(No Model.) 2 Sheets—Sheet 1.

J. T. HALSEY.

STEAM ENGINE.

No. 544,298. Patented Aug. 13, 1895.

FIG. 4.

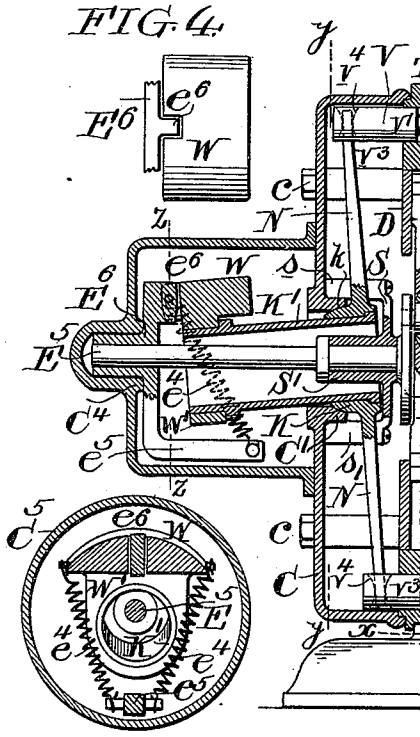


FIG. 1.

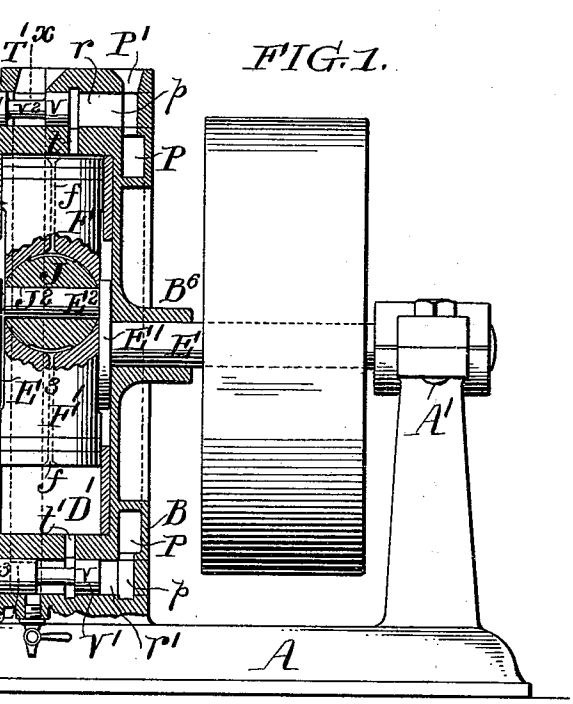
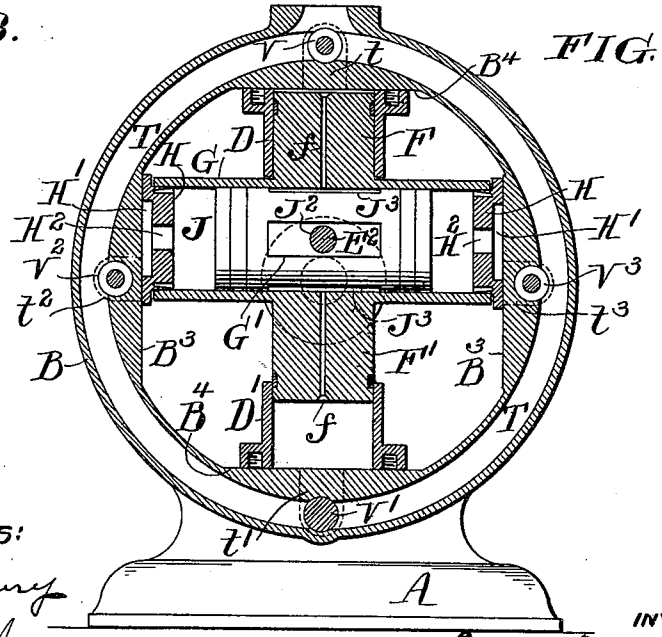


FIG. 3.

FIG. 2.



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(No Model.) 2 Sheets—Sheet 2.

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FIG. 5.

