

No. 719,053.

H. F. SHAW.
ENGINE.

PATENTED JAN. 27, 1903.

NO MODEL.

APPLICATION FILED MAY 14, 1902.

2 SHEETS—SHEET 1.

Fig. 1.

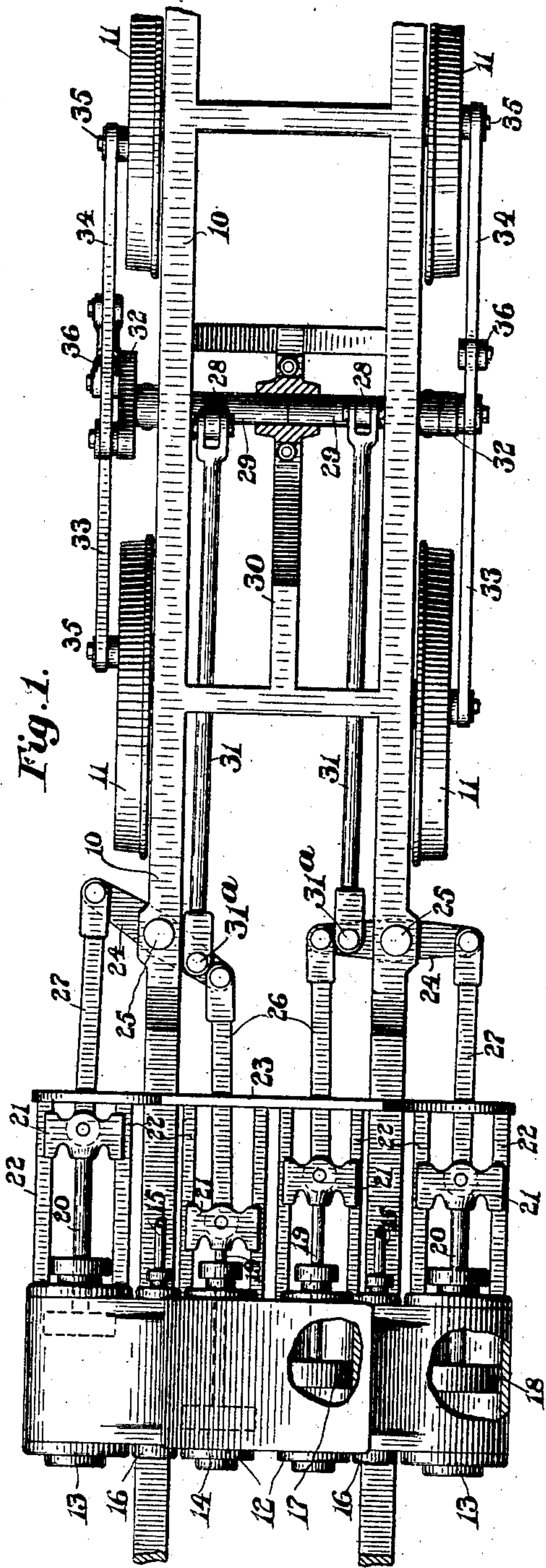
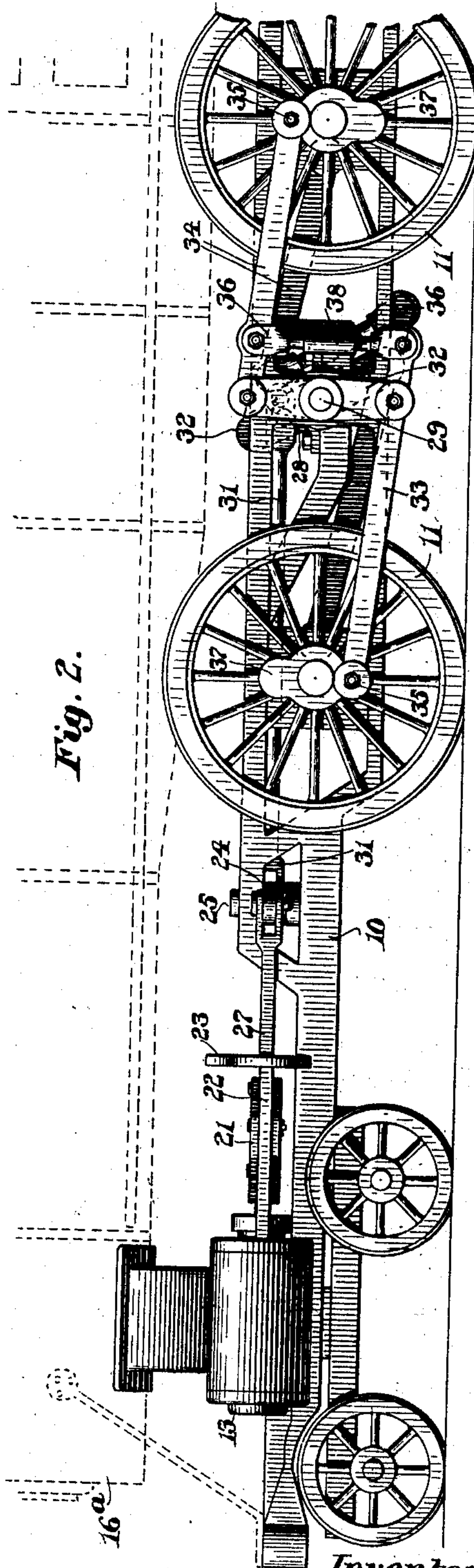


