(No Model.)

E. D. LEAVITT, Jr.

DIRECT ACTING COMPOUND ENGINE.

No. 283,261. Patented Aug. 14, 1883.

Fig. 1.

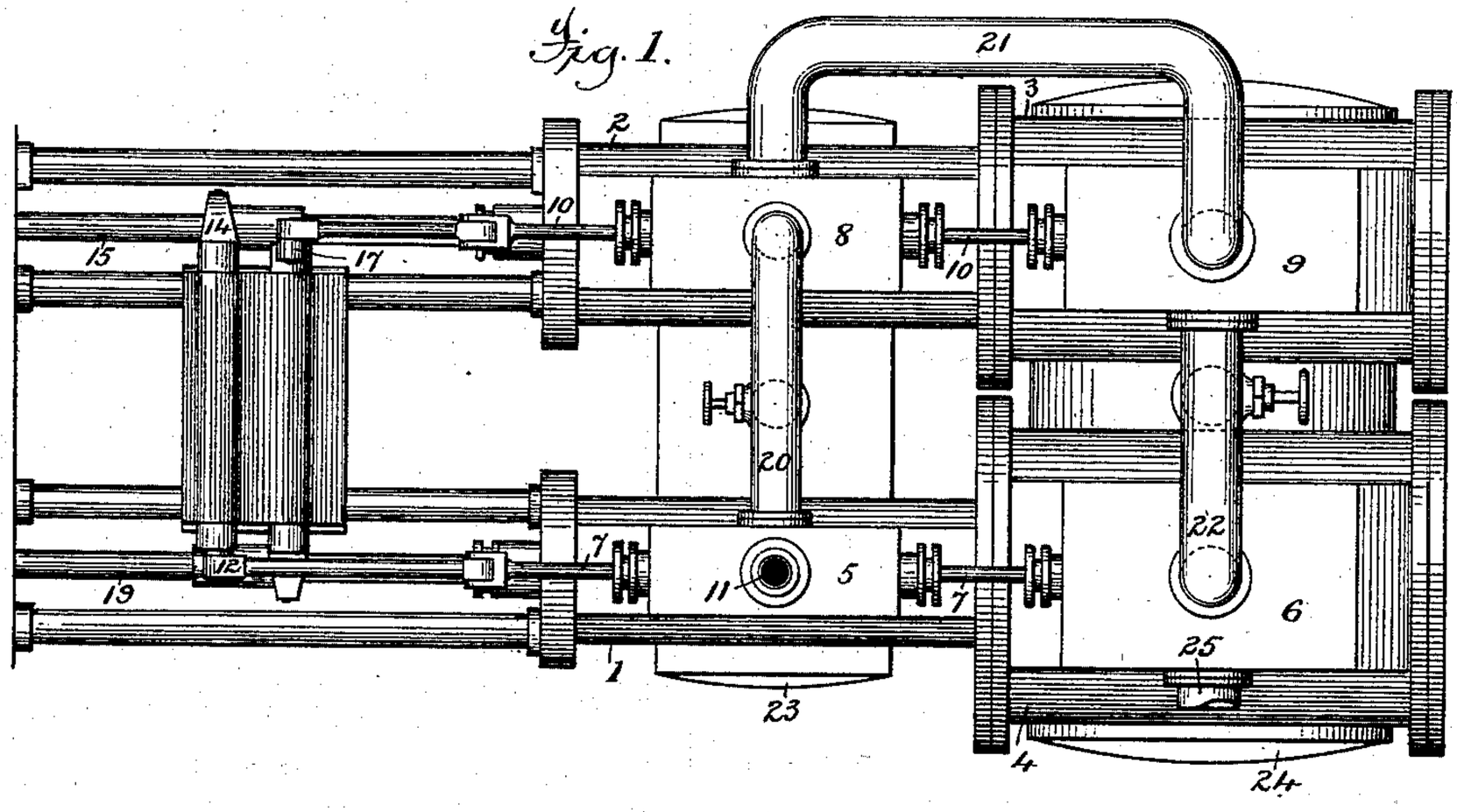
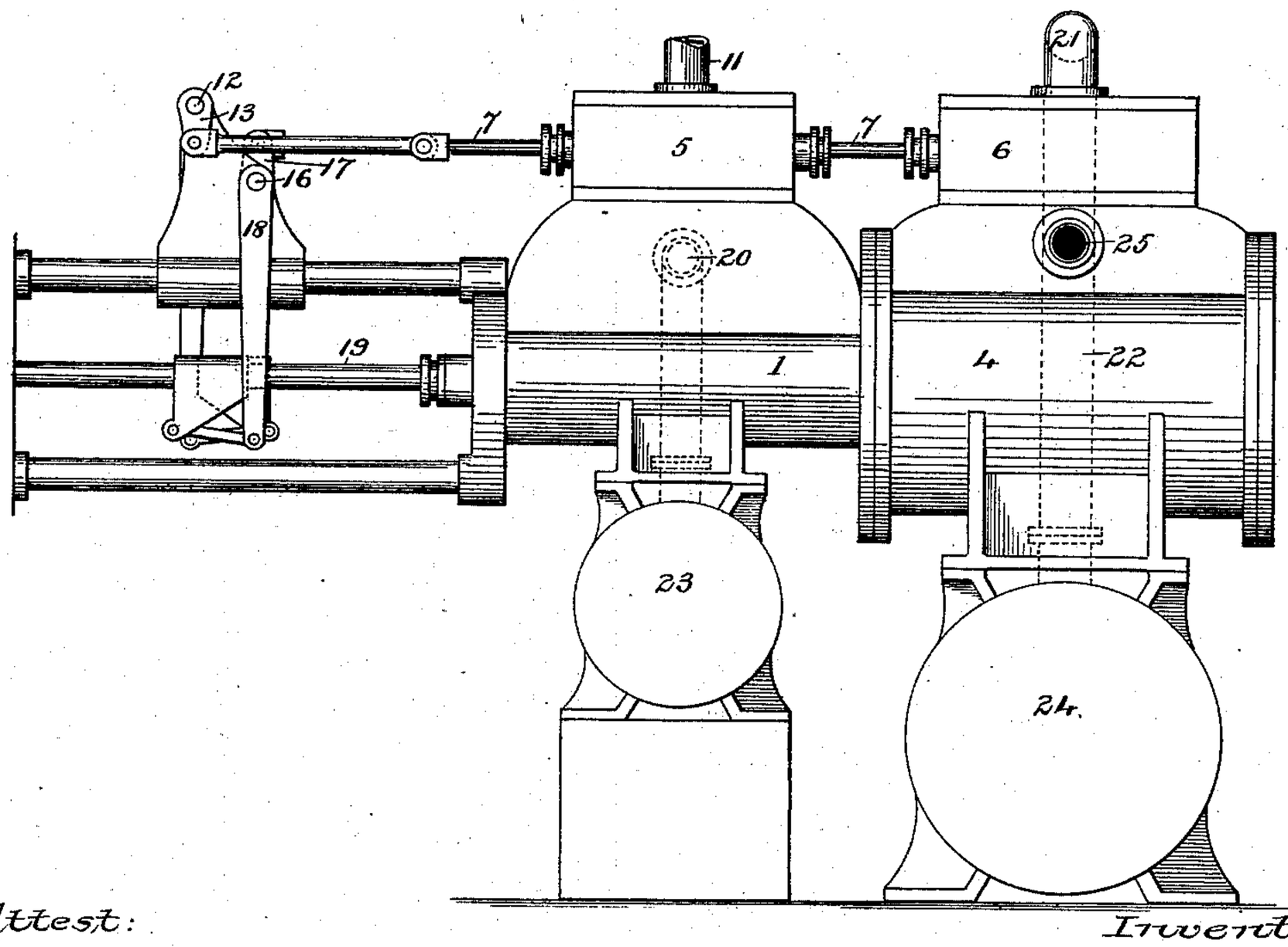