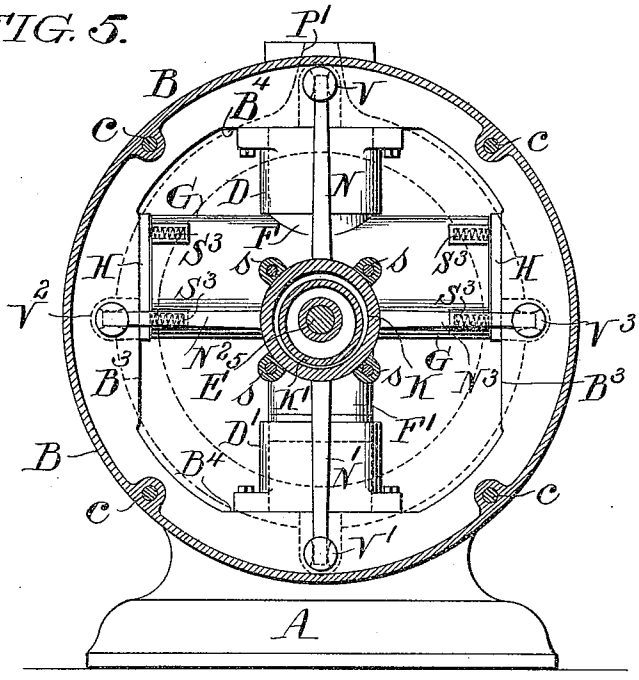


FIG. 6.

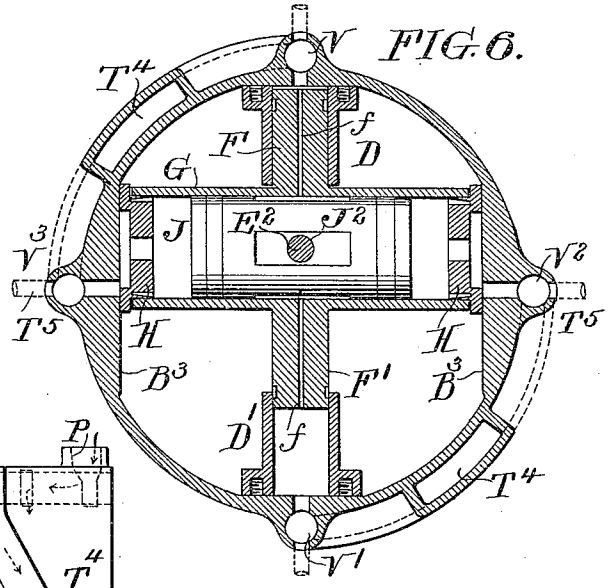


FIG. 8.

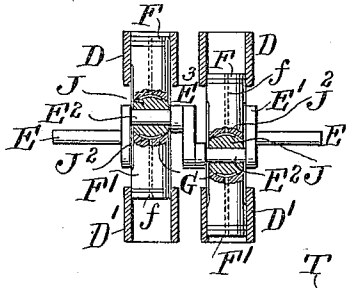
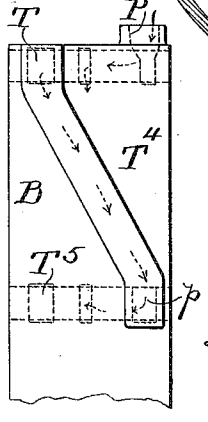


FIG. 7.



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UNITED STATES PATENT OFFICE

JAMES T. HALSEY, OF PHILADELPHIA, PENNSYLVANIA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 544,298, dated August 13, 1895.

Application filed July 28, 1894. Serial No. 518,851. (No model.)

To all whom it may concern:

Be it known that I, JAMES T. HALSEY, a citizen of the United States, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Steam-Engines, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My invention relates to steam-engines, and has for its object to provide a very compact and efficient engine which, while it produces a very great speed, will be perfectly balanced and free from the wear which has heretofore been the great objection to this class of motors.

My invention will be best understood as explained in connection with the accompanying drawings, in which—

Figure 1 is a central vertical section of an engine constructed according to my invention. Fig. 2 is a section on the line $x\ x$ of Fig. 1. Figs. 3 and 4 illustrate details of the valve-actuating mechanism. Fig. 5 is a section on the line $y\ y$ of Fig. 1. Fig. 6 is a view illustrating a modified form where the cylinders are made of different sizes so as to make a compound engine. Fig. 7 is a side view of a portion of the casing shown in Fig. 6, showing the conduit for the steam extending from the exhaust-port of one cylinder to the inlet-port of another; and Fig. 8 is a view illustrating two engines operating on the same shaft, so as to do away with all vibration and make a perfectly-balanced engine.

