

June 5, 1945.

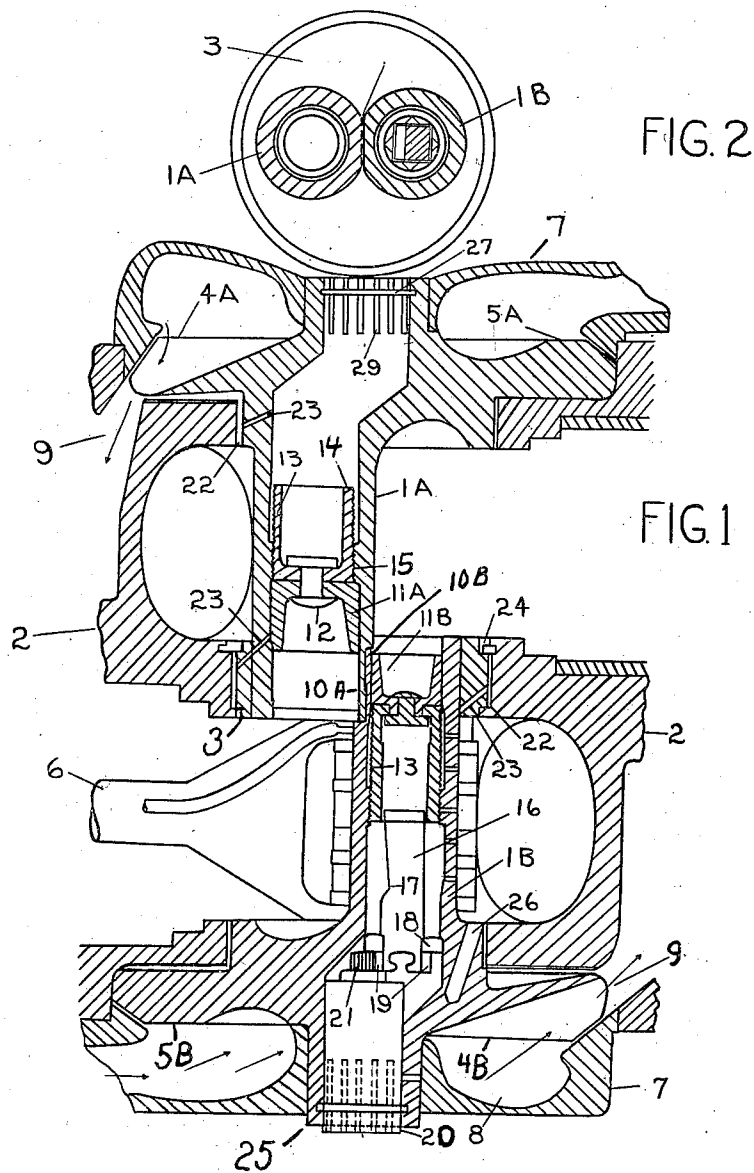
D. K. WARNER

2,377,833

CRANKSHAFT

Filed Aug. 3, 1943

2 Sheets-Sheet 1



Inventor
By *Douglas K. Warner*
Emory Tate Griffith Attorney

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2 Sheets-Sheet 2

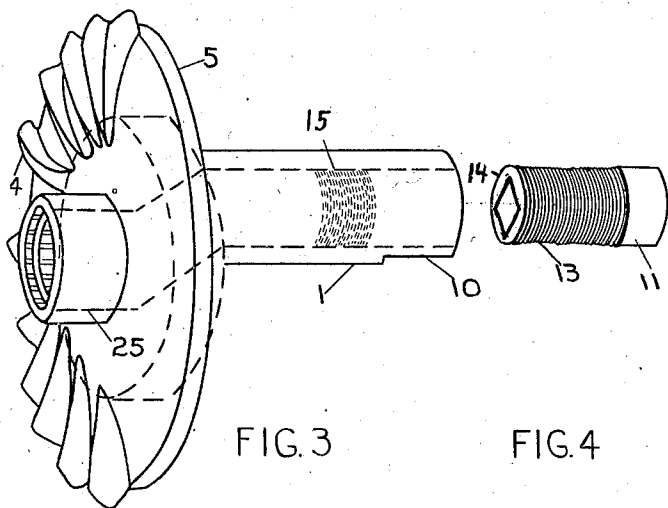


FIG. 3

FIG. 4

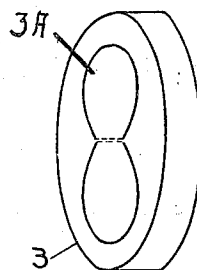


FIG. 5

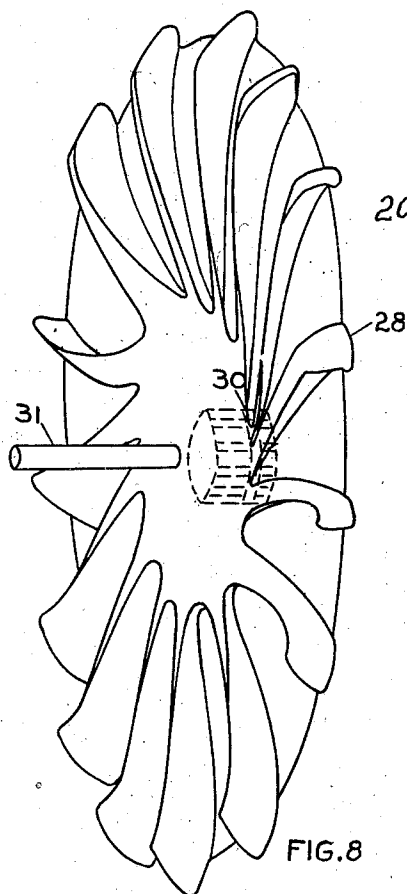


FIG. 8

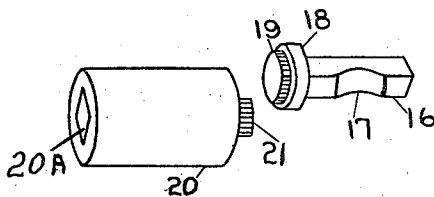


FIG. 6

FIG. 7

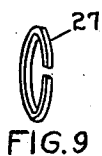


FIG. 9

Inventor
By *Douglas K. Warner*
Fred V. Griffith Attorney

UNITED STATES PATENT OFFICE

2,377,833

CRANKSHAFT

Douglas K. Warner, Sarasota, Fla.

Application August 3, 1943, Serial No. 497,244

4 Claims. (Cl. 74—597)

This invention relates to crank-shafts for engines particularly internal combustion engines having radially-disposed cylinders, such as shown in my co-pending application for patent Serial Number 337,688, in which connecting-rods are mounted upon a crank-shaft, the said connecting rods there being arranged to surround the crank-shaft with annular ends made in two sections keyed together.

To enable the engine to be built with more strength and durability, to withstand the terrific strains of the high speeds attained by these engines, I have made the present invention, which is a crank-shaft formed in two main sections, and a bearing-section, so that the annular box-framed connecting-rods and single solid central rod may be made solid at their crank-pin bearings, and mounted upon the crank-shaft by merely slipping the crank-pin ends into them, and then completing the crank-shaft; the invention of course being applicable to other forms of connecting-rods and other forms of engines.

