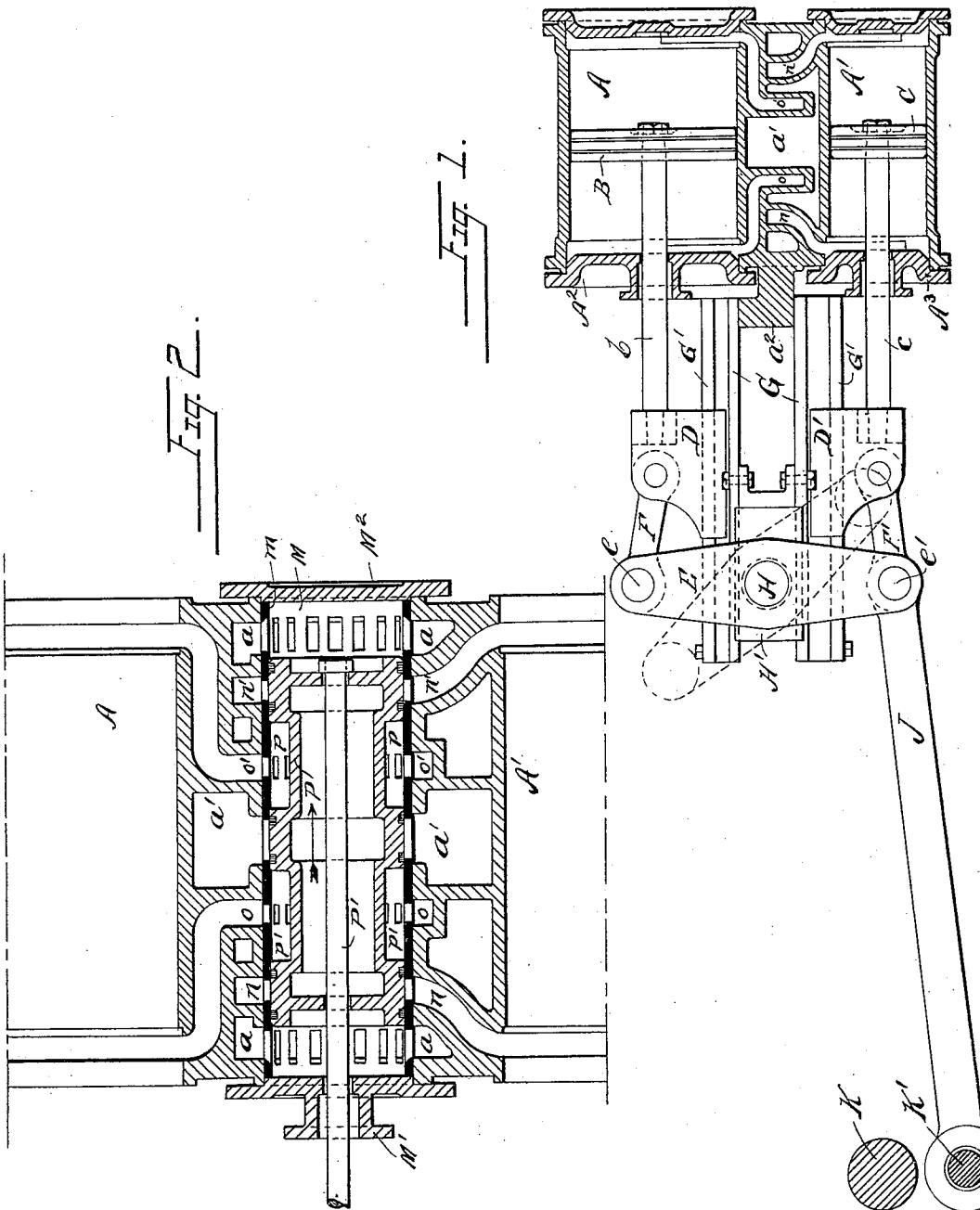


2 Sheets—Sheet 1.

No. 463,450.

Patented Nov. 17, 1891.



