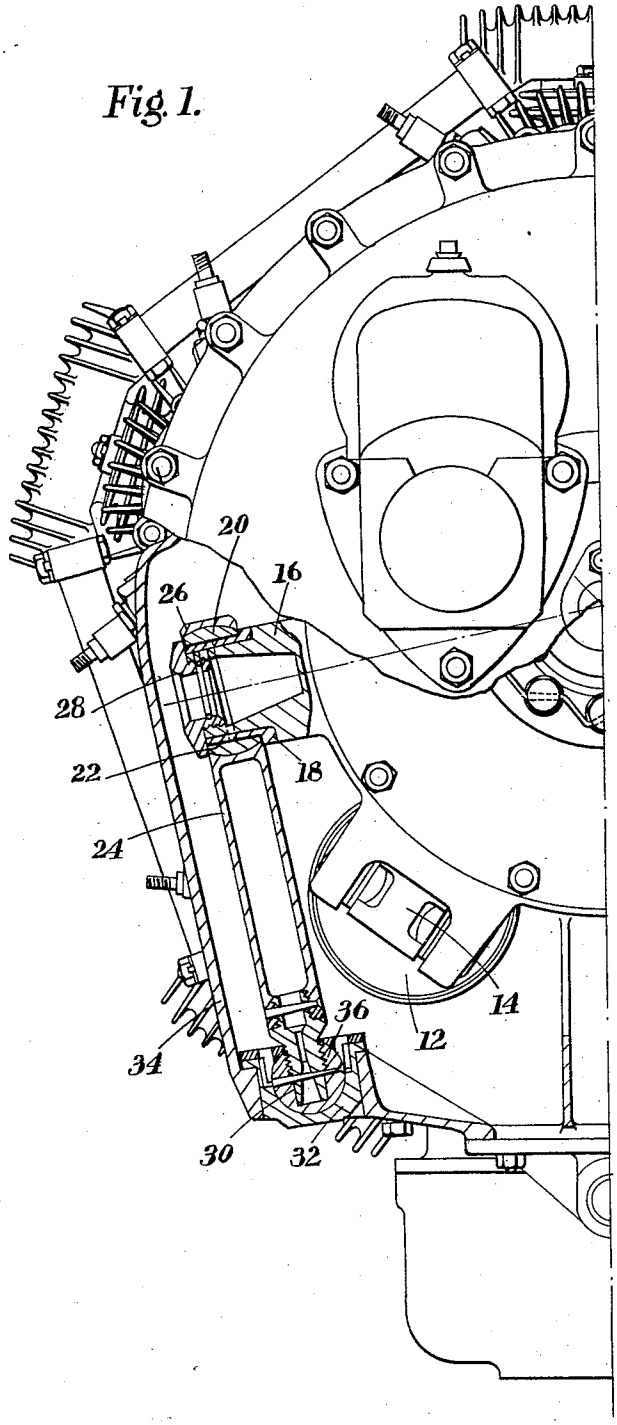
May 10, 1932. M. L. BRAMSON 1,858,182

ENGINE OR PUMP

Filed March 3, 1931 3 Sheets-Sheet 1

Fig. 1.



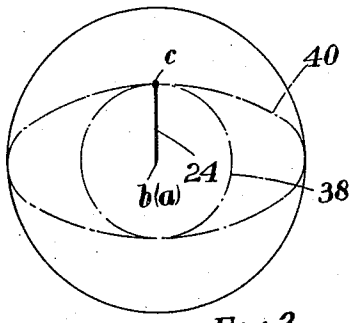


Fig. 3.

Fig. 4.

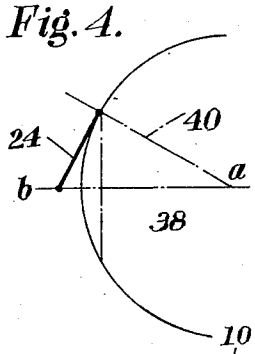
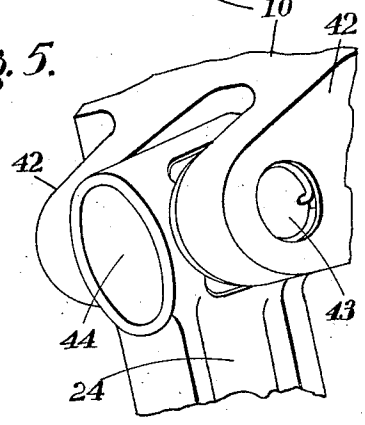


Fig. 5.



