March 15, 1949. E. S. HALL 2,464,228

RECIPROCATING MECHANISM

Filed July 14, 1944 2 Sheets-Sheet 1

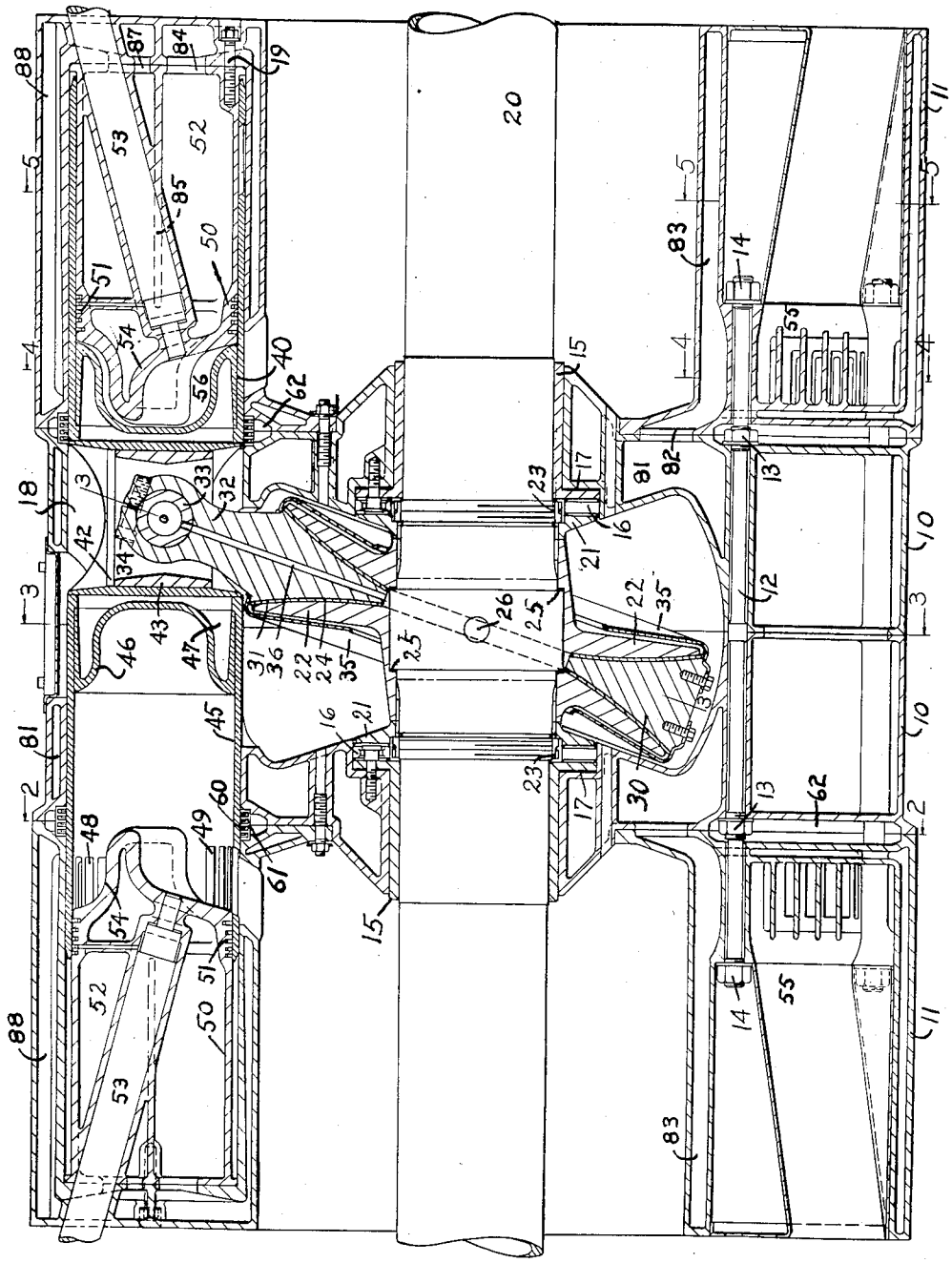


Fig-1-

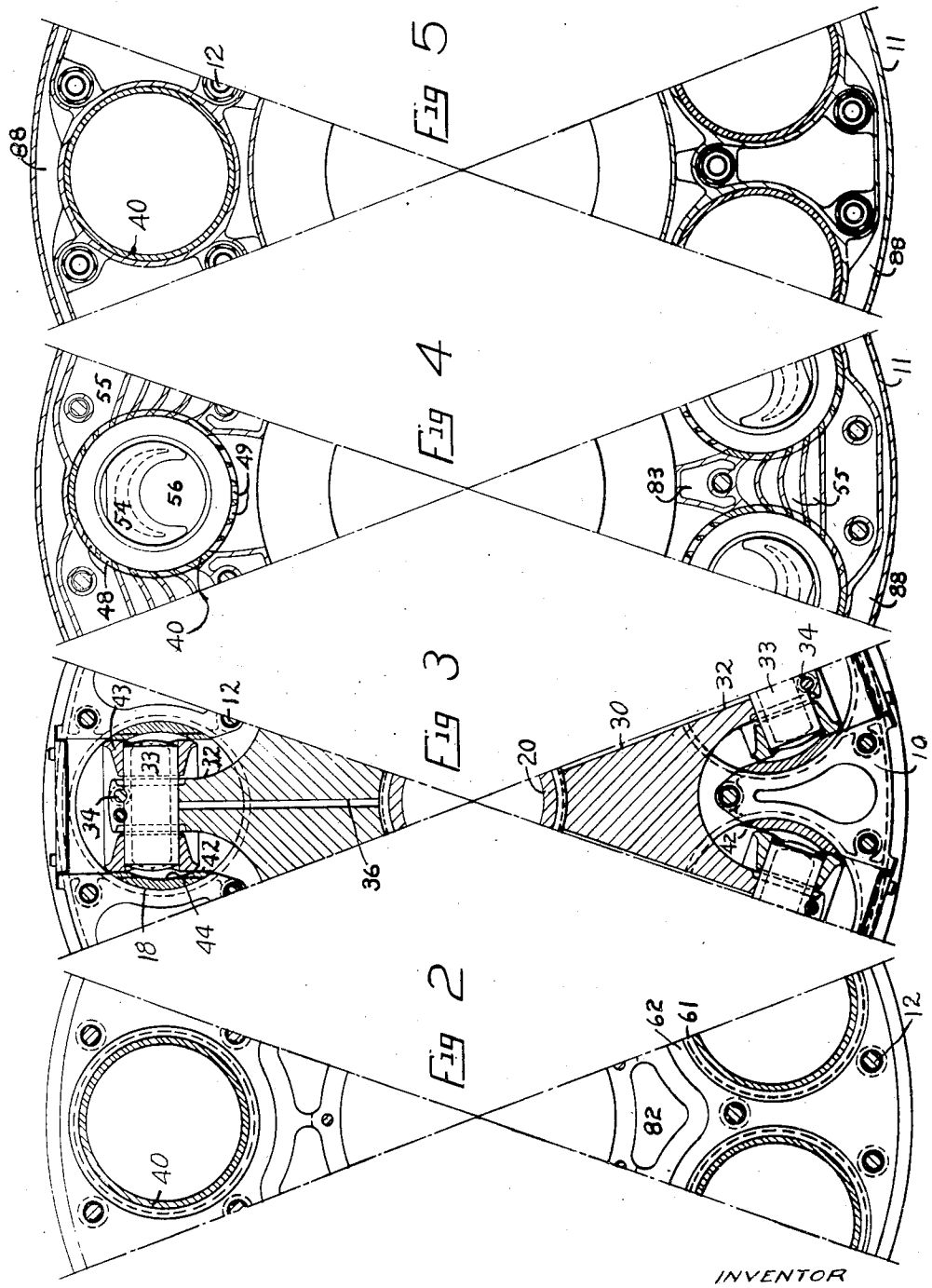
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RECIPROCATING MECHANISM

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Application July 14, 1944, Serial No. 544,997

5 Claims. (Cl. 123—58)

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This invention relates to reciprocating mechanisms for engines, pumps, and compressors of the class having cylinders parallel to the shaft, the class commonly called barrel type, axial, or round engine mechanisms. This application is a continuation in part of my application Serial No. 494,628, filed July 14, 1943, and now abandoned.