Fig. 2.



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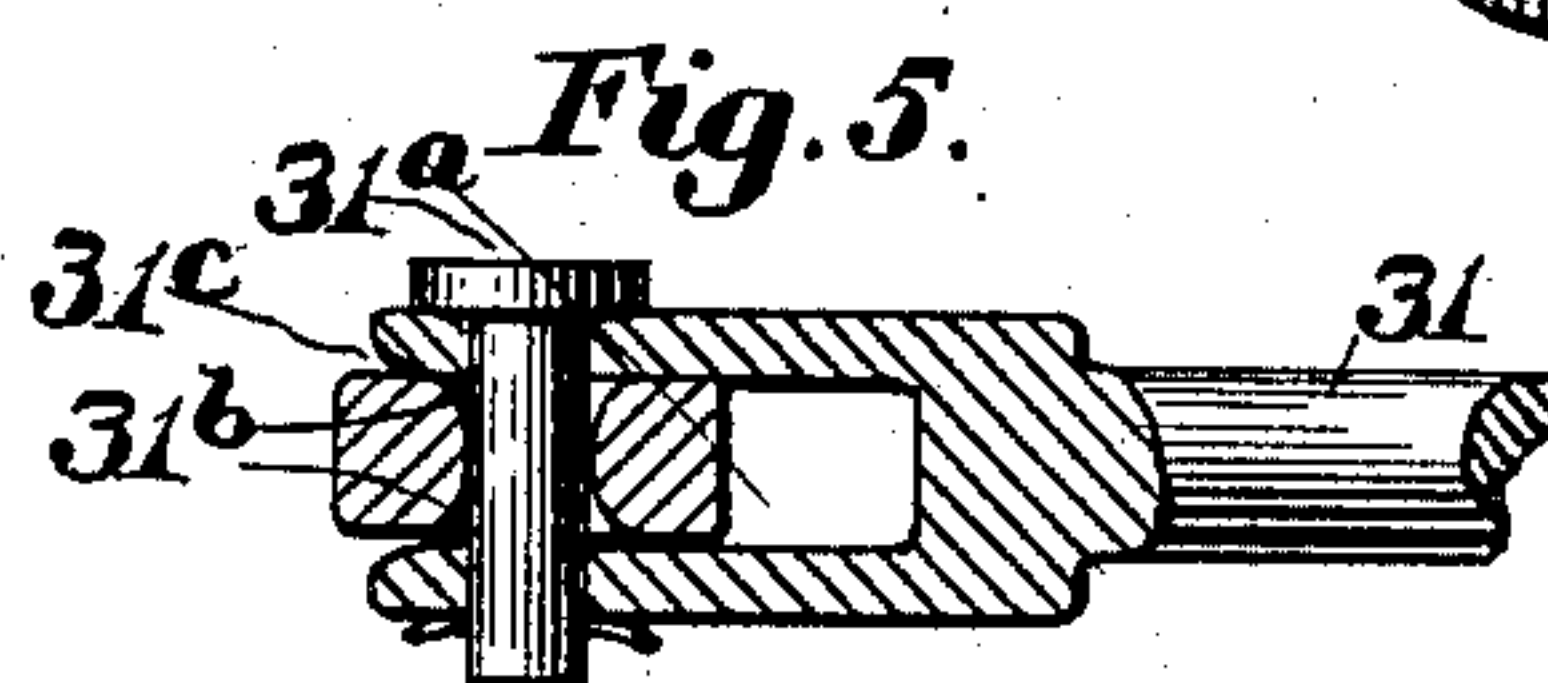