INVENTOR

Mogens Louis Bramson,

BY

Frank Allerton

ATTORNEY

May 10, 1932. M. L. BRAMSON 1,858,182

ENGINE OR PUMP

Filed March 3, 1931 3 Sheets-Sheet 2

Fig. 1a.

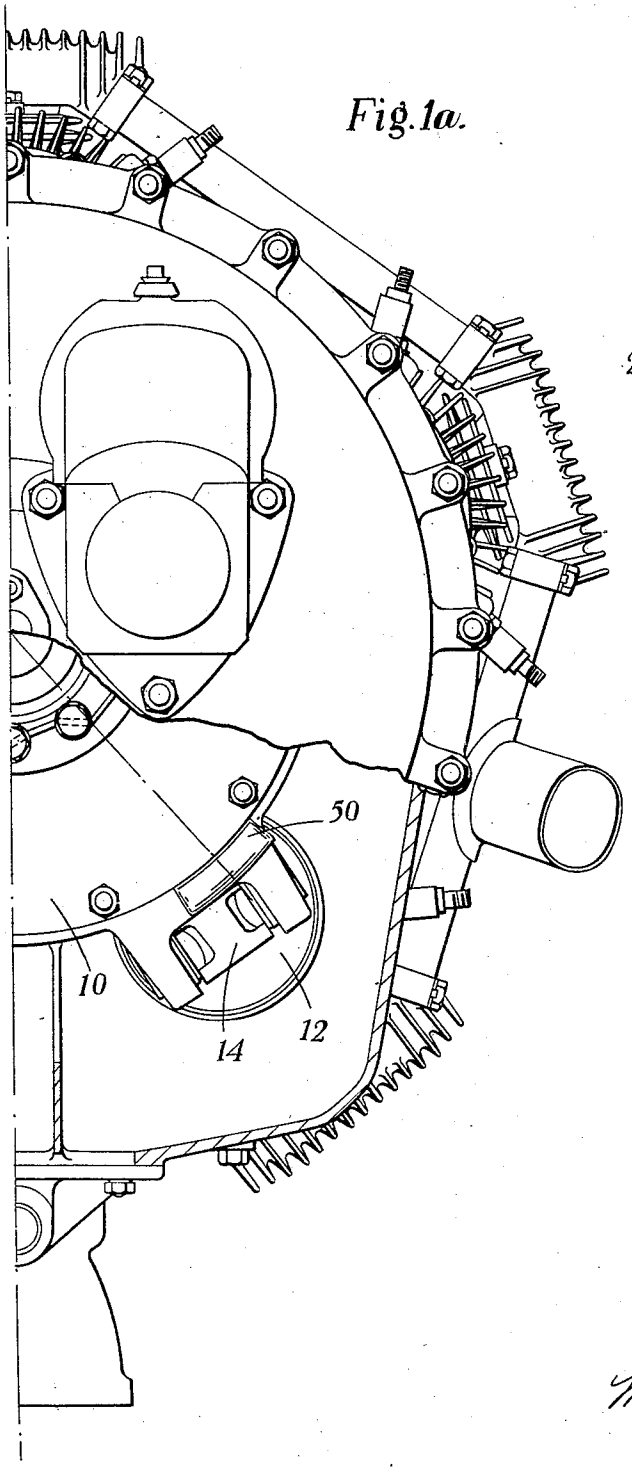
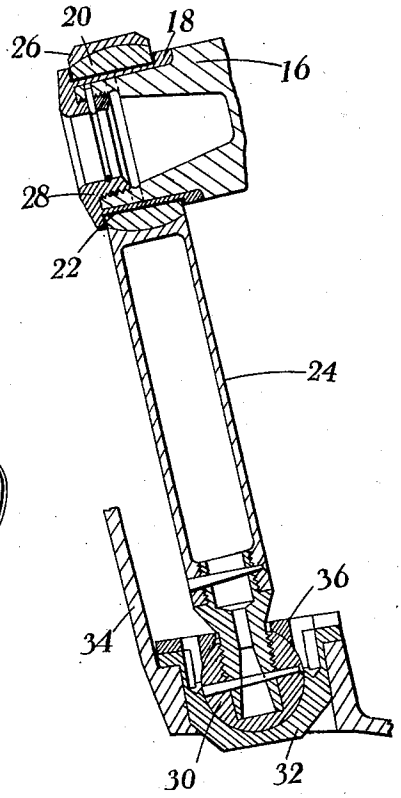


Fig. 2.