In the construction shown in Fig. 1, A is a suitable base having a bearing A′ for the shaft E and covering the case B of the engine. Where small and light engines are employed for running portable drills or other similar services, the base A, of course, may be dispensed with and the shaft of the engine connected in any suitable way with the drill. The case B has suitable bearing-faces B^3 B^4, as best shown in Figs 2 and 5. Secured against the faces B^4 are cylinders D D′ arranged opposite to each other.

F F′ are pistons adapted to reciprocate cylinders D D′ respectively.

G is a cylinder secured to the pistons F F′.

J is a piston adapted to reciprocate in the cylinder G.

H H are heads which close the ends of the cylinder G, and which are adapted to bear against the slide on the faces B^3 of the case. The heads H have preferably formed in them recesses H′, somewhat smaller than the internal area of the cylinder G, and passages H^2 leading into said cylinders, the effect of which is to substantially balance the head. The pressure of the motive fluid within the cylinder G against the heads H will, however, be greater than the counterbalancing pressure in the recesses H′, and will, therefore, tend to hold the heads H against their bearing-faces B^3. If desired, suitable springs S^3, arranged in sockets on the cylinder G, may be arranged so as to bear against the heads H and keep them in engagement with their bearing-faces when there is pressure of steam or the motive fluid acting against the head.

Piston J is provided with a bearing at J^2 in which turns a crank-pin E^2, which is connected by means of the crank-plate E′ to the shaft E. This pin, as has been said, turns in the piston J and reciprocates in a slot G′ in the cylinder G.

In order to balance the engine, I provide recesses J^3 J^3, preferably of the same size as the interior area of the cylinders D D′, and provide conduits for the passage of motive fluid from the steam-spaces of these cylinders to the recesses. These conduits are very conveniently formed by means of perforations f in the pistons F F′, as shown. This much of my engine is substantially the same as that shown in my application, Serial No. 467,311, filed March 23, 1893. The arrangement of the valves for admitting motive fluid to and permitting its escape from the cylinders and the valve-gear for operating these valves has been changed, so as to form a much easier running and more easily regulated engine, and especially to reduce the clearance space.

The valve-chests r r' r^2 r^3 are arranged beyond the ends of the cylinders and are preferably parallel to the direction of the shaft. The valves V V′, &c., arranged in these chests, are preferably piston-valves, and, as shown, consist of pistons v v' connected by a rod v^2.

To operate the valves, I preferably employ the valve-gear best shown in Figs. 1 and 5. N N′, &c., are arms, the ends of which are connected to the valves V V′, &c. This con-

struction may very conveniently be formed by making a slot v^4 in the rear end v^3 of the valves into which the ends of the arms extend. The arms are secured to a hub K, which has a rounded face k. A correspondingly-shaped bearing C′ serves to support this hub K, which has therefore a free motion in the manner of a universal joint on the bearing C′. The pressure of the live steam or other motive fluid against the valves V V′, &c., serves to hold the hub K to the bearing C′, and it will also be noticed that as the valves are arranged opposite each other the pressure on one will balance that on the opposite one—that is, the pressure on the valve V will balance that on the valve V′—so that the valve-gear has simply to overcome the friction of a valve in its seat and does not have to move any of the valves against steam-pressure.

Secured to the hub K is a sleeve K′, to the end of which an eccentric is connected, which serves to operate the sleeve K′, so as to give a wabbling motion to the hub K and the arms N N′ secured thereto, and these arms give the valves a reciprocating motion in their chests.

As shown, the crank-pin E^2 is connected to a plate E^3 very similar to the crank-plate E′ and the plate E^3 is carried by a shaft E^5, which is in line with the shaft E, and of course, revolves with it, being connected to the crank-pin E^2. On the end of the shaft E^5 is secured a guide-hub E^6, which carries on one side a guide-feather e^6 and on the other a finger e^5. Sliding in and out with the feather and revolving with the shaft E^5 is a weight W, which is drawn inwardly toward the shaft by means of a suitable spring or springs secured to the finger e^5, as shown. Connected to the weight W is a ring W′, which surrounds the sleeve K′ and serves as an eccentric to operate it. This ring W′ and weight W are normally in the position shown in Fig. 3, and when in this position will operate to give the valves their greatest throw. When the weight is thrown outwardly against the force of the spring on the too rapid revolution of the shaft it will draw the eccentric-ring more nearly concentric with the shaft and reduce the motion of the sleeve and consequently the throw of the valves.

