No. 883,866. PATENTED APR. 7, 1908.

R. E. DEAN.

STEAM ENGINE.

APPLICATION FILED JAN. 4, 1907.

2 SHEETS—SHEET 1.

FIG. 1.

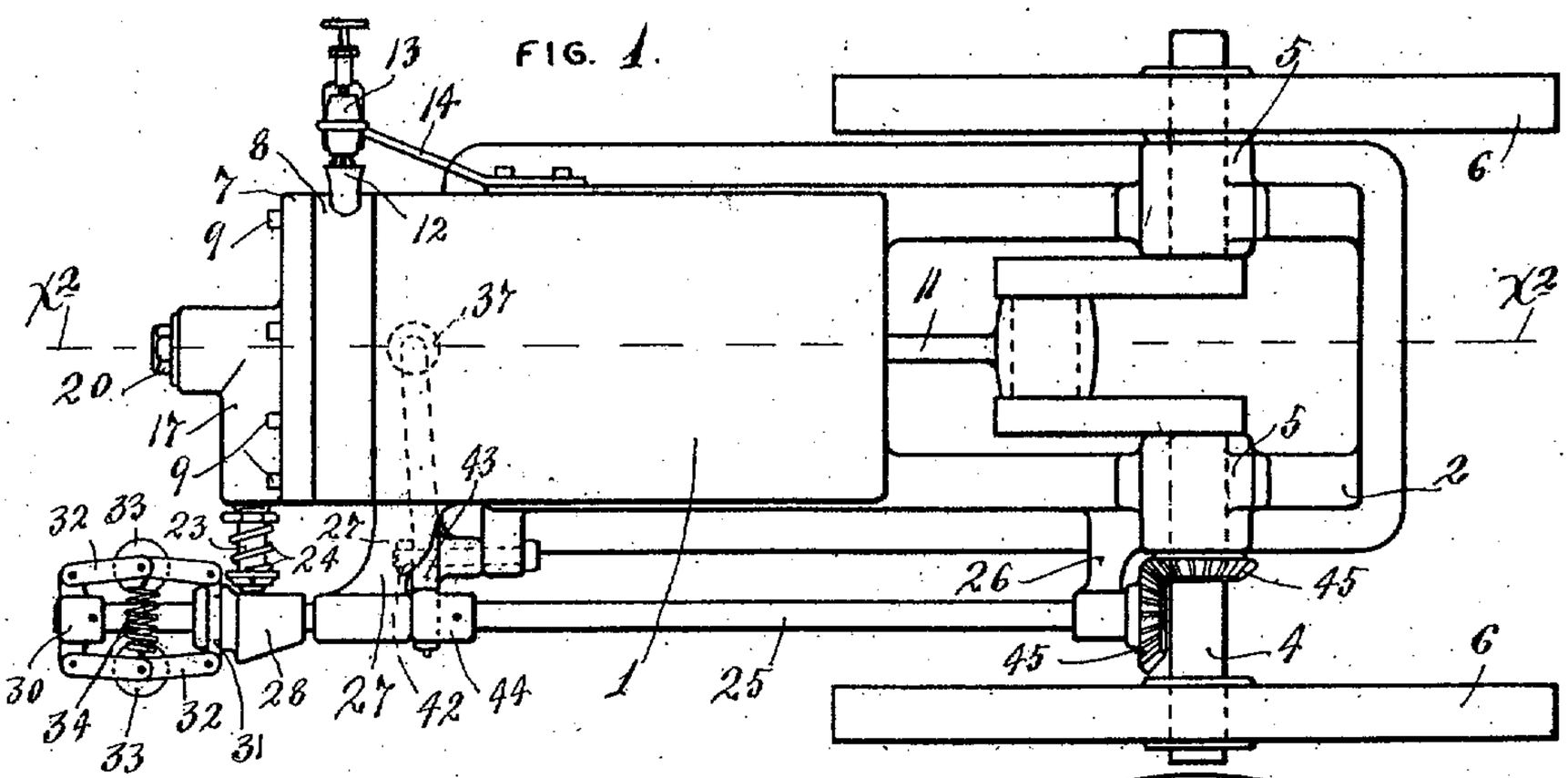



FIG. 2.

