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M. N. FORNEY.

FLUID PRESSURE ENGINE.

APPLICATION FILED AUG. 8, 1902.

NO MODEL.

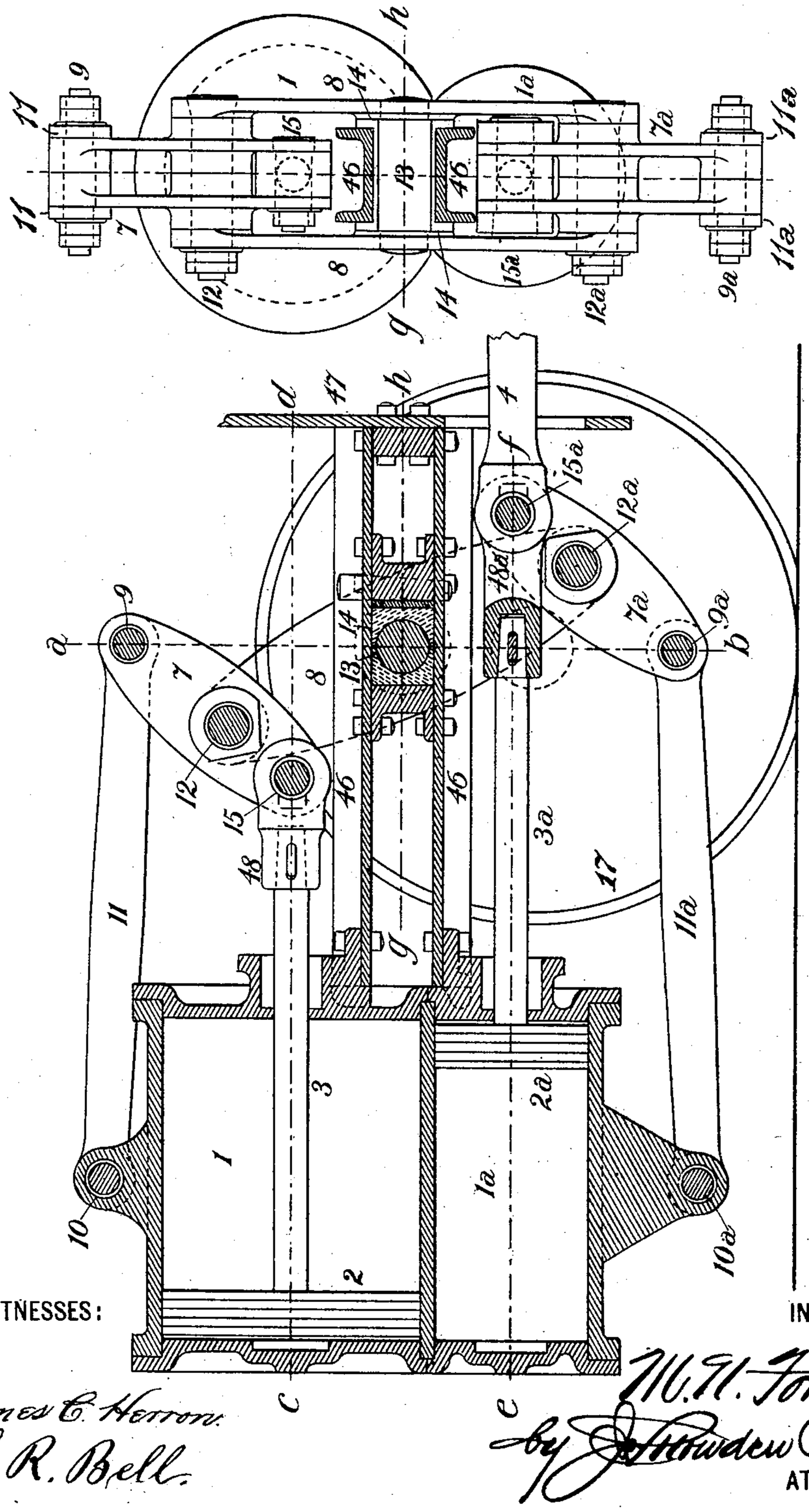

Fig. 2

Fig. 1

WITNESSES:

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UNITED STATES PATENT OFFICE.

MATTHIAS N. FORNEY, OF NEW YORK, N. Y.

FLUID-PRESSURE ENGINE.

SPECIFICATION forming part of Letters Patent No. 735,739, dated August 11, 1903.

Application filed August 8, 1902. Serial No. 118,967. (No model.)

To all whom it may concern:

Be it known that I, MATTHIAS N. FORNEY, of the borough of Manhattan, in the city and State of New York, have invented a certain new and useful Improvement in Fluid-Pressure Engines, of which improvement the following is a specification.

