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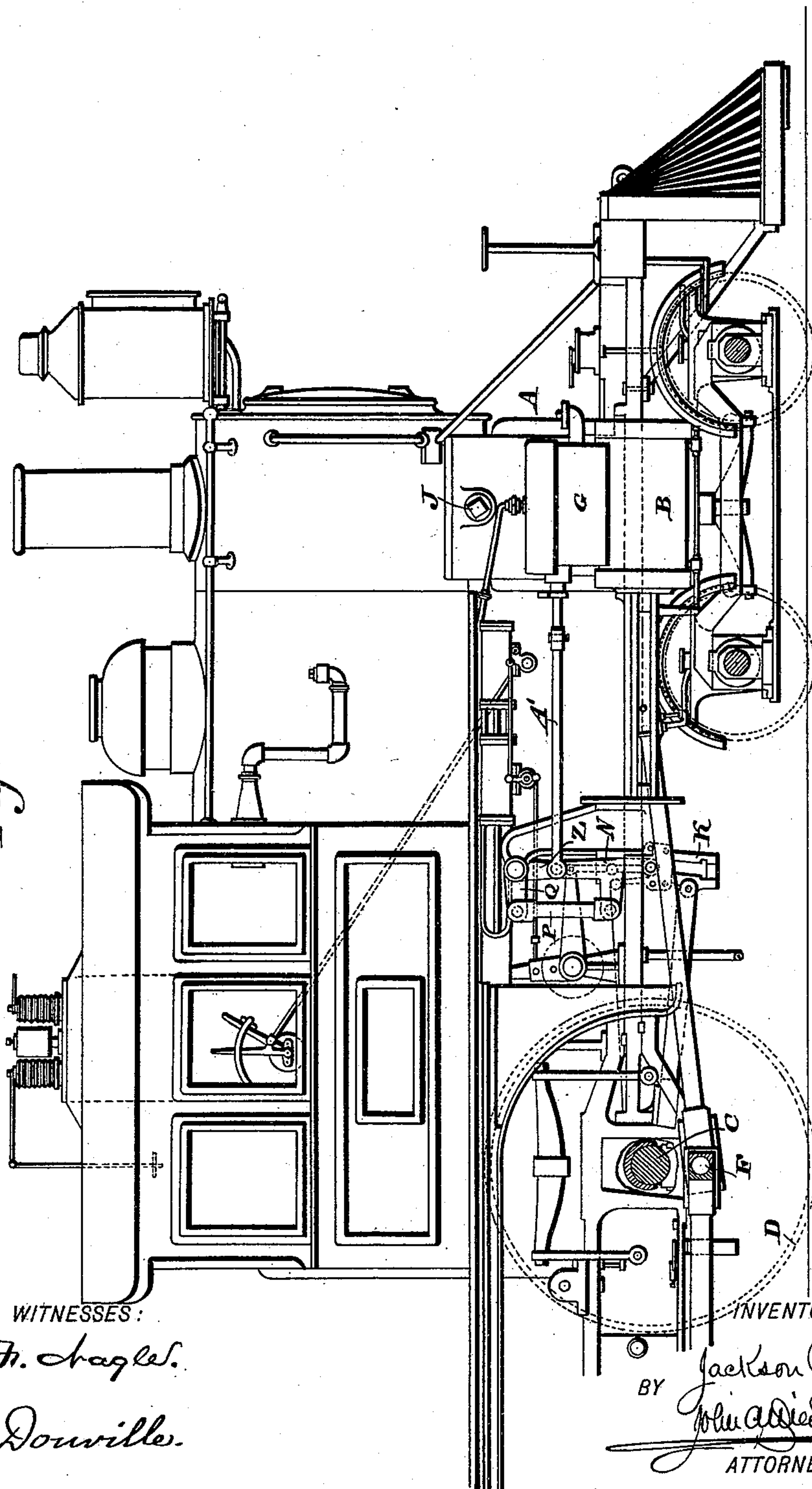
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J. RICHARDS.
LOCOMOTIVE ENGINE.

No. 488,774.

Patented Dec. 27, 1892.

Fig. 1.



