

(No Model.)

F. W. JENKINS.  
COMPOUND ENGINE.

No. 309,228.

Patented Dec. 16, 1884.

Fig. 1.

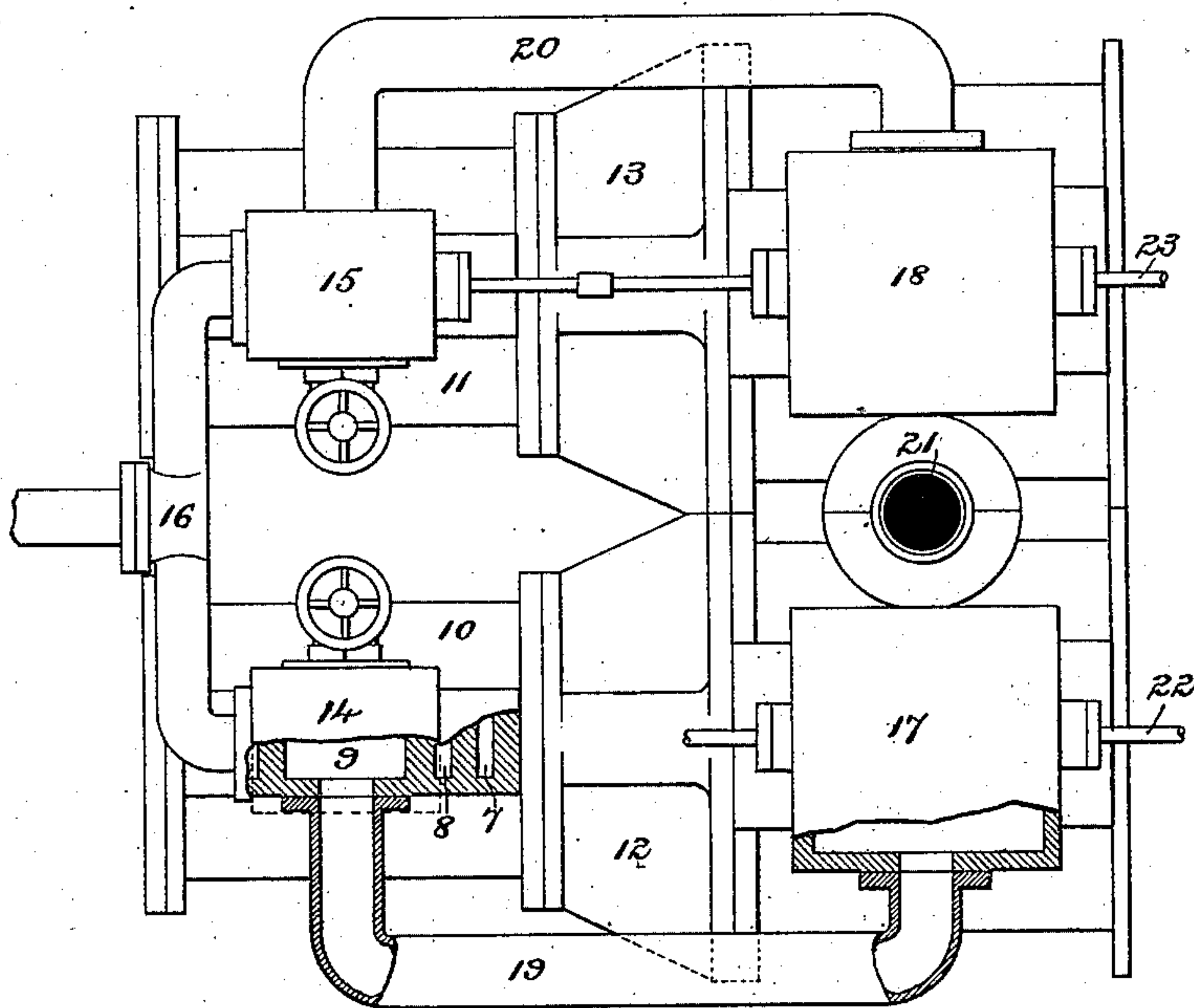


Fig. 2.

