

[54] **ADJUSTABLE ECCENTRIC CRANKSHAFT**

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[56] **References Cited**

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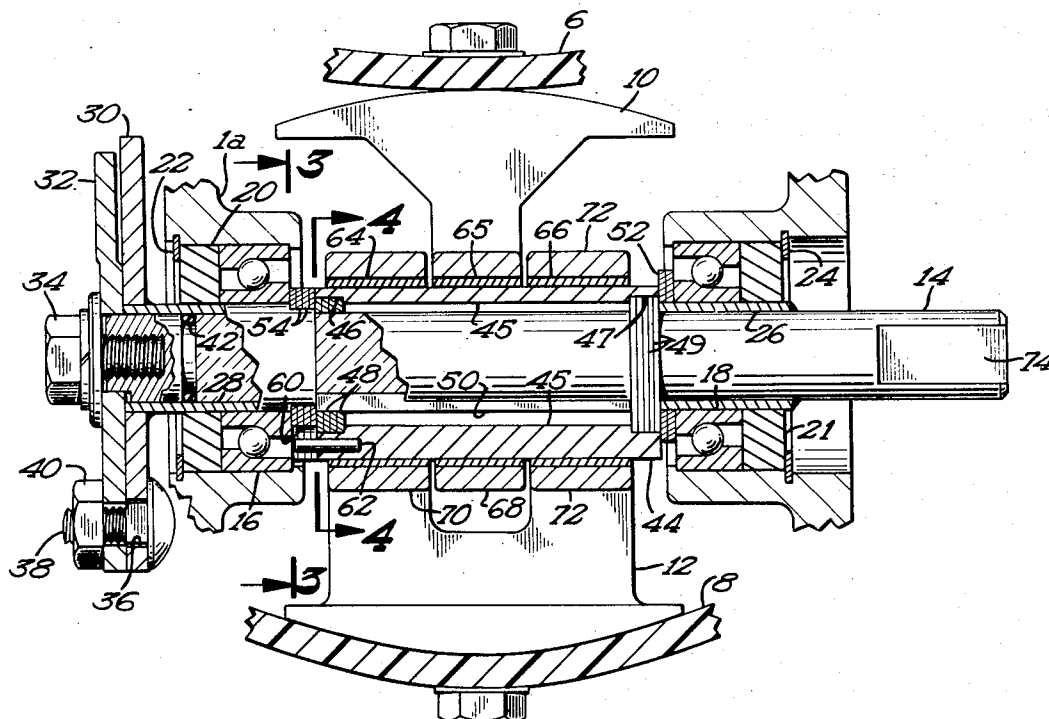
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