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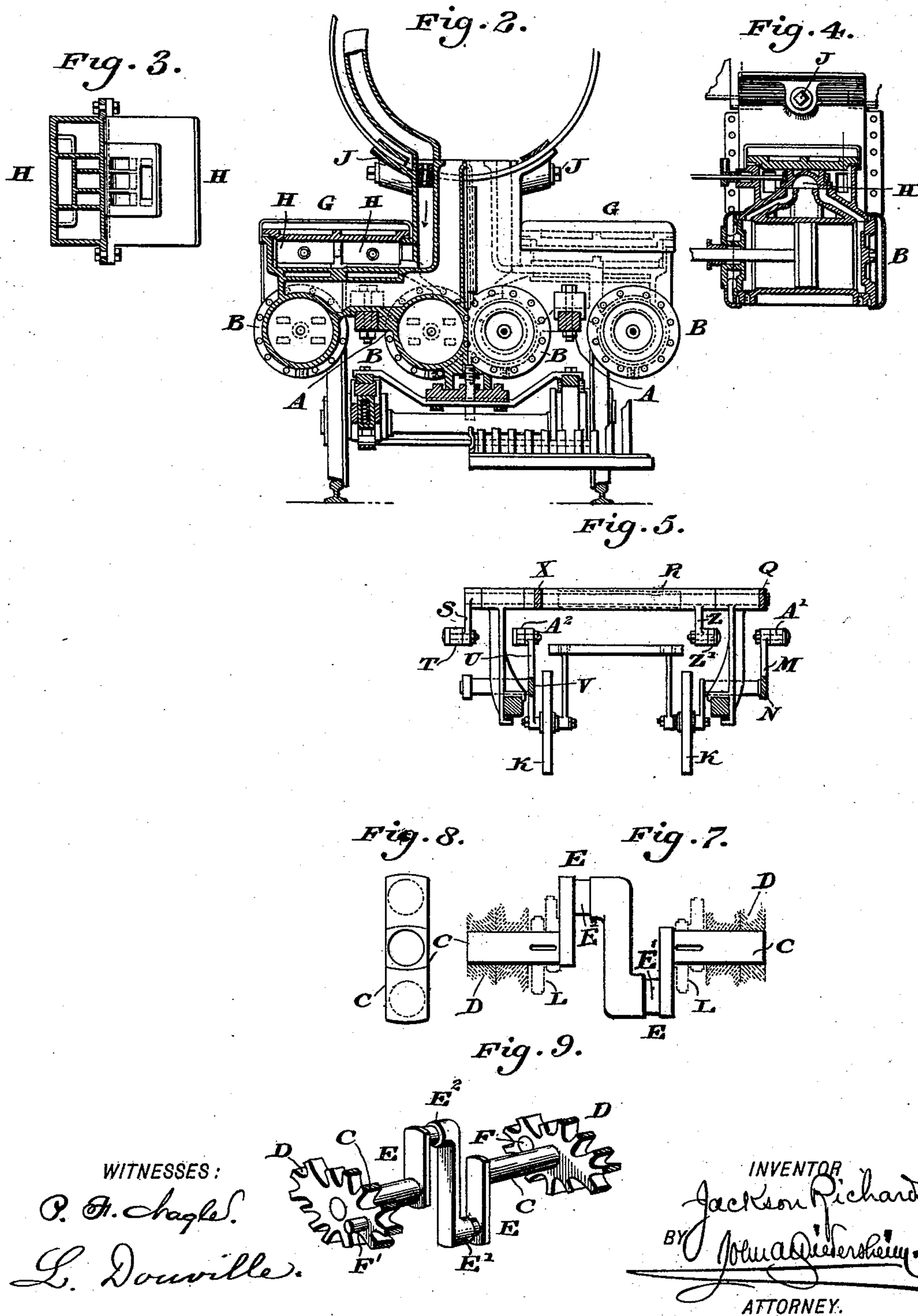
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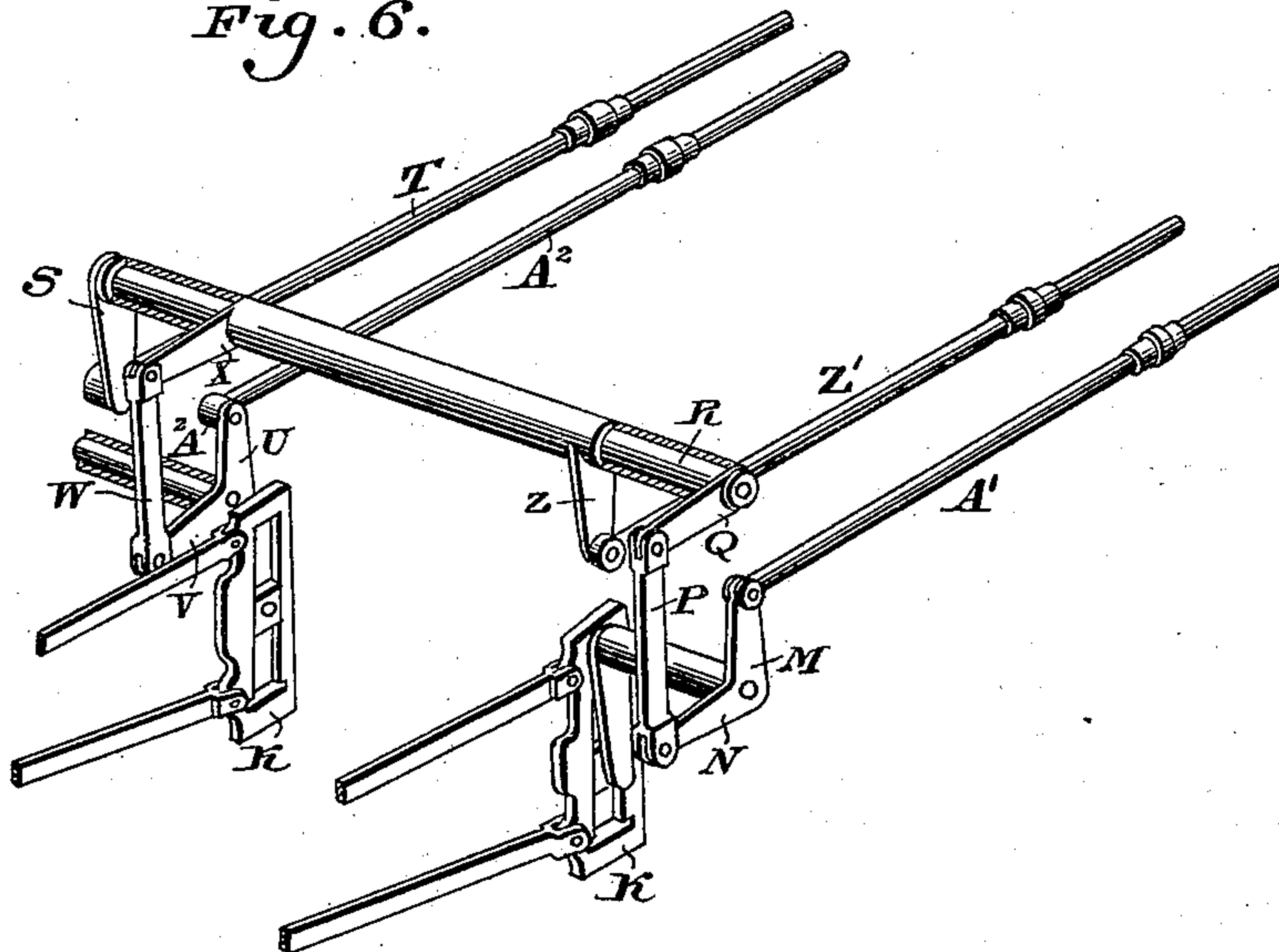
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Fig. 6.



