

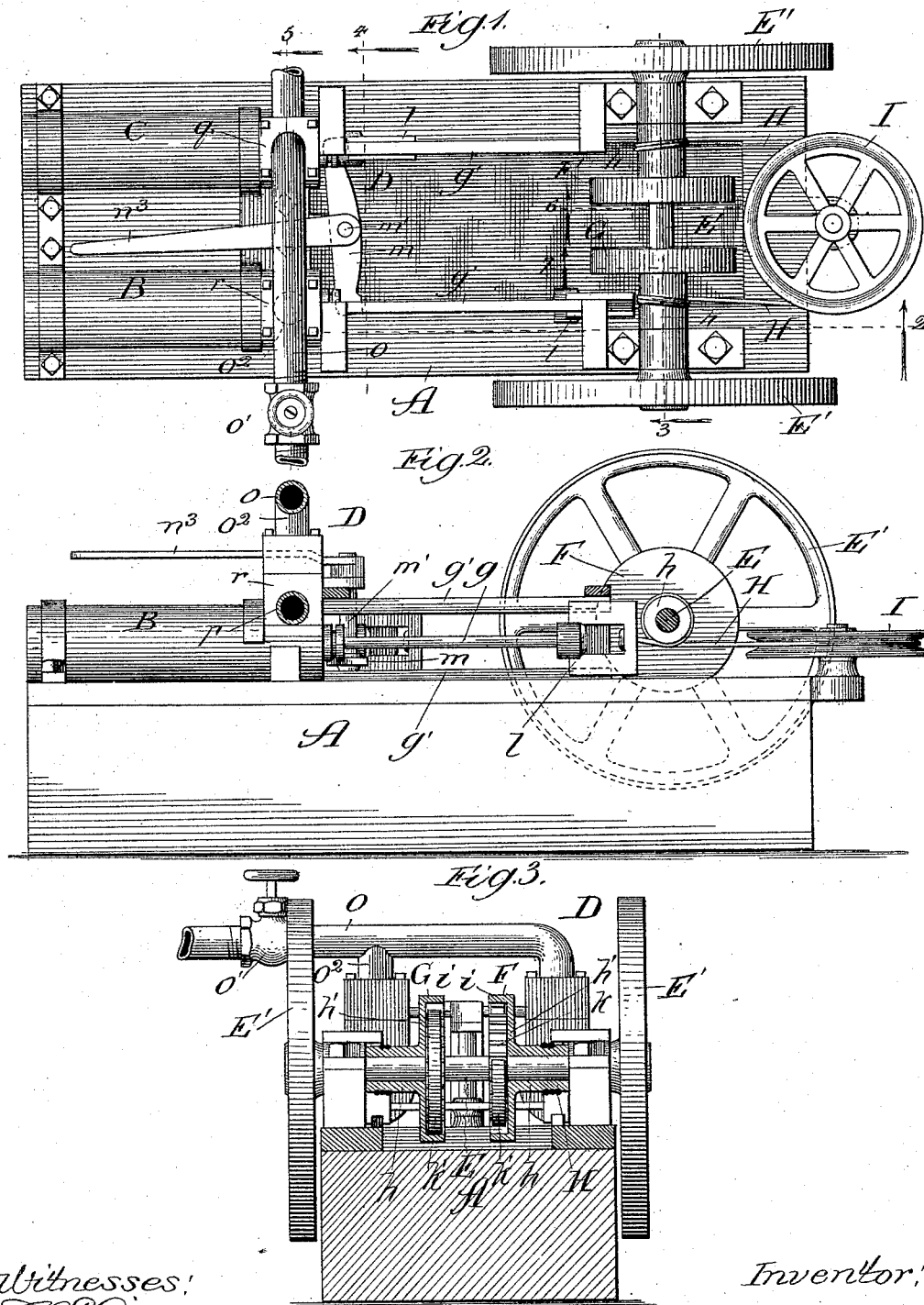
(No Model.)

3 Sheets—Sheet 1.

D. J. SMITH.
RECIPROCATING ENGINE.

No. 489,766.

Patented Jan. 10, 1893.



Witnesses:

Edw. J. Gaylord.
Clifford White.

Inventor:

David J. Smith,

By *Dyrenforth and Dyrenforth.*
Attys

(No Model.)

3 Sheets—Sheet 2.

D. J. SMITH.
RECIPROCATING ENGINE.

No. 489,766.

