J. H. McGOWAN & D. B. CALDWELL.

Crank-Connections for Steam Engines.

No. 143,292. Patented September 30, 1873.

Fig. 1.

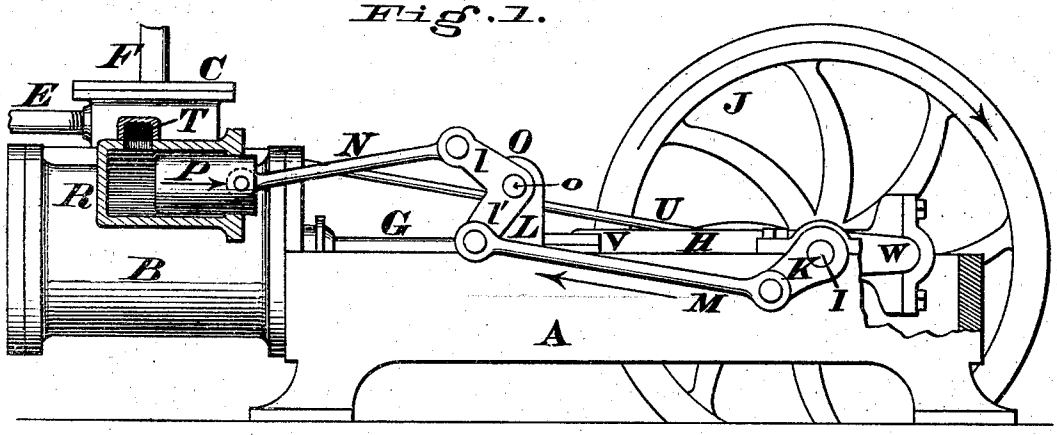



Fig. 2.

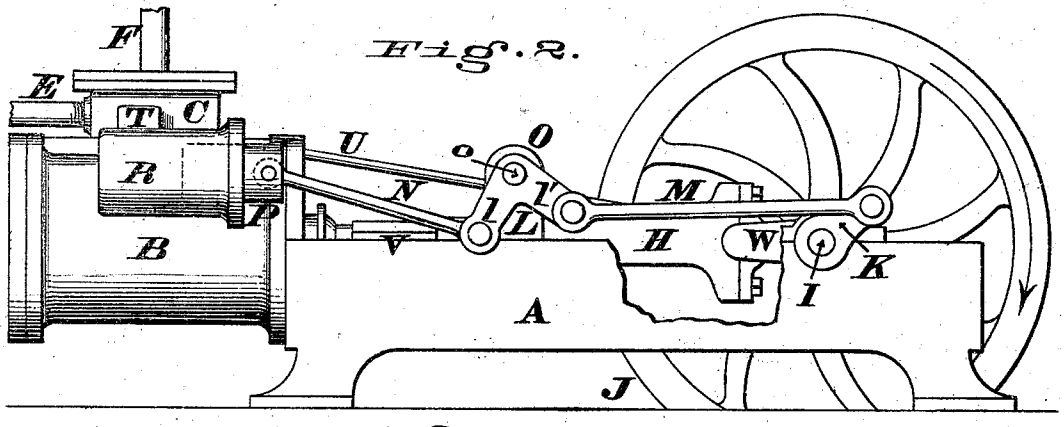



Fig. 3.

