable igniter devices, said cams simultaneously adjustable with the adjustment of the cam-shaft, said igniter-cams constructed to give an earlier and a later spark according to the position of adjustment of the cam-shaft, whereby the time of ignition and of exhaust may be simultaneously controlled, and whereby the ignition devices may be separately and independently adjusted, the contacting faces of the several gear-cases upon the engine frame or base being in alinement.

4. In a multiple-cylinder engine the combination of a frame or base, multiple cylinders mounted upon said base, a removable gear-case for each cylinder, a crank-shaft, cam-shaft brackets engaged upon the engine-frame within each of the gear-cases, a cam-shaft in the same plane as the crank-shaft extending through the several gear-cases and carried by said brackets, a set of igniter and exhaust actuating cams upon said shaft within each gear-case for each cylinder, and independently-adjustable igniter devices, the igniter-cams being rigidly engaged upon the cam-shaft, said cams simultaneously adjusted with the adjustment of the cam-shaft, the exhaust-cams provided with a relief-cam surface, and the igniter-cams provided with plural cam-surfaces upon their peripheries whereby the time of ignition and of exhaust may be simultaneously controlled, and whereby the ignition devices may be separately and independently adjusted, the contact-faces of said brackets upon the engine-frame being in alinement.

5. In a multiple-cylinder engine the combination of a multiple-cylinder engine frame or base, multiple cylinders mounted upon said base, a removable gear-case for each cylinder, a crank-shaft, plural cam-shaft brackets, a longitudinally-adjustable cam-shaft in the same plane as the crank-shaft extending through the gear-cases and carried by said

brackets, igniter and exhaust actuating cams upon the cam-shaft in each of said cases, independently-adjustable igniter devices each comprising an igniter-rod actuated by the igniter-
5 cam, and means to adjust the foot of the rod forward and backward, whereby the time of ignition and of exhaust may be simultaneously controlled, and whereby the ignition devices may be separately and independently
10 adjusted.

6. In a multiple-cylinder engine the combination with an engine frame or base, of multiple cylinders mounted upon said base, a removable gear-case for each cylinder, a crank-
15 shaft, plural cam-shaft brackets, a longitudinally-adjustable cam-shaft in the same plane

as the crank-shaft extending through the several gear-cases and carried by said brackets, igniter and exhaust actuating cams upon the cam-shaft in each of said cases, independently-adjustable igniter devices each comprising an igniter-rod actuated by the igniter-
20 cam, a slotted eccentrically-actuated igniter-adjusting arm, and means to restore the igniter-rod to normal position. 25

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ALANSON P. BRUSH.

Witnesses:

N. S. WRIGHT,

KATE E. WELLS.