My present invention is an improvement on that set forth in Letters Patent of the United States No. 489,648, granted and issued to me under date of January 10, 1893, and is more particularly designed for application to compound steam-engines, but is applicable to other fluid-pressure and to binary engines which are not compound; and its object is to facilitate and further improve the means whereby the reciprocating elements of engines of such character are made to counterbalance each other by a more convenient disposition of their parts, which results in a reduction of cost of the engines.

The improvement claimed is hereinafter fully set forth.

In the compound engine set forth in Letters Patent No. 489,648 aforesaid the piston-rod of the low-pressure cylinder is directly connected to what is termed a "primary" lever, which is in turn articulated to a pair of "secondary" levers, which oscillate on journals or trunnions supported in fixed bearings, the system of levers forming a "parallel" motion, which constrains the piston-rod to move in a straight line. In this construction the axes of the journals or trunnions of the secondary levers are in a plane which coincides with the axis of one of the cylinders, which is the line in which the center of its piston-rod moves. The piston-rod of the high-pressure piston is connected to the lower end of the secondary lever; but as these move in a path which is an arc of a circle to secure rectilineal movement of this piston-rod it requires to be and is shown as connected to the levers by means of a guide, cross-head, and short links.

Under my present invention the guide, cross-head, and short connecting-links of Patent No. 489,648 are wholly dispensed with, and my improvement is adapted to application in connection with cylinders the relative location of which may be substantially varied.

In the accompanying drawings, Figure 1 is a vertical longitudinal central section through a pair of cylinders of a four-cylinder compound locomotive-engine, illustrating an embodiment of my invention in which the cylinders of each pair are located one above another and both outside of the engine-frame; and Fig. 2 a transverse section on the line *a b* of Fig. 1 looking toward the cylinders, the oscillating levers being shown in elevation and in a vertical position instead of in section to facilitate clearness of representation.

My invention is herein illustrated as applied in a four-cylinder compound locomotive-engine having a high-pressure cylinder 1^a and a low-pressure cylinder 1 located one above another on each side of the engine, with their axes in the same vertical plane. The cylinders 1^a 1, which are of the ordinary construction, are fitted, respectively, with pistons 2^a 2, secured upon piston-rods 3^a 3, the outer ends of which are not, as in common practice, secured to cross-heads sliding on guides, but are coupled, through a system of oscillating levers presently to be described, to a connecting-rod 4, through which their movements are transmitted to a crank-pin (not shown) on one of the driving-wheels of the locomotive. Motive fluid is admitted to and exhausted from the cylinders by any suitable valve mechanism, which, as it does not form part of my present invention, is not herein set forth.

The system of oscillating levers above referred to, which forms what is known as a "parallel" motion, by means of which the outer ends of the piston-rods are caused to move in straight lines, thereby dispensing with the cross-heads and guides ordinarily employed for this purpose, is in this instance of the following construction: Two double-armed lever-bars, which collectively may be termed a "primary" lever 7, are coupled at their lower ends by a pin 15 to a head 48, fixed upon the outer end of the low-pressure piston-rod 3, and are coupled at their upper ends by a pin 9 to a pair of radius-links 11, the opposite ends of which are coupled to a pin 10, fixed on the top of the low-pressure cylinder 1.

Two double-armed lever-bars, which collectively may be termed a "secondary" lever

8, are fixed upon the ends of a journal 13, which is fitted to oscillate in a bearing 14, secured to and between upper and lower channel-bar supports 46, the forward ends of which are connected to the heads of the cylinders and the rear ends to a transverse brace 47. The axis of the journal 13 of the secondary lever 8 is located in a horizontal plane *g h*, which is substantially midway between the central horizontal planes *c d* and *e f* of the low-pressure and high-pressure cylinders.

The upper arm of the secondary lever 8 is coupled to the primary lever 7 by a pin 12, located intermediate of its end connecting-pins 9 15. The lower arm of the secondary lever is coupled by a pin 12^a to a second primary lever 7^a intermediate of its ends, said second primary lever corresponding substantially with the first primary lever 7 and similarly thereto formed of two double-armed lever-bars set side by side. The lower arm of the second primary lever 7^a is coupled by a pin 9^a to the rear ends of a pair of radius-links 11^a, the forward ends of which are coupled to a pin 10^a, fixed on the bottom of the high-pressure cylinder 1^a. The upper end of the second primary lever is coupled by a pin 15^a to a forked head 48^a, fixed on the outer end of the high-pressure piston-rod 3^a and to the connecting-rod 4, which extends to the crank-pin.