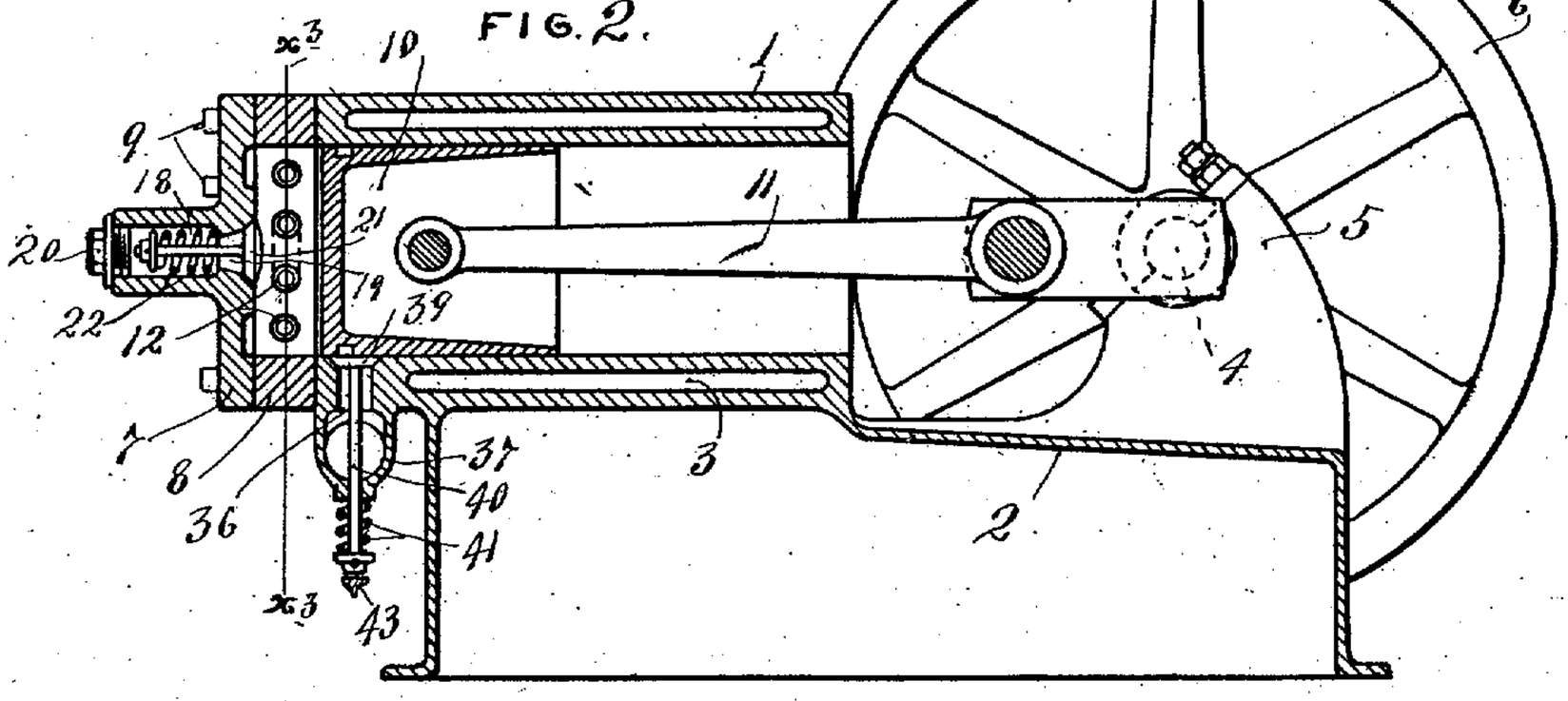
