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G. K. BENNER & H. B. NICODEMUS.

COMBINED GAS AND STEAM ENGINE.

APPLICATION FILED MAR. 11, 1903.

NO MODEL.

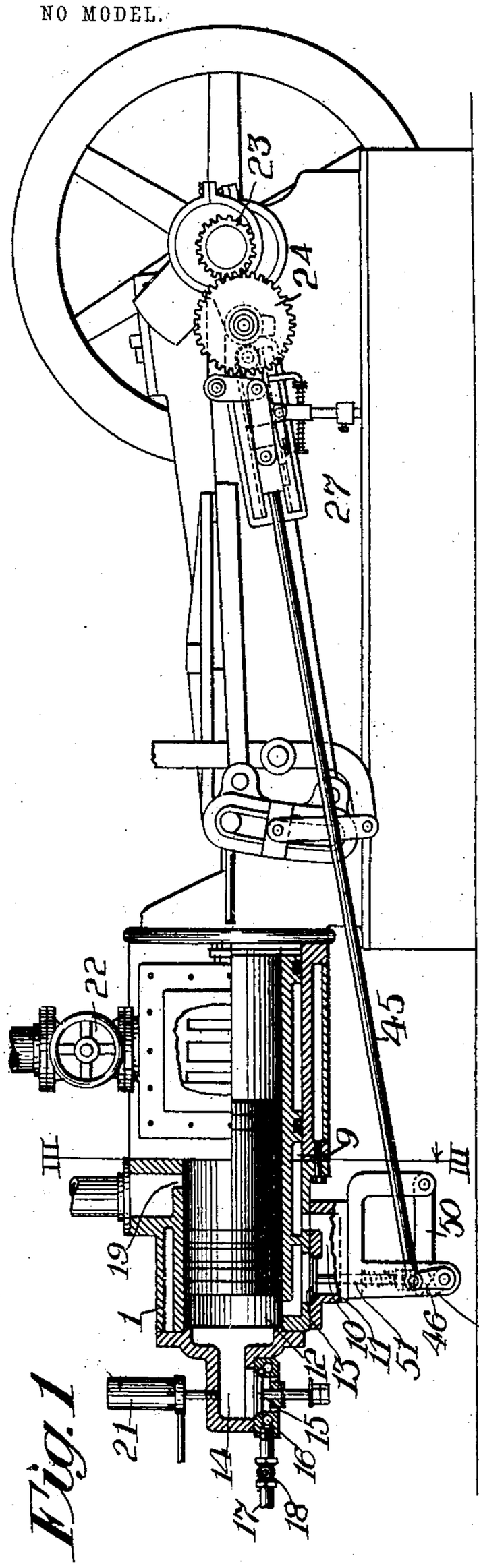

Fig. 1

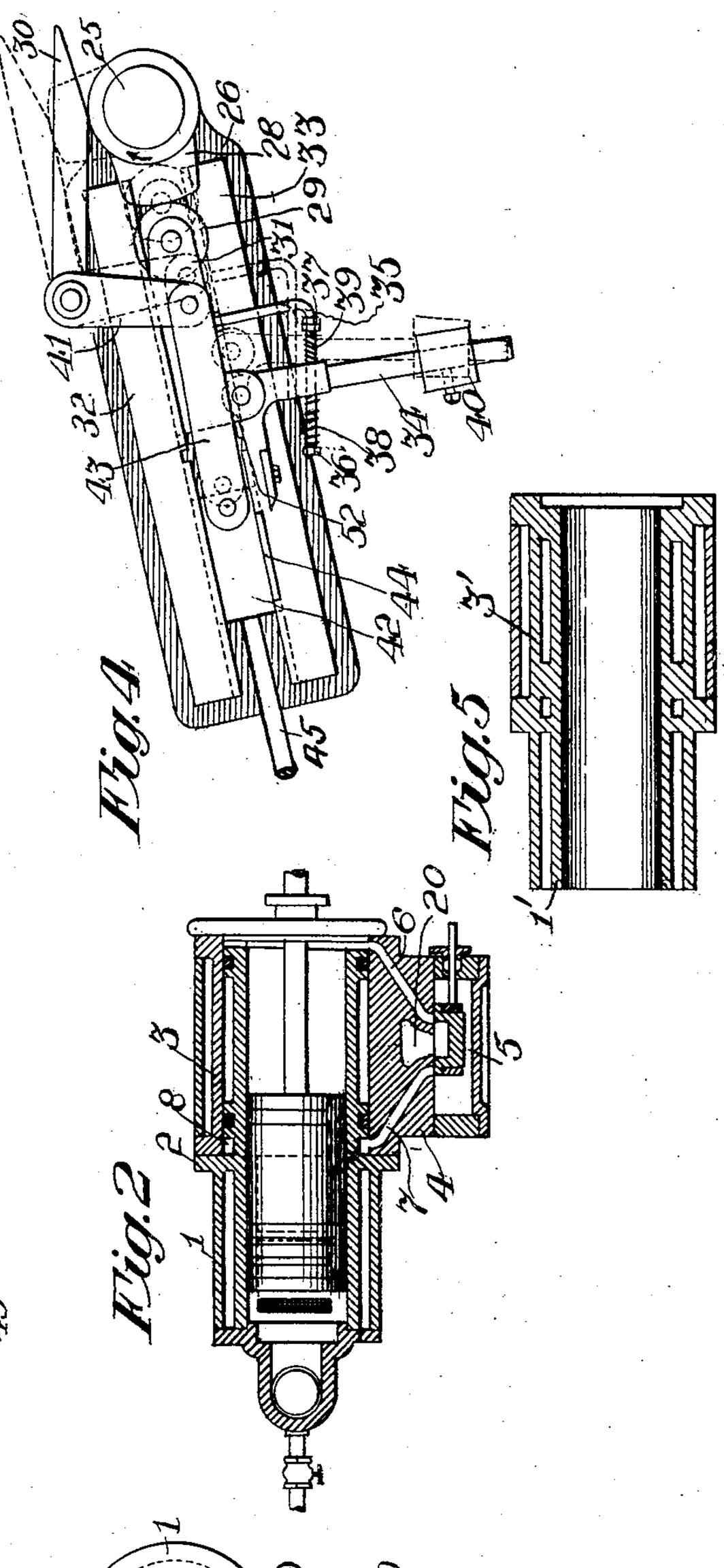

Fig. 4

Fig. 5

Fig. 2

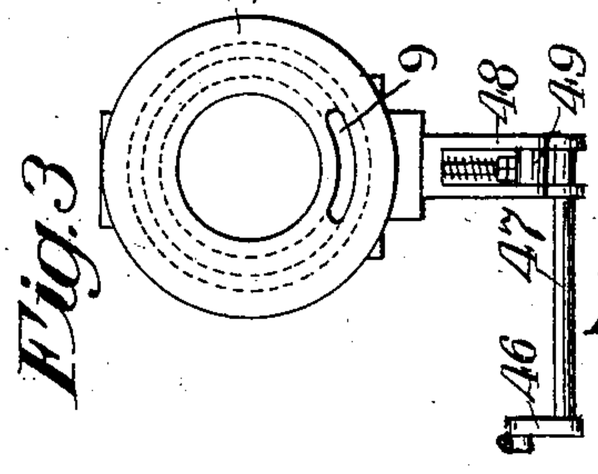

Fig. 3

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No. 771,601. Patented October 4, 1904.

UNITED STATES PATENT OFFICE.

GEORGE K. BENNER AND HENRY B. NICODEMUS, OF ALLEGHENY, PENNSYLVANIA; SAID NICODEMUS ASSIGNOR TO SAID BENNER.

COMBINED GAS AND STEAM ENGINE.

SPECIFICATION forming part of Letters Patent No. 771,601, dated October 4, 1904.

Application filed March 11, 1903. Serial No. 147,236. (No model.)

To all whom it may concern:

Be it known that we, GEORGE K. BENNER and HENRY B. NICODEMUS, citizens of the United States of America, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in a Combined Gas and Steam Engine, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in engines, and more particularly to that class of engines which are designed to run either explosively or by fluid-pressure—such, for instance, as a combined gas and steam engine.

