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M. NEUMAYER.

EQUALIZING GEAR FOR RECIPROCATING PRIME MOVERS.

APPLICATION FILED AUG. 31, 1904.

2 SHEETS—SHEET 1.

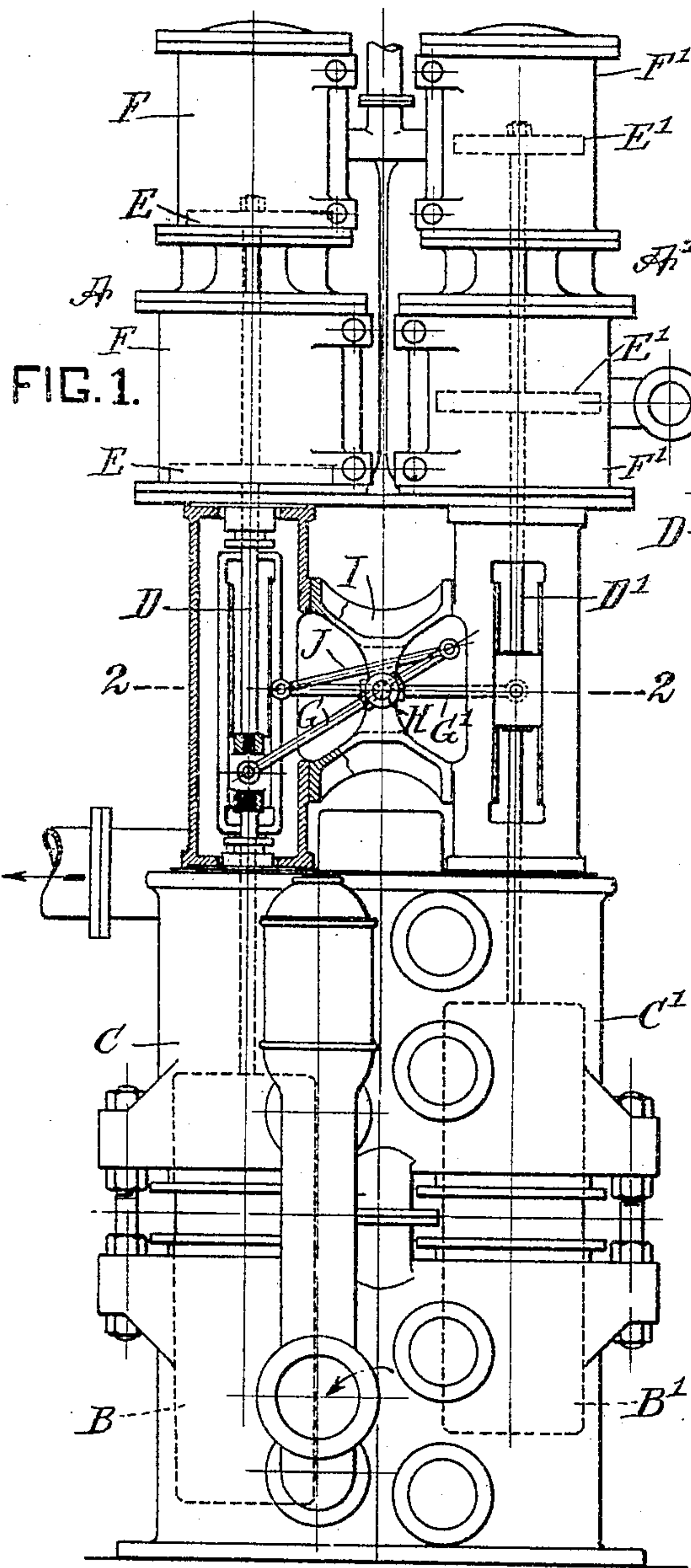


FIG. 1.