Sam'l. F. Ponce Jr. Inventor

Ed. Kelly.
David Levan

By *his* Attorney

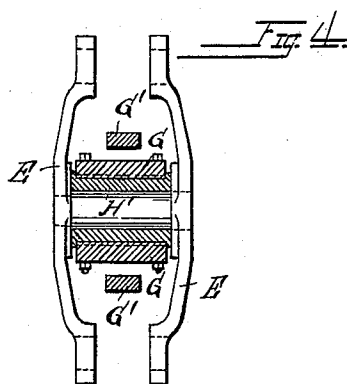
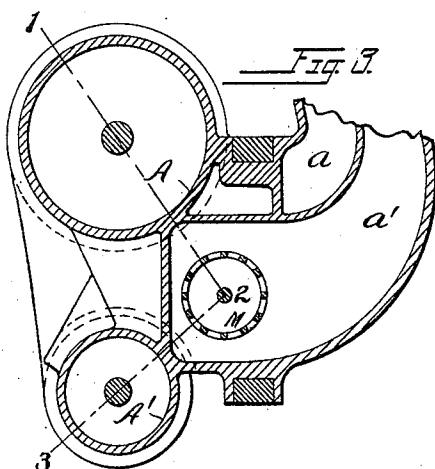
(No Model.)

2 Sheets—Sheet 2.

S. F. PRINCE, Jr.
COMPOUND ENGINE.

No. 463,450.

Patented Nov. 17, 1891.



Witnesses

E. A. Kelly
David Levan

Saml. F. Prince Jr. Inventor

By

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Attorney

J. H. H. H.

UNITED STATES PATENT OFFICE.

SAMUEL F. PRINCE, JR., OF READING, PENNSYLVANIA.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 463,450, dated November 17, 1891.

Application filed August 5, 1891. Serial No. 401,734. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL F. PRINCE, Jr., a citizen of the United States, residing at Reading, in the county of Berks, State of Pennsylvania, have invented certain Improvements in Compound Engines, of which the following is a specification.

The object of my invention is to provide an improved valve structure for compound engines, whereby simplicity in the form and arrangement of the valve and ports will be combined with economy in operation.

The accompanying drawings, in connection with which the invention is fully described, show a design intended more particularly for locomotive-engines; but the invention may evidently be readily adapted to other desired forms.

Figure 1 is a side elevation of a portion of an improved engine involving my invention, the cylinders being shown in section. Fig. 2 is an enlarged section of the steam-chest and valve on the line 1 2 3 of Fig. 3. Fig. 3 is a transverse section of the cylinders. Fig. 4 is a transverse section showing the rock-arm arrangement.

A represents the low-pressure and A' the high-pressure cylinder, both of which are formed in one casting, together with the extended exhaust-passage *a'* and live-steam passage *a*, which are common to both cylinders, as is also the intermediate cylindrical steam-chest M, the general arrangement of these parts being similar to that of compound engines heretofore designed.

The pistons B and C in my improved construction are adapted to move in opposite directions, the steam being delivered from either end of the high-pressure cylinder to the corresponding end of the low-pressure cylinder by means of a novel form of valve structure, which will be hereinafter described. In order to utilize the power which is simultaneously exerted in opposite directions upon the two pistons on the connecting-rod J of the engine, the piston-rods *b* and *c*, after passing through the respective cylinder-heads A² and A³, are shown attached to separate cross-heads D and D', which are in turn connected by links F and F' to opposite ends *e* and *e'* of a rock-arm E. This rock-arm is pivoted intermediately on a pin H, having bearing in a

fixed box H', and is operatively connected to the main connecting-rod J directly at *e'*, as shown; or, if preferred, the rod J may evidently be pivoted to the cross-head D', the latter in either case being linked to the rock-arm. It is evident that the opposite movements of the two pistons are thus, through the medium of the rock-arm, made to co-operate in reciprocating the rod J and, by means of the connection of the latter with the crank-pin K', in rotating the main shaft-axle K.