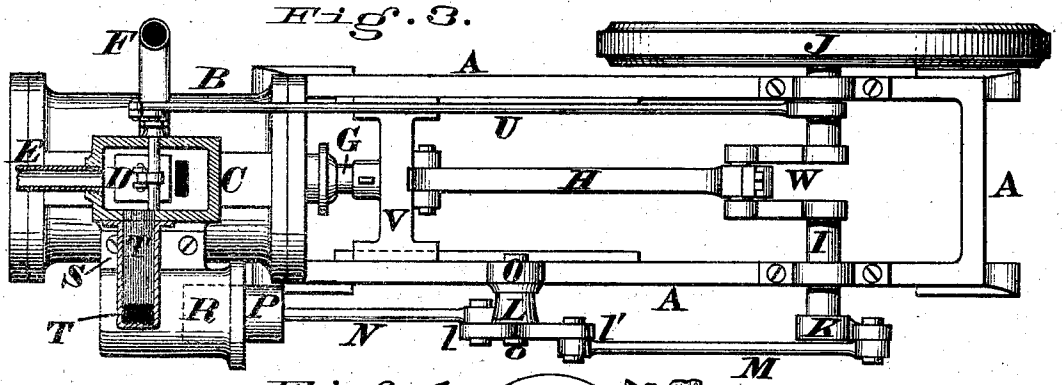
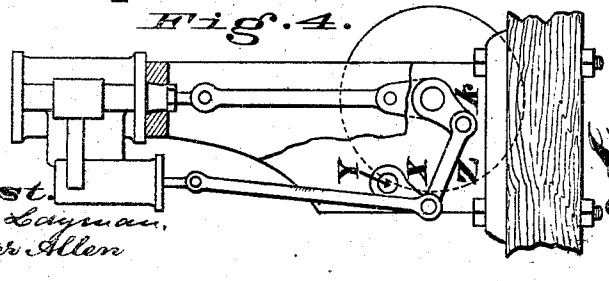



Fig. 4.



Attest
Jas. H. Layman,
Walter Allen

J. H. McGowan and
D. B. Caldwell By Knight Bros
Attys.

# UNITED STATES PATENT OFFICE.

JOHN H. McGOWAN AND DAVID B. CALDWELL, OF CINCINNATI, OHIO.

## IMPROVEMENT IN CRANK-CONNECTIONS FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **143,292**, dated September 30, 1873; application filed August 2, 1873.

*To all whom it may concern:*

Be it known that we, JOHN H. McGOWAN and DAVID B. CALDWELL, both of Cincinnati, Hamilton county, Ohio, have invented a new and useful Crank-Connection for Steam-Engines, of which the following is a specification:

This invention relates to that class of improvements in reciprocating steam-engines for which Letters Patent were granted to us September 19, 1871, No. 119,039; and our present invention consists in an arrangement of cranks and coupling-rods, whereby we are enabled to dispense with the gearing shown in the aforesaid patent, the details of the connecting devices and their mode of operation being hereinafter fully described.

Figure 1 is a side elevation of a steam-engine embodying our improvements, the auxiliary cylinder being in section, and the crank shown at one of the "dead-centers." Fig. 2 is another elevation of the engine, with the crank at the dead-center opposite to that shown in the preceding figure. Fig. 3 is a plan of the engine, the steam-chest of the main cylinder and the channel leading to the auxiliary cylinder being sectioned. Fig. 4 represents a modification of our improvements applied to an upright engine.

A represents a suitable frame or bed-plate, to which a cylinder, B, is secured in any usual or approved way, said cylinder being provided with an ordinary steam-chest, C, slide or other valve D, steam-pipe E, and escape-pipe F. G is the piston-rod, V the cross-head, and H the pitman, the latter connecting with a crank, W, of the main shaft I, which carries a fly-wheel, J, and a crank, K. The crank K is keyed to the shaft I in such a position as to stand at an angle of about fifty degrees with reference to the driving-crank W. This angle may, however, be varied according to the judgment of the engine-builder; but in no case should it be less than forty-five degrees; otherwise the full benefits of our improvements will not be obtained. Proceeding from the crank K to one of the arms, *l'*, of a bell-crank, L, is a connecting-rod, M, while the other arm, *l*, of said bell-crank has a coupling-rod, N, pivoted to it. The bell-crank L is journaled upon a stud-shaft, *o*, which is fitted within a standard or bracket, O, that projects vertically from the frame A. One end of the coupling-rod N is connected to the piston or trunk P of an auxiliary cylinder, R, which latter is securely attached to a plate, S, that projects laterally from the steam-cylinder B, as more clearly shown in Fig. 3. T is a port or channel, which allows a free and unrestricted passage of live steam from the chest C to the auxiliary cylinder R, and thence back to said chest, for a purpose that will presently appear. U is the eccentric rod, which operates the valve within the steam-chest C.