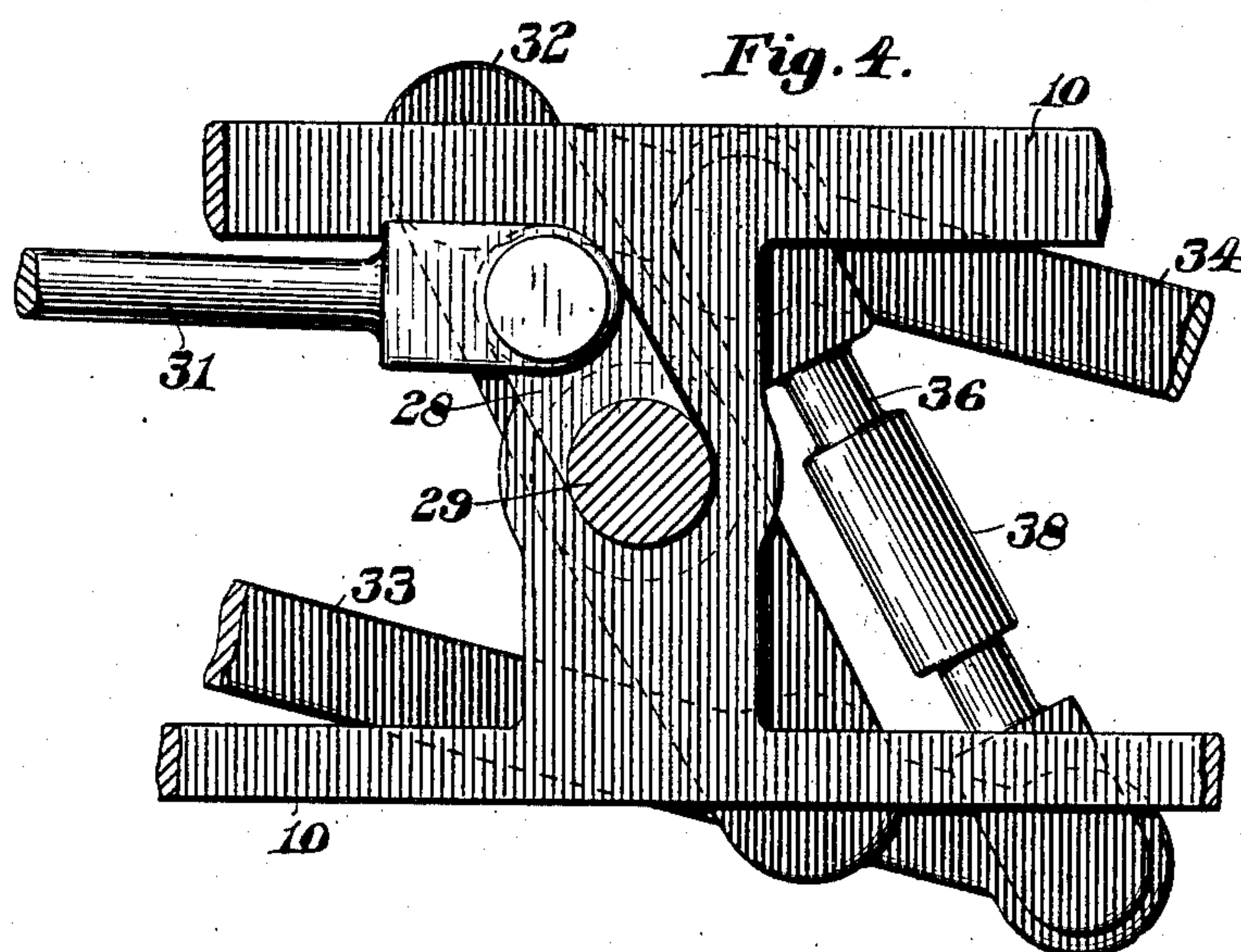
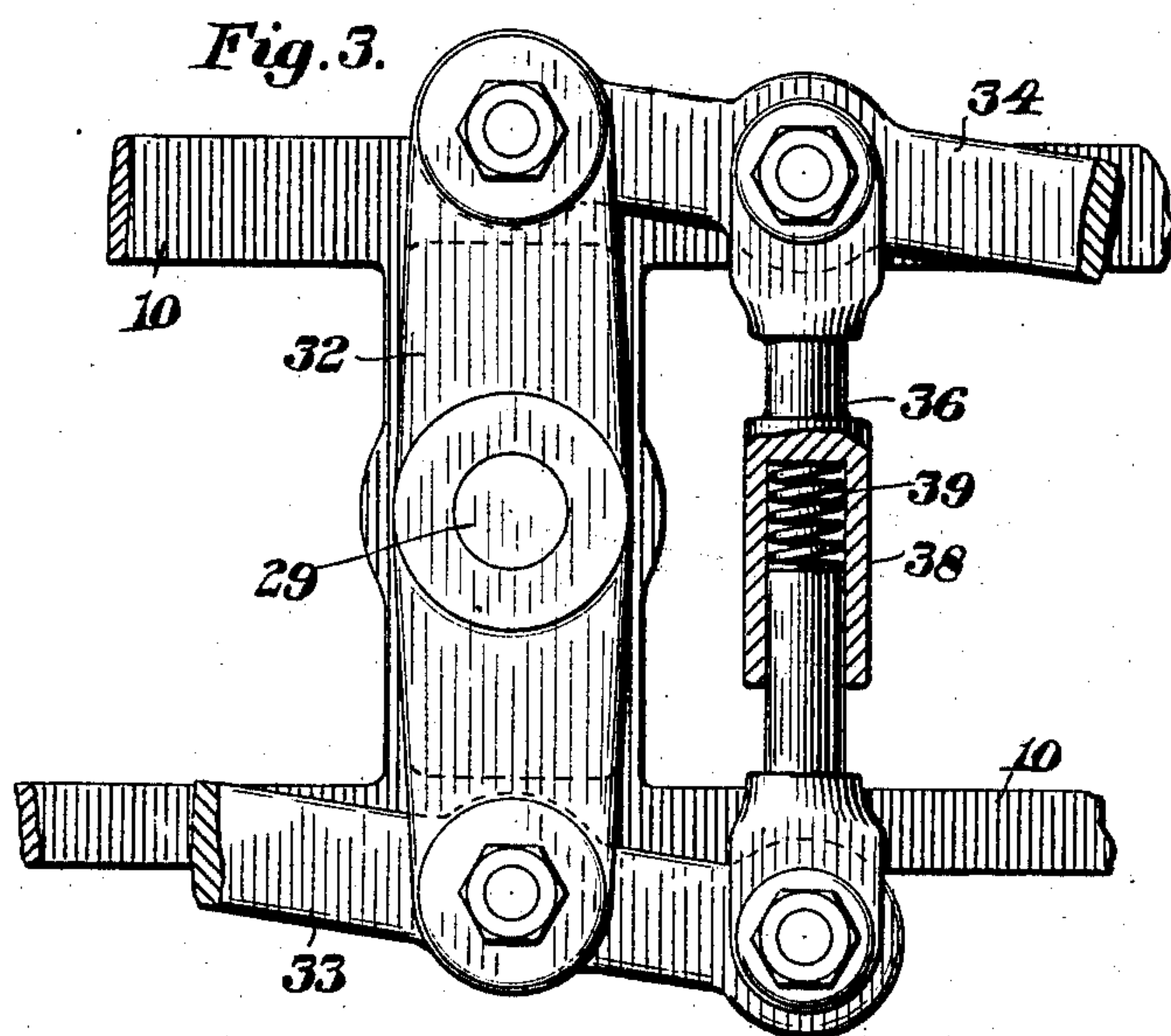
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UNITED STATES PATENT OFFICE.

