3 Sheets—Sheet 1.

J. MONTGOMERY.

Steam Engine.

No. 108,718. Patented Oct. 25, 1870.

FIG. 1.

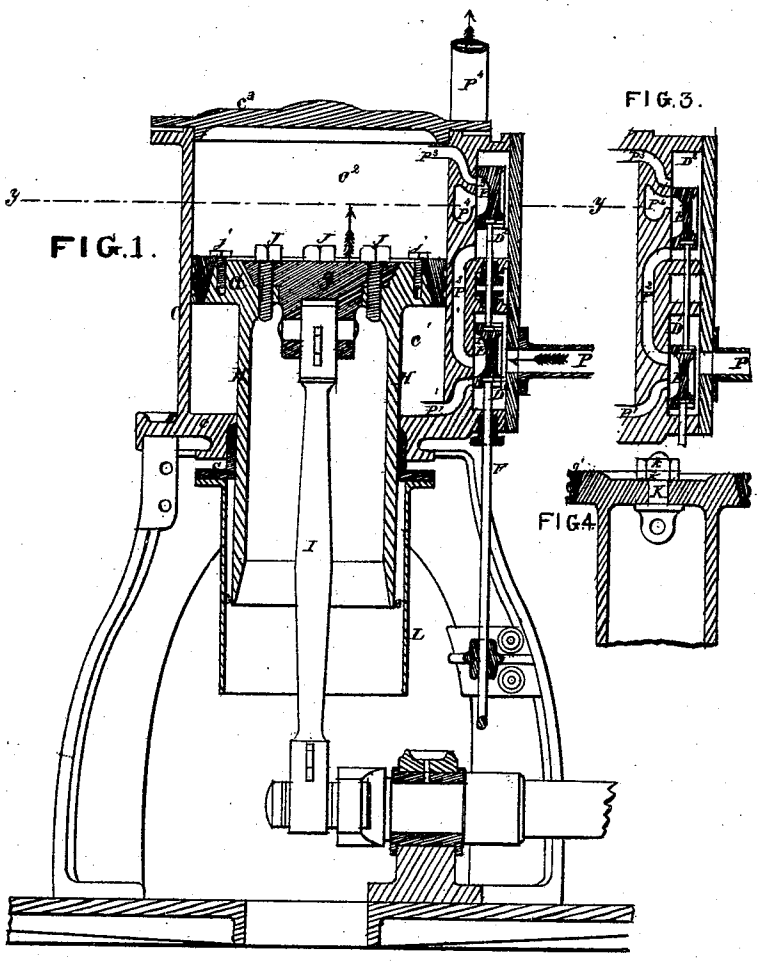
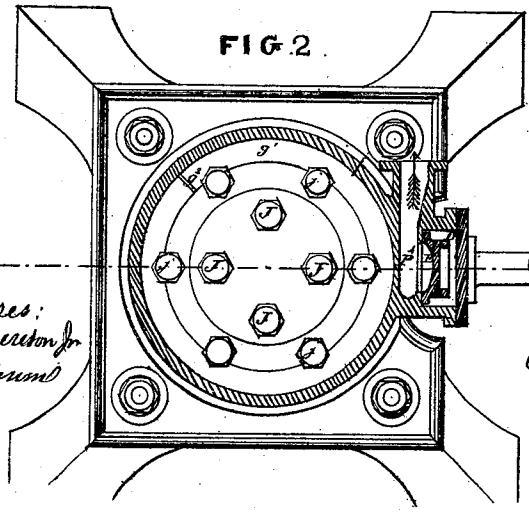


FIG. 3.

FIG. 4

FIG. 2



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3 Sheets—Sheet 2.