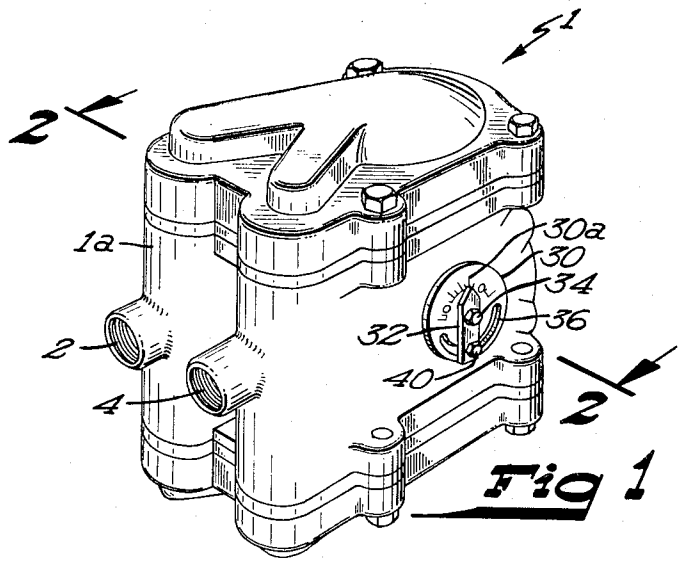
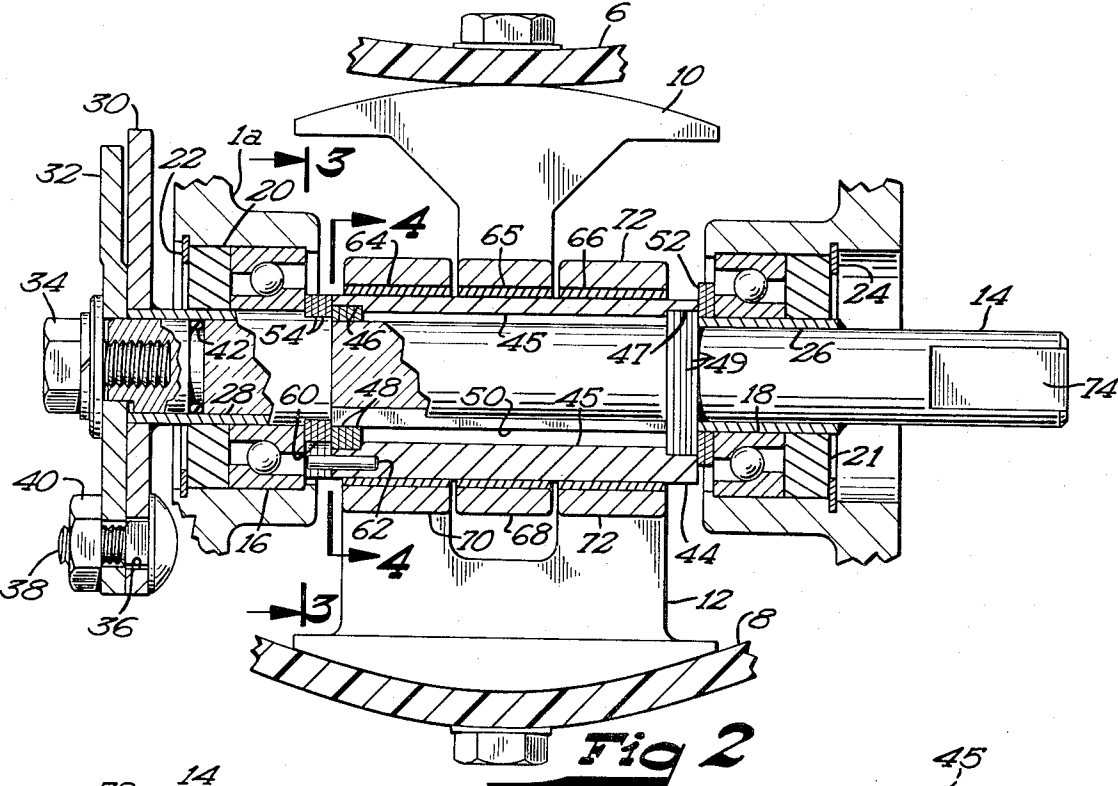
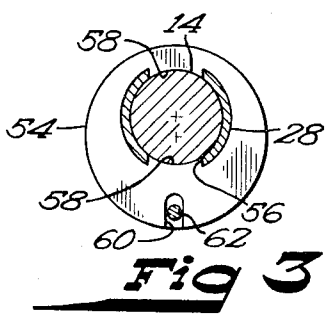
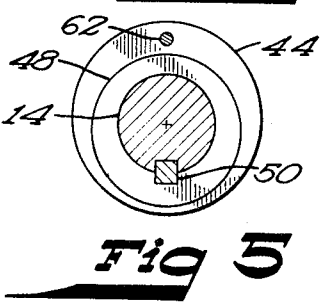
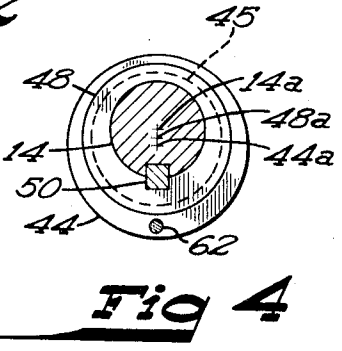
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ABSTRACT