With this and other objects in view, my invention consists in the novel construction and combination and arrangement of parts herein-after shown and described herein; the crank-shaft illustrated having two crank-pins for a twin row motor with ten connecting rods.

In the accompanying drawings forming part of this specification, in which like numerals of reference indicate like parts in the several views:

Figure 1 is a longitudinal central section of a crank-shaft embodying my invention.

Figure 2 is a transverse section on the line x—x of Figure 1.

Figure 3 is a perspective elevation of a portion of the crank-shaft with a blower-fan upon one crank-arm of it.

Figure 4 is a similar view of a plug forming part of the invention.

Figure 5 is a detail of the centre disk.

Figure 6 and Figure 7 are details of the wrench-tool used to assemble the crank-shaft.

Figure 8 is a perspective elevation of an end of the crank-shaft carrying a blower-fan, and showing a certain detail.

Figure 9 is a similar view of a split ring used in securing a high pressure blower fan or a drive shaft.

In the practice of my invention, I construct the crank-shaft in two like parts, 1A, and 1B. These follow in the main the usual shape and form of a tubular crank-shaft. They are mounted in the usual or any approved pattern of housing or crank-case 2, fitting the engine to be con-

structed. The inner or meeting and lapping ends of the crank-shaft, that is, the crank-pins, are inserted in the centre disk or crank-arm 3, which is also the centre main bearing of the crank-shaft, journaled in the crank-case or housing 2, and held from end-wise play by a shoulder in the crank-case and an expanding locking ring 24, and provided with a double opening 3A having an approximately figure 8-shaped configuration.