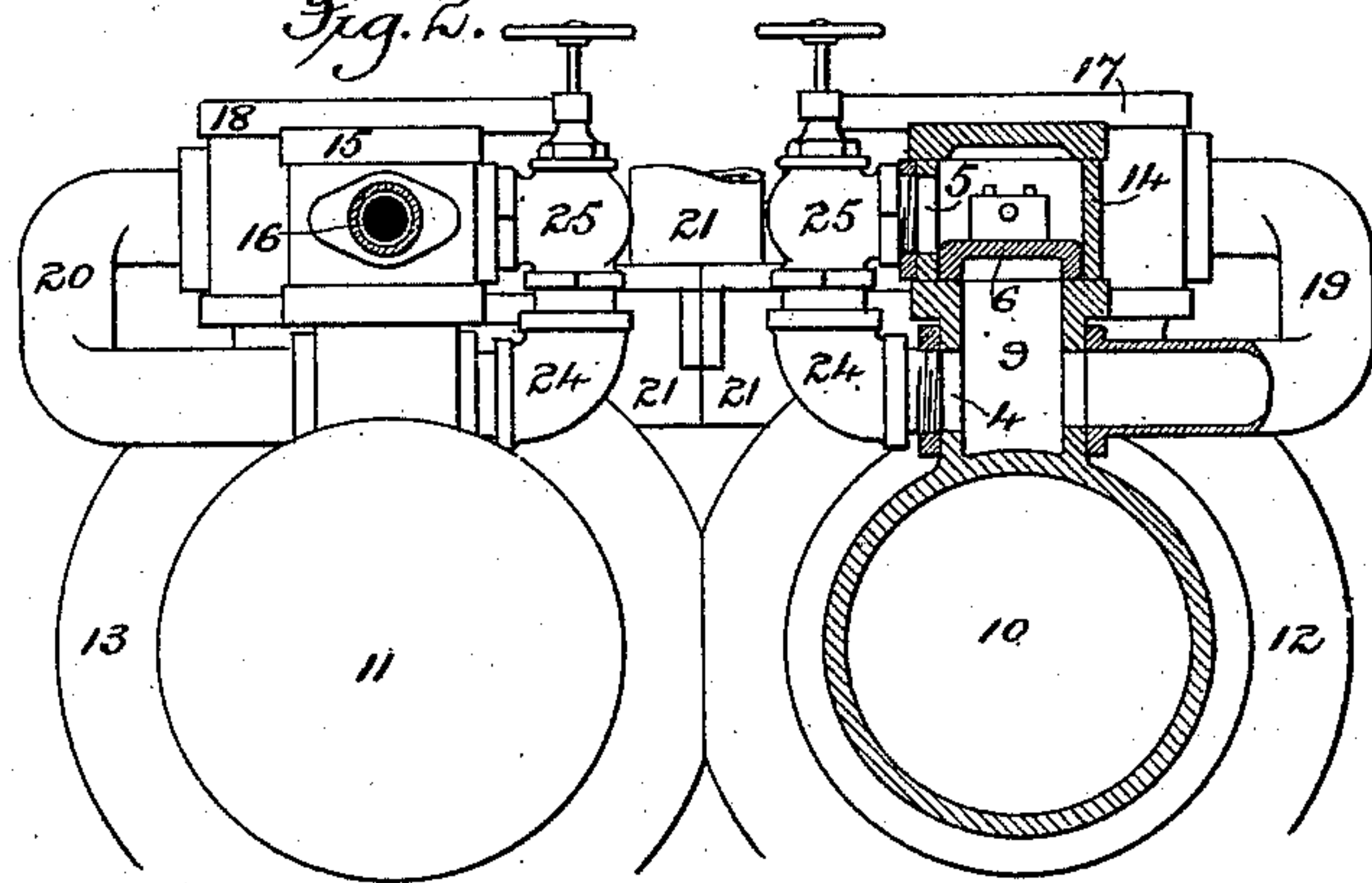
