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MULTICYLINDER INTERNAL COMBUSTION ENGINE.

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1,355,485. **Patented Oct. 12, 1920.**

Fig. 1

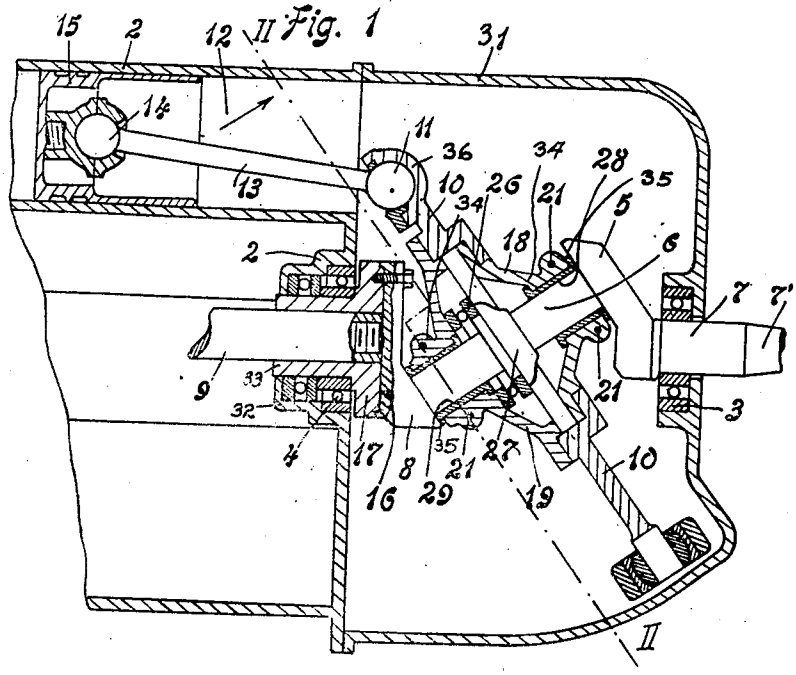
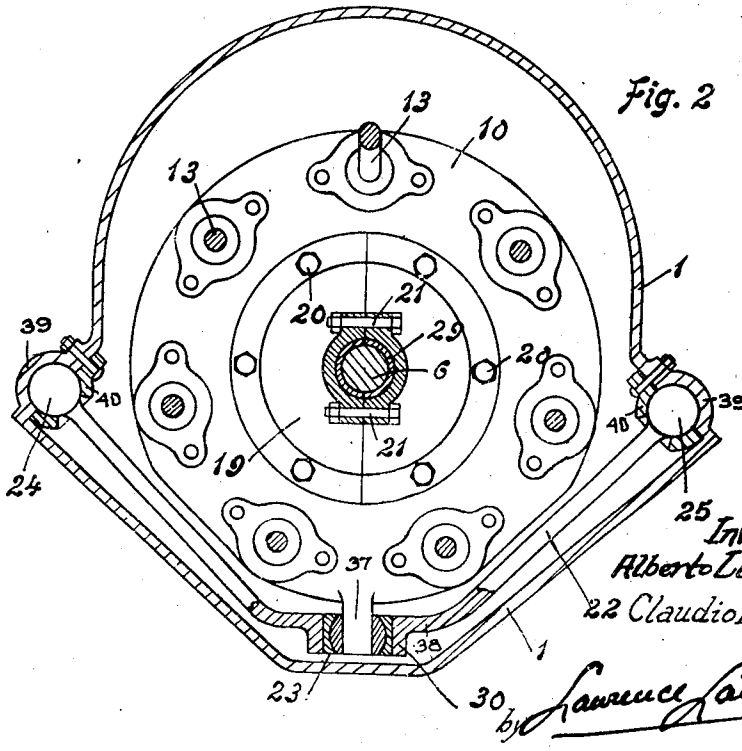


Fig. 2



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MULTICYLINDER INTERNAL-COMBUSTION ENGINE.

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To all whom it may concern:

Be it known that we, ALBERTO LLEÓ and CLAUDIO BARADAT, subjects of the King of Spain, and residents of Barcelona, Spain, have invented certain new and useful Improvements in Multicylinder Internal-Combustion Engines, of which the following is a specification.

The invention relates to certain improvements in internal combustion engines of the multicylinder type in which the pistons are connected through a wabble plate mechanism to translate the reciprocatory movement of the pistons into rotary movement of a centrally disposed driven shaft.