Upon each outer crank-arm of the crank-shaft sections 1A and 1B respectively are integrally-forged fans 4A and 4B, having counter-weight valve-closure portions 5A and 5B for a portion of their circumference, the fans being mounted so that the counter-weight portions of each are oppositely disposed to the adjoining crank-arm and therefore to that on the opposite shaft-end and said counter-weight comprising also inlet check-valves for scavenge compression below the pistons of a two cycle motor such as in my application Serial No. 337,688 aforesaid.

After fitting the crank-pin sections and before finally inserting them in the centre disk bearing 3 for complete assemblage of the device, I mount the connecting-rods 6 of the cylinder pistons upon the said shaft-sections, or upon the usual bushings, this being done by first assembling the rods inside the crank-case, and then inserting the crank-pins therethrough only one of these connecting-rods being shown. The crank-shaft fan-casings 7 are attached to the crank-case, and serve to support the end main bearings. Passages 8 and 9 connect the fan with the scavenging portion of an internal combustion engine such as in my application aforesaid Serial No. 337,688, and the return therefrom.

Where the meeting and lapping ends of the crank-pins come together in the centre disk-bearing or crank-arm 3, in its double, communicating or 8-shaped orifice, the said crank-pins are flattened at their inner sides to lie closely, and later when tightened, lie frictionally, in juxtaposition. These side faces of the crank-pin ends are flattened for a little more than the depth of the ring 3 which they enter, and for approximately half of this flattened end-portion the flattening is done just enough to make the end smooth to the other, but the next half of this end-portion is indented more to make each of the end-portions formed of a thin part 10 and a shoulder 10A, so that when adjusted in position these ends will lock in a sort of dovetail, as shown in Figure 1, tending to check outward movement

or separation of the ends, when clamped in working order.

In each of these crank-pin ends I insert an expansion plug 11A or 11B, to which is rotatably attached by a rivet-shaped connector 12, a screw-plug 14, provided with an external screw-thread 13, which engages the interior thread 15 of the shaft-end. The open end of the screw-plug 14 is formed with a square or hexed socket 14A to receive the like end of a crank-pin wrench-rod 16, made with a short crook or concaved side 17, to enable it to be slid into the off-centered or elbowed bores of each crank unit. Upon the outer end of this crank-pin wrench-rod is an annular flange 18, surmounted by an annular gear 19. When this wrench-rod is slipped into its place in the socket of the screw-plug 14, there is then inserted in the bore of the main-bearing shaft-end a chuck 20, which is turned in the shaft-bore by wrench applied in socket 20A, and is provided with a pinnion 21 meshing with the gear 19 on the crank-pin wrench-rod 16.

The whole crank-shaft is journaled in anti-friction bushings 22 in the crank-case, which are also provided with oil-holes 23, and a expanding-locking-ring 24 to hold the bearing. The crank arm 25 which carries the fan 4A projects outwardly to form the semi-circular sector fan 4A, 4B, which is provided with a number of drilled holes 26 to reduce the weight of the semi-circular sector which carries the fan-blades, leaving the opposite sector of the fan disk as a heavy, solid counterweight and rotary valve closure. A split ring 27 holds the splines 30 of compressor-fan 28, which fits into the splined bore 29 of the crank-shaft end 1A or 1B. The fan may be released by comprising the ring 27 by any desired means.

The operation of the device will be manifest from the foregoing description, taken in connection with the drawings. This crankshaft can be and is made with fan blades integrally forged with its crank arms, and its connecting rods also make so as to be mounted thereon without using the weaker divided rod, by this invention of making said crank-shaft of two main sections united in a central bearing section. By reason thereof, also, the connecting rods can be made strong enough for extreme speed, which is only possible if said connecting rods are made solid, as in this device. As the fans are forged from the crankshaft billet, it is but necessary to slide the crank-pins into the crank-case and through the bushings which have previously been inserted through the crank ends of a group of connecting rods assembled in one of the crank-case compartments, and then insert the free ends of the shaft in the centre disk or bearing 3. Before doing so, however, the plugs 11A and 11B must be screwed fully into the crank-pin ends, then the wrench-rods 16 are inserted in the parallel elbowed shaft-bores, the chuck 20 following, and by turning the chuck by any suitable tool fitting its socket 20A, the pinion 21 meshes with and turns, the annular gear 19, thus screwing in the rotatably attached plug 14, and forcing in the expansion plug 11, expanding the lapping end of the crank-pin in the bearing-ring 3. Simultaneously, or alternately, the expansion plug on the opposite crank-pin-end is also tightened, and both these plugs so expand the crank-pin-ends in the bearing-ring or centre crank-arm 3, that they force the two flattened sides together, engaging the shoulder 10A in the more indented portion 10 of the opposite side, and forming a joint so tight as to constitute an almost integral shaft, certainly