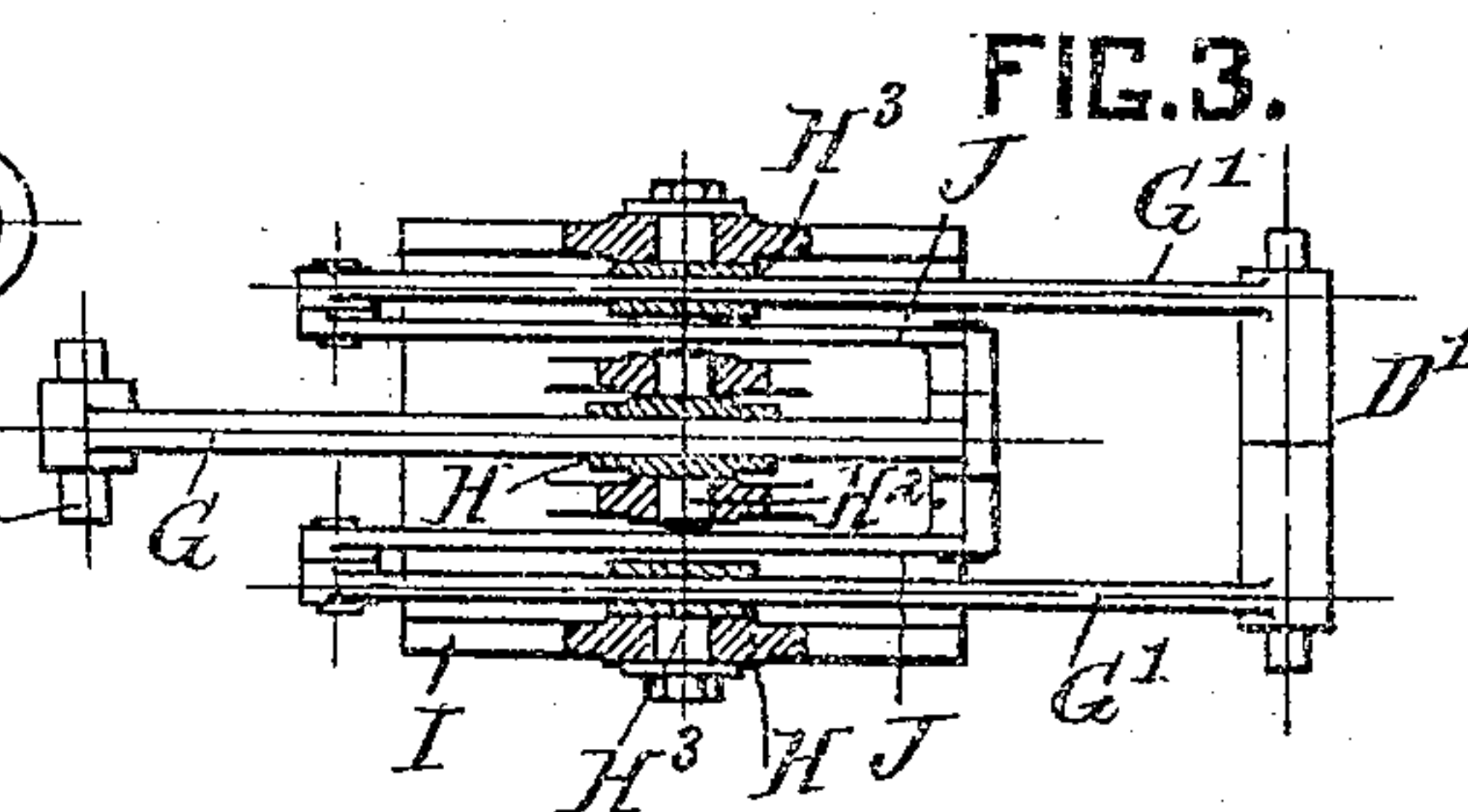