INVENTOR
Rogers Louis Bramson,
BY
James S. Ammerman
ATTORNEY

May 10, 1932. M. L. BRAMSON 1,858,182

ENGINE OR PUMP

Filed March 3, 1931 3 Sheets-Sheet 3

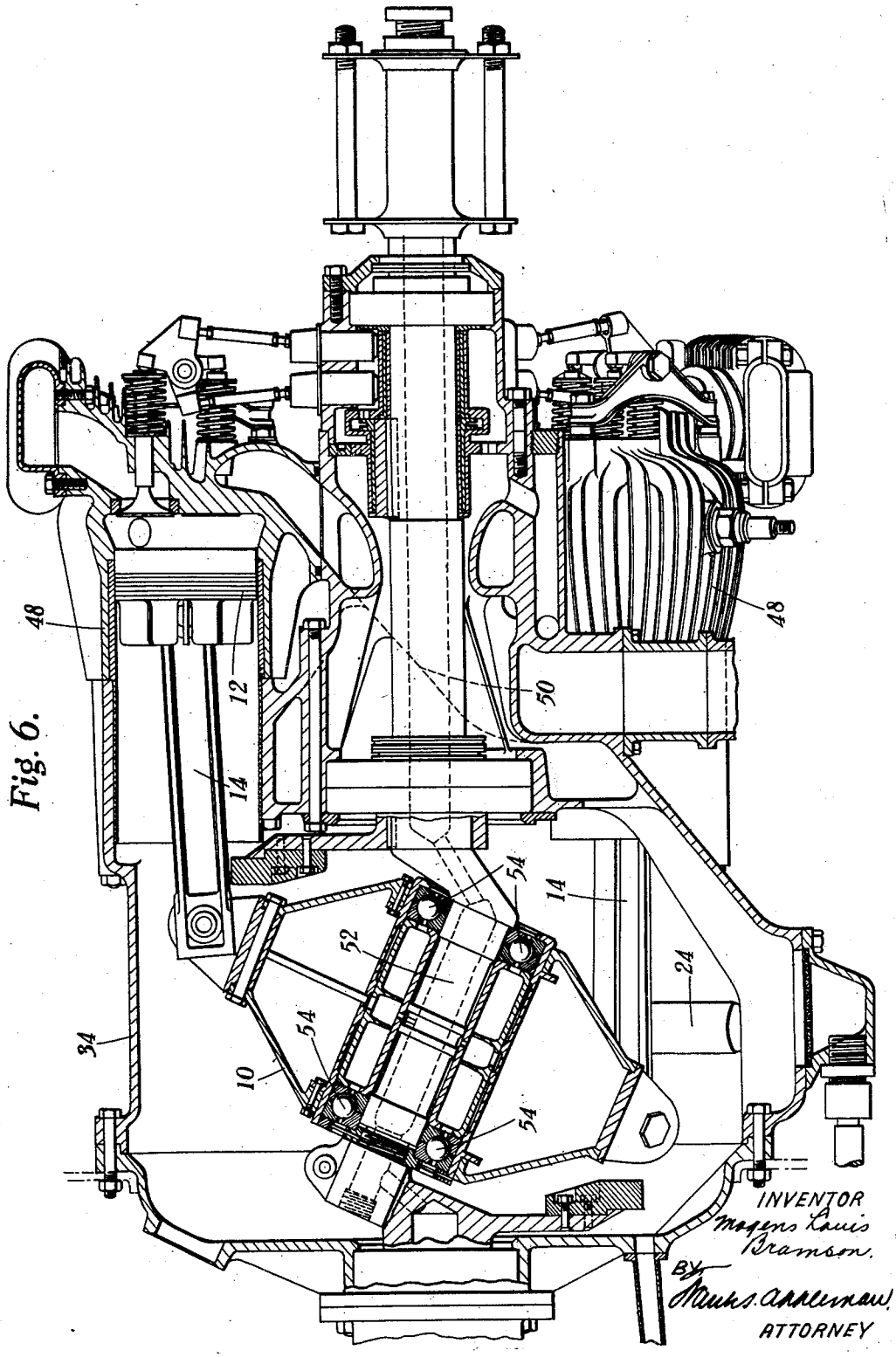


Fig. 6.