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JACKSON RICHARDS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE
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LOCOMOTIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 488,774, dated December 27, 1892.

Application filed December 17, 1891. Serial No. 415,343. (No model.)

To all whom it may concern:

Be it known that I, JACKSON RICHARDS, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Improvement in Locomotive - Engines, which improvement is fully set forth in the following specification and accompanying drawings.

My invention consists of a four-cylinder engine provided with valve gear of novel construction, whereby the engine may be balanced and run steady, and attain a high rate of speed with great power, and there is a compactness, rigidity and simplicity of parts, said construction being hereinafter fully set forth.

Figure 1 represents a side elevation of a locomotive engine embodying my invention. Fig. 2 represents a partial front view and partial transverse vertical section thereof. Fig. 3 represents a partial horizontal section and partial plan view of the saddle seat. Fig. 4 represents a longitudinal vertical section of one of the cylinders and valves and adjacent portions. Fig. 5 represents a partial front view and partial vertical section of the valve motion detached. Fig. 6 represents a perspective thereof. Fig. 7 represents a view of the double crank shaft employed. Fig. 8 represents an end view thereof. Fig. 9 represents a perspective view thereof, showing relative position of all the four crank pins, and showing also portions of the driving wheels.

Similar letters of reference indicate corresponding parts in the several figures.

Referring to the drawings:—A designates the saddle of a locomotive engine, and B designates four cylinders which are cast thereon, and placed side by side in pairs, one pair being at the right and the other pair at the left of the engine.