A crankshaft in a reciprocating machine has an outer crank sleeve rotatably mounted on two spaced apart eccentric collar assemblies affixed to the crankshaft which normally clamp the crank sleeve tightly in place. A threaded fastener extending through an accessible adjusting plate at one end of the crankshaft and normally holding the crankshaft assembly tightly together may be loosened to release the collar assemblies and permit the rotational adjustment of the crank sleeve through coupling means joined to the adjusting plate, to provide a predetermined eccentric displacement with respect to the rotational axis of the crankshaft.

10 Claims, 5 Drawing Figures





ADJUSTABLE ECCENTRIC CRANKSHAFT

BACKGROUND OF THE INVENTION

Crankshafts with eccentrics which may be rotatably adjusted on the shaft to vary the stroke or displacement of pistons driven by the crankshaft are known. See, for example, U.S. Pat. No. 3,375,730 to Antonenko and U.S. Pat. No. 3,007,349 to Loeber. Prior adjustable stroke crankshaft mechanisms have suffered from the disadvantage of being unduly complicated and requiring special additional parts adding excessively to the size and cost of the reciprocating machines in which they are used, as well as being difficult to adjust. These disadvantages and problems are overcome in the relatively simple, compact, easily assembled and readily adjustable eccentric crankshaft mechanism of this invention.

BRIEF SUMMARY OF THE INVENTION

The adjustable eccentric crankshaft mechanism of this invention is particularly characterized by the mounting of an outer eccentric crank sleeve on inner eccentrics affixed to a crankshaft in such a way, in combination with a very simple adjusting mechanism, as to avoid any significant increase in the length of the crankshaft or in the size of the reciprocating machine housing in which the crankshaft operates, while permitting the quick and easy rotational adjustment of the crank sleeve from outside the machine without the aid of any special tools.

These basic objectives and advantages are realized by rotatively supporting the aforesaid crank sleeve on a pair of inner eccentric collars, preferably in the form of two sets of washers or rings, seated in recesses formed in opposite ends of the crank sleeve and affixed to the crankshaft for rotation therewith. These inner eccentric collars or rings not only cooperated with the outer eccentric crank sleeve in its various positions of rotational adjustment thereon to provide a desired total eccentric displacement or throw on the crankshaft, but also serve, in combination with two holding sleeves bearing thereagainst on opposite ends of the crankshaft to locate and tightly clamp the crank sleeve in place on the crankshaft when a threaded fastener on one outer end of the crankshaft is tightened.

As a particularly advantageous adjustment and assembly feature of the crankshaft mechanism, one of the aforesaid holding sleeves is slideably and rotatably mounted on one end of the crankshaft and is affixed at its outer end to an external adjusting plate normally secured to one end of the crankshaft for rotation therewith by the threaded fastener which draws the entire assembly tightly together. The inner end of the rotatable holding sleeve affixed to the adjusting plate is coupled to a drive collar utilized to adjustably rotate the outer eccentric crank sleeve on the inner eccentric collars by rotation of the adjusting plate when the fastener is loosened.

These and other objects and advantages of the invention will become readily apparent as the following description is read in conjunction with the accompanying drawings wherein like reference numerals have been used to designate like elements throughout the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is perspective view of a reciprocating pump in which the adjustable eccentric crankshaft of this invention is mounted;

FIG. 2 is a vertical section view of the eccentric crank sleeve assembly shown within the pump housing;

FIG. 3 is a vertical section view taken along lines 3—3 of FIG. 2;

FIG. 4 is a vertical section view taken along lines 4—4 of FIG. 2; and

FIG. 5 is a vertical section view similar to FIG. 4 and showing the adjustable eccentrics in a position of neutral eccentricity.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The pump shown in FIG. 1 is illustrative of the type of reciprocating machine in which the adjustable eccentric crankshaft of this invention may be utilized. Pump 1 is provided with intake and discharge ports 2 and 4 respectively. This pump is of the double acting type, having a pair of flexible diaphragms 6 and 8 serving as pumping elements and attached to a pair of opposed pistons 10 and 12. These pistons are mounted on crankshaft 14 in a manner hereinafter described and are reciprocated thereby to drive the diaphragm pumping elements 6 and 8 in alternating suction and discharge strokes.