INVENTOR
Magens Louis
Bramson.
BY
Marks & Clerk
ATTORNEY

Patented May 10, 1932

1,858,182

UNITED STATES PATENT OFFICE

MOGENS LOUIS BRAMSON, OF LONDON, ENGLAND, ASSIGNOR OF ONE-HALF TO AERO SYNDICATE LIMITED, OF LONDON, ENGLAND, A COMPANY OF GREAT BRITAIN

ENGINE OR PUMP

Application filed March 3, 1931, Serial No. 519,826, and in Great Britain March 6, 1930.

This invention relates to engines or pumps of the wobbler or of the swash-plate type, but more particularly to those of the wobbler type. In such engines or pumps the torque must be transmitted from the driving member, whether wobbler or swash-plate, to the cylinder assembly, and it has been proposed to employ for this purpose a torque-member in the form of a gimbal-ring or Hooke's joint pivoted to the wobbler or swash-plate about one axis and to the cylinder assembly about another axis at right angles to the first, the point of intersection of the two axes being coincident with the point of intersection of the axis of the shaft proper and the axis of the inclined crank-pin or race-way. Torque members of this kind, however, are not satisfactory in practice, particularly when heavy torques have to be transmitted, one disadvantage being that they are necessarily subjected to bending stresses and must therefore be heavily built. A secondary effect thereof is the large value of the angular accelerations of the torque member which are difficult to balance.

The principal object of the present invention is to provide a torque-member which is not subjected to bending stresses (except those due to its own inertia) and may therefore be made lighter, and also cheaper and simpler than those hitherto proposed. Accordingly, the improved torque member consists of a simple link jointed at one end to the wobbler or swash-plate at or near its periphery, and at its other end to the cylinder assembly or crank-case at a point laterally displaced from the point at which the link is connected to the wobbler or swash-plate. Such a link may be made in such a way (for example in the form of a straight rod) that it is loaded only in tension or compression, no part of it being subjected to bending. Consequently it may be made very light.

Preferably the line joining the two points of connection of the link is as nearly perpendicular as circumstances will allow to the radius at the point of connection to the wobbler or swash-plate, as seen in the direction of the axis of the driving shaft when the point of attachment of the link to the wobbler or swash-plate is in its median position. For any given length of radius, the load on the link is a minimum when the link is perpendicularly disposed as aforesaid, but in many cases it may be desirable for practical reasons to adopt a different angular position at the cost of an increase in the load.

The joint at the crankcase end of the link must either be a universal joint (preferably a ball and socket joint), or else a pin joint whose pivotal axis coincides with a line joining the centre of the joint with the centre of the wobbler or swash plate. If a pin joint is used provision must be made to transmit thrust components acting along the pin. The joint at the wobbler end of the link is preferably a journal bearing joint whose axis coincides with the wobbler radius to that point. Other combinations of joints may be used provided they embody the same or greater freedom of movement than those mentioned.

Two links may be employed if desired, their points of attachment to the wobbler or swash-plate being diametrically opposite and the links being equal in length and symmetrically disposed in relation to the axis of the driving shaft.

A preferred construction according to this invention is illustrated in the accompanying drawings, in which

Figure 1 is an end elevation partly in section of an engine provided with a toque member according to this invention,

Figure 2 is a sectional elevation of the torque member on a larger scale,

Figures 3 and 4 are diagrams illustrating the character of the movement of the wobbler,

Figure 5 is a perspective view showing a modified form of universal joint, and

Figure 6 is a sectional side elevation of the engine with parts broken away.