Patented Jan. 10, 1893.

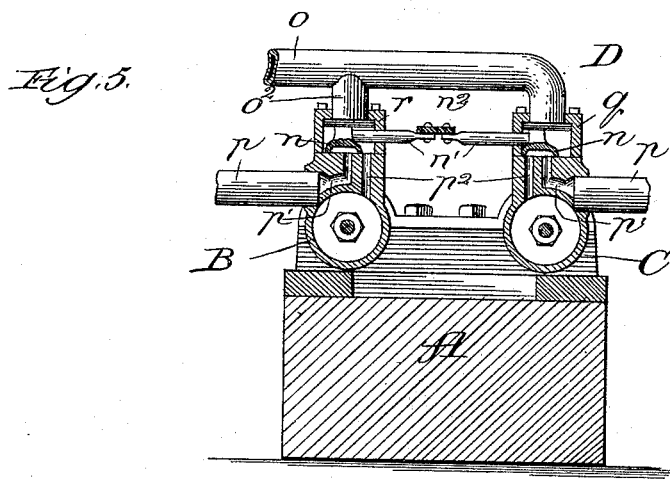
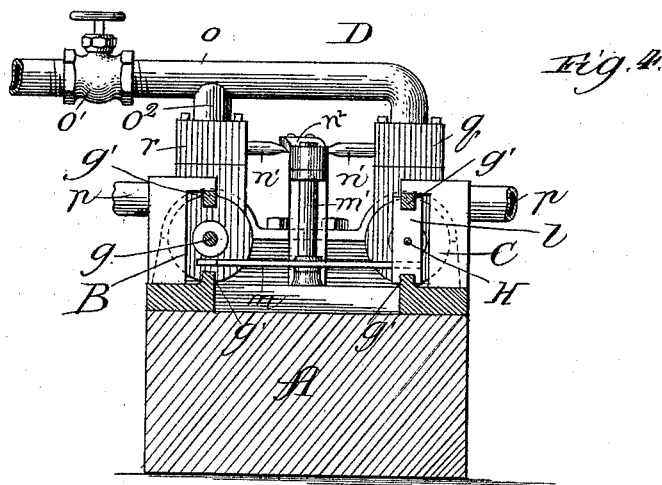


Fig. 6.

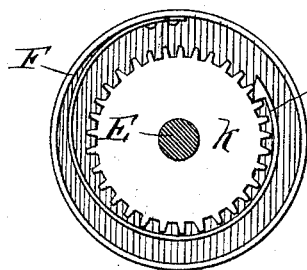
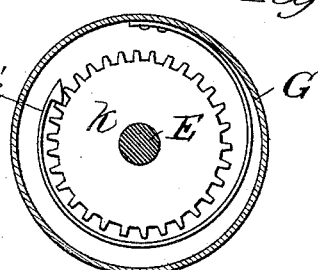


Fig. 7.



Witnesses:

Edw. J. Gaylord
Clifford A. White

Inventor:

David J. Smith
By Dyerforth & Dyerforth
Attys

(No Model.)

3 Sheets—Sheet 3.

D. J. SMITH.
RECIPROCATING ENGINE.

No. 489,766.

Patented Jan. 10, 1893.

Fig. 8.