In FIG. 2, crankshaft 14 is shown rotatively supported at opposite end portions thereof in ball bearings 16 and 18 mounted in opposite housing walls 1a and 1b of pump 1. Seal rings 20 and 21, in combination with sealed gaskets 22 and 24 provide a tight seal between bearings 16 and 18 and the housing walls around the end extremities of crankshaft 14. Affixed to the right end of crankshaft 14, as viewed in FIG. 2, is a holding sleeve 26 journaled in bearing 18. A second holding sleeve 28 rotatably and slideably mounted on the other end of crankshaft 14 cooperates with sleeve 26 in a retainer and clamping function to normally hold an adjustable eccentric crank sleeve in place on crankshaft 14 for rotation therewith, in a manner hereinafter explained. Rotatable holding sleeve 28 is affixed at its outer end to an adjusting plate 30 having graduations 30a thereon calibrated to show eccentric adjustment in predetermined increments. As may be noted with respect to FIGS. 1 and 2, adjusting plate 30 is positioned on crankshaft 14 externally of the housing of pump 1, at a readily accessible location. Positioned against the outside face of indicator plate 30 is a pointer indicator 32 normally held in engagement with plate 30 for rotation therewith during operation of the pump by bolts 34 and 38. Bolt 34 is screwed into one end of crankshaft 14 in the manner shown in FIG. 2 and serves in cooperation with holding sleeves 26 and 28 as a fastening device when it is tightened to draw the entire crankshaft assembly tightly together. Formed in adjusting plate 30 is an arcuate slot 36 through which the retainer bolt 38 extends. One end of pointer 32 is apertured to receive bolt 38, and a nut 40 extended onto the end of bolt 38 normally assist in holding pointer 32 securely to plate 30 to maintain the indicated position of eccentric adjustment to which plate 30 has been rotated relative to pointer 32 in the course of an eccentric adjustment operation described below.

O-ring 42 seated in an annular groove at one end of crankshaft 14 maintains a seal between this end of the crankshaft and holding sleeve 28.

An outer eccentric crank sleeve 44 is positioned on crankshaft 14 with its cylindrical bore 45 radially spaced from the outer periphery of crankshaft 14. The radially offset center 44a of crank sleeve 44 with respect to center 14a of crankshaft 14 is shown in FIG. 4. Formed in the opposite ends of crank sleeve 44 are a pair of eccentric recesses 46 and 47, each of which has an annular shoulder face, one of which is shown at 46a in FIG. 4. A pair of inner, eccentric collar means, preferably taking the form of two sets of eccentric washers 48 and 49 are seated within recesses 46 and 47. Inner eccentric collars 48 and 49 are affixed to crankshaft 14 for rotation therewith by means of a key 50 extending through a keyway in these collars, as is clearly illustrated in FIGS. 2 and 4. Eccentric crank sleeve 44 is supported on eccentric collars 48 and 49 at its opposite ends and is rotatably adjustable thereon about crankshaft 14 to position the eccentric or throw of crank sleeve 44 at different angular positions with respect to inner eccentrics 48, 49 and crankshaft 14. Inner eccentric collars 48 and 49 serve as stops and locating means to position and hold crank sleeve 44 on crankshaft 14. Moreover, the use of inner eccentrics in the form of spaced apart collars 48 and 49 affixed to crankshaft 14 to support crank sleeve 44 radially, outwardly from crankshaft 14 avoids having to maintain close machining tolerances between the bore of crank sleeve 44 and either crankshaft 14 or an inner eccentric sleeve. Eccentric washers 48 and 49 can be easily stamped to conform to the shape of eccentric recesses 46 and 47 machined in the ends of crank sleeve 44.

Spacer washers 52 are positioned between one end of crank sleeve 44 and bearing 18. Interposed between the opposite end of crank sleeve 44 and bearing 16 is an eccentric drive collar 54 rotatably mounted on crankshaft 14 adjacent to one end of sleeve 44. As may be noted more clearly by reference to FIGS. 2 and 3, the inner end of adjustable holding sleeve 28 is slotted at 56 and fits over radially projecting lugs or shoulders 58 on the inner periphery of drive collar washers or rings 54. In this manner, holding sleeve 28 serves as a coupling means between adjusting plate 30 and drive collar washers 54. A radial slot 60 extending transversely with respect to the longitudinal axis of crankshaft 14 within drive collar washers 54 receives one end of a roll pin coupling member 62 which extends at its opposite end longitudinally into the body of crank sleeve 44. Pin 62 extends substantially parallel to the longitudinal axis of crankshaft 14 and serves as a coupling device between drive collar washers 54 and crank sleeve 44.

The crankshaft drive assembly is completed by a set of three needle bearings 64, 65 and 66 journaled on crank sleeve 44. Mounting collar 68 of piston 10 is fitted on bearing 65; and longitudinally spaced mounting collars 70 and 72 of piston 12 embrace bearings 64 and 66. A flattened face 74 on the drive end of crankshaft 14 is provided to accommodate the attachment of a drive pulley or other drive device utilized to rotate crankshaft 14. It will be apparent that as crankshaft 14 rotates, crank sleeve 44 will impart opposed reciprocal motion to pistons 10 and 12 to drive pump diaphragm 6 and 8.