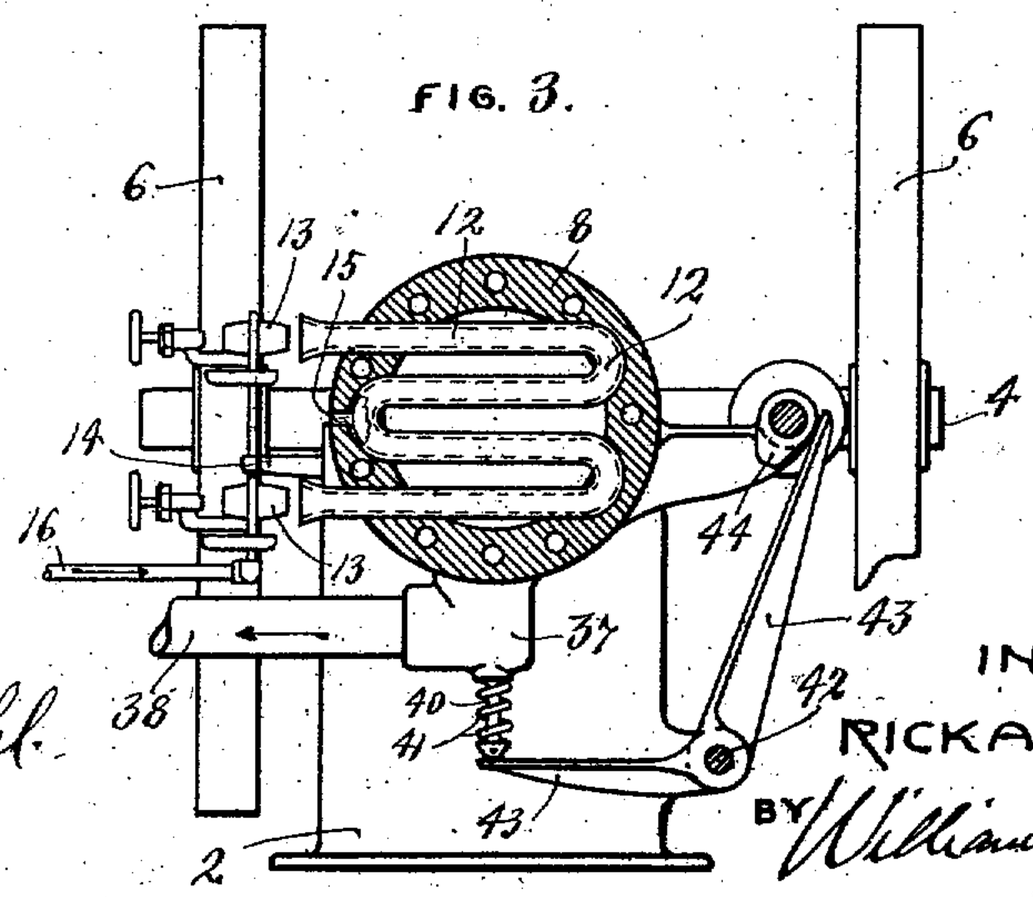