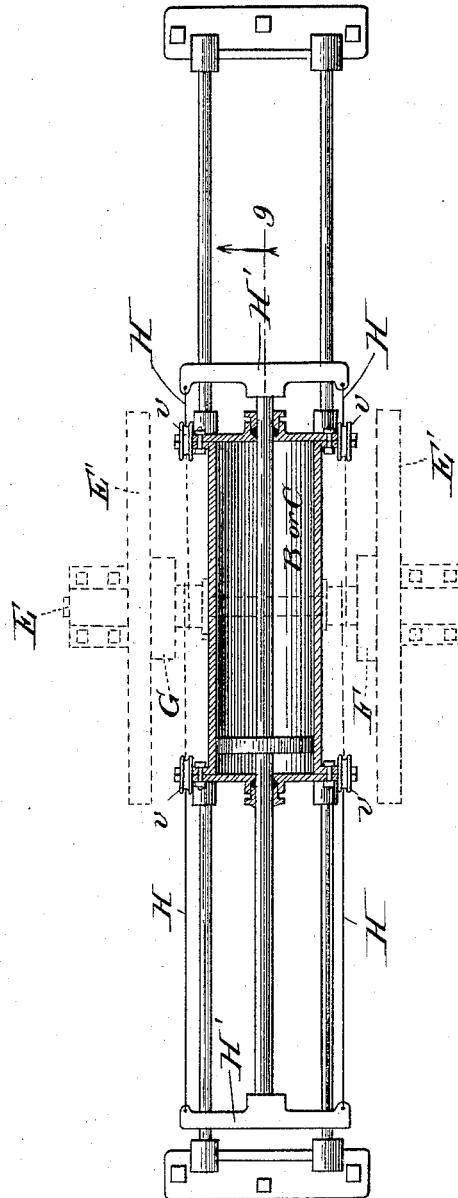
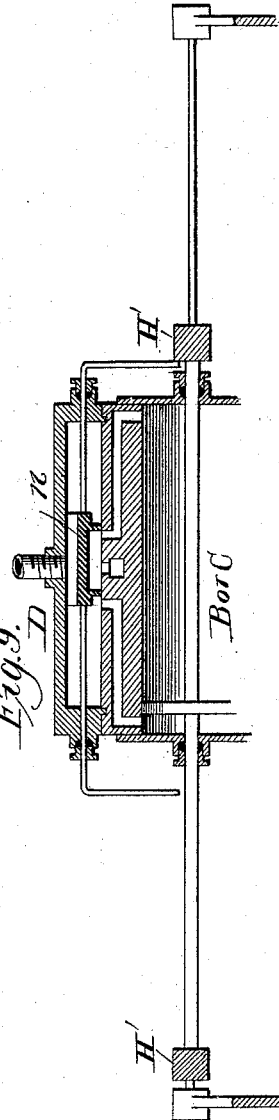


Fig. 9.



Witnesses:

Charles Gaylord
Clifford White

Inventor:

David J. Smith.

By Dyrenforth and Dyrenforth,

Attys

UNITED STATES PATENT OFFICE.

DAVID J. SMITH, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO GEORGE D. TURNER, OF SAME PLACE.

RECIPROCATING ENGINE.

SPECIFICATION forming part of Letters Patent No. 489,766, dated January 10, 1893.

Application filed June 13, 1892. Serial No. 436,428. (No model.)

To all whom it may concern:

Be it known that I, DAVID J. SMITH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Reciprocating Engines, of which the following is a specification.

My invention relates to an improvement in the class of engines, driven by steam or other power, in which the power is applied to a reciprocating piston and by the latter transmitted to a rotary shaft from which it is applied.

The object of my improvement is to provide a construction of engine in the class referred to, whereby the obvious advantage shall be afforded of avoiding any dead-center or centers, whatever, to be overcome. This I accomplish by so connecting the piston from opposite ends of a power-cylinder, or, the pistons from corresponding ends of two such cylinders, with the driving, or power-transmitting, shaft, that each stroke of the one piston, or one stroke of each of the two pistons, shall be exerted on the shaft successively at opposite sides of its longitudinal center to drive it continuously in the same direction, without the intervention of any form of crank or eccentric on or for the shaft.

My invention is illustrated in the accompanying drawings:

Figure 1 is a plan view of my improved engine. Fig. 2 is a sectional view of the same in side elevation, the section being taken at the line 2—2 on Fig. 1 and viewed in the direction of the arrows. Figs. 3, 4, 5, 6 and 7 are sectional views, taken, respectively, at the lines 3, 4, 5, 6 and 7 on Fig. 1 and regarded as indicated by the arrows. Fig. 8 is a sectional plan view representing the single-cylinder modification hereinbefore referred to. Fig. 9 is a section taken at the line 9 on Fig. 8, viewed in the direction of the arrow and showing the valve-mechanism as adapted to the single-cylinder modification.

Generally stated, my improvement, applied with the preferred plan of construction and manner of operation represented, in Figs. 1 and 5 inclusive, involves a pair of parallel cylinders each containing a piston, a rotary driving-shaft carrying clutch-mechanism, and

a cable connecting the two pistons over an interposed guide and passed from its connections with the pistons about the clutch-mechanism to cause it to actuate the clutch to engage and rotate the shaft in one direction by the back-stroke of each piston.