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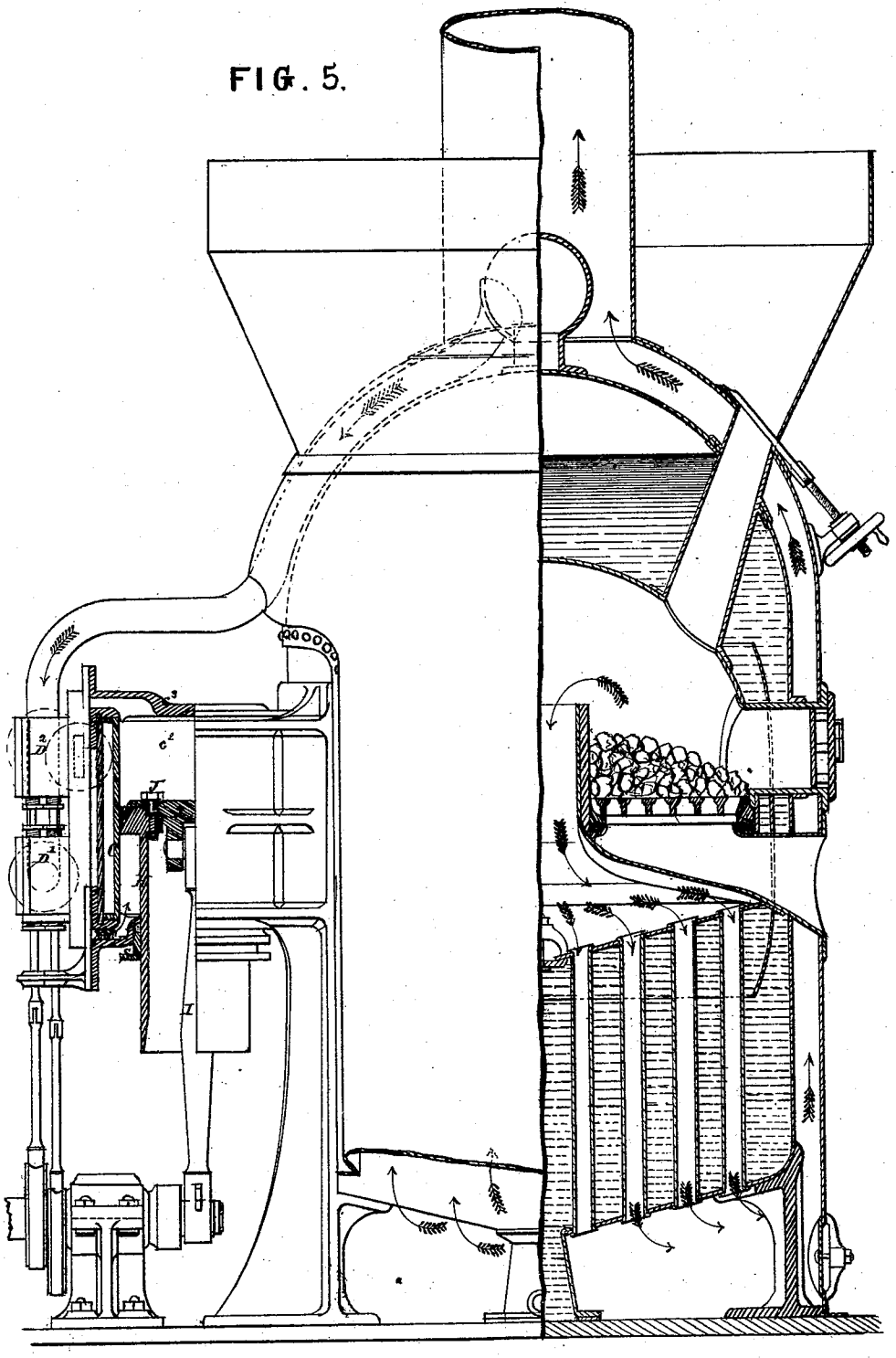
FIG. 5.



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3 Sheets—Sheet 3.

J. MONTGOMERY.

Steam Engine.

No. 108,718. Patented Oct. 25, 1870.