Fig. 2.



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DIRECT-ACTING COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 283,261, dated August 14, 1883.

Application filed June 27, 1883. (No model.)

To all whom it may concern:

Be it known that I, ERASMUS DARWIN LEAVITT, Jr., a citizen of the United States, residing in the city of Cambridge, county of Middlesex, and State of Massachusetts, have invented certain new and useful Improvements in Direct-Acting Compound Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to a direct-acting pumping-engine of the general construction of that shown and described in United States Letters Patent No. 24,838, and known as the "Worthington Duplex Pumping-Engine."

In order to secure the successful operation of engines of this class, the two following conditions must be maintained: First, a uniform or nearly uniform propulsive power must be exerted during the entire stroke of the engine, and, second, the propulsive energy of the steam must be so divided that each side of the engine will develop one-half of the total power. The first of these conditions is imposed by the fact that no balance-wheel is used, and that the load upon the pistons or plungers of the pumps is uniform, or nearly so, throughout the entire stroke, so that any considerable falling off of the power applied to the steam-pistons would result in the slowing and final stopping of the engine before it had reached the end of its stroke. The second condition is imposed by the necessity of having the plungers or pistons of both pumps of the same size, which is necessary in order to secure a steady and uniform discharge of water.

It is well known to those familiar with the science of steam-engineering that steam can be most economically used at a comparatively high pressure, and also that, in order to utilize the largest proportion of the power generated, it is necessary to use the steam expansively. This principle of using steam has heretofore been applied to this class of engines in three ways: first, by providing each side of the engine with one high-pressure cylinder and one expanding-cylinder, each high-pressure cylinder receiving steam from the generator; second, by providing one side of the engine with one high-pressure cylinder and the other side with one low-pressure cylinder, a tank being interposed between the two, as shown and described in United States Letters Patent No. 116,131; and, third, by providing one side of the engine with one high-pressure cylinder and one expanding-cylinder, and the opposite side with one expanding low-pressure cylinder, as shown and described in United States Letters Patent No. 251,730. In the first and second of these organizations the use of only two cylinders and the necessity of maintaining a uniform or nearly uniform propulsive power throughout the entire stroke rendered the amount of expansion permissible comparatively small, and thus to a great degree deprived the engine of the benefits of this principle of using the steam, while in the third organization it was found impossible to secure one of the essential features of an engine of this class—that is to say, the equal division of the propulsive power between the two sides of the engine.