Following is a detailed description of my improved construction, according to aforesaid preferred plan:

A is the engine-bed. At one end of the bed are supported, in parallel relation to each other, the cylinders B and C, which may be open at their rear ends. At the forward ends of the cylinders is suitable valve-mechanism D for controlling the power (steam) supply to, and exhaust from, each. This valve-mechanism may involve any suitable construction, but that illustrated, which involves no important novel features, comprises chests *r* and *q*, into which the cylinders respectively lead at their forward ends, each chest being provided at its outer side with an exhaust-outlet *p* leading from a duct *p'* running to it from the base of the steam-chest, and with a duct *p''* leading directly into the cylinder from the base of the steam-chest, the latter containing a concave-base slide-valve *n*, which in one position covers the port *p'* only and in its other position covers both ports *p'* and *p''* and forms a communicating connection between them on the base of the steam-chest; and a steam-inlet pipe *o*, provided with a shut-off valve *o'*, leads at one end into the chest *q* and has a branch *o''* leading into the chest *r*. The two valves *n* are connected together by linking their stems *n'* to one end of a hand-lever *n''* fastened at its opposite end to the upper end of a vertical rock-shaft *m'*, journaled in suitable bearings and carrying at its lower end, to oscillate with it, a cross-bar *m* extending at its extremities into the paths of the cross-heads *l* hereinafter described.

E is the driving-shaft journaled in suitable bearings at the end of the bed opposite that carrying the cylinders and which, preferably, as shown, carries a fly-wheel *E'* at each end, both of which fly-wheels may be used as belt-pulleys. At opposite sides of the longitudinal center of the driving-shaft are the clutches F and G, each comprising as the construction shown (though any other form of clutch-mech-

anism may be used that will answer the purpose) a cog-wheel k fast on the shaft and surrounded by the inward extending circular flange or rim i of a disk h' extending from a sleeve h loosely surrounding the shaft; and inside each rim i is fastened a spring dog k' adapted to engage the teeth of its cog-wheel when the respective sleeve h is turned in one direction (as that away from the cylinders) and to slip over the cogs when the sleeve is turned in the opposite direction.

The piston in each of the cylinders B and C has its rod g fastened, at the outer end thereof, to a cross-head l movable in suitable parallel guides g' extending between the shaft and cylinders; and a cable H is fastened at one end to one of the cross-heads, passes thence underneath and with one or more (and preferably two) turns about the adjacent sleeve h , thence about a horizontal guide-pulley I supported on the bed near its front end, and under and with one or more (and preferably two) turns about the other sleeve to the adjacent cross-head l , to which it is secured. The sleeves h should be circumferentially grooved, as indicated in Fig. 3, to receive the turns of the cable.

The operation is as follows: With the parts in the relative positions illustrated, the piston in the cylinder B is at the end of its outer or forward stroke and that in the cylinder C is at the end of its inner or backward stroke, in reaching which its cross-head l will have struck the adjacent end of the cross-bar m and effected turning of the vertical shaft in the direction to move the valve n in the chest r from uncovering the inlet-port p^2 and covering the exhaust-port p' , and the valve in the chest q to the position of covering both ports. Then steam will enter the chest r through the branch-pipe o^2 and cylinder B through the duct p^2 in advance of the piston and drive the latter backward. The back stroke of this piston pulls on the adjacent end of the cable H, thereby turning the sleeve h , which is in line with the cylinder B, in the direction causing its dog k' to turn the adjacent cog-wheel k , and, through the medium of the latter, the shaft E. The cable about the other sleeve h will, in being pulled as described, turn that sleeve in the direction causing its dog k' to slip over the cog-wheel k of the clutch F while being turned by the engagement of the clutch G with the shaft, and will furthermore, obviously, pull out the piston of the cylinder C and force the steam ahead of it, (and previously introduced to effect the inner stroke of that piston) out of the exhaust through the passages p^2 and p' . When the piston of the cylinder C has thus been pulled to the end of its outer stroke, its cross-head l will have struck the adjacent end of the cross-bar m that turns the shaft m' in the direction causing the valves n respectively to open the steam-inlet to the cylinder C and close that and open the exhaust of the cylinder B, thereby driving back the piston

of the cylinder C, producing engagement of the clutch F with the shaft and thus continuing the rotation thereof in the one direction, while rendering the clutch G inoperative and drawing out the piston of cylinder B and thus exhausting the steam from the latter. Thus, as will be seen, each piston, by the same stroke (stated as backward, though the relative arrangement of parts might be such as to cause the forward stroke of each to do the work) drives the shaft in the same direction, which is thus driven in continuous rotation without any dead-centers to be overcome. And, as will be observed, the speed attainable of the shaft E is very great, inasmuch as the diameter of each sleeve, or the length of stroke of each piston, or both, may be accordingly great. It should also be mentioned that the cushioning-effect of the exhaust from the cylinders will operate to maintain the cable taut.