The present disclosure constitutes a development of the subject matter contained in our copending application for internal combustion engines Ser. No. 135798, filed Dec. 18, 1918, and the present invention is further developed in our copending application on multicylinder internal combustion engines Ser. No. 349652, filed Jan. 5, 1920.

It is to be understood that in devices of the type outlined, a severe distortional strain is imposed by the thrusts of the several pistons upon the inclined wabble plate construction which rotates the shaft. Any attempt to provide a massive construction at this place is objectionable in that it adds weight to the structure and it is vitally important in some engine constructions that this wabble plate construction be as light as possible and yet to possess sufficient rigidity to transmit the strains imposed thereon.

Accordingly, one of the objects of the invention is to provide a light hollow shell wabble plate construction between the pistons and the inclined portion of the shaft, in which construction the metal is distributed to most efficiently absorb and translate the longitudinal thrusts of the pistons into rotary movement of the shaft without distortion.

Another object of the invention in connection with this shell construction is to provide an organization of parts which can be readily assembled or demounted for repairs or for substitution of parts.

Further featuring the ruggedness of construction inherent in the disclosure, another object of the invention is to provide a simple form of one piece casting or drop forging to constitute the inclined crank portion of the shaft and the integral connecting portions at opposite ends thereof for receiving the thrusts from the light shell construction carried thereby.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings, and in part will be more fully set forth in the following particular description of one form of mechanism embodying our invention, and the invention also consists in certain new and novel features of construction and combination of parts hereinafter set forth and claimed.

Referring to the accompanying drawings: Figure 1, is a vertical sectional view taken axially through the right hand end of an engine of the type outlined and showing a preferred embodiment of the invention; and Fig. 2 is an inclined transverse sectional view taken on the broken line II—II of Fig. 1.

In the following description and in the claims, parts will be identified by specific names for convenience of expression but they are intended to be as generic in their application to similar parts as the art will permit.

In the accompanying drawings there is shown main frame 1, one end of which is closed by a wabble plate containing head 31. The end of frame 1 is defined by a transverse partition 2 through which opens piston cylinders 12 encircling and extending parallel to a straight axially disposed shaft 9. The partition 2 is enlarged adjacent its center to provide a housing 32 to accommodate the radial and end thrust bearings 4. A shaft supporting sleeve 33 is rotatably mounted in the bearings 4 and in turn supports and is rigidly fastened to one end of the main shaft 9. The portion of the sleeve 33 which projects beyond the partition and into the head 31 is enlarged to form a face plate 17 disposed in a plane perpendicular to the axis of rotation and having a diameter materially greater than the diameter of the shaft 9.

The continuation of the shaft 9 through the head 31 is provided by means of a one-piece Z-shape casting or drop forging from one end of which projects a pivot 7 constituting a straight portion concentrically disposed relative to the axis of the shaft 9. The pivot 7 is mounted in ball bearings 3 carried by the head 31 and is designed to have power taken off its end portion 7'. The Z-shaped member includes at the end opposite the

pivot 7 a face plate 16 which abuts the outer side of the plate 17 and is removably fastened thereto by means of screws 20.

By this connection the plates are secured together with their faces in contact whereby rotary movement is transmitted through the coacting plates which thus constitute torque receiving members having peripheral engaging portions spaced exteriorly of the peripheral of the connected straight shaft portion and at a relatively great distance from its axis of rotation.

A cylindrical crank 6 intersects the axis of rotation of the shaft 9, projects equal distance on opposite sides thereof and is connected integrally with the plate 16 through a massive head 8 at the edge of the plate. The opposite end of the crank 6 is connected to the pivot 7 by means of a strong crank head 5 which extends at right angles to the crank.

A wabble plate construction connecting the pistons with the inclined crank is loosely mounted upon the inclined crank 6 and is made up of a plurality of readily separable parts. The construction includes a pair of hollow frusto-conical shells 18 and 19 with their large ends facing, and disposed relatively close to each other and with their small ends extending outwardly to form hub sleeves 34 loose on the crank 6. A sleeve bearing 28 is interposed between the hub 34 forming part of the cone 18 and the crank 6, and similarly a bearing 29 is interposed between the cone 19 and the crank 6. The crank heads 5 and 8 co-act with the inclined crank and extend beyond the outline thereof to form stop shoulders 35 constituting abutments for limiting the outward, longitudinal movement of the cones. A thrust ring 10 is carried by the outer periphery of the cone 18, constitutes a spacing member between the large end of the cones and is provided adjacent its periphery with a plurality of spherical sockets 36 one for each of the piston cylinders.