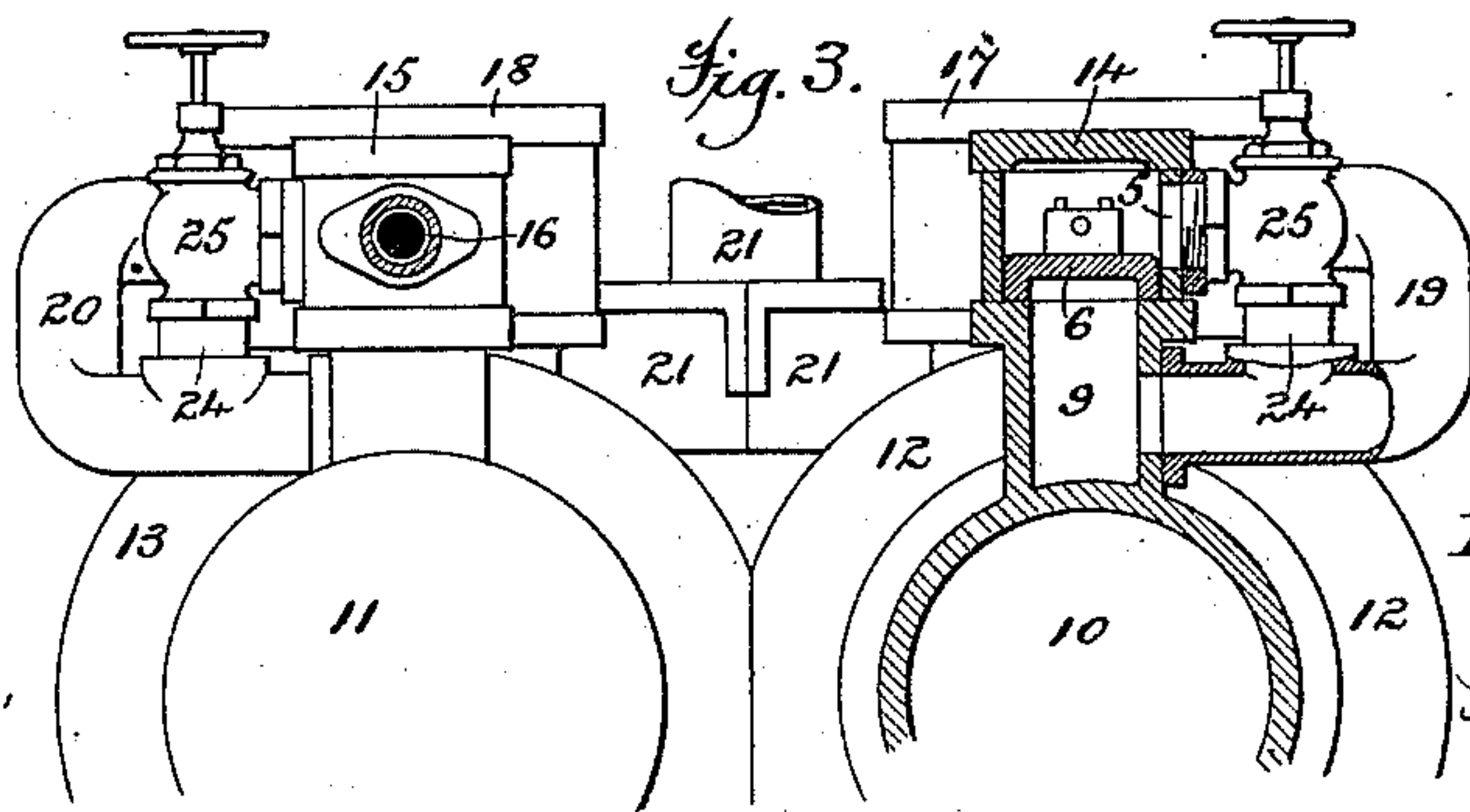


