(No Model.)

J. H. DUFFEY.

STEAM ENGINE RELIEF VALVE.

No. 333,616. Patented Jan. 5, 1886.

FIG. 1

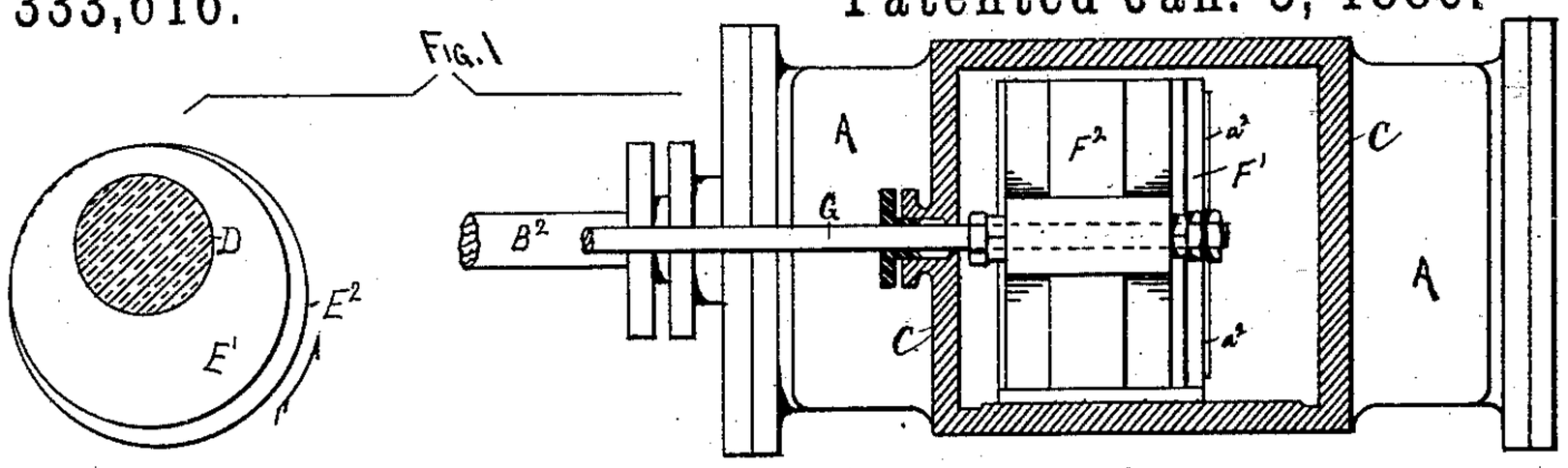


FIG. 3

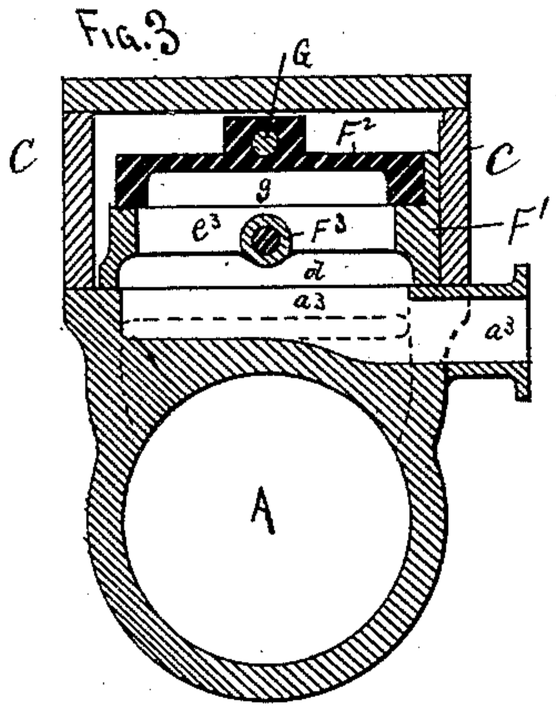


FIG. 2

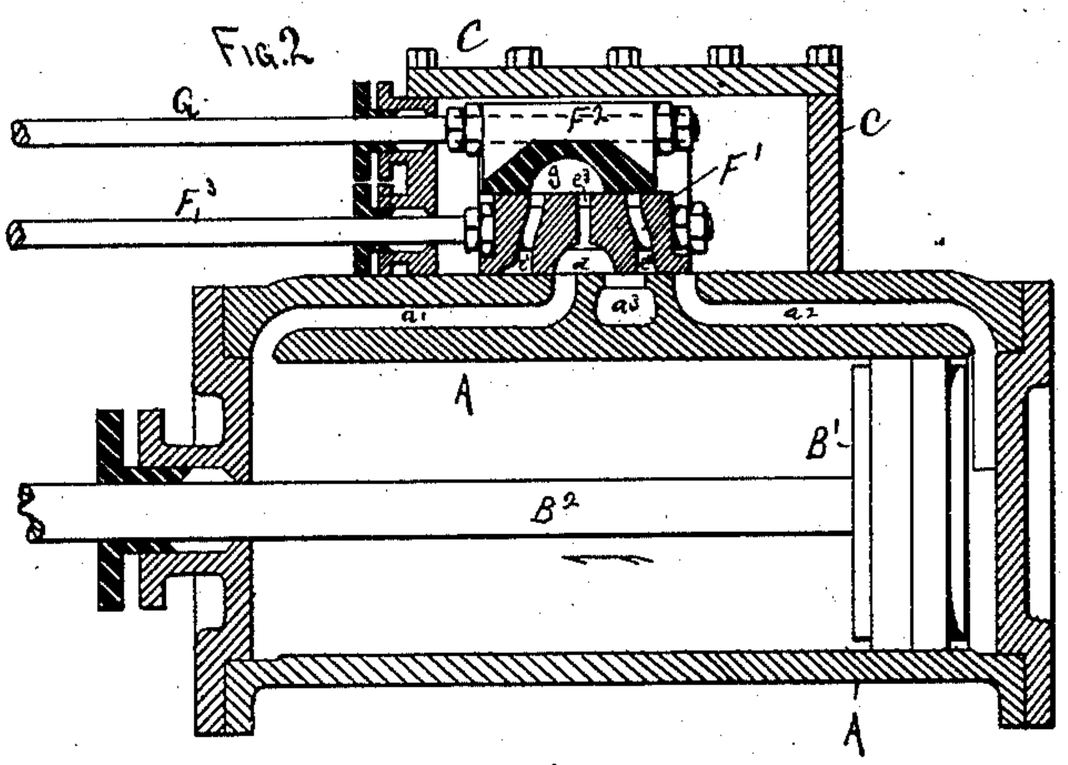


FIG. 5

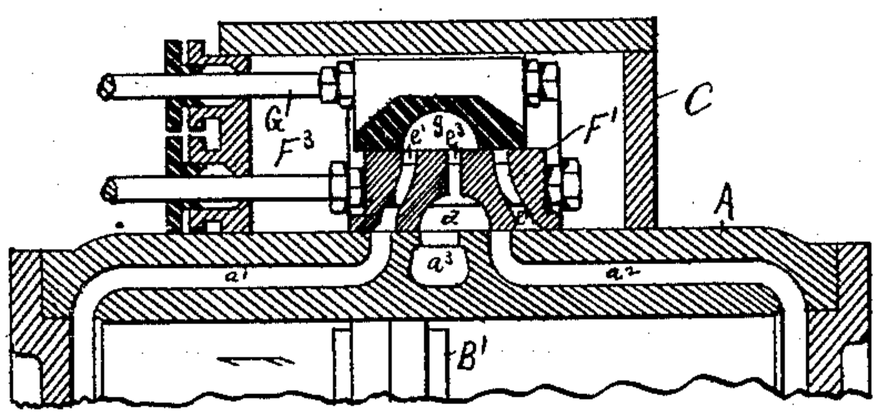


FIG. 4

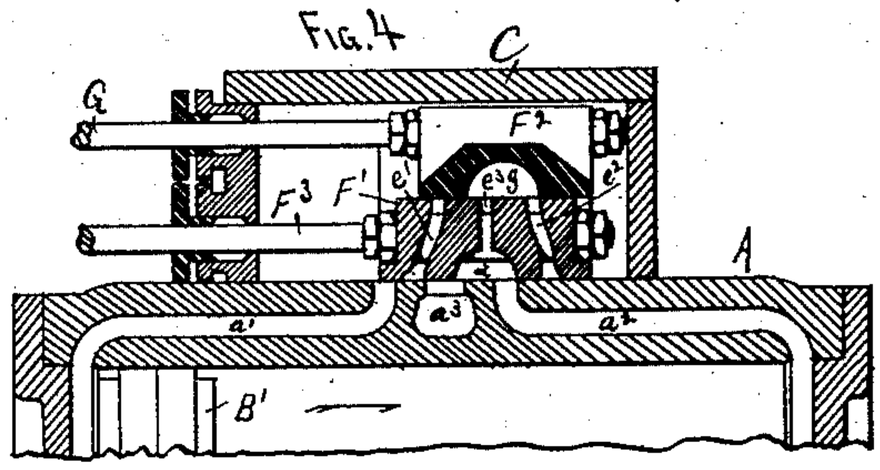


FIG. 6

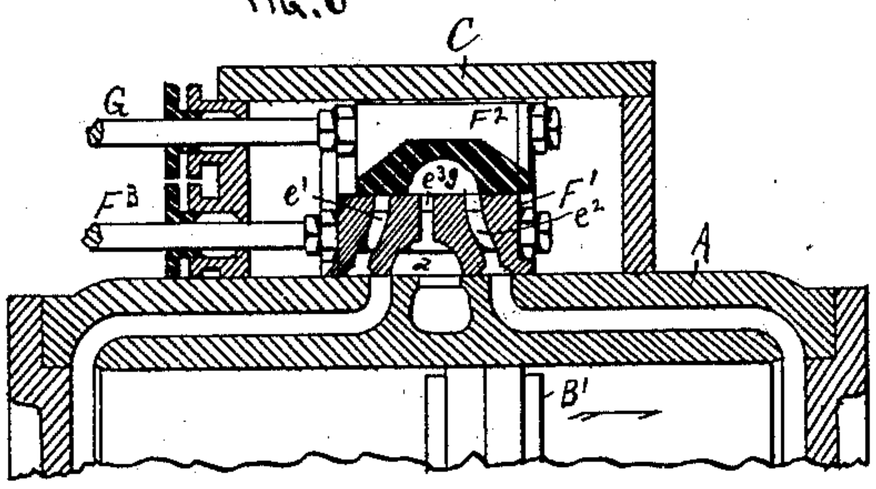


FIG. 7

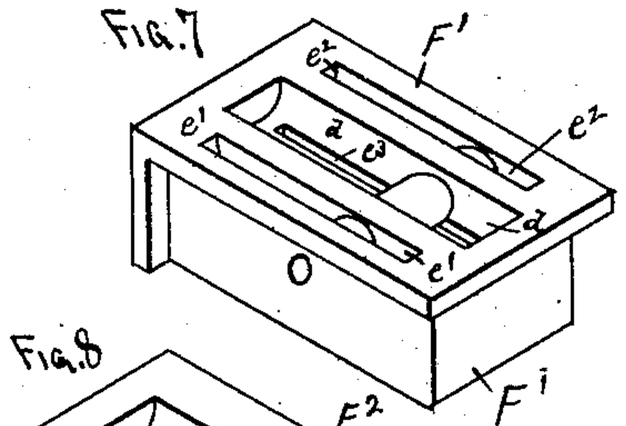
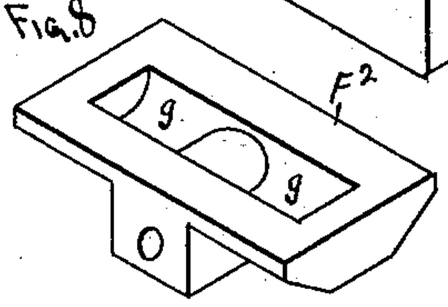


FIG. 8



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UNITED STATES PATENT OFFICE.

JAMES HENRY DUFFEY, OF ST. PAUL, MINNESOTA.

STEAM-ENGINE RELIEF-VALVE.

SPECIFICATION forming part of Letters Patent No. 333,616, dated January 5, 1886.

Application filed October 5, 1885. Serial No. 179,086. (No model.)

To all whom it may concern:

Be it known that I, JAMES HENRY DUFFEY, a citizen of the United States, and residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Steam-Engine Relief-Valves, of which the following is a specification.

This invention relates to steam-engines; and it consists in the arrangement of the valves by which steam is admitted to the cylinder, whereby the formation of back-pressure in the exhaust end of the cylinder is prevented and the expansive power of the steam used to a much greater degree, as hereinafter shown and described.

This invention may be applied to nearly all forms of engines; but for the purpose of illustration I have shown it in the drawings applied to an ordinary engine, the slide-valve of which is modified to adapt it to my invention.

In the drawings, Figure 1 represents a side view of the cylinder and steam-chest, the latter being in section, and a cross-sectional view of the driving-shaft with the two eccentrics in outline thereon. Fig. 2 is a sectional view through the cylinder and steam-chest, showing the position of the valves when the piston-head is at the extreme right end of its stroke. Fig. 3 is a cross-sectional view of Fig. 2 on a line through the exhaust port and valves. Fig. 4 is a view similar to Fig. 3, showing the position of the valve when the piston-head is at the extreme left end of its stroke. Fig. 5 is a view similar to Fig. 4, showing the position of the valves when the piston is a little past its center toward the left, and Fig. 6 is a similar view showing the position of the valves when the piston is a little past the center toward the right. Figs. 7 and 8 represent perspective views of the two valves reversed.

In Figs. 2, 4, 5, and 6 small arrows are shown to indicate the direction in which the piston is traveling.