When bolt 34 is tightened within the threaded end of crankshaft 14, it draws shiftable and rotatable holding sleeve 28 and crankshaft 14 together with the result that the inner ends of holding sleeves 26 and 28 bear against inner eccentric collars 49 and 48 respectively, and urge these collars tightly against the annular shoulder faces of recesses 46 and 47 on the opposite ends of crank sleeve 44. Crank sleeve 44 is thus positioned by and tightly clamped between longitudinally spaced, inner eccentric collars 48 and 49. With bolt 34 tightened, the entire adjustable eccentric crankshaft assembly will be held securely together, including adjusting plate 30, drive collar 54, inner eccentric collars 48 and 49 and outer eccentric crank sleeve 44; and all of these components will rotate with crankshaft 14.

When it is desired to adjust the eccentric disposition of crank sleeve 44, bolts 34 and 38 are loosened. This permits adjusting plate 30 to be rotated on crankshaft 14, relative to pointer 32 which will remain stationary with crankshaft 14. As adjusting plate 30 is rotated, its affixed sleeve 28 will rotate drive collars 54, which in turn rotate crank sleeve 44 on stationary, inner eccentric collars 48 and 49. Coupling pin 62 will move in and out within slot 60 of drive collar 54 as crank sleeve 44 is rotated by drive collar 54 in either a clockwise or counterclockwise direction. The use of inner eccentrics 48 and 49 in combination with outer eccentric sleeve 44 permits an eccentric adjustment on crankshaft 14 over a relatively wide range. In FIG. 5 crank sleeve 44 is shown rotated by coupling pin 62 of drive collar 54 to a neutral position wherein the eccentrics of crank sleeve 44 and inner eccentric collars 48 and 49 neutralize each other to provide substantially zero eccentric displacement or throw on crankshaft 14. In FIG. 4, crank sleeve 44 is shown rotated by adjusting plate 30 to an angular position with respect to inner eccentrics 48 and 49 wherein the eccentrics or throws of crank sleeve 44 and inner eccentrics 48 and 49 are at the same angular position on crankshaft 14 and combined to produce maximum eccentric displacement thereon. After adjusting plate 30 has been rotated relative to crankshaft 14 and pointer 32, pointer 32 will serve to indicate on the graduations or eccentric scale of plate 30 the extent of eccentric displacement with respect to crankshaft 14 in accordance with a predetermined angular adjustment position of the maximum throw or eccentric of crank sleeve 44 relative to inner eccentrics 48 and 49 and crankshaft 14. After this adjusting operation, bolts 34 and 38 are again tightened, thereby clamping the entire crankshaft assembly tightly together, and insuring that pointer 32 will be held tightly to adjusting plate 30 to preserve the adjusted eccentric setting.

Although eccentric drive collar 54 has been shown in combination with external adjusting plate 30 and its affixed sleeve 28 as the preferred way of rotatably adjusting crank sleeve 44, it is anticipated that various other types of external adjusting devices could be utilized to rotate drive collar 54. It is also appreciated that various other changes may be made in the size, shape and manner of construction and assembly of the adjustable eccentric crankshaft mechanism disclosed herein, without departing from the spirit and scope of my invention, as defined by the following claims.

I claim:

1. In a reciprocating machine, an improved adjustable eccentric crankshaft mechanism comprising:

an elongated crankshaft rotatably supported at spaced points along its length;
 a pair of eccentric collar means mounted on said crankshaft at longitudinally spaced locations thereon and affixed to said crankshaft for rotation therewith;
 an outer eccentric crank sleeve having an eccentric cylindrical bore embracing said crankshaft in radially spaced apart relation thereto;
 a pair of eccentric collar means having an annular shoulder face at opposite end portions of said crank sleeve, said eccentric collar means being seated in said recesses and said crank sleeve being supported on said eccentric collar means and rotatably adjustable thereon about said crankshaft to position the eccentric of said crank sleeve at different angular positions with respect to the eccentrics of said pair of collar means to thereby provide a desired total eccentric displacement on said crankshaft;
 eccentric drive collar means rotatably mounted on said crankshaft adjacent to one end of said crank sleeve;
 coupling means between said drive collar means and said crank sleeve;
 means external to said reciprocating machine for rotating said drive collar means; and
 fastening means threadedly engaged with one end of said crankshaft and cooperable with retainer means on said crankshaft to normally urge said pair of eccentric collar means tightly against said annular shoulder faces of said crank sleeve recesses and thereby position and clamp said crank sleeve securely on said crankshaft, the loosening of said fastening means permitting the rotation of said drive collar means on said crankshaft and the rotational adjustment of said crank sleeve therewith.