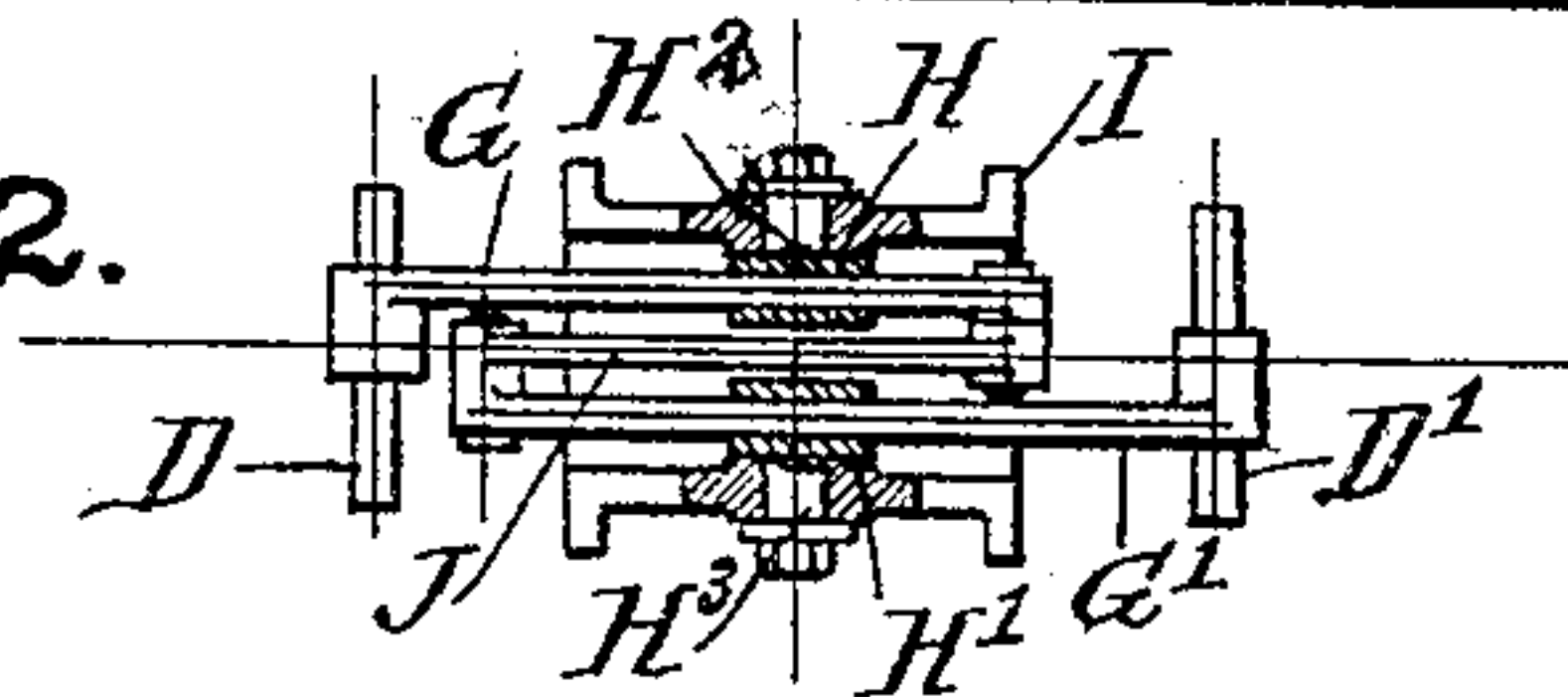


