

1,263,407.

3 SHEETS—SHEET 1.



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COUNTERBALANCED CRANK SHAFT.
APPLICATION FILED SEPT. 22, 1917.

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Patented Apr. 23, 1918.
3 SHEETS—SHEET 2.

Fig. 3.

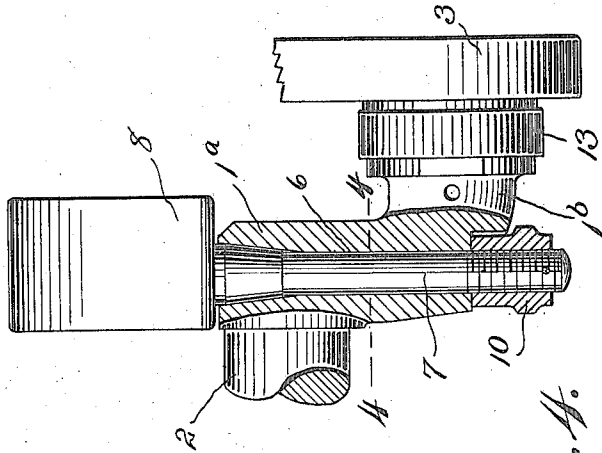


Fig. 4.

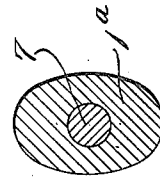
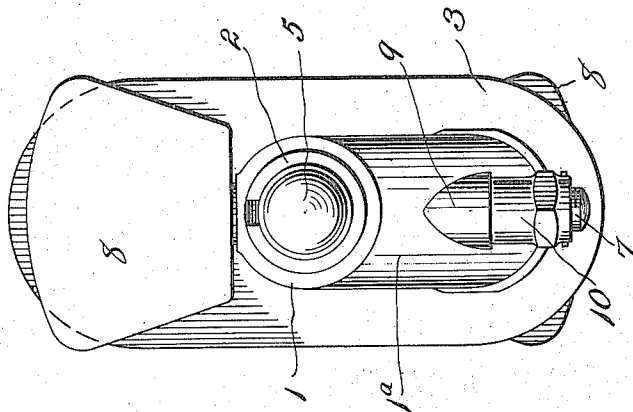


Fig. 2.