one acting integrally. The engine is stronger and more easily assembled than if made with divided connecting-rods, crank-ends, and a one piece crank-shaft, as serious fatigue stresses in the connecting rods are removed, permitting, as above stated, higher engine speeds and more power. To increase the strength of the driven fan 28, which is mounted in the bore of the main end of the shaft, or whatever equivalent driven mechanical factor to which the engine power is applied, and to permit the same to turn upon its own centre of gravity, regardless of the flexure of the crank-shaft, again conducing to its strength; and also further so that the forging of the integral fans 4A and 4B and their blades on and with the crank-shaft may be accomplished with less difficulty, each main section of said crank-shaft is made as short as possible and without the usual overhang beyond the main bearings, and is splined in a bore in the shaft within the main bearing. A material part of my invention is my new device for locking the drive-shaft to the crank-shaft as shown, with the expanding ring 27 which locks in a matching groove intersecting the circle of spline grooves in the crank-shaft when the drive-shaft is inserted the proper distance therein. Since the splines offer a large enough area for torque stress, the fit of the drive-shaft in the crank-shaft need not be tight, so that bending of the crank-shaft will not stress the fan, which should turn true on its own centre of gravity irrespective of shaft motion variance.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A crank-shaft hollow throughout and formed in two main sections, which are each mounted in bearings at opposite ends of the crank-case, and which overlap each other at the centre of the shaft, and are formed interiorly with threads to receive expansion devices, and are flattened exteriorly at their meeting and overlapping sides, the said sections of the crank-shaft being formed at their inner overlapping ends with open bores to receive therein expansion devices which operate in the said bores of the overlapping ends of said sections, both said expansion devices and the bores of the outer crank-shaft ends being formed and adapted to receive operating devices insertible into said outer end bores, whereby to expand the inner overlapping ends, and an orificed central bearing disk in which the overlapping ends of the crank-pin-sections are inserted, and which when the expansion devices are actuated, holds said overlapping ends frictionally engaged with each other and with said orificed bearing disk to form one continuous shaft, whereby said crank-pin-ends may before engagement, be slipped through connecting-rod crank-ends integrally formed, to mount the same upon said shaft.

2. A crank-shaft formed with two hollow crank-arm and crank-pin sections, each mounted in a bearing at its outer end in the crank-case, with the inner ends of said crank-pin portions overlapping at the centre of said crank-shaft to form a longitudinally continuous shaft from each said outer bearings to the other, the inner overlapping ends being flattened at their sides where they overlap, to lie in close contact, and interiorly threaded to receive expansion devices, and the outer ends of the shaft sections being formed and adapted to receive operating tools insertible therein and therethrough; expansion devices insertible into the bores of the inner ends, and

adapted to expand said ends, a central bearing disk in which the inner crank-pin ends are inserted in contact together, whereby they are held in frictional engagement with said disk and with each other when the interior expansion devices are actuated by the removable tools to expand said overlapping crank-pin ends.

3. A crank-shaft hollow throughout and formed in two main sections, which are each mounted in bearings at opposite ends of the crank-case, and which overlap each other at the centre of the shaft, and are formed to receive expansion devices, and are flattened exteriorly at their meeting and overlapping sides, the said sections of the crank-shaft being formed at their said inner overlapping ends to receive expansion devices which operate in the bores of said inner ends, and an orificed central bearing disk in which the overlapping ends of the said sections are inserted, and which when the expansion devices are actuated holds said overlapping ends or crank-pin-

ends frictionally engaged with each other and with said orificed bearing disk, to form one continuous shaft, whereby said crank-pin-ends may before engagement be slipped through connecting-rod crank-ends integrally-formed, to mount the same upon said shaft.

4. A crank-shaft formed with two crank-arm and crank-pin sections, each mounted in a bearing at its outer end in the crank-case, with the inner ends of said crank-pin portions overlapping at the centre of said crank-shaft to form a longitudinally continuous shaft from each said outer bearings to the other, the said overlapping ends of the crank-pin portions lying closely together in contact, a central bearing disk adapted to receive both said overlapping ends of the crank-pin portions, in which said ends are inserted in close and tight contact, and means whereby they are held in frictional engagement with said disk and with each other.

DOUGLAS K. WARNER.