FIG. 3.

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2 SHEETS—SHEET 2.

FIG. 5.

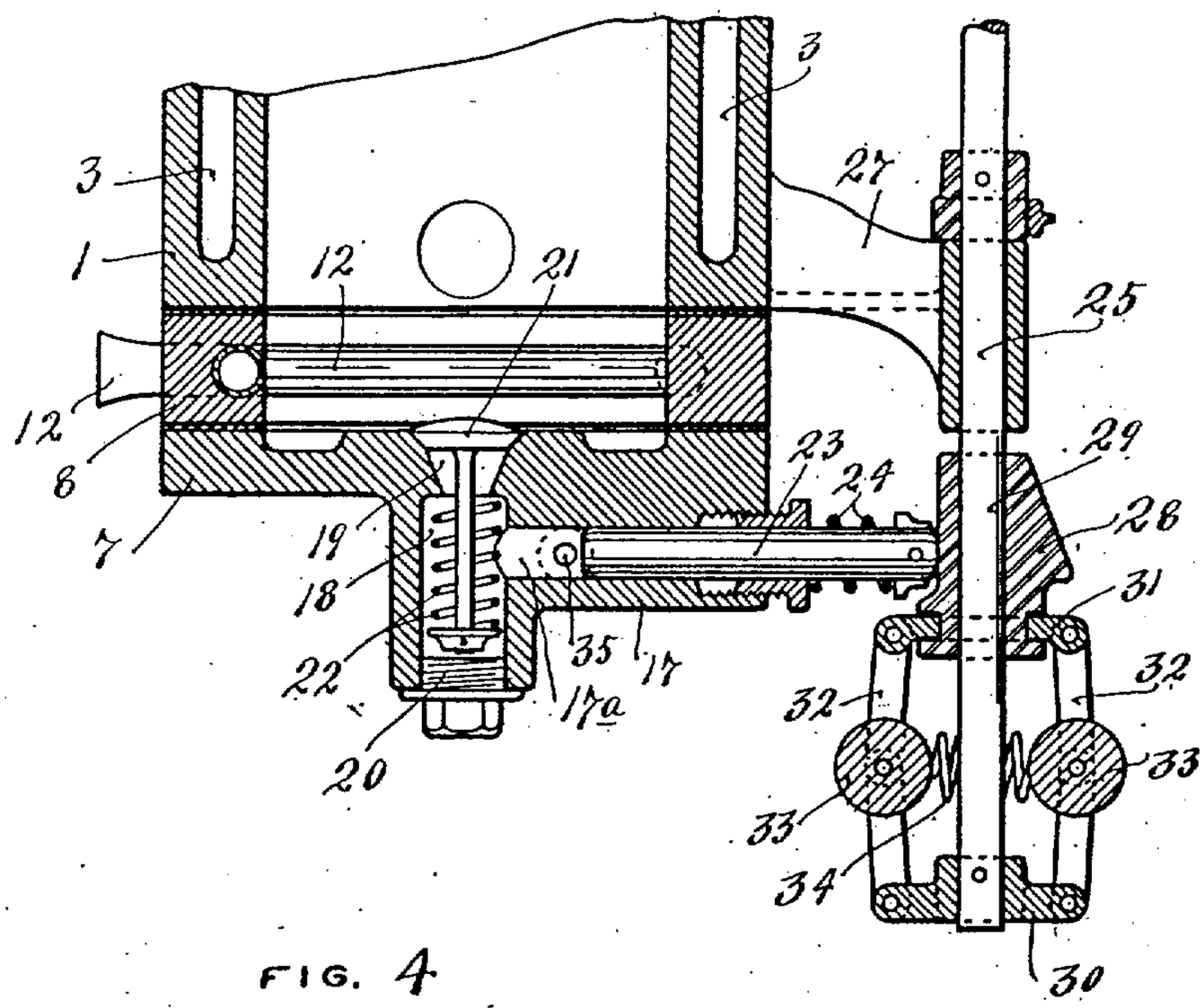
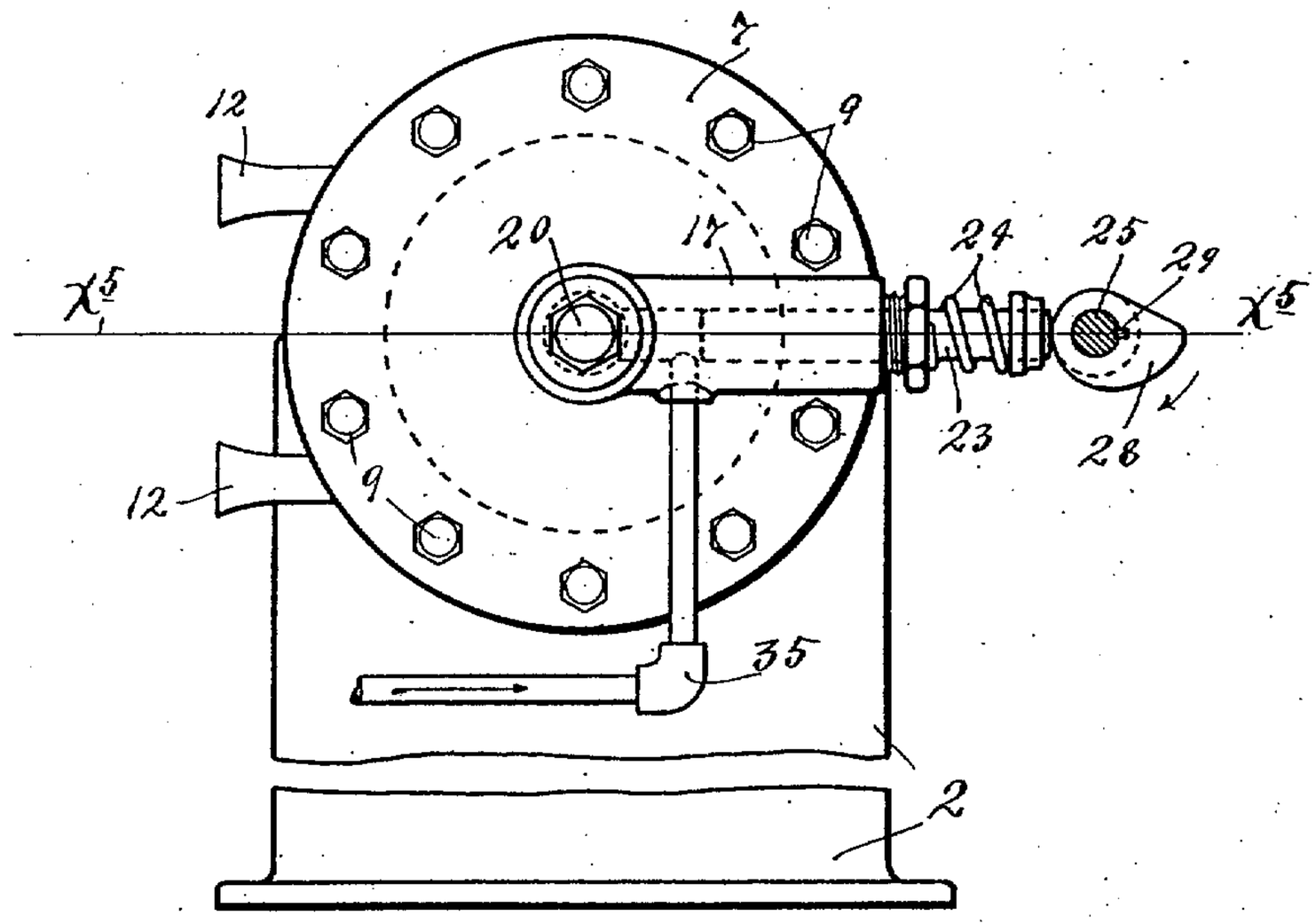