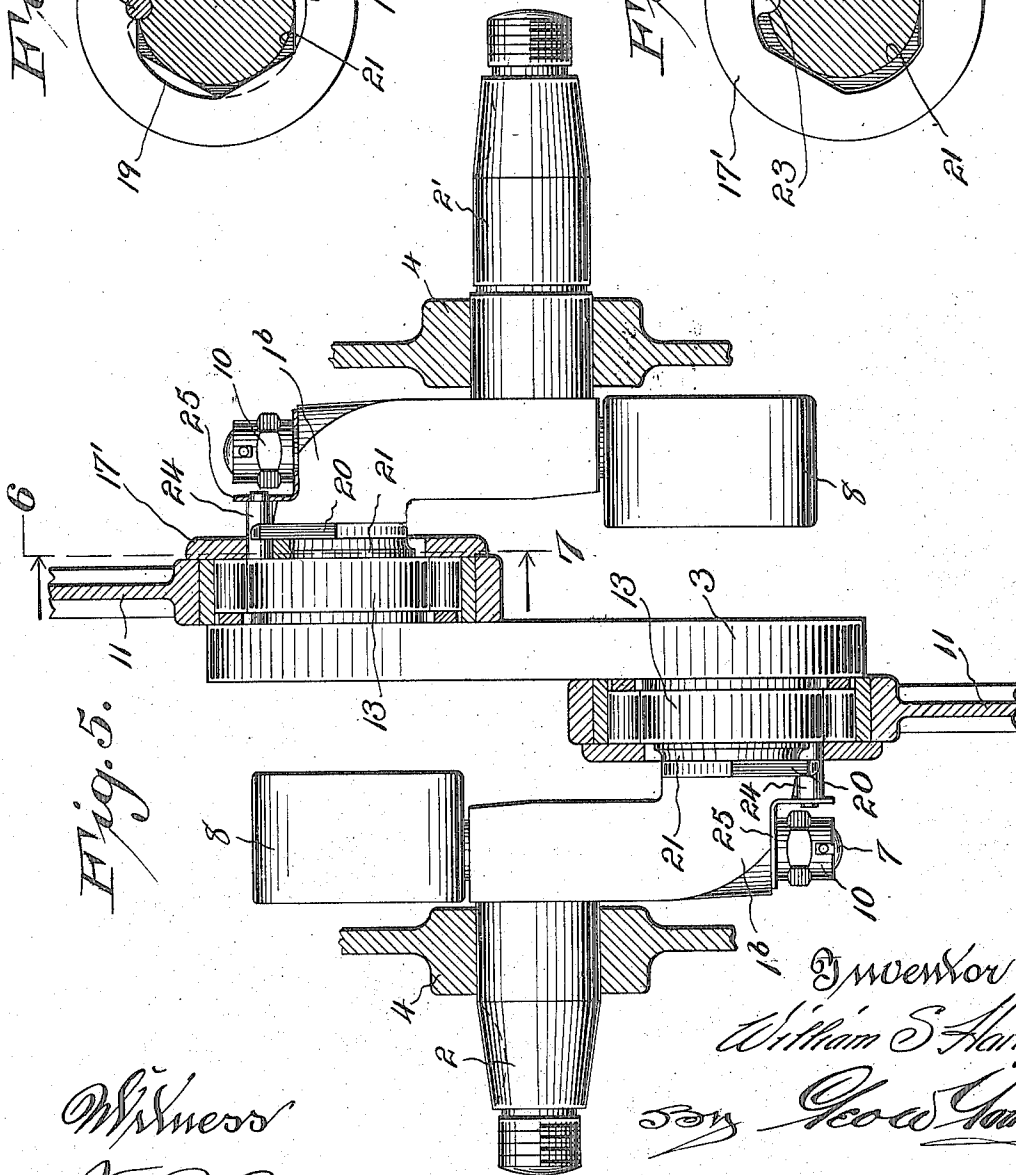
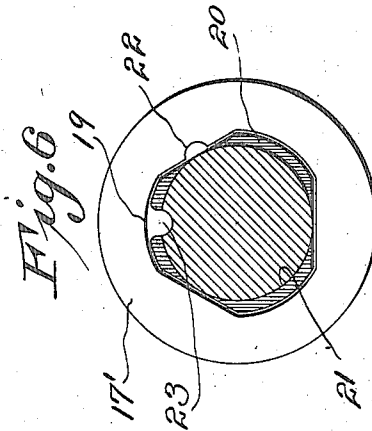


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UNITED STATES PATENT OFFICE.

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COUNTERBALANCED CRANK-SHAFT.

1.263,407.

Specification of Letters Patent.

Patented Apr. 23, 1918.

Application filed September 22, 1917. Serial No. 192,653.

To all whom it may concern:

Be it known that I, WILLIAM S. HARLEY, a citizen of the United States, and resident of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Counterbalanced Crank-Shafts; and I do hereby declare that the following is a full, clear, and exact description thereof.

My invention relates broadly to internal combustion engine construction, and more specifically to crank shafts for such engines.

Through considerable experiment it has been found that internal combustion engines provided with counter-balanced crank shafts operate with greater ease and smoothness than those engines not so equipped.

It is, therefore, one object of this invention to provide an internal combustion engine, particularly motor-cycle engines with a crank shaft having counter-balance weights for preventing the stopping of the movement of the parts when the same are on dead center.

In carrying out the foregoing object, it also has been discovered that it is essential that the counter-balanced weights be readily detachable from the crank shaft to permit one piece annular ball or roller bearing races to be slipped into position. It is well-known that split races for holding ball or roller bearings are not practicable and therefore the present invention has been designed with the idea of permitting the ready assemblage of one piece bearing races, as well as one piece connecting rods, with a one piece crank shaft.

An additional object is to provide a one piece crank shaft, adapted to be operated by a pair of pistons, which are connected by a flat plate, against the opposite sides of which the connecting rods from said pistons are adapted to engage.

With the above and other objects in view, the invention resides in the novel features of construction, combination and arrangement of parts, which will be hereinafter more particularly described and claimed, and shown in the drawings, wherein:

Figure 1 represents a plan view of a crank shaft constructed in accordance with my invention, the same having portions of connecting rods mounted thereon, said connecting rods being shown in section.

