

J. H. COOPER & A. D. EMERY.
Compound Steam-Engines.

No. 140,892.

Patented July 15, 1873.

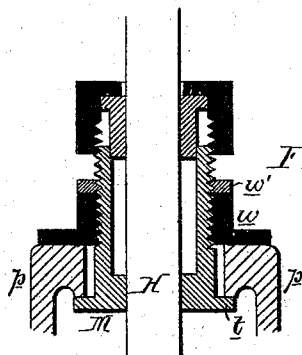


FIG. 5.

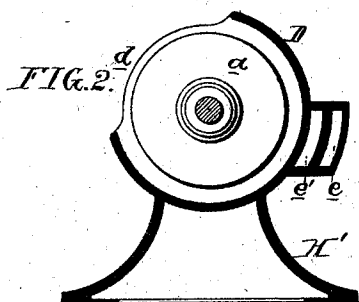


FIG. 2.

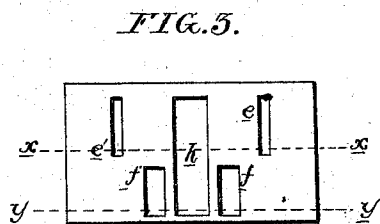


FIG. 3.

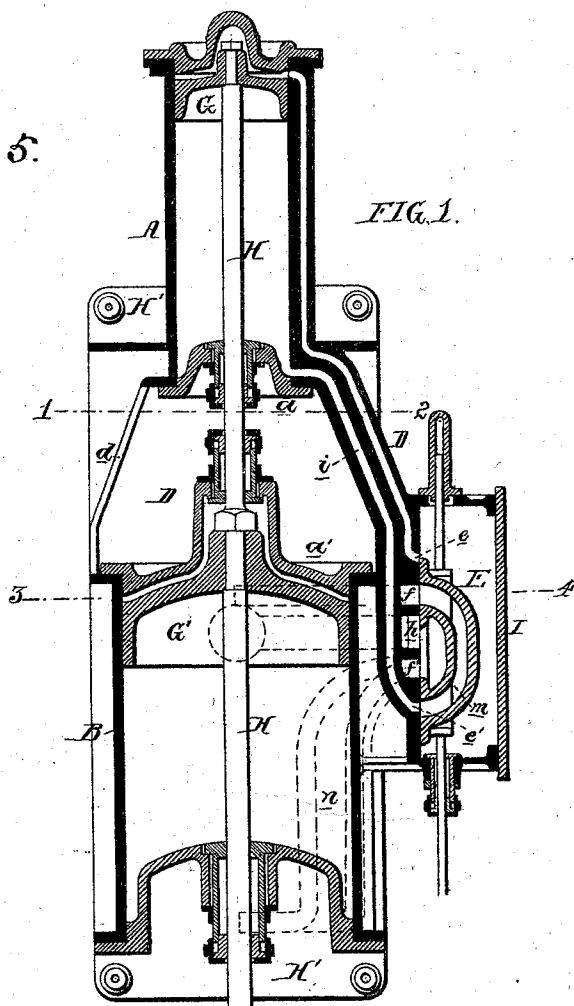


FIG. 1.

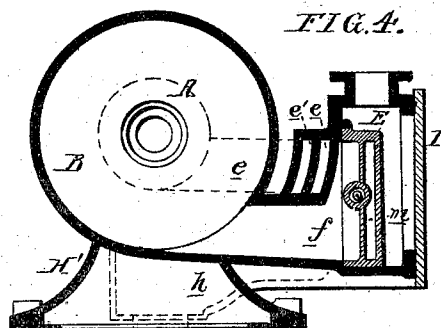


FIG. 4.

Witnesses, Harry Smith
Thomas McIlwain

J. H. Cooper and
A. D. Emery
by their attys,
Hazen and Son,

UNITED STATES PATENT OFFICE.

JOHN H. COOPER AND ABRAM D. EMERY, OF PHILADELPHIA, PA.

IMPROVEMENT IN COMPOUND STEAM-ENGINES.

Specification forming part of Letters Patent No. **140,892**, dated July 15, 1873; application filed February 27, 1873.

To all whom it may concern:

Be it known that we, JOHN H. COOPER and ABRAM D. EMERY, both of Philadelphia, Pennsylvania, have invented certain Improvements in Compound Steam-Engines, of which the following is a specification:

The objects of our invention are, first, simplicity and economy in the construction of compound steam-engines; second, the continuous draining of the water of condensation from the cylinders of engines of this class; and, third, the prevention of undue strain on the piston-rod, which is common to both the large and small cylinder of a compound engine; and these objects we attain in the manner we will now proceed to describe, reference being had to the accompanying drawing, in which—

Figure 1 represents a sectional plan of the two cylinders, valve-ports, and passages of our improved compound engine; Fig. 2, a transverse section on the line 1 2, Fig. 1; Fig. 3, a face view of the ports; Fig. 4, a section on the line 3 4; and Fig. 5, an enlarged sectional view of stuffing-box for the piston-rod.