HENRY F. SHAW, OF BOSTON, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO
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ENGINE.

SPECIFICATION forming part of Letters Patent No. 719,053, dated January 27, 1903.

Application filed May 14, 1902. Serial No. 107,228. (No model.)

To all whom it may concern:

Be it known that I, HENRY F. SHAW, a citizen of the United States of America, and a resident of Boston, in the county of Suffolk
5 and State of Massachusetts, have invented certain new and useful Improvements in Engines, of which the following is a specification.

My invention relates to engines, and more particularly to those of the compound locomotive type, having among its principal objects the arrangement of the connecting members between the piston or pistons and driving-wheels in such a manner as to avoid the use of crank-shafts or like rotating elements
15 and to effect a balance of parts which will obviate the difficulties arising from the strains in the structure and pounding upon the track present in the ordinary locomotive-engine.

In the accompanying drawings, Figure 1 is
20 a top plan view of a portion of a locomotive embodying one form of my invention. Fig. 2 is a side elevation thereof with a portion of the boiler indicated in dotted lines. Fig. 3 is a detail in side elevation, parts being
25 broken away, of the balancing system for the crank-pin connecting-rods. Fig. 4 is a vertical sectional detail of one of the rock-shafts and associated parts, and Fig. 5 is a horizontal sectional detail showing the connection
30 between the lever and connecting-rod.

Similar characters indicate like parts throughout the several figures of the drawings.

The main frame of the engine is designated
35 by the numeral 10, and in this frame are journaled the axles of driving-wheels 11, here shown as four in number, one pair being located upon each side of the frame. Near one end of the frame are mounted the cylinders,
40 in the present instance four in number, comprising the high-pressure cylinders 12 12 and the low-pressure cylinders 13 13. These cylinders may be cast integrally with the saddle 14 and are conveniently located with their
45 axes in substantially the same horizontal plane, the high-pressure inside and the low-pressure outside the main frame. Suitable valves, of which the stems 15 only are shown, are situated in casings 16 between the high
50 and low pressure cylinders and serve to control the admission and exhaust of steam.

The saddle also supports in the usual manner one end of a boiler 16^a, which is preferably of the Atlantic or Vanderbilt type, since some such arrangement of fire-box as they possess
55 lends itself most effectively to the disposition of elements hereinafter described.

The pistons 17 17 and 18 18 operate within the high and low pressure cylinders, respectively, and their rods 19 19 and 20 20 may be
60 each connected to the usual cross-head 21, moving upon the guides 22, conveniently supported at their ends by the saddle and by the usual transverse plate or yoke 23. Beyond the yoke at each side of the main frame le-
65 vers 24 are fulcrumed at 25 upon said frame and project inside and outside the same. To the inner end of each lever and to the cross-head of the high-pressure cylinder a connecting-rod 26 is pivoted, while a connecting-rod
70 27 similarly joins the outer end of each lever with the low-pressure cylinder. To each lever at a point within the frame and to an arm 28, projecting from a rock-shaft 29, extending,
75 preferably, half across the frame and journaled therein and in a suitably-supported center bar 30, is articulated a connecting-rod 31. As this connecting-rod is shown as having a slight movement in both horizontal and
80 vertical planes, the connecting-pin 31^a may operate in an opening having somewhat enlarged rounded ends, as at 31^b, to permit it to rock freely, and the upper end of the rod bearing upon the top of the lever at 31^b may
85 be also curved. Each rock-shaft has secured to it at its end outside the frame a rock-arm 32, situated intermediate the driving-wheels and connected therewith by rods 33 34, pivoted to the opposite ends of the rock-arm and to crank-pins 35 of the driving-wheels. One
90 of the driving-wheel connecting-rods (here shown as that numbered 33) is extended beyond the rock-arm, and to this extension and to an opposite point on the rod 34 is pivoted a link 36, forming, with the rods and rock-
95 arm, a parallel motion. This causes the connecting-rods of each pair to balance one another, supporting their entire weight upon the rock-shaft and doing away with the necessity of counterweighting the driving-wheels except for a small weight at 37 sufficient to counterbalance the crank-pin.
100

To avoid the possibility of springing the connecting-rods 33 34 in event of the driving-wheels encountering depressions or elevations in the rails and changing their relative horizontal position, the link 36 is preferably made yieldable, being divided and provided with a spring-section, which may consist of a casing 38, secured to one portion and containing a spring 39, with which the other portion contacts. This spring may be so proportioned and capable of exerting such tension that it will have no tendency to separate the rods in their normal position, but prevents their approach except under a stress greater than that exerted by the weight of the rods and less than that which would strain or spring them. This being the case it is clear that the link will cause the crank-pin connecting-rods to balance one another and yet will yield before any undue strain is thrown upon them.