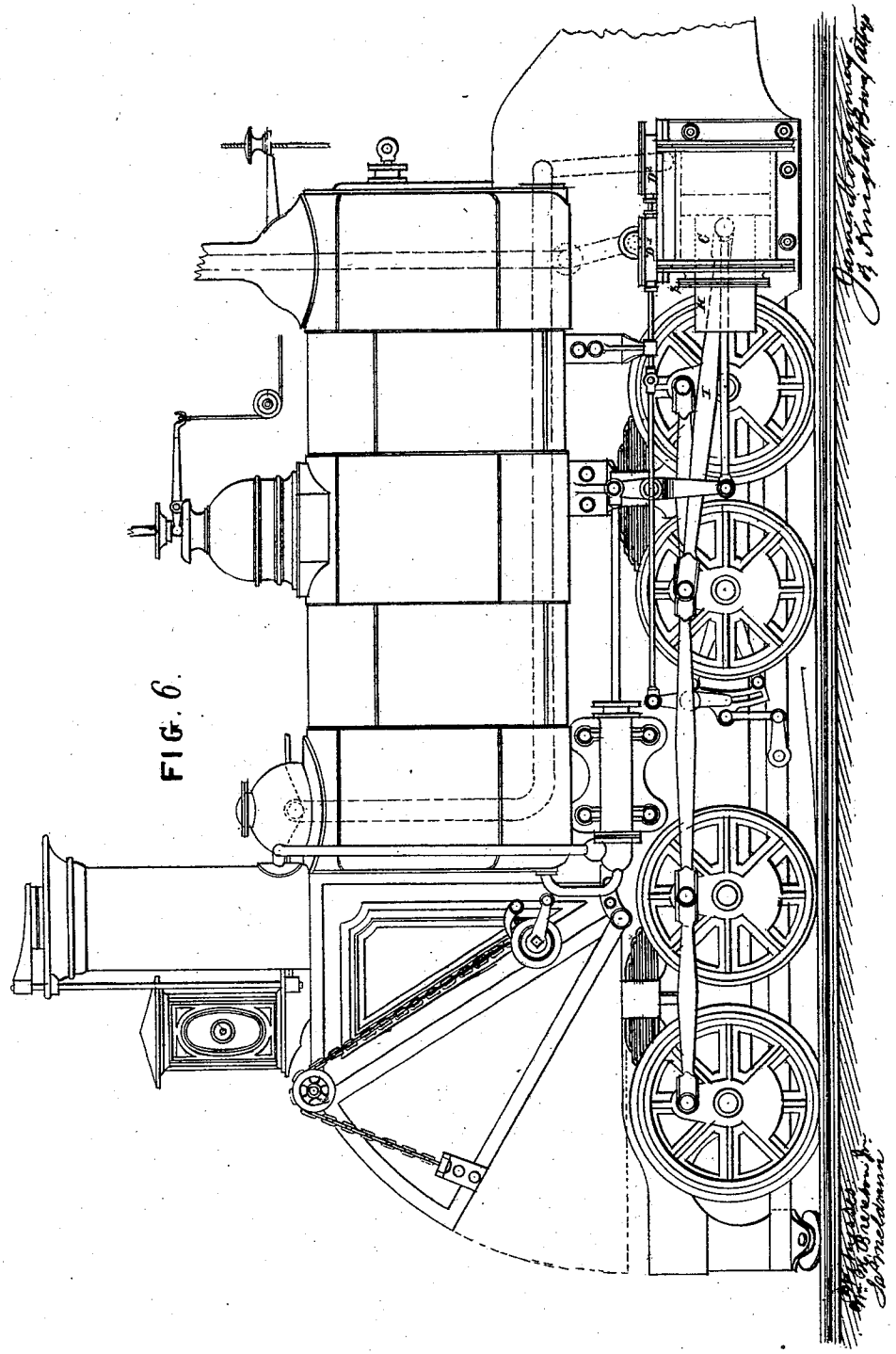

FIG. 6.

UNITED STATES PATENT OFFICE.

JAMES MONTGOMERY, OF NEW YORK, N. Y.

IMPROVEMENT IN STEAM-ENGINES.

Specification forming part of Letters Patent No. **108,718**, dated October 25, 1870.

To all whom it may concern:

I, JAMES MONTGOMERY, of the city, county, and State of New York, have invented certain new and useful Improvements in Steam-Engines and their accessories, of which the following is a specification.