The object of this invention is to provide means whereby when said engine is running by fluid-pressure the control of said fluid-pressure with respect to the speed of the engine is suitably controlled and whereby when the same is used as a gas or explosive engine the same may be so regulated that the explosions will only occur when the speed of the engine is reduced to a predetermined point.

A further object of the invention is to provide means whereby the changing from fluid-pressure to explosive power is controlled by two adjacently-situated valves, whereby the operator may effectually carry out the same without stopping or reducing the speed of said engine.

A further object of this invention is to adapt any existing fluid-pressure engine so that the same may be used as either fluid-pressure or explosive engine.

In describing the invention in detail reference is had to the accompanying drawings, forming a part of this specification, and wherein like numerals of reference indicate like parts throughout the several views, in which—

Figure 1 is a side elevation of our improved engine, partly in section. Fig. 2 is a longitudinal plan view of the cylinder and steam-chest in section. Fig. 3 is a section taken on the line III III of Fig. 1 looking in the direction of the arrow with the piston removed therefrom. Fig. 4 is a view showing the speed-controlling mechanism on the engine, on an enlarged scale. Fig. 5 is a longitudinal sectional view of a modified form of cylinder, showing the same made in one piece.

In carrying out our invention we provide a barrel or cylinder, which is designated by reference-numeral 1, which is of substantially such form that one head of the cylinder of any fluid-pressure engine may be removed and the said barrel inserted therein. A flange 2 is provided on the barrel 1, and this flange is bolted to the cylinder 3 in the usual manner. The usual extension 4 on the cylinder 3 remains the same as if such engine was a fluid-pressure engine, and the steam-chest 5 is also of the existing form. The port 6 and port 7 which were in the fluid-pressure engine still remain fluid-pressure-inlet ports, the port 6 communicating with one end of the cylinder, as before; but the port 7 communicates with an annular chamber 8, formed in the outer face of the barrel 1 between the flange 2 and the flange 2^a. The interior of the cylinder forms the outer wall of this chamber, which has communicating with it the port 9 in the barrel 1. This port 9 is connected with the port 10, which is formed in the part 11, mounted at a suitable position on the part 1, the said port 10 communicating with the rear end of the cylinder 12, which is formed in the part 1. A valve 13 is interposed between the port 10 and the rear of the cylinder. Secured to the rear end of the part 1 is an explosion-chamber 14, which is provided with an air-inlet port 15 and gas or gasolene inlet ports 16, said ports 16 receiving their fluid from the pipe 17, having the valve 18 provided near said explosion-chamber for the purpose of controlling the feed of said gas or gasolene. The exhaust-port 19 is provided for use in connection with the engine when the same is running as an explosive-engine, and the usual port 20 is provided adjacent to the steam-chest for use when the same is running as a fluid-pressure engine. An igniter 21, which may be of any well-known form, is provided at the explosive-chamber for use when the engine is operated as an explosive-engine. The throt-

tle-valve 22 is provided adjacent to the steam-chest, whereby the control of the fluid-pressure may be obtained.

It will be seen from the foregoing description that by throttling the fluid-pressure by the valve 22 and permitting the explosive agent to become operative by the operating of the valve 18, said valve being adjacently located, the change from one motive power to another will be readily accomplished.

As a means for controlling the said engine, especially when the same is running as an explosive-engine, there is connected with its driving-shaft a gear 23, which meshes with gear 24, which is secured to the shaft 25, mounted in the frame 26, which is secured to the frame 27 of the engine, and on said shaft 25 is mounted a cam 28. This cam is so positioned that during its revolution it will cause a reciprocatory movement to be imparted to the roller 29 and the lever 30, said roller being rotatably mounted in the slide 31, which reciprocates in ways 32 33, secured to the frame 26. The slide 31 has pivotally mounted to its forward end a lever 34, and mounted on said slide between the lever 34 and the roller 29 is an angular arm 35, the lower portion of which passes through an aperture in said lever 34 and on either side of said lever is provided with nuts 36 37, which confine springs 38 39, bearing against opposite sides of said lever. Mounted on the lower end of said lever 34 is an adjustable weight 40, provided for the purpose herein to be mentioned. The lever 30 is formed substantially as a bell-crank, and the part 41 of said lever is connected with a slide 42 by means of the link 43, said slide 42 operating in ways 32 33 and has provided on its lower surface a plate 44. The rod 45 extends from said slide 42 to the crank 46, secured to the shaft 47, which is mounted in the yoke 48 and between the two members forming the yoke is provided with a cam-piece 49, which is adapted to act on the lever 50, carried by said yoke, the said lever acting on the spring-pressed stem 51 of the valve 13. We may when building an entirely new engine construct the cylinder in one piece, as seen in Fig. 5, in which the cylinders 1′ and 3′ are cast integral. It will be evident, however, that when attaching the gas-engine cylinder to a steam-engine cylinder the form as heretofore described would be employed.