The live steam or other motive fluid enters at P′.

P is a conduit or passage for steam, preferably cast in the case B and extending preferably all around the engine, and p are ports leading from this steam-passage into each valve-chest.

T is an exhaust-passage, also conveniently cast in the case and having ports leading to each valve-chest.

$t\ t'\ t^2\ t^3$ are ports leading respectively from the chests $r\ r'\ r^2\ r^3$ to the cylinders D D′ and the two ends of the cylinders G. This construction of passages is very convenient, and as the ports $t\ t'$, &c., are very short there will be but small clearance space. Of course any other system of steam-conduits can be provided, if desired.

A very important feature in my construction is the casing which incloses the valves and gear. The case B is a sort of box-case inclosing the operative parts of the engine proper, and has no opening on the side opposite the valve-gear through which steam could leak, except the bearing B^6 for the shaft E. As this is a bearing for a rotating shaft there is no difficulty in providing a steam-tight packing at this point. On the side of the engine opposite the bearing B^6 is the valve-gear, and the valves also project out from their chests so as to be connected to the arms N N′, &c. To prevent the escape of motive fluid on this side I provide a casing C, which is either made in one piece, or two pieces, as shown, and which is secured to the case B by any suitable means, as bolts c. This casing carries a bearing for the hub K, and also at C^4 a bearing for the rear end of the shaft E^5.

I also provide at S a plate against which the crank-plate E^3 bears, and secured to the plate S is a bearing S′ for the shaft E^5.

$s\ s$ are bolts or pins which carry the plate S.

In operation steam is admitted to the pistons successively, and they operate to rotate the shaft E. All of the friction of the cylinder G and the piston J, where almost the entire wear comes, is taken up by the balancing-steam in the recesses J^3. There will be some steam, or some of any other motive fluid which may be employed, which will leak past the packing on the pistons and escape into the space inclosed by the case B and casing C, by which the engine is inclosed. This steam cannot escape farther however, and the pressure in the casings at last becomes almost that of the high-pressure fluid, so that there will be, after this pressure is reached, little, if any, tendency of the motive fluid to leak, either around the pistons or around the piston-valves. This pressure in the chamber inclosed by the casings does not in any way impede the free action of the parts since each piston, as F F′, advances into the inclosed space exactly as much as the other one retires.

In Fig. 6 I have shown the cylinders D and D′ of a size different from that of the cylinder G, in the present case smaller, so that the engine can be operated as a compound engine.

$T^4\ T^4$ are conduits leading from the exhaust-ports T of the cylinders D D′ to the inlet-ports p of the cylinder.

T^5 indicates the final-exhaust conduits.

I also contemplate in some cases providing the shaft E with two or more cranks, and operating each crank by an independent engine, of the character shown in Fig. 1. Such a construction is shown in Fig. 8, where the two cranks shown are preferably set at an angle of one hundred and eighty degrees, one from the other. Obviously one of these independent engines could be made larger than the other and the steam exhausted from the en-

gine with smaller cylinders employed as the motive fluid for the smaller. This construction, where two or more engines operate on the same shaft, makes a very well balanced motor.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an engine, the combination of the oppositely arranged cylinders D D′, the cylinder G, pistons F F′ attached to the cylinder G and working in the cylinders D D′, a piston J fitting in the cylinder G and having recesses J^3 of substantially the same area as the heads of the pistons F F′ arranged as described, a bearing J^2 in said piston, a crank pin turning in said bearing, passages for putting the recesses J^3 in communication with the steam spaces of the cylinders D D′, valve chests *r r′* &c., arranged beyond the ends of the cylinders, ports *t t′* &c., leading therefrom to the cylinders, and valves operating in said chests and adapted to govern the flow of motive fluid to and from said cylinders.

2. In an engine, the combination of the oppositely arranged cylinders D D′, the cylinder G, pistons F F′, attached to the cylinder G and working in the cylinders D D′ and having perforations *f*, a piston J fitting in the cylinder G and having recesses J^3 of substantially the same area as the heads of the pistons F F′ arranged, as described, to communicate with the perforations *f*, a crank pin turning in a suitable bearing in the piston J, valve chests *r r′* &c., arranged beyond the ends of the cylinders, piston valves adapted to reciprocate therein and passages *t t′* &c., leading from the valve chests to the several cylinders.