Nature and Objects of the Invention.

The subject of the first part of my invention is a combined high and low-pressure steam-engine, in which a body of steam may be worked expansively twice in one cylinder, by the aid of a duplex arrangement of steam-chests and valves, as hereinafter described.

My invention consists, second, in an improved construction of steam-piston, which, when the free head of the cylinder is removed, admits of taking the said piston to pieces and removing the pitman, or of readily tightening up the piston by means of simple tap-bolts.

My invention consists, third, in making the center of the piston, or other part thereof to which the connecting-rod is attached, removable by means substantially as hereinafter set forth.

My invention consists, fourth, in a duplex arrangement of valve-gear and steam-chests upon one cylinder, for the purpose of admitting steam at one end of the said cylinder, conducting it to the other end, and thence exhausting it.

My invention consists, fifth, in a hollow metallic shield surrounding the hollow piston-rod, to protect it from dust and from cold air.

My invention consists, sixth, in an improved manner of constructing and applying a packing-ring to keep the piston tight within the cylinder.

Description of the Accompanying Drawing.

Figure 1 represents a vertical longitudinal section of an overhead engine, the line *x x*, fig. 2, indicating the plane of section.

Figure 2 represents a horizontal or transverse section of the same at *y y*, fig. 1.

Figure 3 represents a longitudinal section through the steam-chests, valves, and steam-ports, showing the valves in a different position.

Figure 4 represents a longitudinal section of piston, illustrating a modification in its construction and in the mode of attaching the connecting-rod.

Figure 5 represents, in part, an end elevation and, in part, a vertical section of a marine-engine and its accessories illustrating my invention, the boiler being constructed in the manner described in Letters Patent No. 27,922, granted to me on the 17th day of April, 1860.

Figure 6 is a side elevation of a locomotive, illustrating the application of my invention.

General Description.

My engine may be mounted upon a bed-plate, or bolted to the side of a horizontal or vertical boiler of any proper construction.

To the cylinder C are attached two valve-chests, D^1 D^2, containing valves E^1 E^2, which are operated by a rod, F, by any suitable mechanism, and control the ports and passages P P^1 P^2 P^3 P^4, in the manner hereinafter explained.

To the piston G is attached a hollow piston-rod, H, of very large diameter, working through a stuffing-box, S, in the head *c* of the cylinder C, so that the steam in the front end of the cylinder will be confined to an annular space, c^1, having a working area on the piston, which, for use with high-pressure steam, may be equal to about one-third the area of the entire rear face of the piston.

For economy and reliability the piston G and hollow piston-rod H may preferably be cast in one piece.

The connecting-rod or pitman I passes within the hollow piston H, and is connected with the piston G, either directly to the central part *g* thereof, as shown in fig. 1, or through the medium of a yoke or connecting-bolt K and nuts *k k'*, as shown in fig. 4.

Under the construction last described the yoke K, with the pitman I, may be readily removed from the piston by taking off the rear head c^3 of the cylinder and unscrewing the nuts *k k'*.

If preferred, the center *g* of the piston may be made separately from the outside, the two parts going together with an oblique joint, and being secured by tap or other bolts J, fig. 1.

This figure also illustrates my mode of fitting the piston tightly to the cylinder, either

in the original construction of the parts, or when the piston has become loose by wear. The periphery is either originally cast or subsequently turned in the conical form represented, and a case-hardening ring, g', is fitted thereto and tightened by means of bolts j. This ring may be cut obliquely in a common manner, and the cut g^2, fig. 2, filled with metal wedged into it, a thicker plug or wedge being substituted when a further expansion is necessary.

L represents a hollow metallic shield, constructed preferably in two parts, attached to the stuffing-box S so as to be removable therewith, and employed to cover the hollow piston-rod H and prevent its surface becoming coated with dust or other impurities, or cooled by currents of air. This shield is of especial value in the application of my invention to locomotive-engines.

To prevent radiation of heat, and consequent condensation of steam, I line the interior of the hollow piston-rod H, and wrap the exterior of the shield L with felt or other proper material, and I also apply a soft rope of spun yarn, or some other loose packing, between the piston-rod and shield, to prevent the circulation of air between them.