A represents the cylinder, B′ the piston-head, B^2 the piston-rod, a' a^2 the steam-ports, a^3 the exhaust-port, and C the steam-chest, all formed and arranged as in an ordinary slide-valve steam-engine.

I have not shown the slides, cross-head, connecting-rod, engine-frame, &c., as their construction is so well known as to need no illustration; but at the left of Fig. 1 I have shown a cross-sectional view of the main driving-shaft D, with two eccentrics, E′ E^2, in outline thereon, my improved arrangement of valves requiring two eccentrics.

F′ represents the slide-valve, having the usual exhaust-cavity, *d*, on its under side, and adapted to be moved back and forth by a stem, F^3, connecting it with the eccentrics E′ on the main driving-shaft D. (See Fig. 1.) The slide-valve F′ differs from an ordinary slide-valve by being provided with side ports, e' e^2, one on each side of the exhaust-port *d*, and with a central port, e^3, leading from the exhaust-cavity *d* back through the body of the valve between the ports e' e^2, as shown. The back of the valve F′ is provided with a steam-tight face, and upon this back face another valve, F^2, is adapted to be vibrated by a stem, G, connecting it with the second eccentric, E^2, on the shaft D. (See Fig. 1.) The throw of the eccentric E^2 is a little greater than the throw of the eccentric E′. In an engine of ten-inch bore and twenty-inch stroke this difference is about one-half an inch, but may be varied to suit circumstances. The valve F^2 is provided with a cavity, *g*, in its under side, wide enough to cover the ports e' e^3 or e^2 e^3, but not wide enough to cover all three of the ports e' e^2 e^3 at once.

After an engine exhausts, the exhaust end of the cylinder is filled with heated air and steam under a pressure equal to or slightly in excess of the atmosphere, and when the slide-valve F′ is moved over to cut off the steam on the steam end of the cylinder it also cuts off the exhaust or closes the connection between the exhaust-port a^3 and the steam-port a' or a^2, (which for the time being happens to be at the exhaust end of the cylinder,) leaving the exhaust end of the cylinder full of air and without means of escape, which air the piston-head in the completion of its stroke compresses very suddenly, forming what is known as "back-pressure," which greatly retards the engine and requires a greater pressure of steam on the other side of the piston to move it than would be required if this back-pressure were not present.

To form a means of escape for the air in the

exhaust end of the cylinder, and to prevent the possibility of the formation of back-pressure therein, is the function of the supplemental valve F^2 and the ports $e' e^2 e^3$ in the valve F'. This action is clearly illustrated by the different figures of the drawings.

In Fig. 2 the valve F' is shown just opening to admit steam to the right hand end of the cylinder, while the exhaust-port a^3 is open, the valve F^2 and its ports $e' e^2 e^3$ at this point being inactive, as will be readily seen.

In Fig. 4 the relative positions of the valves are shown in the reverse position, representing their positions at opposite points of the stroke from that shown in Fig. 3.

In Fig. 5 the valve F' is shown after it has been moved far enough to cut off the steam to utilize its expansive power, which movement in an ordinary valve also cuts off the exhaust-escape; but in my arrangement the movement of the valve F' brings the port e' above the port a', and the eccentric E^2 will move the valve F^2 so that its cavity g will connect the ports e' and e^3, and thus open communication with the outer air through the ports a', e', e^3, d, and a^3, or, in other words, prevent the cutting off of the exhaust-ports a^3 from the exhaust end of the cylinder.

Fig. 6 shows the arrangement of the valves at the opposite point of the stroke from that shown in Fig. 5, both ends of both valves being the same except for the slight differences the "lap" and "lead" of the valves may render necessary.

By this simple device I entirely prevent the accumulation of confined air in the exhaust end of the cylinder, leaving the piston free to move without resistance, and am consequently enabled to utilize to a much greater extent the expansive force of the steam, as an engine provided with this relief-valve F^2 can be set to cut off at an earlier moment of its stroke than an engine provided with the ordinary valve only.

Having thus described my invention, what I claim as new is—

In a steam-engine, a cylinder having the steam-ports $a' a^2$, exhaust-port a^3, and piston B', a valve, F', having exhaust-cavity d, side ports, $e' e^2$, and central port, e^3, and adapted to be moved back and forth to alternately open and close said steam and exhaust ports, and a relief-valve, F^2, having cavity g and adapted to be moved back and forth over said valve F' to connect its cavity g alternately with said ports $e' e^3$ and $e^2 e^3$, whereby communication is opened between said exhaust-port a^3 and the exhaust end of said cylinder to prevent the formation of back-pressure therein.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JAMES HENRY DUFFEY.

Witnesses:
C. N. WOODWARD,
H. S. WEBSTER.