The operation of the valves is such that each pair of high and low pressure pistons reciprocate in opposite directions, rocking the levers 24 upon their fulcrums, while the cranks of the driving-wheels on the opposite sides are set quartering. This results in the pistons of each pair balancing one another, thus equalizing the thrust upon the frame at each side, and therefore the total thrust upon both sides of the frame. At the same time the absence of the usual parallel rods and massive counterweights in the driving-wheels, together with the balancing of the connecting-rods, relieves the system of the stresses produced while running by the opposite throw of these widely-separated elements. This results in a balanced system and does away with the sway, pounding, and strain which are so destructive to the locomotive, rails, and road-bed.

Among other advantages arising from my invention, in addition to the well-known gain in efficiency from compounding, the following may be mentioned as important: The movement of the piston-rod connecting-rods is substantially horizontal and in what closely approximates a right line, and thus entirely avoids the upward pressure upon and resulting heating and wear of the guides and cross-heads due to the sharp angularity of the ordinary connecting-rod when the crank-pins of the driving-wheels are at or near their highest and lowest points. The usual weak and troublesome crank-shaft is entirely dispensed with, the pistons and driving-wheels being connected by a continuous series of oscillating elements, none rotating through a complete turn, but the throw of all save the crank-pin connecting-rods being so slight as to cause little wear. The relation of the various connecting elements is such that when the pistons are at the end of their stroke, and therefore exerting no power, and the crank-pins are at their dead-points the levers 24 are in their most inclined position, and therefore capable of transmitting least power. On the

other hand, when pistons are receiving the maximum effect from the expansion of the steam the levers are in a position to most effectively transmit it.

Having thus described my invention, I claim—

1. The combination with a cylinder, its piston and two driving-wheels, of a lever connected with the piston, a rock-arm intermediate the driving-wheels, means for connecting the lever and rock-arm, and a connecting-rod between the rock-arm and each of the driving-wheels.

2. The combination with a cylinder, its piston and two driving-wheels, of a lever connected with the piston, a rock-shaft intermediate the driving-wheels, a connecting-rod between the lever and rock-shaft, a rock-arm secured to the rock-shaft, and a connecting-rod between the rock-arm and each of the driving-wheels.

3. The combination with a cylinder, its piston and two driving-wheels, of a lever connected with the piston, a rock-shaft intermediate the driving-wheels, a connecting-rod between the lever and rock-shaft, a rock-arm secured to the rock-shaft, a connecting-rod between the rock-arm and crank-pins of the driving-wheels, and a link joining the driving-wheel connecting-rods.

4. The combination with a cylinder, its piston and two driving-wheels, of a lever connected with the piston, a rock-shaft intermediate the driving-wheels, a connecting-rod between the lever and rock-shaft, a rock-arm secured to the rock-shaft, and balanced connecting-rods between the rock-arm and crank-pins of the driving-wheels.

5. The combination with a cylinder, its piston and two driving-wheels, of a lever connected with the piston, a rock-shaft intermediate the driving-wheels, a connecting-rod between the lever and rock-shaft, a rock-arm secured to the rock-shaft, a connecting-rod between the rock-arm and crank-pins of the driving-wheels, and a yieldable link joining the driving-wheel connecting-rods.

6. The combination with a cylinder, its piston and a pair of driving-wheels, of a rod connected with the crank-pin of each driving-wheel and actuated from the piston, and a yieldable link joining the rods.

7. The combination with a cylinder, its piston and a pair of driving-wheels, of a rod connected with the crank-pin of each driving-wheel and actuated from the piston, and a link including a spring tending to prevent the approach of the rods.

8. The combination with a cylinder, its piston and a pair of driving-wheels, of a rod connected with the crank-pin of each driving-wheel and actuated from the piston, and a link including a spring tending to prevent the approach of the rods, the tension of said spring offering a less resistance to approach than the stress necessary to break the rods or associated parts.