Briefly stated, under the above construction each of the piston-rods is coupled to one end of a separate primary lever, and said levers are coupled at their opposite ends to radial links attached to fixed bearings and are coupled intermediately to opposite ends of a secondary lever, which oscillates in a fixed bearing intermediate of the axial planes of the cylinders. By proportioning the primary and secondary levers and their points of connection properly to each other the ends of the two primary levers to which the piston-rods are coupled will move in approximately straight lines. This approximation may be made so close to a true straight line that the departure therefrom will not be of any practical importance.

The location of the main journal 13 of the secondary lever between the axial lines of the upper and lower piston-rods enables the journal and its bearing to be interposed between the two side bars or plates of the secondary lever, and the capacity of free movement is thus afforded to the upper and lower primary levers between the bars of the secondary lever and above and below the journal 13. There being more room in a locomotive-engine between the side bars of the levers than there is outside of them, the length of the bearing may consequently be increased, and only one bearing is required instead of two, as in Patent No. 489,648. The construction of the journal bearing and supports is correspondingly simplified and cheapened, and the same advantage results from the elimination in my present improvement of the cross-head, guide, and connecting-links of the high-pressure piston-rod, which are employed in the construction of said patent.

It will be obvious that the main connecting-rod 4 may, if preferred, be coupled to the low-pressure piston-rod instead of to the high-pressure piston-rod, as shown, and that the high-pressure cylinder may be placed above instead of below the low-pressure cylinder. It will also be seen that the outer ends of the primary levers may be guided by sliding blocks, as in Patent No. 439,648, which sliding blocks would constitute movable fulcrums; but the radius-links herein described and shown are deemed by me to be preferable.

I claim as my invention and desire to secure by Letters Patent—

1. The combination of two reciprocating members, two primary oscillating levers, each coupled at one end to one of the reciprocating members and having a movable fulcrum at its opposite end, a secondary oscillating lever journaled between its ends in a fixed bearing and coupled at its ends to the primary levers, and a rod connecting the oscillating-lever system to a crank.

2. In a fluid-pressure engine, the combination of a pair of cylinders, a piston and rod for each cylinder, two primary oscillating levers, each coupled at one end to one of the piston-rods and having a movable fulcrum at its opposite end, a secondary oscillating lever journaled between its ends in a fixed bearing and coupled at its ends to the primary levers, and a rod connecting the oscillating-lever system with a crank.

3. In a fluid-pressure engine, the combination of a pair of cylinders, pistons and piston-rods fitted to reciprocate in relatively opposite directions in said cylinders, a primary oscillating lever coupled, at one end, to one of said piston-rods and having a movable fulcrum at its opposite end, a second primary lever coupled, at one end, to the other piston-rod, and having a movable fulcrum at its opposite end, a secondary oscillating lever journaled between its ends in a fixed bearing and coupled, at its ends, to the centers of the primary levers, and a rod connecting the oscillating-lever system with a crank.

4. In a fluid-pressure engine, the combination of a pair of cylinders, pistons and piston-rods fitted to reciprocate in relatively opposite directions in said cylinders, a primary oscillating lever coupled, at one end to one of said piston-rods, and having a movable fulcrum at its opposite end, a second primary lever coupled, at one end to the other piston-rod and having a movable fulcrum at its opposite end, a secondary lever coupled, at its ends, to the primary levers, a fixed bearing located between the extended axes of the cylinders, a journal fixed centrally to the secondary lever and mounted in said bearing, and a rod connecting the oscillating-lever system with a crank.

5. In a fluid-pressure engine, the combina-

tion of a pair of cylinders, pistons and piston-rods fitted to reciprocate in relatively opposite directions in said cylinders, a primary lever coupled, at one end, to one of said piston-rods, a radial link coupled to the opposite end of said primary lever and to a fixed pivot, a second primary lever coupled, at one end, to the other piston-rod, a radial link coupled to the opposite end of said primary lever and to a fixed pivot, a secondary lever journaled, between its ends, in a fixed bearing, and coupled, at its ends, to the primary levers, and a rod connecting the oscillating-lever system with a crank.

6. In a fluid-pressure engine, the combination of a pair of cylinders, pistons and piston-rods fitted to reciprocate in relatively opposite directions in said cylinders, a primary oscillating lever coupled, at one end, to one of said piston-rods and having a movable fulcrum at its opposite end, a second primary lever coupled, at one end, to the other piston-rod, and having a movable fulcrum at its opposite end, a secondary oscillating lever composed of a pair of bars fixed upon a journal, intermediately of their ends, and spaced sufficiently apart to admit of the oscillation of the primary levers between them, a fixed bearing located between the extended axes of the cylinders and supporting the journal of the secondary lever, pins coupling the ends of the secondary lever to the primary levers, and a rod connecting the oscillating-lever system with a crank.

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