A trunk form of piston 15 is slidably mounted in each cylinder and a piston rod 13 with spherical heads 11 and 14 at opposite ends engages in the oppositely disposed socket 36 in the thrust ring and in the piston 15.

The lower end of the ring 10 is provided with a reduced extension 37 which engages in a kunckle joint 23 to provide a universal connection between the ring 10 and crotch portion 38 of a U-shaped rocking fork 22 for holding the ring against rotation about the axis of the shaft 9.

The rocking fork has spherical bearings 24 at its upper free ends which engage the underside of sockets 39 formed at opposite sides of the head 31 and are held in place by removable retaining cups 40 engaging the underside of the bearing 24. These sockets and retaining cups constitute stop members for resisting the tendency of the fork to rotate in its plane in either direction while hanging the fork for free rotary movement about an axis connecting the centers of the bearing 24.

An end thrust bearing is positioned between the crank 6 and the head 8. This bearing includes a flange 27 formed integrally on the crank 6 intermediate its ends and within the housing provided by the cones.

An end thrust bearing 26 is provided between the flange 27 and the inner end of the hub on the cone 19 for transmitting strains from the crank 6 direct to the head 8 through the hub 28 and bearing 29.

We claim:

1. In a device of the class described, the combination of a shaft including alined portions, a crank inclined to the axis of said alined portions and rigidly connecting the same to rotate therewith about the common axis of rotation, a wabble ring construction loosely mounted on said inclined crank, power pistons operatively connected to said ring construction to cause the same to function, said ring including an extension projecting from its lower edge, a U-shaped rocking fork for resisting rotary movement of the wabble ring construction, said fork having a kunckle-jointed connection at its crotch with said extension, and pivotal supports for the free ends of said fork, confining the movement of the fork to a rocking movement about an axis passing through said pivotal supports and said fork acting to minimize resistance to the rocking movement of the wabble ring construction.

2. In a device of the class described, the combination of a shaft including a crank inclined to the axis of rotation of the shaft, a wabble ring construction loosely mounted on said inclined crank, a rocking fork operatively connected to said construction to prevent rotary movement thereof about said axis while permitting all other movement about said shaft and pivotal means for hanging said fork, said means including a relatively strong stop member disposed in alinement with and in advance of the side of the fork toward which the wabble construction tends to turn, said stop member acting effectively to resist any such tendency of the fork to revolve in its containing plane while permitting a free oscillation of the rocking fork about a transverse axis in said containing plane.

3. In a device of the class described, the combination of a shaft including a crank inclined to the axis of rotation of the shaft, a wabble ring construction loosely mounted on said inclined crank, a support provided with a pair of spherical sockets on opposite sides of the wabble construction, a U-shaped

rocking fork operatively connected to the said construction to prevent rotary movement thereof about said axis, spherical bearings defining the ends of said fork and rotatably mounted in said sockets to rockably suspend said fork.

4. In a device of the class described, the combination of a shaft including a crank inclined to the axis of rotation of the shaft, a wabble ring construction loosely mounted on said inclined crank, a U-shaped fork operatively connected to the wabble construction to prevent rotary movement thereof about said axis, said fork including spherical ends, pivotal mountings for the fork at the free ends thereof, said mountings including stop means overlapping and underlapping the spherical ends thereby to resist any tendency of the fork to be rotated in a direction toward the overlapping stop means by the tendency of the wabble construction to rotate.

5. In a device of the class described, the combination of a shaft including a crank inclined to the axis of rotation of the shaft, a wabble ring construction loosely mounted on said inclined crank, a U-shaped fork pivotally mounted at its free end and free to oscillate lengthwise of the axis, a single universal joint between the wabble ring construction and the crotch of the fork permitting all relative movement between the fork and wabble ring construction except relative rotation about said axis.

6. In a device of the class described, the combination of a wabble ring construction provided with an extension from one edge thereof, a rocking fork pivotally mounted at its free ends to rock freely about an axis of oscillation, and a knuckle joint between said extension and the crotch of said fork thereby to prevent rotary movement of the wabble ring while minimizing movement of the ring in all other directions relative to the swinging fork.

7. In a device of the class described, the combination of a power shafting including two alined straight portions and a connecting solid portion substantially Z-shaped and including a crank portion inclined to the axis of rotation of the straight portions, one of the straight portions and the Z-shaped connection portion being in one piece, one end of the Z-shaped portion being in the form of a face plate and constituting part of a fastening means disposed externally of the projected outlines of the straight portions, means passing through said fastening means for demountably securing said one-piece portion to the other straight portion, a thrust plate construction carried by the inclined crank portion and operatively connected to rotate the shafting about its axis.