FIG. 3.

FIG. 2.



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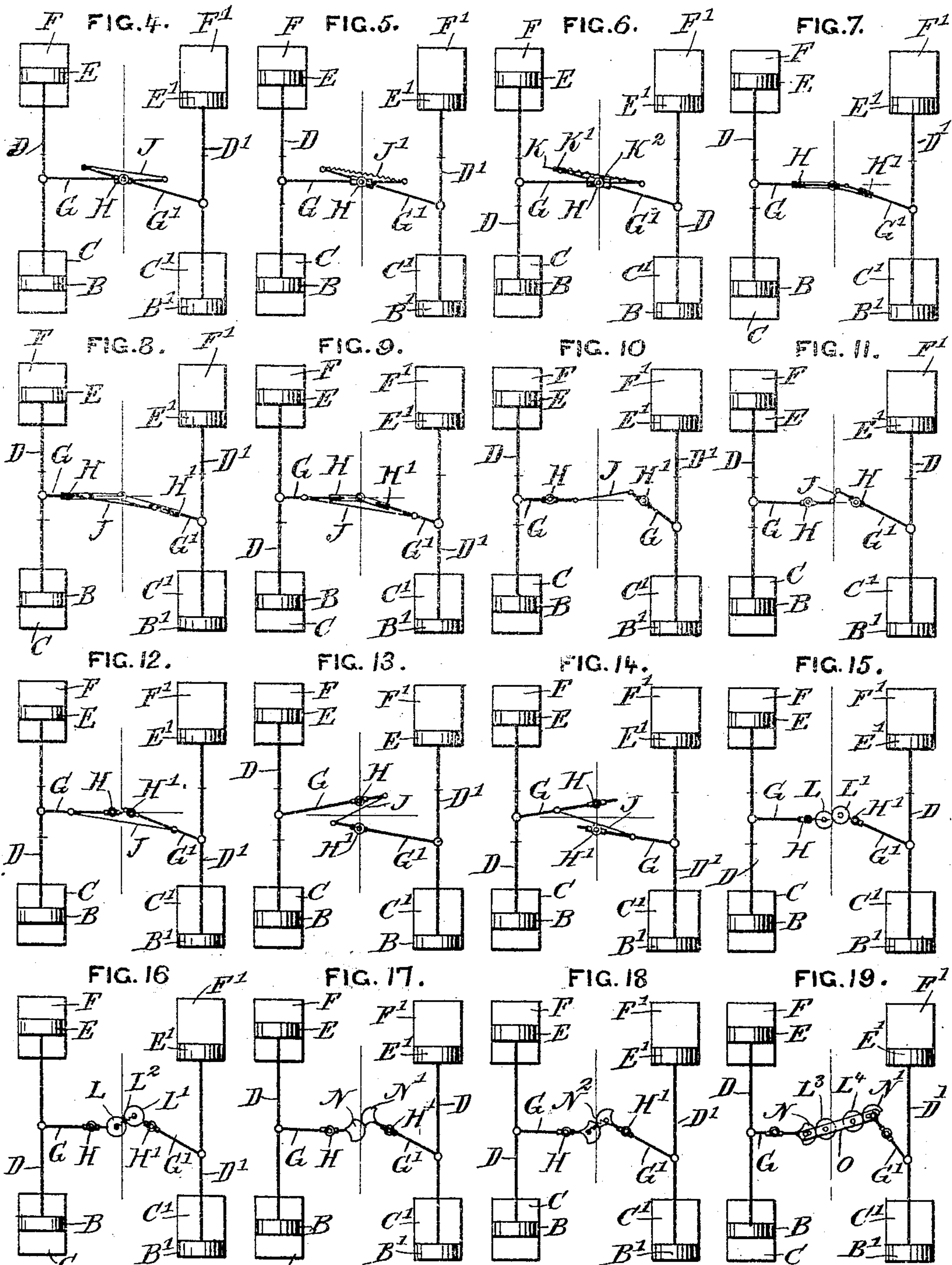
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## EQUALIZING GEAR FOR RECIPROCATING PRIME MOVERS.

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# UNITED STATES PATENT OFFICE.

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## EQUALIZING-GEAR FOR RECIPROCATING PRIME MOVERS.

SPECIFICATION forming part of Letters Patent No. 778,700, dated December 27, 1904.

Application filed August 31, 1904. Serial No. 222,850.

*To all whom it may concern:*

Be it known that I, MAXIMILIAN NEUMAYER, a subject of the Emperor of Austria-Hungary, and a resident of the city of New York, borough  
5 of Brooklyn, in the county of Kings and State of New York, have invented a new and Improved Power-Equalizing Gear for Reciprocating Prime Movers, of which the following is a full, clear, and exact description.

10 The invention relates to prime movers having a pair of cylinders and pistons reciprocating therein; and its object is to provide a new and improved power-equalizing gear for such prime movers, arranged to give the piston  
15 which has passed a central position a rapidly-increasing mechanical assistance from the other piston to eliminate all danger of the prime mover stopping when a piston reaches the central critical position referred to.

20 The invention consists of novel features and parts and combinations of the same, as will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is  
25 represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of the improvement as applied to a prime mover actuating a duplex pump, parts being in section. Fig. 2 is a sectional plan view of the same on the line 2 2 of Fig. 1. Fig. 3 is a like view  
35 of a modified form of the same, and Figs. 4 to 19 are diagrammatic views of other modified forms of the improvement.

A pair of prime movers A A' are shown in Fig. 1 as compound steam-engines arranged tandem and employed for driving plungers B B' in the cylinders C C' of a duplex pump, and the piston-rods D D' of pistons E E', reciprocating in the cylinders F F' of the prime  
40 movers A A', are connected with the plungers B B'. The piston-rods D D' are pivotally connected with levers G G', fulcrumed on and mounted to slide in swivels H H', having their pivots H<sup>2</sup> H<sup>3</sup> mounted to turn in suitable bearings on a bracket I, forming part of the frame-work of the prime movers and the duplex  
50 pump. The outer or free ends of the levers

G G' are pivotally connected with each other by a link J. The swivels H H' form the fulcrums for the levers G G', and when the pistons E E' reciprocate the levers G G' are caused to slide in the swivels H H', so that the  
55 latter form variable fulcrums for the said levers, and as the levers by the link connection J act one upon the other it is evident that forces are transmitted from one piston to the other, especially as the said levers G G' practically act as walking-beams. 60