3. In an engine, the combination with the oppositely arranged cylinders D D′ of the cylinder G, pistons F F′ connected to the cylinder G and operating in the cylinders D D′, a piston J in the cylinder G, and means to balance it substantially as described, piston valves V V′ &c., arms N N′ &c., connected to the valves and means for actuating the arms, substantially as and for the purpose specified.

4. In an engine, the combination of the oppositely arranged cylinders D D′, the cylinder G, pistons F F′ connected to the cylinder G and operating in the cylinders D D′, a piston J in the valve G and means to balance it substantially as described, valve chests *v v′* &c., arranged at the ends of the cylinders, ports *t t′* &c. opening from said chests to the cylinders, valves V V′ &c. arranged in the chests, arms N N′ connected to the valves, and means for actuating the arms, substantially as and for the purpose specified.

5. In an engine, the combination of the oppositely arranged cylinders D D′, the cylinder G, pistons F F′ operating in the cylinders D D′ respectively, and connected to the cylinder G, a piston J in said cylinder, means to balance it as described, valves V V′ for governing the flow of motive fluid to and from the cylinders, arms N N′ connected to the valves, means for operating the arms, and a governor for altering the movement of the arms and so regulating the throw of the valves for the purpose of regulating the speed of the engine.

6. In an engine, the combination of the oppositely arranged cylinders D D′, the cylinder G, pistons F F′ operating in the cylinders D D′ respectively, and connected to the cylinder G, a piston J in said cylinder, means to balance it as described, valves V V′ for governing the flow of motive fluid to and from the cylinders, arms N N′ connected to the valves, a hub K to which the arms are secured, a sleeve K′ secured to the hub and a suitable eccentric for giving the proper motion to the sleeve K′ and through the hub K and arms N N′ &c. to the valves.

7. The combination in an engine of oppositely arranged cylinders D D′, pistons F F′ operating therein, a cylinder G to which the pistons F F′ are connected, a piston J having recesses J^3 J^3 arranged in the cylinder G, a steam connection from the steam spaces of the cylinders D D′ to the recesses J^3 of the piston J, valves V V′ &c., arranged substantially as described and a valve gear consisting of the arms N N′ &c., hub K, sleeve K′, and eccentric W′ for actuating said valves.

8. The combination in an engine of oppositely arranged cylinders D D′, pistons F F′ operating therein, a cylinder G to which the pistons F F′ are connected, a piston J having recesses J^3 J^3 of substantially the same area as the heads of the pistons F F′ arranged in the cylinder G, a steam connection from the steam spaces of the cylinders D D′ to the recesses J^3 of the piston J, valves V V′ &c. arranged substantially as described, a suitable valve gear for actuating said valves and a casing inclosing the valve gear substantially for the purpose specified.

9. In an engine, the combination with the oppositely arranged cylinders D D′, cylinder G, pistons F F′ operating in the cylinders D D′ respectively, and connected to the cylinder G, a piston J adapted to reciprocate in said cylinder, a crank pin E^2 turning in a bearing in said piston, valves V V′ &c., for governing the flow of motive fluid to and from the cylinders, arms N N′ &c., secured to a hub K and connected to the valves V V′ &c., a sleeve K′ secured to the hub K, a ring W′ adapted to surround the sleeve K′ and actuate it so as to operate the valves, and a weight W connected to the ring and adapted to change its position, and consequently the throw of the valves.

10. An engine consisting of two sets of cylinders D D′, pistons adapted to reciprocate in each cylinder, cylinders G, each of which is connected to the pistons operating in one set of cylinders D D′, pistons J J, one in each cylinder G, having recesses J^3 of substantially the same area as the heads of the pistons op-

erating in the cylinders D D′, steam connections from the steam spaces in the cylinders D D′ to the recesses J^3 of each piston J and a shaft E having a number of cranks, the pins E^2 of which turn in the bearings J^2 of the pistons J substantially as described.

11. In an engine, the combination with the oppositely arranged cylinders D D′, a cylinder G, pistons F F′ connected to the cylinder G and adapted to operate in the cylinders D D′ a piston J operating in the cylinder G provided with recesses J^3 of substantially the same area as the heads of the pistons F F′ and having a bearing J^2 in which a suitable crank pin turns, the said cylinders D D′ and pistons F F′ having a different area from that of the cylinder G and piston J, suitable conduits, whereby motive fluid exhausted from the smaller of the cylinders will be conducted to those of larger effective area and suitable valves for governing the flow of the motive fluid.

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Witnesses:
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