

*N<sup>o</sup> 9,486,*



# UNITED STATES PATENT OFFICE.

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## EQUALIZING APPARATUS FOR ENGINES WHICH USE STEAM EXPANSIVELY.

Specification of Letters Patent No. 9,486, dated December 21, 1852.

*To all whom it may concern:*

Be it known that I, WM. HENRY MORRISON, of Indianapolis, in the county of Marion and State of Indiana, have made a new and useful Pneumatic Apparatus for Equalizing the Action of Steam when Used Expansively; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the annexed drawings, making part of this specification.

The object of my improvement is to equalize the action of steam when used expansively in a reciprocating engine; so that during the first part of the stroke of the piston, when the full power of the steam is admitted to the cylinder, a power shall be accumulated to be returned to the engine when the power of the steam is lessened by expansion, and the peculiar applicability of my device to such, is derived from its capacity of being modified, to suit the intended period of cut off, or other circumstances of the engine. This result is accomplished by the use (one on each side of the center of motion) of two equalizing cylinders, which by being placed a greater or less distance asunder, cause the most rapid accumulation of equalizing force to take place, earlier or later in the stroke, in accordance with the period of cut off, &c.; so that when the steam is under the greatest headway, the most rapid accumulation of equalizing force can be taking place.

In the drawing annexed (*a*) is a portion of the piston rod of the steam cylinder or of a rod suitably connected therewith; (*b*) is an arm having a fixed center of vibration at (*c*) and jointed at (*d*) to the rod (*a*); (*e*, *f*,) are two arms also jointed at (*d*) and with the arm (*b*) forming toggles, which respectively work the blocks (*g*, *h*,) in the slides (*i*, *j*,) to these blocks are attached piston rods (*k*, *l*,) and the pistons (*m*, *n*,) working in air-tight cylinders (*o*, *p*,), these cylinders being open at the top so as to allow the atmosphere free access to the upper sides of the pistons.

The range of the center (*d*) at the end of piston rod (*a*) is shown by the dotted line (1, 2, 3, 4, 5, 6,) and the chord of the arc described is the length of the stroke. It will be perceived that on the stroke of the steam cylinder piston, the pistons (*m*, *n*,) are de-

pressed in the air-tight cylinder (*o*, *p*,) until the point (3) is reached; from this point to the point (4) the piston (*m*) ascends, the piston (*n*) still descending; thence to the end of the stroke (6) both pistons are ascending. The cylinders being full of air, or of any other elastic fluid, compressed or otherwise, at the commencement of the stroke, the air in them is diminished in volume by the descent of the pistons until a point is reached, seen in the drawing in dotted line (C), that is until the arms of the toggle (*b*, *e*,) are in line; passing this, at the point (4) dotted line (D) the piston (*n*) has attained its lowest depression; each piston after passing its respective point of lowest depression, by the elasticity of the air or other elastic fluid contained in its cylinder, contributing power during the remainder of the stroke.

In the drawing the cylinders are shown so placed relatively to the other parts that the pistons in both cylinders descend during the first five-twelfths of the stroke; one (*m*) rises and one (*n*) descends during a further sixth of the stroke, and during the remaining five-twelfths of the stroke both pistons are rising. The central lines of the air-tight cylinders are shown placed immediately under the points of one-third and two-thirds stroke of the piston (the said points marked respectively 2 and 5 in the drawing), and should it be wished that the pistons should reach their greatest depression at one-third and two-thirds stroke respectively, the distance between their cylinders (*o*, *p*,) must be increased until the points of attachment of the arms (*e*, *f*,) on the blocks (*g*, *h*,) are on a line respectively with (2) and (5) and the center (*c*) when the arm (*b*) is brought into the same straight line respectively with the arms (*e*) and (*f*).

Any other required variation is made by altering the position of the cylinders, or of their number, which may be increased or diminished as may be best suited to the degree of expansion or point of cut off of the steam in each case.

The precise form and arrangement shown in the drawing may be varied to suit the requirements of different descriptions of engines such as beam, side lever, horizontal, &c.

Having thus described the nature of my method of equalizing the action of steam, I



claim therein as new and of my invention  
and desire to secure by Letters Patent—

The application to a reciprocating engine,  
(in which the steam is used expansively) of  
5 the described or equivalent toggle move-  
ment, in combination with a pair of equaliz-  
ing cylinders, which being placed at a  
greater or less distance, (one on each side of  
the midrange of the toggle,) the most rapid  
10 accumulation of equalizing force is made to

take place earlier or later in the stroke, in  
accordance with the period of cut off, &c.;  
for the purposes herein explained.

In testimony whereof, I have hereunto set  
my hand before two subscribing witnesses. 15

WM. HENRY MORRISON.

Witnesses:

JOSEPH DENNIS,

WINSTON P. NOBLE.