The engine is of the wobbler type, the wobbler 10 being mounted on an oblique crank-pin 46 and being connected to the pistons 12 by piston-rods 14. A boss 16 integral with and projecting from the periphery of the wobbler is provided with a cylindrical bearing sleeve 18 the axis of which passes through the point of intersection of the axes of the engine shaft and of the oblique crank-

pin. This point will hereinafter be referred to as the centre of the wobbler. Surrounding the bearing sleeve 18 and free to rotate thereon is a ring 20 having a spherical outer surface, a liner 22 of white metal being interposed between the outer surface of the sleeve 18 and the inner surface of the ring 20.

A tubular link 24 is provided with an enlarged end 26, and provided with a spherical seating fitting the spherical surface of the ring 20, which is retained on the boss by a flanged nut 28. Grooves (not shown) are cut in the spherical seating to enable the ring to be inserted edgeways into the seating. The other end of the link has fixed to it a ball 30 which is seated in a spherical cup 32 fixed in the side of the crank-case 34 and is held in this cup by a ring 36.

It will be appreciated that when the engine is working the centre of the spherical surface of the ring 20 is constrained to move in a path which is an arc of a circle described on a sphere having its centre at the centre of the wobbler. This sphere, centered at *a*, is shown diagrammatically in Figure 3 as seen in the direction of the radius through the centre *b* of the ball 30, and in Figure 4 as seen from the side of Figure 3. The path of the point *c*, which is the centre of the ring 20, lies on the small circle 38 of the sphere. Obviously the radius of this circle will depend on the length of the link 24, and if this link were of infinite length, the path of the point *c* would be the great circle 40. Owing to the departure of the path from a great circle, the wobbler will oscillate slightly about the axis of the engine (a line through the point *a* perpendicular to the paper in Figure 4) but the amplitude of this oscillation will be small. The longer the link however, the smaller the extent of this oscillation.

The motion of the parts may also be regarded as an oscillation of the triangle *a b c* about the line *a b*. Evidently the angle *a c b* will not vary, and for this reason the joint at *c* could have one degree of freedom only (that is, the spherical joint between the parts 20, 26 could be omitted) if in practice it could be ensured that the axis of the sleeve 18 would pass exactly through the centre of the wobbler. It is to provide against inaccuracy of manufacture in this and other respects (for example the possibility of slight mis-alignment due to stresses set up during working, temperature differences and the like) that the spherical joint aforesaid is provided in the preferred construction. It is not desired that there shall be any movement between these spherical surfaces about the line *a c*, and therefore a pin may be fixed in the part 20 or 26 working in a slot in the other part, to prevent such movement. As the triangle *a b c* merely oscillates about the line *a b*, it is clear that in theory the joint at *b* also might be a simple pin joint coaxial with the line *a b*, but for the reasons given above in connection with the joint at *c*, it is preferred to employ a ball-and-socket joint.

When a Hooke's joint is employed at the point *c*, it may be of the kind shown in perspective in Figure 5, the wobbler 10 being provided with lugs 42 for the reception of the pin 43 and the link 24 being enlarged and bored to receive the larger pin 44 through which the pin 43 extends diametrically.

The construction of link shown in Figures 1 and 2 is designed to work in compression, but the link may also be employed in tension and the modifications necessary to this end will be clear to those skilled in the art.

For a given radius *a c*, the load on the link is a minimum when the angle *a c b* is a right angle, and consequently it is preferred to arrange the parts so that this angle is at least approximately a right angle.

It will be clear that the boss 16 and about one-half of the mass of the link 24 together constitute an addition to the mass of the wobbler at the point *c*. This would be balanced statically if a similar boss and link were added in a diametrically opposite position, but in that case the moments of inertia of the wobbler about different diameters would not be equal, and in consequence unbalanced dynamic couples would be occasioned. It is therefore preferred to add two further masses to the wobbler, each equal to the mass mentioned above, at the same radius, and at 120° from one another and from the point C. This is equivalent to a uniform increase in the moment of inertia of the wobbler, or in other words its moment of inertia will be the same about any diameter, although greater than before. Such masses may conveniently be thickenings of the metal of the wobbler, one of which is indicated at 50 in Figure 1. The increased moment of inertia of the wobbler is of course compensated by a corresponding increase in the moment of inertia of the balancing masses customarily attached to the crank-shaft for the purpose of introducing a rotating dynamic couple equal to and 180° out of phase with that occasioned by the wobbler, pistons and connecting rod. It would equally be within the invention to add three or more masses to the wobbler, provided that they and the point C are equally spaced around its periphery. When two identical links 24 are used at opposite ends of a diameter, two additional masses only are required, placed at opposite ends of a diameter perpendicular to the diameter first mentioned.