C designates a crank axle, to which two driving wheels D, D, are secured, said axle having cranks E, E thereon, and said wheels having their crank pins F, F', so arranged that right hand crank pin F is ninety degrees ahead of the crank pin E², and crank pin E' is diametrically opposite pin E², while the left hand pin F' is ninety degrees ahead of pin E' or diametrically opposite pin F. By this arrange-

ment, the cranks are spaced ninety degrees apart around the circle, with the intention that diametrically opposite cranks balance each other. The connecting rods of the pistons of the two outer cylinders are attached to the crank pins F, F', while the connecting rods of the pistons of the two inner cylinders are attached to the cranks E, E, of the crank axle.

G designates the steam chests, each of which contains two valves H with ports for live and exhaust steam, each chest having a steam supply pipe connected with it, and all four exhaust ports leading into the smoke box.

It will be seen that I provide two engines of two cylinders, each of the engines being independent of each other. The right hand outer and the right hand inner cylinders with their auxiliaries and their connections with one wheel crank pin and one axle crank, form one engine. The left hand outer and left hand inner cylinders with their auxiliaries, and their connection with the other wheel crank pin and axle crank, form the other engine.

It will be seen that the locomotive engine may be driven by the four cylinders, so that a high rate of speed and great power may be attained. Either engine or part of entire engine if disabled may be run without interfering with the other engine or part, or causing dead centers in the remaining engine. In such case, steam may be entirely cut off from the chest of the disabled side by means of valves J, located in the saddle casting of the ordinary stop-cock type.

In order to operate the four valves, I employ but two links K, and two sets of eccentrics L. The valves of the outer cylinders are driven from the right link as follows:—The right hand outer valve receives motion from the rocker arm M. The left hand outer valve receives motion from the arm N which by means of a rod P connected with an arm Q on a shaft R, the latter extending to the left side, where by means of an arm S, motion is communicated to the valve stem T. The valves of the inside cylinders are driven from the left hand links as follows:—The left hand inner cylinder valve receives motion from the left hand link by means of the rocker arm U,

the right hand inner cylinder valve also receives motion from the left hand link and rocker by means of the arm V, and a rod W connecting the arm V with the sleeve X, which
 5 fits loosely on the shaft R, and extends to the right hand side, where by means of an arm Z, it transmits its motion to the valve stem Z'. Thus it will be seen that the valve stem A' on the rocker M moves in opposite direction to the valve stem T, and that the valve
 10 stem Z' always moves in opposite direction to the valve stem A² on the rocker U. By these means there will be a steady motion, due to a more perfectly balanced engine, as steam is
 15 taken simultaneously on both sides, thus also preventing all lurching and moving of the engine from one side to another, and furthermore preventing the wheels from mounting the rails when running at a high rate of speed around
 20 a curve of small radius. Again straight running is insured, and the pulling off of tires, the breaking of spokes out of the wheels, and the bending of rails and hammer-blow effect on bridges are obviated. Furthermore, owing to
 25 the valve coupling and motion-transmitting mechanism, there is a greater compactness, rigidity and simplicity of parts than when two shafts are employed across the engine, as heretofore noticed. When the outside right
 30 hand crank is on the forward center, then the right hand inside crank is top half stroke, and the left hand inside crank is at bottom half stroke, and the outer left hand crank is at the back center. By this arrangement the en-
 35 gine is made balanced, and all dead centers are avoided, even when only one half the engine is in use, in the event of disablement of the other half.

The valves in the steam passages in the saddle form the subject matter of another appli-

cation Serial No. 445,741 filed September 13, 1892 since the date of the present application, and are not claimed herein.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is:—

1. A four cylinder balanced engine provided with valve gear having two links and two sets of eccentrics for its four valves, a shaft, a rocker arm connected with the right hand
 50 outer cylinder valve, mechanism connected with the left hand outer valve and the said shaft substantially as described for moving said valve in an opposite direction to movement of said right hand valve, a rocker arm
 55 connected with the left hand inner valve, and mechanism substantially as described connected with the right hand inner cylinder valve and a sleeve fitting loosely on said shaft for moving said valve in an opposite direction
 60 to said left hand inner cylinder valve said parts being combined substantially as described.

2. A balanced four-cylinder engine having the valve gear for its four valves provided
 65 with two links and two sets of eccentrics, a shaft, a rocker arm connected with one of the outer valves, an arm connected by a rod with said shaft at one end, and an arm on the other end of the shaft connected with the other
 70 outer valve, a rocker arm connected with one of the inner valves and an arm connected with a sleeve loosely mounted on the said shaft and connected by an arm to the other inner valve, said parts being combined sub-
 75 stantially as described.

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Witnesses:

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