FIG. 4

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# UNITED STATES PATENT OFFICE.

RICKARD E. DEAN, OF MASON CITY, IOWA.

## STEAM-ENGINE.

No. 883,866. Specification of Letters Patent. Patented April 7, 1908.

Application filed January 4, 1907. Serial No. 350,750.

*To all whom it may concern:*

Be it known that I, RICKARD E. DEAN, a citizen of the United States, residing at Mason City, in the county of Cerro Gordo and State of Iowa, have invented certain new and useful Improvements in Steam-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 that class of steam engines wherein the steam is intermittently and instantaneously generated by the contact of a spray of water with highly heated surfaces.

My invention has for its object to improve this type of engine and to this end it consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

In steam engines of the type above noted, it has hitherto been common to generate steam intermittently by the contact of a spray of water with highly heated surfaces; but in such engines the generation of steam has taken place outside of the engine cylinder and has been intermittently admitted into the cylinder by a properly timed valve.

As the broad feature of my invention, I place the highly heated generating surfaces within the cylinder and intermittently generate the steam directly within the cylinder, by the introduction of water into the cylinder and onto the said generating surfaces, at the proper times with respect to the piston movements, by means of properly timed water injecting mechanism.

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

Referring to the drawings, Figure 1 is a plan view of the improved engine. Fig. 2 is a vertical section taken approximately on the line $x^2$ $x^2$ of Fig. 1. Fig. 3 is a transverse vertical section taken approximately on the line $x^3$ $x^3$ of Fig. 3. Fig. 4 is a front end elevation of the engine with some parts broken away and some parts sectioned; and Fig. 5 is a horizontal section taken on the line $x^5$ $x^5$ of Fig. 4, some parts being broken away.

The numeral 1 indicates the engine cylinder which, as shown, is cast integral with a frame or base 2, but which may be of any suitable construction. Also, the said cylinder is shown as provided with a surrounding water jacketing chamber 3.

The numeral 4 indicates the engine crank shaft which is journaled in suitable bearings 5 on the bed frame 2, and as shown carries a pair of fly wheels 6, one or both of which may be used as driving pulleys, or if desired, of course, said crank shaft may be provided with an independent driving pulley. That end of the cylinder 1 which is nearest the crank shaft is open, but the other end thereof is closed by means of a cylinder head 7. An annular cylinder section 8 is preferably interposed between the head 7 and the main body portion of said cylinder. The said parts 7 and 8 may be rigidly but detachably secured to the cylinder 1, by means of machine screws 9 or other suitable devices. The joints between the said parts must, of course, be steam tight. Working within the cylinder 1 is a piston 10 that is connected to the crank of the crank shaft 4 by a crank rod 11.

The steam generating surface is afforded by a crooked metal tube 12, portions of which are preferably cast into the ring or annular cylinder section 8. The ends of said tube project outward beyond the said ring 8, and these outwardly projecting ends are preferably of funnel shape. A pair of gas burners 13, shown as supported from the cylinder 1 by an arm 14, are positioned to direct flame directly into the ends of the generating tube 12. At its intermediate portion, said generating tube is shown as provided with an outlet passage 15, which passage also extends outward through the said ring, so as to afford an opening for the discharge of the products of combustion from the burners 13. The numeral 16 indicates a small tube for delivering gas or hydro carbon oil to the burners 13. By the flame from the burners 13, the generating tube 12 may be kept at any desired heat for the proper generation of steam. One or more of the said burners may, of course, be employed.

The water delivery passage to the cylinder, as shown, is formed in an elbow 17 cast integral with the cylinder head 7. This elbow 17 is formed with a small plunger seat $17^a$, a small water containing chamber 18 and an admission port 19. The outer end of the chamber 18 is shown as closed by a removable plug 20. The admission port 19 is normally closed by a spring seated valve 21, the spring 22 of which as well as the stem

of which valve, are located within the water chamber 18. A small pump plunger 23 works within the plunger seat 17ª and is yieldingly pressed outward by a coiled spring 24.

The numeral 25 indicates a shaft mounted in suitable bearings 26 and 27 on the base 2 and cylinder 1, respectively. The numeral 28 indicates a pump actuating cam which is tapered longitudinally and is connected to said shaft by a key 29 which causes it to rotate with said shaft, but permits the same to slide on said shaft. The sliding movements or adjustments of said cam 28 are controlled by a centrifugal governor which, as shown, comprises a head 30 carried by the said shaft, another head 31 connected to said cam, a pair of toggle levers 32 connecting said two heads, a pair of governor balls 33 carried by said toggle levers, and a spring 34 connecting said governor balls and yieldingly drawing the same toward the axis of the shaft 25. The numeral 35 indicates a water supply pipe that leads from a suitable source of water supply, such as an elevated tank, and opens into the plunger seat 17ª which is inward of the position occupied by the inner end of the plunger 23 when the latter is in its outermost position, as best shown in Fig. 5.