Fig. 3.



Attest:

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# UNITED STATES PATENT OFFICE.

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## COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 309,228, dated December 16, 1884.

Application filed February 29, 1884. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK W. JENKINS, a citizen of the United States, residing in the city of Brooklyn, county of Kings and State of New York, have invented certain new and useful Improvements in Compound Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

10 This invention relates to that class of engines which consist of a cylinder into which the steam is admitted direct from the generator, and a second cylinder of larger size, into which the steam passes from the exhaust of the first cylinder, and in which it acts expansively, and which are classed in the art under the general title of "Compound Engines." The engines of this class possess many advantages and have gone into very extensive use, particularly for pumping and other like purposes where it is desirable that the piston-rod of the engine should act directly upon the load. The especial adaptation of this class of engines for such uses is due to the fact that by them the economy due to the use of the steam expansively is secured, and at the same time a practically uniform propulsive power is maintained throughout the entire stroke of the engine without the aid of a fly-wheel or other heavy moving part. In order to secure the most economical results with an engine of this class it is desirable that the size of the engine should be so graduated with relation to the work to be performed that when operating under its ordinary running conditions the full power of the engine will be but little in excess of the resistance offered by the constant load. It frequently happens, however, in running these engines that for various reasons it is desirable that the engine should be able to temporarily perform an amount of labor considerably in excess of that which it is ordinarily called upon to perform, and consequently it is highly desirable that the engine should be capacitated to meet these temporary demands, even though to do it the steam must be temporarily used in an uneconomical manner.

It is the object of the present invention to

provide means by which this result is accomplished; and to that end the invention consists in providing the steam-chest of the smaller cylinder with connections by which the steam admitted to said chest from the boiler may, when desired, be allowed to pass directly to the steam-chest of the larger cylinder, so as to act upon the piston of said larger cylinder at its initial or boiler pressure throughout its entire stroke, instead of expansively and at a reduced initial pressure. It will readily be seen that when the steam is thus admitted to the larger cylinder at its initial or boiler pressure the pressure of the steam upon both sides of the piston of the smaller cylinder will be equal, so that said smaller piston will be constantly held in equilibrium, and will consequently perform no work; but it will also be observed that the relative areas of the smaller and larger pistons are such that the increased pressure thus applied to the larger piston will very much more than compensate for the loss of the smaller piston, so that when the engine is operating in this manner it will develop a much greater power than when operating in the ordinary manner, although to develop this increased power it will sacrifice the economy due to the use of the steam expansively.

In the accompanying drawings, Figure 1 is a plan view, partially in section, of an ordinary duplex compound engine embodying the invention. Fig. 2 is an end elevation, partly in section, of the same, looking from the left of Fig. 1, and Fig. 3 is a similar view illustrating a modification to be hereinafter referred to.

Referring to said drawings, it is to be understood that the engine therein shown consists of two cylinders, 10 11, which receive steam direct from the boiler, and in which the steam acts at its full pressure throughout the whole or nearly the whole stroke of the piston, and two larger cylinders, 12 13, into which the steam passes from the exhaust of the first cylinders, and in which it acts expansively, after which it is exhausted into a condenser or into the open air, the whole forming an ordinary duplex compound engine. The cylin-



ders 10 11 are provided with the usual steam-chests, 14 15, into which the steam is admitted through the pipe 16 direct from the boiler, and the cylinders 12 13 are also provided with similar steam-chests, 17 18, which are connected by pipes 19 20 with the exhaust-ports of the first cylinders, the exhaust-ports of these last cylinders being provided with a pipe, 21, leading to a condenser or to the open air. The several cylinders are provided with induction and exhaust ports 7 8 9, of the usual construction, which are controlled by valves 6 of the common form, the rods 22 23 of which are provided with the usual connections by which the valves of each side of the engine are operated by the main piston-rod of the opposite side, as in the well-known "Worthington Duplex Pumping-Engine."

In order to permit the steam to pass directly from the boiler to the cylinders 12 13 when it is desired to temporarily increase the capacity of the engine as before explained the steam-chests 14 15 are provided with openings 5, which communicate through pipes 24 with like openings, 4, in the walls of the exhaust-ports 9 of the cylinders 10 11, as shown in Figs. 1 and 2. The pipes 24 are provided with ordinary throttle valves or cocks, 25, by which said pipes can be opened or closed, so as to establish or shut off communication between the chests 14 15 and the ports 9, as may be desired.