It has been herein suggested that one cylinder may be employed instead of the two. This modification is illustrated in Fig. 8. It involves a connection of the cable H passed over guide-pulleys v at the sides and near the ends of the cylinder with the opposite sides of the then single piston through the medium of cross-head connections H' with the piston-rod; and the connection of the cable-ends, which I may express by stating it to be with "contrary sides" of the piston-mechanism, is thus practically the same in the two-cylinder construction which may be regarded as one-cylinder of double the length cut transversely in two with the originally opposite ends brought side by side. In this modification, as will appear from inspection of Fig. 8, the driving-shaft E extends across the cylinder and carries the oppositely engaging clutches F and G engaged by the cable H in the same manner, the cable being led to them practically in the same way, as in the two-cylinder, or "divided-cylinder," construction.

Fig. 9 shows the valve-mechanism D modified to adapt it for use with the single-cylinder construction represented in Fig. 8; and the details of the modified valve-construction and manner of its operation will be quite clear from mere inspection of the drawings and without further description.

The details of my improvement as shown and described are thought to best serve my purpose, though I realize that they may be variously changed without thereby departing from the spirit of my invention. Hence I desire to be understood as including all such changes as within my invention.

What I claim as new and desire to secure by Letters Patent is—

1. In a reciprocating engine, the combination with the driving-shaft of a clutch on the shaft at each side of its longitudinal center, a cable passing toward opposite ends with one or more corresponding turns about each clutch, piston-mechanism having the cable-ends connected therewith to be pulled alternately at

opposite ends by successive piston-strokes, and being provided with suitable valve-mechanism for controlling the supply to and exhaust from the piston-mechanism, and a guide for the cable, substantially as described.

2. In a reciprocating engine, the combination with the driving-shaft of a clutch on the shaft at each side of its longitudinal center and correspondingly operative to engage the shaft, a cable passing toward opposite ends with one or more corresponding turns about each clutch, a pair of cylinders provided with suitable valve-mechanism for controlling the supply and exhaust and each having its piston connected with one end of the cable, and a guide at the opposite side of the shaft from the piston-mechanism and about which the cable passes to the shaft, substantially as described.

3. In a reciprocating engine, the combination with the driving-shaft of a clutch on the shaft at each side of its longitudinal center and correspondingly operative to engage the shaft, a cable passing toward opposite ends with one or more corresponding turns about each clutch, a pair of cylinders provided with suitable valve-mechanism for controlling the supply and exhaust and each having a cross-head on the outer end of its piston-rod connected with one end of the cable, guides for the cross-heads, and a guide at the opposite side of the shaft from the piston-mechanism and about which the cable passes to the shaft, substantially as described.

4. In a reciprocating engine, the combination with the driving-shaft of a clutch on the shaft at each side of its longitudinal center

and correspondingly operative to engage the shaft, a cable passing toward opposite ends with one or more corresponding turns about each clutch, a pair of cylinders each having a cross-head on the outer end of its piston-rod connected with one end of the cable, and guides for the cross-heads, a guide at the opposite side of the shaft from the piston-mechanism and about which the cable passes to the shaft, said cylinder being provided with valve-mechanism for controlling the supply to and exhaust from the cylinders and extended into the path of the cross-heads to be operated thereby, substantially as described.

5. In a reciprocating engine, the combination with the driving-shaft of a clutch on the shaft at each side of its longitudinal center and comprising a cog-wheel *k* fast on the shaft, a sleeve *h* loose on the shaft and having a disk *h'* provided with a rim *i* and carrying a dog *k'* to engage the cog-wheel, a cable *H* passing toward opposite ends with one or more corresponding turns about each clutch-sleeve, a pair of cylinders *B* and *C* each having on the outer end of its rod *g* a cross-head *l* movable in guides *g'* and connected with one end of the cable, and a guide-pulley *I* at the opposite side of the shaft from the piston-mechanism and about which the cable passes to the shaft, said cylinder being provided with valve-mechanism *D* extended into the path of the cross-heads to be operated thereby, substantially as described.

DAVID J. SMITH.

In presence of—

M. J. FROST,
J. W. HANSON.