8. In a device of the class described, the combination of a power shafting including two alined straight portions and a connecting portion inclined to the axis of rotation of the straight portions, one of the straight portions and the inclined portion being in one piece and provided with a face plate disposed in a plane perpendicular to the axis of rotation, a coacting face plate secured to the adjacent end of the other straight shaft portion and fastening means for securing the plates together with the outer portions of their faces in contact whereby rotary movement is transmitted to said other shaft portion from the inclined portion through the coacting face plates which constitute torque receiving members having peripheral engaging portions spaced externally of the periphery of the connected straight shaft portion and at a relatively great distance from the axis of rotation.

9. In a device of the class described, the combination of a straight shaft, a face plate secured to one end of said shaft and provided with an extension in the form of a shaft mounting sleeve extending along said shaft, an anti-friction mounting for said sleeved end of the shaft encircling said sleeve, and positioned close to said face plate, a crank inclined to the axis of rotation of said shaft and provided with a face plate abutting said first named face plate on the side thereof opposite the anti-friction mounting, means for securing the plates together, and a wabble plate construction mounted on the crank.

10. In a device of the class described, the combination of a straight shaft, a face plate secured to one end of said shaft and provided with an extension in the form of a shaft mounting sleeve extending along said shaft, an anti-friction mounting for said sleeved end of the shaft encircling said sleeve, and positioned close to said face plate, a crank inclined to the axis of rotation of said shaft and provided with a face plate abutting said first named face plate on the side thereof opposite the anti-friction mounting, readily accessible bolts passing from the exposed face of said last named face plate into the first named face plate to secure the plates to each other, and a wabble plate construction mounted on the crank.

11. In a device of the class described, the combination of a shaft provided at one end with a face plate projecting transversely of the axis of the shaft and beyond the outlines of the shaft, a crank inclined to the axis of rotation of the shaft and provided at one end with an integral head including a face plate contacting with the first named face plate and concentrically disposed relative to the axis of rotation of said shaft and means for securing said head including face plate to the face plate on the shaft thereby to form a strong but demountable connection between the shaft and the inclined crank.

12. In a device of the class described, the combination of a one-piece shafting including head portions mounted for rotary movement about a common axis of rotation and an inclined cylindrical crank disposed at an angle to and extending across said axis, crank heads connecting the ends of the cylindrical crank with said axially disposed head portions and projecting beyond the outlines thereof to form abutments at each end of the inclined crank, hollow frusto-conical shells with their large ends facing each other, and with their small ends loose on said crank, and held against outward movement by said abutments and a thrust ring carried by the outer large ends of said hollow shells and means for securing piston rods to one face of the ring externally of the adjacent ring holding shell.

13. In a device of the class described, the combination of a one-piece shafting including head portions mounted for rotary movement about a common axis of rotation and an inclined cylindrical crank disposed at an angle to and extending across said axis, crank heads connecting the ends of the cylindrical crank with said axially disposed head portions and projecting beyond the outlines thereof to form abutments at each end of the inclined crank, hollow frusto-conical shells with their large ends facing each other, and with their small ends loose on said crank, and held against outward movement by said abutments and a thrust ring carried by the outer large ends of said hollow shells and means for securing piston rods to one face of the ring externally of the adjacent ring holding shell, a flange secured to the portion of the crank inclosed by the shells and an end-thrust bearing between said flange and the shell which is on the side of the ring having the piston rods.

14. In a device of the class described, the combination of a one-piece shafting including head portions mounted for rotary movement about a common axis of rotation and an inclined cylindrical crank disposed at an angle to and extending across said axis, crank heads connecting the ends of the cylindrical crank with said axially disposed head portions and projecting beyond the outlines thereof to form abutments at each end of the inclined crank, hollow frusto-conical shells with their large ends facing each other, and with their small ends loose on said crank, relatively long radial thrust anti-friction bearings between the shells and the inclined crank at opposite ends thereof and held against outward movement of said abutments and a thrust ring carried by the outer large ends of said hollow shells and means for securing piston rods to one face of the ring externally of the adjacent ring holding shell.