The engine is shown in side sectional elevation in Figure 6, the cylinders being designated 48, the crank shaft 50 and its inclined portion 52. The wobbler 10 is mounted rotatably on this inclined portion by means of ball bearings 54. The piston rods 14 are shown universally jointed to the pistons 12

at one end and to the periphery of the wobbler 10 at the other end.

I claim:—

1. In combination, a plurality of cylinders assembled with their axes parallel to one another in an annular assembly and each having a piston, a crank-shaft centrally disposed within said assembly with its axis parallel to the axis of the cylinders and having an inclined crank portion, a driving member rotatably mounted on said inclined portion, a plurality of piston rods each connected to one of the pistons and to the driving member, and a link jointed at one end to the driving member at a point displaced laterally from its centre and jointed at the other end to the cylinder assembly at a point displaced laterally from the axis of the crank-shaft; the link being jointed to the cylinder assembly by a ball-and-socket joint and to the driving member by a joint having one degree of freedom about an axis which is radial to the axis of the crank-shaft, said joint last mentioned further including a joint member having at least one further degree of freedom.

2. In combination, a plurality of cylinders assembled with their axes parallel to one another in an annular assembly and each having a piston, a crank-shaft centrally disposed within said assembly with its axis parallel to the axis of the cylinders and having an inclined crank portion, a driving member rotatably mounted on said inclined portion, a plurality of piston rods each connected to one of the pistons and to the driving member, and a link jointed at one end to the driving member at a point displaced laterally from its centre and jointed at the other end to the cylinder assembly at a point displaced laterally from the axis of the crank-shaft, the link being jointed to the cylinder assembly by a ball-and-socket joint and to the driving member by a joint having one degree of freedom about an axis which is radial to the axis of the crank-shaft, said joint last-mentioned further including a ball-and-socket joint having its centre on the radius axis.

3. In combination, a plurality of cylinders assembled with their axes parallel to one another in an annular assembly, and each having a piston, a crank-shaft centrally disposed within said assembly with its axis parallel to the axes of the cylinders and having an inclined crank portion, a driving member rotatably mounted on said inclined portion, a plurality of piston rods each connected to one of the pistons and to the driving member, a link jointed at one end to the driving member at a point displaced laterally from its centre and jointed at the other end to the cylinder assembly at a point displaced laterally from the axis of the crank-shaft, and a plurality of balance masses on said driving member which masses, together with the point of attachment of the link to the driving member, are placed at equal angular intervals around said driving member with respect to the axis of the crank-shaft.

4. In an engine of the kind described, in combination, a crank-case, a wobbler within said crank-case, and a straight link jointed at one end to the periphery of the wobbler and jointed at the other end to the crank-case.

5. In an engine of the kind described, in combination, a crank-case, a wobbler within said crank-case, and a straight link jointed at one end to the periphery of the wobbler and jointed at the other end to the crank case, said link extending in a direction substantially perpendicular to the radius through the point at which the link is jointed to the driving member.

6. In an engine of the kind described, in combination, a crank-case, a wobbler within said crank-case, and a straight link jointed at one end to the periphery of the wobbler and jointed at the other end to the crank-case by means of a ball-and-socket joint.

7. In a engine of the kind described, in combination, a crank-case, a wobbler within said crank-case, and a straight link jointed at one end to the periphery of the wobbler and jointed at the other end to the crank-case by means of a ball-and-socket joint, said link extending in a direction substantially perpendicular to the radius through the point at which the link is jointed to the driving member.

8. The invention of claim 7 wherein the link is jointed to the periphery of the wobbler by a joint having one degree of freedom only about an axis which is radial to the centre of the wobbler.

9. In an engine of the kind described, in combination, a wobbler, a link jointed at one end to the periphery of the wobbler and at the other end to a fixed part of the engine displaced laterally from the centre of the wobbler, and a plurality of balance masses on said wobbler which balance masses, together with the point of attachment of the link to the wobbler, are placed at equal angular intervals around the wobbler.

In witness whereof I hereunto subscribe my name this 19th day of February, 1931.

MOGENS LOUIS BRAMSON.