By the power-equalizing gear described the piston E or E' which has just passed its central position receives a gradually-increasing mechanical assistance from the other piston E' or E, and hence all danger of stopping of the engine at this critical point is prevented. In similar mechanisms previously employed this resistance is great at the beginning of the stroke, rapidly decreases, and is very small at  
65 or near the center of the stroke. Likewise the assistance given to the piston is very small at or near the center of the stroke, slowly increases until near the end of the stroke it increases rapidly, and is very great at the end of the stroke. 75

By the arrangement described the forces are transmitted in such a manner as to offer to the piston which is just about to pass the center a greater but more rapidly decreasing  
80 resistance and to give the piston which just passed the center a more rapidly increasing assistance, thereby obviating the danger of stopping the engine at this point. This is accomplished by the combined motion of the levers G and G', which not only act as levers turning about a fulcrum, but also transmit forces in the direction of their axes. The fulcrum divides the lever into two unequal lengths, the ratio of which is decreasing as the  
85 piston reaches the center of the stroke and increasing as the piston travels away from the center of the stroke, and it is by this shifting fulcrum that the desired action is obtained. 90

It is understood that when one piston E or E' is at the beginning of its stroke there is an excess of pressure by the motive agent on this piston, while a lack of pressure is had after the piston passes a central position—that is, after the motive agent is cut off. Now by 100



transferring the excess of pressure on one piston by the equalizing-gear to the piston-rod of the other piston at the time the latter has passed a central position it is evident that  
 5 the excess of pressure on one piston is utilized to assist the other piston, and hence the power is equalized.

Presuming that the piston E is at the beginning of the return or up stroke and the  
 10 piston E' has just passed the central position, it is evident that the lever G exerts a pull on the link J, which in turn pushes on the outer end of the lever G', so that the latter exerts an upward pressure on the piston D' to assist  
 15 the piston E' in its upward stroke after the piston E' has passed the central position. As the piston E' advances toward its upper end the angle between the piston-rod D' and the lever G' decreases, and hence the power exerted by the lever G' on the piston-rod D' and  
 20 piston E' gradually increases to the end of the stroke. When the piston E' is at the beginning of its stroke, the surplus power is transmitted by the equalizing-gear to the other  
 25 piston E, now passing a central position.

As shown in Figs. 1 and 2, the transverse axes of the swivels H and H' are coinciding and the axes are located midway between the axes of the piston-rods D D'.

30 As illustrated in Fig. 3, the lever G' is made in two parts sliding in corresponding swivels H, and the link J is likewise made in two parts to connect the outer ends of the two-part lever G' with the outer end of the lever  
 35 G. Otherwise the construction is the same as above described in reference to Fig. 1.

Fig. 4 represents the pistons E E' in a different position, while in Fig. 5 a spring J' is substituted for connecting the outer ends of  
 40 the levers G G' with each other, and, as illustrated in Fig. 6, the outer end of the lever G is pivotally connected with one end of a rod K, mounted to slide in a swivel K', fulcrumed on the outer end of the lever G', and on the said  
 45 rod K is coiled a spring K', pressing at one end on the rod K and with its free end on the swivel K'.

In the modified form shown in Fig. 7 the levers G and G' are mounted to slide in the  
 50 swivels H H', formed on arms having transverse pivots the axes of which coincide, and the free ends of the said levers are in this case pivotally connected with each other.

In the modified form shown in Fig. 8 the  
 55 levers G G' are mounted to slide in the swivels H H', held on swing-arms, the same as described, and shown in Fig. 7; but in this case the free ends of the levers G G' are pivotally connected with each other by the link J. A  
 60 similar arrangement is shown in Fig. 9, the difference, however, being that the link J connects with the levers G G' at points between the swivels H H' and the pivots connecting the levers with the piston-rods D D'.

65 In the modified form shown in Fig. 10 the

swivels H H' are spaced apart and the free ends of the levers are connected with each other by the link J, and as illustrated in Fig. 11 a similar arrangement is had, the only difference being that the link J is very short in  
 70 comparison to the one shown in Fig. 10 and the swivels are located nearer together.

In the modified form shown in Fig. 12 the levers G G' are mounted to slide in the swivels spaced apart and the link J connects the le-  
 75 vers with each other between the swivels and their fulcrums on the piston-rods D D'.