The broad object of the invention is to provide an improved reciprocating mechanism with the most piston displacement in the smallest bulk and weight. To this end, the cylinders are arranged parallel to the shaft, for it is well-known that the properly designed barrel type or round engine is the most compact, with the most capacity in the least space with lowest weight and cost.

The most compact barrel engine construction is the normal type having double-ended reciprocating members (hereinafter called "recipers") operably connected to the shaft by a single mechanism. As an engine, such a mechanism can run most effectively on the two-stroke cycle, reciper inertia forces offsetting peak cylinder pressures on every stroke, relieving the mechanism of high maximum loadings and providing two moderate power impulses per stroke, with resulting extraordinarily smooth torque output.

The weight of such a machine, of given stroke, tends to vary with its length. An object of the invention is to provide the shortest two-stroke barrel engine mechanism. Of the possible arrangements—ported cylinders with loop scavenge, uniflow with poppet valves or with sleeve valves, etc.—the shortest machine can be that using reciprocating cylinders and fixed pistons. An object of the invention is to provide a reciprocating cylinder engine mechanism in which the inside surface of the reciper may serve as a cylinder coacting with the fixed piston while the outside cylindrical surface may serve as a crosshead, a good part of the reciper length being traversed by the piston rings internally and the oil control rings externally. Much of the reciper length thus does double duty, resulting in a shorter reciper and a shorter and lighter machine.

In any barrel engine mechanism, the most compact and shortest machine can be had only by using "straight-thru" recipers, each essentially cylindrical and completely contained within its cylindrical exterior, capable of passing straight thru the cylindrical guide surface in which it operates. Anything on the reciper projecting outside its cylindrical limit requires more than a stroke length in which to reciprocate, inevitably

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increasing engine length and weight. An object of this invention is to provide straight-thru recipers permitting the shortest engine, yet with crosshead portions of larger diameter than the cylinders, thus permitting more generous bearing areas in the parts operably connecting the recipers with the shaft, relative to piston area, than is usually possible with the straight-thru reciper. Another troublesome problem in the design of most large engines is how to provide replaceable cylinder "liners." An object of this invention is to solve this problem by providing a mechanism with replaceable cylinder units, readily assembled of steel by furnace brazing, steel being used where it is needed most—to confine cylinder pressures—permitting lighter alloys to be used in crosshead guides and pistons, without any need for ferrous "liners." Another object is to provide a steel reciper of reasonably low weight; with the cylinder head adjacent the crosshead, the need for the long column member supporting a reciprocating piston head is absent, so that by proper design, the steel reciprocating cylinder unit need be no heavier than an aluminum piston unit of comparable size and service.

In most engines, piston speed may be limited by inertia effects on piston rings. An object of this invention is to provide an engine mechanism in which both compression and oil control rings are free from inertia effects.

Other objects are to provide a simple engine frame structure comprising essentially two pairs of castings (or welded assemblies) held together by thru-bolts, and to make the reciprocating rotary conversion mechanism completely contained within the inner pair of castings or weldments, with crosshead guides for the recipers and main bearings for the shaft, so that, when assembled, the mechanism may be operable as a machine independently of the working medium or cycle, the thru-bolts having an inner set of nuts to hold the inner pair of castings together in the absence of the outer pair. Another object is to isolate the working medium from the lubricating oil more effectively than is possible in an engine having reciprocating pistons. Reciprocating cylinders opening away from the mechanism effectively prevent contamination of the lubricating oil by the working medium and prevent the passage of lubricating oil into the working cylinders. Other objects are to provide oil control rings for preventing oil from following the recipers from the crosshead guides into the outer pair of frame members; to provide a drainage chamber for the oil from the oil control

rings, conveniently formed between the inner and outer frame members, from which chamber the oil can be led directly to the cleaners before being returned to the main casing; and to provide oil control units acting as dowels to insure the alignment of the bores in the inner and outer frame members.