It is the object of the present invention to produce an organization in which high rates of expansion will be permissible without violating the conditions specified as to distribution and division of power, so that steam may be introduced at a comparatively high initial pressure and exhausted only after its expansive energy has been nearly or quite expended.

To this end the invention consists in a direct-acting duplex engine, the cylinders of which are arranged and combined in the manner hereinafter described and pointed out.

In the accompanying drawings, Figure 1 is a plan view of an engine embodying the invention, and Fig. 2 is a side elevation of the same.

Referring to the drawings, it is to be understood that 1 is a high-pressure cylinder, and 4 an expanding low-pressure cylinder associated therewith to form one side of the duplex engine. These cylinders are provided with the usual steam-chests, 5 6, the valves of which may be operated by a single rod, 7, as shown, said rod being connected in any con-

venient manner, as by the rock-shaft 12 and rock-arms 13 14, with the piston-rod 15 of the opposite side of the engine.

The second side of the engine, like the first, consists of two cylinders, 2 3, both of which are expanding-cylinders. These cylinders are provided with the usual steam-chests, 8 9, the valves of which are or may be operated from a single rod, 10, connected by a rock-shaft, 16, and rock-arms 17 18 with the piston-rod 19 of the first side of the engine.

The steam-chests 5 8, 8 9, and 9 6 are connected by pipes 20, 21, and 22, arranged substantially as shown, the pipes 20 and 22 being preferably arranged to communicate with tanks, as 23 24, into which the steam will be expanded in the manner set forth in the Letters Patent before referred to, instead of being expanded in the cylinders 2 4. The pipes 21 may also, if preferred, communicate with a similar tank operating in the same manner.

The operation of the engine may be briefly stated as follows: The steam will be admitted through the pipe 11 to the cylinder 1, where it will act upon the piston at its full pressure throughout the whole or nearly the whole stroke. As the piston in this cylinder commences its return-stroke the steam already in the cylinder will pass out through the pipe 20 and enter the tank 23 at a reduced pressure, and at the same time steam will be admitted from the tank to the cylinder 2. The steam thus admitted from the tank will act upon the piston in said cylinder at its full pressure during the whole or nearly the whole stroke, after which, upon the return-stroke of the piston, it will pass through the pipe 21 to cylinder 3, where it will act expansively upon the piston of that cylinder. After performing its work in cylinder 3 the steam will pass out through the pipe 22 and enter the tank 24 in a still further expanded condition. From the tank 24 the steam will pass to the cylinder 4, where it will perform its final work, after which it will pass through the pipe 25 and enter the condenser or the open air at a very low pressure.

By means of the organization just described it will be seen that the steam is used expansively at least three times—first in the cylinder 2, then in the cylinder 3, and last in the cylinder 4—thereby making it possible to receive the steam at comparatively high initial pressure, and finally exhaust it at a very low pressure, thus utilizing its expansive energy to a much greater degree than has heretofore been possible in this class of engines. By using the steam expansively upon both sides of the engine it not only becomes possible to divide the total power generated equally between the two sides of the engine, but the gradual loss of power incident to high ratios of expansion is so distributed that practical uniformity of speed and power is obtained throughout the entire stroke of the engine.

The several cylinders will, of course, be so proportioned with relation to each other as to secure the results specified, the proportions shown in the drawings being only approximations for the purpose of illustrating the principle of the invention.

In some cases it may be found desirable to employ more than two cylinders upon each side of the engine. This can be done upon the principle just set forth without departing from or losing the advantage of the invention. While in the present case the two cylinders on each side of the engine are shown as arranged upon the same axial lines, such an arrangement is not necessary. The well-known annular form in which one cylinder surrounds the other may be adopted, or they may be arranged in any other convenient or desirable position.

What I claim is—

1. The combination, with two compound engines arranged to form the two sides of a duplex engine, of connections whereby the steam after being used in one side of the engine is conducted to and used in the second side of the engine, and then returned to and used in the first side of the engine, substantially as described.

2. The combination, with two compound engines arranged to form the two sides of a duplex engine, of tanks 23 24 and connections whereby the steam after being used in one side of the engine is conducted to and used in the second side of the engine, and then returned to and used in the first side of the engine, substantially as described.

3. The combination, with two compound engines arranged to form the two sides of a duplex engine, of connections whereby the steam after being used in one side of the engine is conducted to and used in the second side of the engine, and then returned to and used in the first side of the engine, and means by which each engine actuates the inlet and outlet valves of the other, substantially as described.

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

ERASMUS DARWIN LEAVITT, JR.

Witnesses:
GEO. H. COX,
J. S. COON.