The operation of this controlling mechanism of the device is as follows: The rotation of the shaft of said engine will through the medium of the gears 23 24 cause the relative rotation of the shaft 25, on which the cam 28 is mounted. This cam moving in the direction of the arrow shown in Fig. 4 will, as shown in said figure, cause the controlling parts to be in position as shown in full lines. The further movement of the same will produce a position of the parts such as shown in dotted lines and in which the lever 30 will be elevated, thereby throwing its other member 41, connected to the link 43 and the slide 42, causing the rod 45 to be moved to such a position that the crank 46 through the medium of shaft 47 will cause the cam 49, acting on the lever 50, to raise the valve-stem 51, thereby opening the valve 10, in which position the piston will not suck in any of the explosive mixture, due to the fact that free suction may be had through valve 10. The further rotation of the shaft 25 will cause cam 28 to force the roller 29, secured to the slide 31, rearwardly. The slide 31, lever 30, and arm 35 will thus be moved rearwardly, and should the blow or impact, or, in other words, the speed of said shaft, be sufficient the arm 34 will overcome the pressure of the spring 39, thereby lowering its front plate 52 to such a position as is shown in Fig. 4. Should, however, the blow not be sufficient to overcome said spring 31, the plate 52 will not be depressed and will engage plate 44 on the slide 42, thereby moving the same and causing the valve 10 to be closed, in which position the piston would draw in the charge of the explosive agent. The same being exploded would increase the speed of the engine. It will thus be seen that should the engine exceed the given speed the explosions in the cylinder will not occur; but when the speed of the engine has come to or below such predetermined speed the explosion will occur regularly. The adjustable weight 40 is provided for the purpose of adjusting said predetermined speed, as it will be seen that vertical movement of said weight will increase or decrease the movement of inertia which is necessary to overcome the pressure of said spring 39, thereby varying the necessary blow of impact.

While we have shown this regulating means for the engine, it will be obvious that many variations of the same could be made without departing from the general spirit of our invention.

Having fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In combination with a steam-engine having ports leading from its steam-chest to the end of its cylinder, a barrel projecting into the cylinder and having a port communicating with one of the first-named ports, means for admitting a supply of an explosive mixture into the outer portion of the barrel, a controlling means therefor, and means for controlling the port in said barrel.

2. In combination with the steam-engine cylinder formed with inlet and outlet ports, and controlling means therefor, an explosive-engine cylinder secured to said first-named cylinder, and having its inner portion arranged entirely therewithin, inlet and exhaust valves provided in said last-named cylinder, and a piston operating in said last-named cylinder.

3. In combination with the steam-engine

cylinder, the shaft, the piston, and the steam-chest, a pair of inlet-ports leading from the said chest to the opposite ends of said cylinder, a barrel arranged in said cylinder and receiving said piston, an air and gas inlet port formed in said barrel, a second port communicating with one of the ports of said cylinder, a valve controlling said first-named ports and being actuated by said shaft, a valve controlling said last-named port, a shaft rotatably mounted adjacent said last-named valve and means actuated by said last-named shaft for operating said last-named valve.

4. In combination with the steam-engine cylinder and barrel formed with a communicating port, a spring-pressed valve controlling the port, a piston, a shaft, a cam on said shaft, a slide actuated by the cam on said shaft, a rod connected to the slide and to the valve whereby the movement of the slide is communicated to the valve, and a spring-pressed pivoted member for controlling the movement of said valve.

In testimony whereof we affix our signatures in the presence of two witnesses.

GEORGE K. BENNER.
HENRY B. NICODEMUS.

Witnesses:
A. M. WILSON,
E. E. POTTER.