The rock-arm box H' is represented as secured between plates G, extending rearward from the cylinder-casting, to which they are bolted at *a*², while guide-bars G' G' are provided above and below said plates G for the respective cross-heads, said plates and guides being secured and braced in any suitable manner. It is evidently immaterial, however, what special construction shall be adopted to support the rock-arm and guide the cross-heads.

Referring now to the steam-distributing mechanism for the cylinders A and A', the steam-chest M is formed, as in previous valve structures, by means of a cylindrical sleeve or bushing *m*, and is closed at either end by heads M' M², through the former of which passes the valve-rod P', to which the valve P is attached and to which motion is given in any suitable manner. The sleeve *m* is provided with openings or perforations arranged circularly at different points of its length to correspond with the several ports leading to and from the cylinders. These ports are as follows: *a a* are the supply-ports for the steam-chest and are located at either end of the chest. *n* and *n'*, adjoining the supply-ports, lead to opposite ends of the high-pressure cylinder A', while *o* and *o'*, on either side of the central exhaust-port *a'*, lead to opposite ends of the low-pressure cylinder A. The cylindrical valve P, which is made hollow to reduce its weight, is reduced in diameter between central and end bearings to form annular chambers *p* and *p'*. These chambers are in constant communication with the low-pressure cylinder-ports *o* and *o'*, and during the operation of the valve alternately connect at opposite ends of the chest with the high-pressure-cylinder ports *n* or *n'* and with the central exhaust-port *a'*.

During the operation of the engine, when the valve P is moved from the central position shown in the direction of the arrow, the port n' , leading into the front end of the high-pressure cylinder A', is thrown into communication with the annular chamber or groove p , and the steam used in the previous high-pressure stroke flows from the front end of the high-pressure cylinder into the front end of the low-pressure cylinder through the port o' . The port n , entering the rear end of the high-pressure cylinder, is opened almost simultaneously, and steam flows through it directly from the steam-chest. Thus the two pistons are being impelled in opposite directions, the rear end of the low-pressure cylinder meanwhile exhausting through the port o and annular chamber p' into the central exhaust-passage a' , with which said chamber is in communication. By the opposite movement of the valve the ports n , n' , and a' are successively closed and thereafter reopened for the return stroke of the piston in the same manner as already described.

By means of my improvements I am enabled to construct a compound engine with an exceedingly simple and desirable valve structure, and at the same time to counterbalance the weight of the reciprocating parts, so as to greatly reduce the usual hammer and wear. In order to effectually accomplish this latter object in the construction shown, the weight of the reciprocating parts for the large-diameter cylinder should be sufficient to counterbalance the oppositely-moving corresponding parts of the lower cylinder, and also that portion of the weight of the engine connecting-rod J which is carried by the rock-arm. This counterbalancing of the oppositely-moving parts of a compound engine has, however, been heretofore secured, and the connection of the oppositely-moving piston-rods to a common rocking arm is also old. The valve and

port arrangement which I have provided for the general form of compound engines described is, however, believed to be novel and advantageous. It may be mentioned that the position of the supply and exhaust ports may obviously be reversed without departing from the principle involved in my construction, and I do not therefore limit myself to the exact arrangement herein set forth; but

What I claim is—

1. In a compound engine, the combination, with the high and low pressure cylinders and the oppositely-moving pistons, a common steam-chest having a port at either end communicating with the corresponding end of the high-pressure cylinder, adjoining ports similarly communicating with the low-pressure cylinder, and a central exhaust-port common to both cylinders, of a valve having passages p and p' , each constantly communicating with one of said low-pressure ports and adapted to be thrown alternately into communication with the adjoining high-pressure port of the central exhaust-port, substantially as set forth.

2. In a compound engine having oppositely-moving pistons, the combination, with a cylindrical steam-chest having supply-ports, high-pressure ports, low-pressure ports, and central common exhaust-port, arranged substantially as described, of a single piston-valve having either end and the portion midway of its length fitted to said cylindrical steam-chest, and the intermediate portions reduced in diameter to form annular steam-passages p p' , adapted to operate in connection with said ports, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

SAML. F. PRINCE, JR.

Witnesses:

W. G. STEWART,

ADAM L. OTTERBEIN.