To illustrate the operation of our engine, we will suppose that steam has been admitted to the cylinder B, so as to rotate the fly-wheel J in the direction indicated by the arrow upon the same, and that the crank W has reached the dead-point most remote from the cylinder, as shown in Fig. 1. Evidently there is now a tendency, as the engine comes to rest, to stop at this dead-point, unless some means are employed for carrying it over the center. This serious difficulty we effectually obviate by the employment of the auxiliary cylinder R and its described accessories. It will be seen that live steam can flow freely into said auxiliary cylinder from the steam-chest C through the unobstructed duct or channel T, and that it will press against the inner end of the piston, plunger, or trunk P in such a manner as to force said piston outward, as indicated by the arrow on it. The thrusting action of piston P is communicated to the rod N, and the bell-crank L reverses this motion, so as to exert a pulling action upon connection M. (See arrow.) The pull upon connecting-rod M is transferred directly to crank K, and consequently said crank is rotated with a power depending on the area of piston P and the pressure of live steam behind it. The crank K is thus rotated a sufficient distance to carry the engine completely beyond the dead-point, and to initiate its return stroke. Having fully accomplished its return stroke, another dead-point is reached, as shown in Fig. 2, and here the pressure of live steam in the auxiliary cylinder forces out the piston of the same, and exerts a thrusting action upon both of the rods M N, thereby rotating the crank K far enough to carry it past the inner center.

As the above-described movements are repeated at every stroke of the piston, it is evi-

dent that the engine is automatically carried beyond the dead-points without consuming live steam or detracting from the power of the motor.

The auxiliary cylinder R has no communication whatever with the external atmosphere, but is simply filled from chest C with a supply of live steam, which returns to said chest as soon as the engine has been assisted over the dead-points.

It is evident that the same results can be produced by supplying the auxiliary cylinder with live steam direct from the boiler; but such an arrangement would not be as compact and simple as the form shown in the illustration.

The engine may be modified, as shown in Fig. 4, in which arrangement the bell-crank is omitted, and an arm, X, is substituted therefor, which arm vibrates upon a stud, Y. Z is a link, which connects said arm X with the crank K upon the fly-wheel shaft. With these exceptions the engine is essentially the same as that shown in the preceding illustration.

It will be seen that either the preferred arrangement shown in Figs. 1, 2, and 3, or the modification represented in Fig. 4, enables us to dispense with the gearing employed in the engine described in the patent previously alluded to, and consequently the noise and backlash incidental to cog-gearing is entirely obviated.

It will be perceived that a fly-wheel is not absolutely essential to the operation of our engine. In practice, however, we prefer to use a light fly-wheel, in order to secure uniform motion and for an additional safeguard.

It will be perceived that the auxiliary cylinder or chamber does not exhaust steam, but simply receives the pressure of the steam on its passage from the boiler to the main cylinder; and we thus utilize the pressure, before it is consumed by the engine, to overcome the dead-points without expenditure of steam.

It will also be understood that the engine, as shown, is simply the ordinary reciprocating slide-valve engine, and to which our improvement is adapted; and that the pressure and power of the auxiliary preserves an automatic relation to that of the engine, so as, without care, attention, or adjustment of any kind, to overcome any increasing resistance at the dead-points consequent on additional work, and the opening of the throttle by the governor to meet the same.

We claim as new and of our invention—

In combination with the driving-shaft I W of a steam-engine, the crank K, bell-crank L *l l'*, connecting-rod M, coupling-rod N, and piston P of the auxiliary cylinder R T, when arranged and adapted to operate substantially as herein described and illustrated.

In testimony of which invention we hereunto set our hands.

JOHN H. McGOWAN.
DAVID B. CALDWELL.

Attest:
GEO. H. KNIGHT,
JAMES H. LAYMAN.