The center of the small cylinder A and that of the large cylinder B are in the same straight line, as shown in the sectional plan, Fig. 1, and the two cylinders are connected together by a tapering casing, D, a transverse section of which is illustrated in Fig. 2, the casing having an opening, *d*, of sufficient size to permit the removal and replacing through it of the heads *a* and *a'*, as well as the pistons G G', of the two cylinders. We prefer to make this casing a part of, and to cast it with, the two cylinders, although, in constructing very large engines according to our invention, it may be advisable to cast the casings separately, or to one only of the two cylinders; but in the latter cases the whole should be firmly bolted together before the cylinders are bored; for by boring them at the same time with the same bar the certain concentricity and parallelism of the bores of the two cylinders will be insured. In connection with the two cylinders, a well-known valve, E, having an internal passage, *m*, is employed; and to render this single valve available for both cylinders we adopt the peculiar system of passages and ports illustrated in Fig. 1 of the drawing, and

also in Fig. 3. In the face against which the valve bears are the two ports *e* and *e'*, communicating with the small cylinder, the two ports *f* and *f'* communicating with the large cylinder and the central exhaust-port *h*, which communicates with an exhaust-pipe, *q*, Fig. 4, the latter being open to the external air if the engine be of the high-pressure class, but being connected with a condenser if the engine be of the condensing type. The ports *e* and *e'* communicate, the former with the rear and the latter with the front end of the small cylinder, through passages continued through the connecting casing D between the two cylinders, as shown in Fig. 1, and also in Fig. 2, the ports *f* and *f'* communicating with opposite ends of the large cylinders, as shown by dotted lines, and in Fig. 4. The pistons G and G' of the two cylinders are attached to the same rod H, and, as shown in Fig. 1, are in the act of moving forward after having reached the limit of their rearward movement, the valve E being in such a position that the live steam admitted from the boiler to the chest I is entering the port *e*, so as to pass to the small cylinder at the rear of the piston G, while the steam in front of the piston in the same cylinder is escaping through the passage *i*, port *e'*, and the passage *n* in the valve E, and port *f*, into the large cylinder at the rear of the piston, the exhaust steam in front of the piston in the latter cylinder escaping through a passage, *n*, shown by dotted lines in Fig. 1, through the port *f'*, and thence, through the central exhaust-port *h*, to the exhaust-pipe *q*. The movement of the valve and its effect as regards the reverse movement of the pistons will be understood without explanation.

A prominent feature of our invention—namely, the combination of the large and small cylinders, passages, and ports with a single valve—contributes to the first object of our invention, namely, simplicity and economy of construction. The third feature, appertaining to the same first object of our invention, is the making of the base H' common to both cylinders and connecting casing, this base extending from a point a short distance beyond the front end of the large cylinder to a point a short distance to the rear of the connecting casing D. The base is cast with, and forms a

part of, the two cylinders and connecting casing, and is directly beneath the heaviest portion of the casting, a portion of the small cylinder only overhanging the base. This plan of casting the two cylinders, connecting casing, and base in one piece may be adhered to in all cases, excepting in the construction of very large engines.

On referring to Fig. 3, it will be observed that the live-steam ports *ee'* are situated above the ports *ff'*, and that the exhaust-port extends in height from the bottom of the ports *ff'* to the tops of the ports *ee'*. These ports are so arranged, in respect to the two cylinders, that the bottoms of the ports *ee'* shall be on a level with, or slightly below, the bottom of the bore of the small cylinder, which is represented by the dotted lines *xx*, and the ports *ff'* on a level with, or slightly below, the bottom of the bore *yy* of the large cylinder. This arrangement insures the effectual draining of the water of condensation from both cylinders, that of the smaller cylinder finding its way along the steam-passages to the larger cylinder, and that of the latter cylinder being drained into the exhaust-passage, which is inclined downward toward the exhaust-pipe *g*, as shown by dotted lines in Fig. 4.

Another feature of our invention is a stuffing-box so constructed and so connected to each cylinder-head *a* and *a'* as to accommodate itself to any slight lateral strain on the piston-rod on the departure of the two cylinders from their proper relative position.

However truly the two cylinders may be bored in respect to each other in the first instance, the difference in temperature of different parts of the connecting casing *D* may temporarily cause such differential expansion of the metal as to throw the cylinders very slightly out of line, the result of which would be a lateral straining of the piston-rod but for the compensating stuffing-box illustrated in Fig. 6, in which *p* represents part of one of the cylin-

der-heads, and *H* a portion of the piston-rod passing through a box, *M*, within which the usual packing is confined by a follower, as in ordinary stuffing-boxes. The box has a flange, *t*, which is caused to bear against the inside of the cylinder-head by a nut, *w*, secured by jam-nut *w'*, so that while the stuffing-box is effectually confined to the head the openings in the latter for the admission of the box are large enough to allow the latter a limited lateral play; hence the box can accommodate itself to any lateral strain imparted to the piston-rod by a tendency of the two cylinders to get out of line with each other.

We claim as our invention—

1. A compound engine having large and small cylinders *A* and *B*, united by an open casing, *D*, or frame, in the side of which communicating passages are formed between one of the cylinders and a steam-chest common to both cylinders, all substantially as set forth.

2. The base *H'*, combined with and forming a part of the large and small cylinders and connecting casing *D*, as specified.

3. The combination of the steam-chest, common to both cylinders, the slide-valve *E*, constructed as described, the ports *ee' ff' h*, arranged in respect to each other, to the valve, and to the bores of the two cylinders, all as set forth.

4. The combination of the two cylinders and piston-rod and the compensating stuffing-boxes, constructed and applied to the cylinder-heads substantially as and for the purpose specified.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JOHN H. COOPER.
ABRAM D. EMERY.

Witnesses:

WM. A. STEEL,
HUBERT HOWSON.