Other objects are to provide a starplate mechanism for converting reciper thrust into shaft rotation, characterized by simplicity, clean and rugged design, ample bearing areas for low specific loading and long life; and to provide an adjustable plate bearing for such a mechanism, free from any difficulty of misalignment.

These and other objects of the invention will be more apparent by reference to the drawings in which

Fig. 1 is a longitudinal section of the body of the mechanism;

Fig. 2 is a cross section of the fixed parts, on the line 2—2 of Fig. 1;

Fig. 3 is a cross section taken substantially on the lines 3—3 of Fig. 1;

Fig. 4 is a section taken on the line 4—4 of Fig. 1; and

Fig. 5 is a section of the fixed parts taken on the line 5—5 of Fig. 1.

In the particular embodiment of the invention illustrated, the mechanism comprises a pair of inner frame members 10 and a pair of outer frame members 11 held together by thru-bolts 12, nuts 13 holding together the inner frame members 10 which support the working parts of the mechanism as an operable assembly, and nuts 14 holding outer frame members 11.

Shaft 20 is operable in journal bearings 15 mounted in inner frame members 10, and is restrained from axial movement by slipper thrust bearings 16 operable with collars 21. Adjustment of the working clearance in thrust bearings 16 may be made by shims 17 behind the flanges of journal bearings 15. Slants 22 are clamped to the central flange of shaft 20 by collars 21 and nuts 23; both slants 22 and collars 21 are splined against rotation on shaft 20. Shaft 20, collars 21, slants 22, and nuts 23 form a rotating unit. Slants 22 have spherical working faces 24, the working clearance between them being adjustable by shims 25. Starplate 30 is operably mounted between working faces 24 of slants 22, starplate 30 having spherical bearing surfaces 31 operably conforming to slant working faces 24.

Starplate 30 has arms 32, one for each of the reciprocating members 40. A wristpin 33 is clamped by screws 34 to each arm 32, the axis of the wristpin being tangent to a circle in the plane of starplate 30.

Wristpin 33 is operable, both axially and rotatably, in bearings in pinhead 43, which is similarly operable in bore 42 in the crosshead portion of reciper 40. The ends of wristpins 33 are formed spherically to coact with internal surfaces 44 formed in the crosshead portions of recipers 40.

Each reciper 40 has two outwardly opening cylinders 45 having cylinder heads 46, axially symmetrical and formed with bellows-like double curvature, a form especially adapted to stand wide variations in temperature without heat checking. Reciper 40 is operable in cylindrical crosshead guide 18 formed in inner frame members 10. Reciper 40 may be conveniently constructed of the lengthwise steel tube which forms cylinders 45, the crosswise tube which provides bore 42, and the two cylinder heads 46, all fitted together and copper brazed into a single unit in an electric furnace, with the desired subsequent heat treatment to refine the grain of the steel.

Coacting with cylinders 45 are fixed pistons 50 having piston rings 51, internal coolant passages 52 and fuel injectors 53. Piston head 54 may be formed in any desired shape. Incoming air may enter thru passages 55 and ports 48 of recipers 40, and exhaust thru ports 49. Fixed pistons 50 are secured in bores in outer casing members 11 by bolts 19.

In operation, rotation of shaft 20 is accompanied by reciprocation of recipers 40 in a well-known manner. Flow of lubricating oil from within shaft 20 may be outward thru holes 26 to spherical bearing surfaces 31 operable upon slant surfaces 24. Oil pans 35 inhibit too rapid flow of oil from the spherical bearing surfaces and retain a supply of oil while the mechanism is idle to insure initial lubrication upon starting.