9. The combination with a cylinder, its piston and a pair of driving-wheels, of an arm rocked by the piston, a connecting-rod between the arm and the crank-pin of each driving-wheel, and a link including a spring-section joining the connecting-rods.

10. The combination with high and low pressure cylinders, their pistons and a driving-wheel, of a lever with which both of the pistons are connected, a rock-arm, means for connecting the lever and rock-arm, and a connecting-rod between the rock-arm and driving-wheel.

11. The combination with high and low pressure cylinders, their pistons and a pair of driving-wheels, of a lever with which both of the pistons are connected, a rock-arm intermediate the driving-wheels, means for connecting the lever and rock-arm, and a connecting-rod between the rock-arm and each of the driving-wheels.

12. The combination with high and low pressure cylinders, their pistons and a pair of driving-wheels, of a lever with which both of the pistons are connected, a rock-arm, means for connecting the lever and rock-arm, a connecting-rod between the arm and the crank-pin of each driving-wheel, and a link including a spring-section joining the connecting-rods.

13. The combination with high and low pressure cylinders, their pistons and a driving-wheel, of a lever with which both of the pistons are connected, a rock-shaft, a connecting-rod between the lever and rock-shaft, and a connector between the rock-shaft and driving-wheel whereby said driving-wheel is rotated.

14. The combination with high and low pressure cylinders, their pistons and a driving-wheel, of a lever with which both of the pistons are connected, a rock-shaft, a connecting-rod between the lever and rock-shaft, a rock-arm secured to the rock-shaft, and a connecting-rod between the rock-arm and the crank-pin of the driving-wheel.

15. The combination with high and low pressure cylinders, their pistons and a driving-wheel, of a lever with which both of the pistons are connected, a rock-shaft, a connecting-rod between the lever and rock-shaft, a rock-arm secured to the rock-shaft, a connecting-rod between the rock-arm and the crank-pin of the driving-wheel, and means for balancing the weight of the driving-wheel connecting-rods.

16. The combination with pairs of high and low pressure cylinders, their pistons and pairs of driving-wheels, of two levers with each of

which a high and a low pressure cylinder is connected, two rock-shafts, a connecting-rod between each lever and one of the rock-shafts, and connectors between the rock-shafts and driving-wheels whereby said driving-wheels are rotated.

17. The combination with pairs of high and low pressure cylinders, their pistons and pairs of driving-wheels, of two levers with each of which a high and a low pressure cylinder is connected, two rock-shafts, a connecting-rod between each lever and one of the rock-shafts, a rock-arm secured to each rock-shaft, and a connecting-rod between each rock-arm and the crank-pin of a driving-wheel.

18. The combination with pairs of high and low pressure cylinders, their pistons and pairs of driving-wheels, of two levers with each of which a high and a low pressure cylinder is connected, two rock-shafts, a connecting-rod between each lever and one of the rock-shafts, a rock-arm secured to each rock-shaft, a connecting-rod between each rock-arm and the crank-pin of a driving-wheel, and means for balancing the connecting-rods.

19. The combination with a main frame, a cylinder, its piston and a driving-wheel, of a lever fulcrumed upon and projecting through the frame and connected with the piston, a rock-shaft connected with the driving-wheel, and a connecting-rod between the inner end of the lever and rock-shaft located within the frame.

20. The combination with a main frame and driving-wheels, of a pair of cylinders having pistons supported one inside and one outside the frame, a lever fulcrumed to and projecting through the frame and connected at opposite ends with the pistons, a rock-shaft connected with the driving-wheels, and a connecting-rod between the lever and rock-shaft.

21. The combination with a main frame and driving-wheels, of a pair of cylinders having pistons supported one inside and one outside the frame, a lever fulcrumed to and projecting through the frame and connected at opposite ends with the pistons, a rock-shaft journaled in the frame and connected with the driving-wheel, and a connecting-rod between the lever and rock-shaft located within the frame.

Signed by me at Boston, Massachusetts, United States of America, this 13th day of May, 1902.

HENRY F. SHAW.

Witnesses:

WALTER E. LOMBARD,
GEORGE L. WEIL.