An exhaust port 36 opens from the outer lower portion of the cylinder 1 and, as shown, leads to an elbow 37 cast integral with said cylinder, and from thence to an exhaust pipe 38. The exhaust port 36 is normally closed by an exhaust valve 39, the stem 40 of which projects downward through the elbow 37 and is subject to a spring 41 that assists gravity in normally holding said exhaust valve closed. Pivoted at 42 to a projection of the base 2, is a bell crank lever 43, the lower arm of which normally underlies the lower end of the valve stem 40, and the upper arm of which is subject to a cam 44 carried by the shaft 25. The rear end of the shaft 25 is coupled to the engine crank shaft 4 by a pair of miter gears 45, so that said shaft 25 is given one rotation for each rotation of said crank shaft.

The cam 44 is arranged to open the exhaust valve 39 approximately at the time when the piston 10 begins its inward stroke and to permit the said exhaust valve to be closed by the spring 41 just before said piston has reached the said exhaust valve.

The sliding pump actuating cam 28 is arranged to act directly upon the outer end of the pump plunger 23, and it is so timed that it will move said plunger inward at or slightly before the piston has completed its inward stroke. The inner portion of the plunger seat 17ª and the entire chamber 18 will always be full of water. Hence, when the plunger 23 is moved inward, the water will be forced inward, the pressure of water against the admission valve 21 will force the said valve open and more or less water, depending on the extent of movement of said pump plunger, will be forced into the cylinder and directly against the hot generating tube 12. The water thus thrown against the generating tube in the form of a spray, will be instantly converted into steam and, hence, will act upon the piston to impart an outward or working stroke thereto.

The amount of water and, hence, the amount of steam generated under an inward movement of the pump piston as already stated, depends on the extent of movement given to said plunger, and the amount of this plunger movement depends on the position of the sliding cam 28 longitudinally of the shaft 25. The centrifugal governor operating on said sliding cam block 28 automatically controls the speed of the engine. More particularly stated, when the speed of the engine increases above the predetermined desired speed, the governor balls move further outward, thereby drawing the cam block 28 toward the said governor, so that its smaller diameter then operates upon the pump plunger 23, thereby shortening the stroke of said plunger and reducing the amount of water introduced into the cylinder per working stroke of piston, and hence, of course, decreasing the steam generation with the result that the speed of the engine will drop back to normal running speed. On the other hand, if the speed of the engine is decreased under increasing load, the spring 34 moves the governor balls nearer together, thereby sliding the cam block 28 away from the governor, so that its larger diameter will then operate on the pump plunger with the result that the plunger stroke will be increased, a greater amount of water will be introduced into the cylinder for each plunger stroke, and a greater steam generation will be produced for each working stroke of the piston.

By the arrangement above described, wherein the generation takes place directly in the cylinder, a maximum efficiency of the steam generated is produced, as the loss of heat due to radiation is thereby reduced to a minimum. Furthermore, the construction described is simple, easily constructed and maintained.

What I claim is:

1. The combination with a steam engine, of a generating tube extending into the cylinder of said engine with its main body portion exposed for generating action, means for forcing a hot blast into said tube, and means for intermittently introducing water into said cylinder and onto said tube, substantially as described.

2. The combination with a steam engine, of a generating tube extending into the cylinder of said engine with its main body por-

tion exposed for generating action and with its ends opening at the exterior of the cylinder, a burner positioned to direct a flame into one of the open ends of said generating tube, and means for intermittently introducing water into said cylinder and onto said generating tube, substantially as described.

3. The combination with a steam engine having a generating tube within its cylinder and provided with a valve-equipped exhaust port and means for operating the valve of said exhaust port with a properly timed action, of means for intermittently introducing water into said cylinder and onto said generating tube, comprising a water supply conduit terminating in an admission port, a spring-pressed valve normally closing said admission port, a pump plunger working in a seat which forms part of said water conduit, an engine driven shaft, a tapered cam carried by but slidable on said shaft and operating on said pump plunger, and a centrifugal governor carried by said shaft and operative to slide said cam block, and thereby vary the action of the latter on said pump plunger, substantially as described.

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

RICKARD E. DEAN.

Witnesses:
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C. B. MCNUTER.