15. In a device of the class described, the combination of a one-piece shafting including head portions mounted for rotary movement about a common axis of rotation and an inclined cylindrical crank disposed at an angle to and extending across said axis, crank heads connecting the ends of the cylindrical crank with said axially disposed head portions and projecting beyond the outlines thereof to form abutments at each end of the incline crank, a hollow thrust ring construction having longitudinal spaced apart hub portions loose on said inclined crank, radial thrust anti-friction devices disposed between each of said hub portions, and the adjacent abutment and an anti-friction end thrust bearing between the portion of the crank within the hollow ring construction and the end of one of said radial thrust bearings whereby said radial thrust bearings act as spacing means for spacing the end thrust bearing from one of the abutments.

16. In a device of the class described, the combination of a shafting including a solid cylindrical crank inclined to the axis of rotation of the shafting, a hollow thrust ring construction including cones provided with spaced apart hub portions loose on said crank, pistons operatively connected to one side of the ring construction to actuate the same, and an anti-frictional end thrust bearing housed within the cones and disposed between the shaft and the hub which is on the side of the construction adjacent the pistons.

17. In a device of the class described, the combination of a shafting including a cylindrical crank inclined to the axis of rotation of the shafting, a hollow thrust ring construction including cones provided with spaced apart hub portions loose on said crank, pistons operatively connected to one side of the ring construction to actuate the same, a flange fixed to the crank to turn therewith and an end thrust bearing encircling said crank spaced radially therefrom and positioned between said flange and one of the hubs of said cones.

18. In a device of the class described, the combination of a shafting including a cylindrical crank inclined to the axis of rotation of the shafting, a hollow thrust ring construction including a pair of cones coacting to form a hollow space and provided with spaced apart hub portions loose on said crank, pistons operatively connected to one side of the ring construction to actuate the same, and end thrust bearings housed within the hollow cone forming space for transmitting strains from the crank to one end of the hub portions and along lines parallel to the central portion of the crank.

19. In a device of the class described, the combination of a shafting including a cylindrical crank inclined to the axis of rotation

of the shafting, a pair of frusto-conical hollow shells loosely mounted on said crank with their large ends in juxtaposition and with their small ends extending outwardly in the form of relatively long sleeves encircling the crank at opposite ends thereof, a piston rod receiving ring encircling said shells and fastening the same together at their outer peripheries and radial bearings at opposite ends of the crank disposed between the same and the sleeve extensions from the hollow shells.

20. In a device of the class described, the combination of a shafting including a cylindrical crank inclined to the axis of rotation of the shafting, a pair of frusto-conical hollow shells loosely mounted on said crank with their large ends in juxtaposition and with their small ends extending outwardly in the form of relatively long sleeves encircling the crank at opposite ends thereof, a piston rod receiving ring encircling said shells and fastening the same together at their outer peripheries and radial bearings at opposite ends of the crank disposed between the same and the sleeve extensions from the hollow shells, and an end-thrust bearing housed within the space outlined by said shells and disposed between the crank and the inner end of one of said sleeves.

21. In a device of the class described, the combination of a shafting including a cylindrical crank inclined to the axis of rotation of the shafting, a pair of frusto-conical hollow shells loosely mounted on said crank with their large ends in juxtaposition and with their small ends extending outwardly in the form of relatively long sleeves encircling the crank at opposite ends thereof, said shells being each formed of a plurality of parts to facilitate the mounting of the same on the crank, means for fastening the parts together about the crank, a piston rod receiving ring encircling said shells and fastening the same together at their outer peripheries and split radial bearings at opposite ends of the crank disposed between the same and the sleeve extensions from the hollow shells.

22. In a device of the class described, the combination of a shafting including a cylindrical crank inclined to the axis of rotation of the shafting, heads defining opposite ends of the crank, a wabble plate construction loosely mounted on said crank and positioned between the heads thereof, said construction including three major parts, a pair of relatively light hollow frusto-conical shells held from relative outward movement by the heads and a ring connecting the outer peripheries of the shells, said ring exteriorly of the shells provided with joints on one side thereof for securing piston rods to the wabble plate construction.

23. In a device of the class described, the combination of a shafting including a cylindrical crank inclined to the axis of rotation of the shafting, heads defining opposite ends of the crank, a wabble plate construction loosely mounted on said crank and positioned between the heads thereof, said construction including three major parts, a pair of relatively light hollow frusto-conical shells held from relative outward movement by the heads and a ring connecting the outer peripheries of the shells, said ring exteriorly of the shells provided with joints on one side thereof for securing piston rods to the wabble plate construction, a flange fixed to the crank and having a bearing face encircling the crank, spaced therefrom and facing one of the shells and an end thrust bearing between said shell and said bearing face.

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