Fig. 2 is an end view of the crank shaft. 55

Fig. 3 is a fragmentary sectional view showing more particularly the manner of detachably connecting the counter-weights to the shaft.

Fig. 4 is a detail transverse section taken substantially on the plane of the line 4—4 of Fig. 3. 60

Fig. 5 is a view similar to Fig. 1 showing more particularly the preferred manner of holding the connecting rod bearings in position, and 65

Figs. 6 and 7 are detail transverse sections taken on the plane of the line 6—7 of Fig. 5 and showing two positions of the connecting rod bearing washer. 70

The crank shaft, which forms the basis of the present invention is primarily adapted for use in motorcycle power plants, in which the operating cylinders are directly opposed. It has long since been found that the only practical manner of constructing an internal combustion engine crank shaft is to cast the same of suitable metal in one piece. If this is not done, the required rigidity and strength of parts is not obtained and the result will be uniformly unsatisfactory. 80

Therefore, the crank shaft, shown in the accompanying drawings, is cast in one piece, and comprises a pair of rightangular cranks 1, and since this shaft is to be used with a two cylinder engine, a pair of spindles 2 and 2' projecting in opposite directions and extended from the corresponding arms 1^a of the cranks, and a flat, elongated connecting plate 3, which unites the other arms 1^b of the cranks, the latter being formed integrally with the opposite flat faces of the plate and adjacent the opposite ends thereof. The plate 3 is relatively thin to permit the crank shaft to be constructed as light as possible, but is of a width substantially twice the diameter of the crank arms to procure the necessary strength. The spindles 2 and 2' are adapted to be journally disposed in the opposite walls 4 of a crank casing, such as shown in Fig. 1 of my co-pending application, Serial No. 192117, one of said spindles being adapted to have a gear keyed thereto, while the other end carries a fly-wheel. The free ends of the spindles are reduced and threaded as at 5 to receive nuts or the like for holding the parts thereon. 100 105

Each of the arms 1^a of the cranks 1 is

provided with a horizontally extending bore 6, which is adapted to receive the stem 7 of a counter-balance weight 8. From Fig. 1 it will be noted that the bores 6 extend at rightangles to the axis of rotation of the spindles, and, also, that the counter-weights 8 are adjacent the free ends of said arms 1^a. The other portion of the arms, that is adjacent the angle of the cranks, is provided with bosses 9 against the flat end of which the retaining nuts 10 engage, said nuts being screwed on the threaded ends of the stems 7. By such an arrangement the mere removal of the nuts 10 will permit the detachment of the counter-weights 8.

As hereinbefore indicated, the counter-weights are adapted to be removed whenever it is necessary to detach the connecting rods 11 or any of the parts associated therewith, it being obvious that said parts are assembled before the weights are initially attached to the cranks. The ends of the connecting rods, which are for engagement with the cranks, are in the form of one piece annular members 12, the openings of which are somewhat greater in diameter than the operating surfaces 13 of said cranks.

Roller bearings 14 are preferably used for overcoming friction between the connecting rods and the crank and these are held in operative position between one piece annular bearing races or rings 15. The usual spacing rings 16 are also provided, which are adapted to space the rollers predetermined distances apart.

These one-piece ring-like members are assembled by sliding the same over the ends of the spindles and then around the cranks 1 until they are in operative position on the bearing surfaces 13, and when thusly disposed they will, also, engage the opposite faces of the connecting plate 3. This plate holds the members against movement in one direction, and retaining washers 17 or 17', which are, also, assembled by disposing the same over the spindles, prevent movement of the parts in the opposite direction. The washers 17, which are shown in Fig. 1, are held in operative position by means of pins 18 which extend transversely through the arms 1^b of the cranks. In Figs. 5, 6, and 7, however, is shown a different and preferred means for positively holding these retaining washers, numbered 17' in these figures, in position. In this form the opening in the washer 17' is substantially hexagonal, the alternate sides of the opening, however, being curved outwardly substantially concentric with the periphery of the washer, as shown at 19. The washers are provided with openings of this shape to permit them to be disposed over collars 20 of similar shape which are formed integrally with the arms 1^b of the cranks and spaced from the roller bearing engaging surfaces 13. The portions

21 of the arms 1^b between these collars and said surfaces 13 are round whereby, after the washers are slipped over the polygonal collars 20, they may be rotated to aline the semi-circular pin receiving notches 22 and 23 formed respectively in one wall of the opening of the washers and the collars 20.