The operation of the engine thus organized is as follows: If the engine is to perform only the ordinary labor for which it is intended, the valves or cocks 25 will be closed, so as to shut off communication through the pipes 24. The throttle-valve of the pipe 16 being then opened, the steam will pass from the boiler to the steam-chests 14 15, and will enter the cylinders 10 11, in which cylinders it will act at the full boiler-pressure throughout the whole or nearly the whole stroke of the pistons, after which, as the pistons in said cylinders commence their return stroke, the steam already in the cylinders will pass through the pipes 19 20 and enter the steam-chests 17 18, from which it will pass to the cylinders 12 13, where it will act expansively upon the pistons of said cylinders, so as to aid the steam which is at the same time admitted directly from the boiler to the corresponding sides of the pistons of the cylinders 10 11, and so the operation is repeated, the steam which enters the cylinders 10 11 at each stroke being exhausted into the steam-chests 17 18, so as to act expansively in the cylinders 12 13 at the next stroke. After acting expansively in the cylinders 12 13 the steam is exhausted through the pipes 21 into a condenser or into the open air. The connections by which the valves of each side of the engine are operated by the movement of the other side will of course be so adjusted as to properly time the movements of the two sides with relation to each other.

The relative size of the cylinders 10 11 and

12 13 may be varied from that shown in the drawings, the proportions there shown being only an approximation of the true proportions for the purpose of illustrating the principle and operation of the invention. These cylinders will, however, be so proportioned that the steam acting upon the pistons of the two cylinders as just described will exert a substantially uniform propulsive power throughout the entire stroke of the engine, and in order to secure the greatest economy in the use of the steam the pistons of the cylinders 12 13 will be of at least two and one-half times the area of the pistons of the cylinders 10 11. From this it will be seen that if the steam is allowed to enter the larger cylinders at its full or boiler pressure these cylinders alone will develop a much greater power than all four of the cylinders will develop when acting in the regular way, as already described, although in doing it the economy of using the steam expansively will be sacrificed. Whenever, therefore, it becomes desirable for any reason to temporarily increase the capacity of the engine, the throttle-valves or cocks 25 are opened, so that the steam will pass directly from the chests 14 15 through the pipes 24 to the exhaust-ports 9 of the cylinders 10 11, and thence through the pipes 19 20 to the steam-chests 17 18, thus causing the steam to be supplied at its full or boiler pressure to both the cylinders 10 11 and 12 13. When this is done, the pressure upon both sides of the pistons of the cylinders 10 11 will, of course, be the same, so that said pistons will always be in equilibrium, and will consequently develop no power; but the increased pressure upon the larger pistons of the cylinders 12 13 will very much more than compensate for this, and thus have the effect of actually increasing the power of the engine. It is not necessary in order to accomplish this result that the pipes 24 should communicate with the exhaust-ports 9 of the cylinders 10 11, as these pipes may, if preferred, be arranged, as shown in Fig. 3, so as to communicate directly with the pipes 19 20, instead of communicating with said pipes through the exhaust-ports 9.

Although the invention is herein shown as applied to a duplex engine, it is to be understood that it is not limited in its application to this class of engines, as it may be applied with equally good results to single compound engines.

What I claim, therefore, is—

1. The combination, with two cylinders arranged to form a compound engine and provided with a pipe for conducting the steam from the exhaust-port of the first cylinder to the steam-chest of the second cylinder, of a pipe arranged to establish communication between the steam-chest of the first cylinder and said conducting-pipe, and a cock or valve, 25, for closing said communication, substantially as described.



2. The combination, with two cylinders arranged to form a compound engine and provided with a pipe for conducting the steam from the exhaust-port of the first cylinder to  
5 the steam-chest of the second cylinder, of a pipe arranged to establish communication between the steam-chest of the first cylinder and said conducting-pipe through the exhaust-port of said first cylinder, and a cock or valve,

25, for closing said communication, substantially as described.

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

FRANK W. JENKINS.

Witnesses:

T. H. PALMER,  
GEO. H. GRAHAM.