Oil may flow outward thru oil passages 36 in starplate 30 into wristpins 33, and thence to lubricate the wristpin bearings in pinheads 43 and the pinhead bearings in bores 42, as well as the ends of wristpins 33 as they contact internal surfaces 44 in recipers 40 to control the starplate motion. Thru other suitable holes the oil may be led into the spaces 47 to cool cylinder heads 46, and thence outward into the chamber between inner casing members 10; alternately chambers 47 may be closed, no direct cooling being provided for cylinder heads 46. Reciper 40 runs in a liquid cooled crosshead guide, and cylinder 45 is swept by piston rings mounted in liquid cooled fixed pistons 50. Oil will be deposited on the outside surface of reciper 40. Oil control rings 60, mounted in cages 61, strip the oil from recipers 40 and drain it into chambers 62, from whence it may be led to oil cleaners before being returned to the system. Cages 61 also serve as dowels to locate outer frame members 11 correctly relative to inner frame members 10.

Coolant from the radiator may be returned first to jackets 81 in inner frame members 10 where the coolant can cool main bearings 15 and crosshead guides 18. Coolant then flows thru ports 82 to inner jackets 83 of outer frame members 11, thru ports 84 into fixed pistons 50, around baffles 85 thru passages 52, and out thru passages 87 into outer jackets 88 of outer frame members 11, from whence it may be returned to the radiator.

Starplate 30 and its associated parts, recipers 40, shaft 20, and slants 22, constitute a mechanism operably supported by inner frame members 10, a mechanism operable as a machine without outer frame members 11 and pistons 50.

From the foregoing description it is apparent that a mechanism has been provided by which the several objects of the invention as discussed may be attained. Altho one specific embodiment of the invention has been shown and described, it will be understood that the invention is capable of modification and that changes in the construction and in the arrangement of the various parts may be made without departing from the spirit or scope of the invention as expressed in the following claims.

I claim:

1. A mechanism comprising a shaft, reciprocating members parallel to said shaft, operable connections between said reciprocating members and said shaft, a pair of frame members operably supporting said shaft and said reciprocating members, thru-bolts holding said frame members

together, another pair of frame members held together by said thru-bolts, and oil control assemblies coacting with said reciprocating members and serving as dowels to locate the frame members of one pair with those of the other pair.

2. A mechanism comprising a shaft, reciprocating members parallel to said shaft, operable connections between said reciprocating members and said shaft, a pair of frame members operably supporting said shaft and said reciprocating members, thru-bolts holding said frame members together, another pair of frame members held together by said thru-bolts, oil control assemblies coacting with said reciprocating members, and an oil drainage chamber formed between each frame member of one pair and its adjacent frame member of the other pair.

3. A mechanism comprising a shaft, reciprocating members parallel to said shaft, operable connections between said reciprocating members and said shaft, an inner pair of frame members operably supporting said shaft and said reciprocating members, an outer pair of frame members, oil control assemblies coacting with said reciprocating members and serving as dowels to locate the outer frame members in alignment with the inner frame members, and means holding the frame members together.

4. In a mechanism of the class described, a shaft, slant plates on said shaft, spherical working faces on said slant plates, a starplate between said slant plates and having bearing surfaces operably conforming to said spherical working faces, and means for adjusting said plates axially upon said shaft to adjust the working clearance between said slant working faces and said starplate bearing surfaces, the adjustment making no other change than to alter slightly the working clearance and the angle of said starplate relative to said shaft.

5. In a mechanism of the class described, a shaft, reciprocating members parallel to said shaft, operable connections between said reciprocating members and said shaft, an inner pair of frame members operably supporting said shaft and said reciprocating members, an outer pair of frame members, oil control assemblies coacting with said reciprocating members, and oil drainage chambers associated with said oil control assemblies and formed between said inner and outer frame members, and means for holding said frame members together.

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