Operation.

In the various views the piston is represented at about one-half stroke, the steam, admitted from the boiler through the passages P P^1 into the annular space c^1, having been cut off so as to work expansively within the said annular space. The steam in the space c^2, at the rear end of the cylinder, is now exhausting through the passages P^3 P^4. As soon as the forward movement of the piston is completed the valve E^1 moves far enough to throw the port P^1 into communication with the port P^2, admitting the high-pressure steam within the annular space c^1 to the steam-chest D^2, the boiler steam in the steam-chest D^1 being still cut off from the engine. This position of the valve is shown in fig. 3.

At the same moment the valve E^2, while still covering the exhaust-port P^4, uncovers the port P^3, throwing it in communication with the steam-chest D^2, so that the expansive force of the steam in the annular space c^1 and steam-chest D^2 is now exerted upon the entire area of the rear face of the piston. This area, being much greater than that of the annular surface of the front side of the piston upon which the steam acts, causes the piston to move in the opposite direction, performing its return stroke. In other words, the pressure in the spaces c^1 c^2 being now equalized, the effective force exerted upon the rear face of the piston by this pressure will be nearly equal to the excess of the said pressure over that of the atmosphere multiplied by the area of the central portion of the piston and the connecting-rod, which on the front side are under atmospheric pressure only.

The return stroke of the piston being completed, the valves are moved back, so as to completely close the steam-chest D^2, open the port P^1 to the steam at boiler pressure within the steam-chest D^1, and connect the port P^3 with the exhaust-port P^4.

The forward stroke is then produced by the pressure of steam within the space c^1 acting on the annular working-face of the front side of the piston, as already explained.

The attenuated steam in the space c^2 has now almost entirely lost its expansive force, but its remaining heat may be utilized by exhausting it into a tank or other receptacle or conductor of feed-water.

This engine is applicable to locomotive, marine, manufacturing, and all other purposes where motive-power is required, and it may be arranged as an overhead engine, as shown in fig. 1, or mounted on its own plate, or attached to the side of a boiler, as before stated.

The vertical form of boiler is valuable for some locomotive purposes, and especially for the class known as "dummy engines," the necessity for a skilled engineer to work the engine being entirely avoided, the supply of fuel being automatic, and the starting, stopping, and reversing-gear being of the most simple character.

Among the advantages of my invention the following may be named:

First, it allows a far greater expansion of steam in a single cylinder than is attainable with common double-acting engines. This is of especial importance in marine-engines, where it is desirable to work the steam expansively to its utmost limit.

Second, it requires far less steam for the reason stated, as a double stroke, or one full revolution, is made with one volume of steam, and this volume, being cut off short in the annular steam-space, is worked by expansion successively at both ends of the cylinder.

Third, this engine will not work with an unequal or jerking motion, as is the case with many other engines, and especially with marine-engines, when arranged to cut off near the beginning of the stroke, so as to produce much greater force at the beginning than at the end of the stroke. This great inequality of force is prevented by the arrangement I have described of working the steam successively at high and low pressure on opposite sides of the piston.

Claims.

I claim as my invention—

1. The combination of the duplex steam-chests D^1 D^2 and valves E^1 E^2, arranged and operating substantially as described, so as to insure that the steam will be expanded twice in the same cylinder.

2. In a steam-engine constructed with a trunk or hollow piston-rod, the piston constructed substantially as herein described, with means for attaching the pitman remov-

ably to its central part, and with a wedge-shaped ring on its periphery for packing or tightening it within the cylinder, in the manner explained.

3. The combination of the pitman I with a removable part, J, either attached to or constituting the center of the piston G, substantially as and for the purposes set forth.

4. The combination of the double steam-chests D^1 D^2 and valves E^1 E^2, arranged to operate substantially as described.

5. The shield L, applied substantially and for the purposes set forth.

6. The peculiar packing-ring, in combination, with the set-screws *j j*, shown in fig. 1, all as and for the purpose made known.

JAMES MONTGOMERY.

Witnesses:

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