In the modified form shown in Fig. 13 the levers are mounted to slide in the swivels H H', located one above the other, and the free ends  
 80 of the levers are connected with each other by the link J.

In the modified form shown in Fig. 14 the levers have their swivels located one above the other, but the link J connects the levers  
 85 with each other between the swivels and their fulcrums on the piston-rods D D'.

In the modified form shown in Fig. 15 the levers engage their swivels spaced apart, and on the outer ends of the levers G G' are ar-  
 90 ranged disks L L' in rolling contact with each other to transmit the power of one lever to the other lever. As shown in Fig. 16, the same arrangement is had, with the addition that the disks have their pivotal ends con-  
 95 nected with each other by a spring L<sup>2</sup>.

In the modified form shown in Fig. 17 the disks are replaced by cams fixed on the free ends of the levers G and G' and in rolling  
 100 contact with each other. In the modified form shown in Fig. 18 the same conditions prevail, with the addition that the cams N and N' are connected with each other by a spring N<sup>2</sup>. In Fig. 19 the cams N and N' at  
 105 the ends of the levers G G' are in rolling contact with disks L<sup>3</sup> L<sup>4</sup>, journaled on a bar O, slidably connected with the cams N N'.

In all of the modified forms described the same result is obtained as above described in  
 110 reference to Fig. 1—that is, the power of one piston is transmitted to the other piston to assist the latter after the same has passed a central position to thus give rapidly-increasing mechanical assistance to this piston from  
 115 the other piston.

The device is very simple and durable in construction and can be readily placed in position on existing engines of the kind described.

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

1. The combination with a pair of reciprocating prime movers, of a pair of levers directly connected with the reciprocating devices of the said prime movers and acting one  
 125 on the other, the levers having stationary fulcrums and movements at angles to the axes of the said fulcrums.

2. The combination with a pair of power-cylinders and reciprocating pistons therein,  
 130



of a pair of slidable swiveled levers acting one on the other and connected with the said pistons.

3. The combination with a pair of power-cylinders and reciprocating pistons therein, of a pair of slidable, swiveled levers connected with the said pistons, and an operating connection between the said levers.

4. The combination with a pair of power-cylinders and reciprocating pistons therein, of swivels, and levers pivotally connected with the said pistons and mounted to slide in the said swivels, the latter forming the fulcrums for the said levers, the latter acting one upon the other.

5. The combination with a pair of power-cylinders and reciprocating pistons therein, of swivels, levers pivotally connected with the said pistons and mounted to slide in the said swivels, the latter forming the fulcrums for the said levers, and an operating connection between the said levers.

6. The combination with a pair of power-cylinders and reciprocating pistons therein, of swivels, levers pivotally connected with the said pistons and mounted to slide in the said swivels, the latter forming the fulcrums for the said levers, and an operating connection between the free ends of the said levers.

7. The combination with a pair of power-cylinders and reciprocating pistons therein, of swivels mounted to turn independent one of the other, and levers pivotally connected with the said pistons and mounted to slide in the said swivels, the latter forming the fulcrums for the said levers, the latter acting one upon the other.

8. The combination with a pair of power-cylinders and reciprocating pistons therein,

of swivels mounted to turn independent one of the other and having their axes coinciding, and levers pivotally connected with the said pistons and mounted to slide in the said swivels, the latter forming the fulcrums for the said levers, the latter acting one upon the other.

9. The combination with a pair of power-cylinders and pistons reciprocating therein, of swivels mounted to turn independent one of the other, levers pivotally connected with the piston-rods of the said pistons and mounted to slide in the said swivels, the latter forming the fulcrums for the said levers, and an operating connection between the said levers.

10. The combination with a pair of power-cylinders and pistons reciprocating therein, of swivels mounted to turn independent one of the other and having their axes coinciding, levers pivotally connected with the piston-rods of the said swivels, the latter forming the fulcrums for the said levers, and an operating connection between the said levers.

11. The combination with a pair of power-cylinders and pistons reciprocating therein, of swivels mounted to turn independent one of the other, levers pivotally connected with the piston-rods of the said pistons and mounted to slide in the said swivels, the latter forming the fulcrums for the said levers, and a link connecting the free ends of the said levers with each other.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MAXIMILIAN NEUMAYER.

Witnesses:

THEO. G. HOSTER,

EVERARD BOLTON MARSHALL.