Fig. 6 shows one washer being slipped over a collar 20, while Fig. 7 illustrates a washer and collar after the pin receiving notches have been alined and provided with a retaining pin 24. The pin obviously prevents rotation of the washer and the collar prevents outward movement thereof. Each pin 24 is retained in operative position by the engagement of one arm of a rightangular bracket therewith, the other arm of which is apertured and disposed over the stem of the adjacent counter-balance member and is held by the nut 10.

From the foregoing description taken in connection with the accompanying drawings, it will be obvious that a very simple arrangement has been devised, whereby one piece bearing races, or rings, and other one-piece members which are adapted to be used in connection therewith, may be quickly and easily assembled in position on a one-piece crank shaft having detachable counter-weights. Various changes in the size and proportion may be made without departing from any of the principles of the invention, as set forth in the appended claims, for instance, a crank shaft of similar construction can be used with equal success with engines having more than two cylinders.

I claim:—

1. A crank shaft of the class described comprising a pair of opposed cranks, one arm of each crank having a bore extending longitudinally therethrough, a pair of spindles projecting in opposite directions from the outer portion of the cranks, a counter-balance weight for each crank, a stem extending from each counter-balance weight, said stems being disposed in opposite directions through the bores, and means for detachably securing the stems in said bores.

2. A crank shaft of the class described comprising a crank, one arm thereof having a bore extending therethrough, a pair of spindles extending in opposite directions from the arms of the crank, a counter-balance weight, a stem extending from the weight and adapted to be disposed in the bore of the crank, and means on the stem for detachably securing the stem in the bore.

3. A device of the class described comprising in combination, a crank shaft, a connecting rod disposed thereon, a poly-sided collar formed on said crank shaft, a washer having a polygonal opening similar to said collar, said washer being adapted to slide over said collar when the sides

of the latter coincide with the walls of the opening, whereby to engage the connecting rod, and means to prevent rotation of said washer.

5 4. A device of the class described comprising in combination, a crank shaft, a connecting rod disposed thereon, a poly-
sided collar formed on said crank shaft and
10 spaced from the connecting rod, a washer having a polygonal opening similar to said
collar, said washer being adapted to slide
over said collar to be positioned between the
15 same and the connecting rod when the sides of said collar and the walls of the opening
coincide, and means to hold said washer
against rotation when disposed between the
collar and connecting rod.

5 5. A device of the class described comprising in combination, a crank shaft, a
20 connecting rod disposed thereon, a poly-
sided collar formed on said crank shaft and
spaced from the connecting rod, said collar
having a notch formed therein, a washer
25 having a polygonal opening similar to said
collar, the former having a notch in one
wall to aline with the first mentioned notch,
said washer being adapted to slide over
said collar to be positioned between the
30 same and the connecting rod when the sides
of said collar and the walls of the opening
coincide, and a pin disposed in said notches
when aligned, whereby to prevent rotation
of said washer.

35 6. A device of the class described comprising in combination, a crank shaft, a
connecting rod disposed thereon, a collar
formed on said crank shaft and spaced

from the connecting rod, a washer movable
over said collar when in one position and
disposed between the same and connecting
40 rod, said collar and washer having notches
adapted to aline when the washer is in one
position, a pin disposed in said alined
notches, and a rightangular bracket secured
45 by one arm to said crank shaft, the other
arm being engaged with said pin to retain
the same in operative position.

7. A device of the class described comprising in combination, a crank shaft, one
arm of the crank having a bore extending
50 therethrough, a connecting rod disposed on
said crank shaft, a collar formed on said
crank shaft, a washer for holding the connecting
rod on the shaft, said washer being
movable over said collar when in one position,
55 said collar and washer having notches
adapted to aline when the washer is in one
position, a pin disposed in said notches
when alined, a counter-balancing member,
a stem extending from said member and
60 disposed through the bore in the crank arm,
one end of said stem extending beyond said
crank arm, a rightangular bracket having
one arm disposed over said projected end of
the stem, the other arm being engaged with
65 said pin, and a fastening member on the
projected end of the stem to retain the
bracket thereon.

In testimony that I claim the foregoing
I have hereunto set my hand at Milwaukee,
70 in the county of Milwaukee and State of
Wisconsin.

WILLIAM S. HARLEY.