2. An adjustable eccentric crankshaft mechanism as defined in claim 1 wherein:

said eccentric drive collar means has a slot therein extending transversely with respect to the longitudinal axis of said crankshaft; and
 said coupling means between said drive collar means and said crank sleeve comprises an elongated member extending substantially parallel to the longitudinal axis of said crankshaft within a wall portion of said crank sleeve and into said slot in said drive collar means, said elongated member moving back and forth within said slot as said crank sleeve is rotated by said drive collar means about said crankshaft in either a clockwise or counterclockwise direction.

3. An adjustable eccentric crankshaft mechanism as defined in claim 1 wherein:

said retainer means on said crankshaft comprises a first holding sleeve slideably shiftable on said crankshaft at one end thereof and bearing at its inner end against one of said pair of eccentric collar means, and a second holding sleeve affixed to the opposite end of said crankshaft and bearing at its inner end against the other one of said pair of eccentric collar means; and
 said fastening means comprises a threaded member operative to draw said first holding sleeve and said crankshaft longitudinally toward each other as it is tightened on said crankshaft to thereby cause said holding sleeves to urge said eccentric collar means

tightly against said end recesses of said crank sleeve.

4. An adjustable eccentric crankshaft mechanism as defined in claim 3 wherein:

the inner end of said first holding sleeve is coupled to said drive collar means; and
 an adjusting plate is affixed to the opposite end of said first holding sleeve externally of said reciprocating machine, the loosening of said threaded member permitting the rotation of said adjusting plate and first holding sleeve about said crankshaft, whereby said adjusting plate and holding sleeve serves as said means for rotating said drive collar means to rotatably adjust said crank sleeve.

5. An adjustable eccentric crankshaft assembly in a reciprocating machine comprising:

a crank shaft rotatably supported at opposite end portions thereof within a housing of said machine;
 an adjusting plate rotatably mounted on one end of said crankshaft externally of said housing;
 an eccentric drive collar rotatably mounted on said crankshaft, eccentrically with respect to the longitudinal center axis of said crankshaft, said drive collar having a slot therein extending transversely of the longitudinal axis of said crankshaft;
 coupling means between said adjusting plate and said drive collar;
 an outer eccentric crank sleeve having an eccentric cylindrical bore through which said crankshaft extends, said crank sleeve being rotatably adjustable on said crankshaft and positioned longitudinally thereon with one end adjacent to said drive collar;
 an elongated coupling member extending substantially parallel to the longitudinal axis of said crankshaft within a wall portion of said crank sleeve and into said slot in said drive collar; and
 fastening means normally holding said adjusting plate, drive collar and crank sleeve tightly together on said crank shaft for rotation therewith, the loosening of said fastening means permitting the rotational adjustment of said adjusting plate on said crankshaft, and of said drive collar and crank sleeve therewith, said elongated coupling member moving back and forth within said slot in said drive collar as said crank sleeve is revolved with said drive collar in either a clockwise or counterclockwise direction.

6. An adjustable eccentric crankshaft assembly as defined in claim 5 wherein:

opposed, stop, locating means are positioned on longitudinally spaced locations on said crankshaft and bear against opposite end portions of said crank sleeve;
 a first holding sleeve is affixed to said adjusting plate and is slideably shiftable therewith on said crankshaft to urge one of said locating means against one end of said crank sleeve;
 a second holding sleeve is affixed to an opposite end portion of said crankshaft and bears against the other one of said locating means at the opposite end of said crank sleeve;
 said fastening means comprises a bolt threaded longitudinally into said one end of said crankshaft with the head of said bolt being outside of said adjusting plate, and the tightening action of said bolt tending

to draw said adjusting plate and said crankshaft longitudinally together, whereby said holding sleeves urge said opposed locating means tightly against the opposite ends of said crank sleeve to thereby clamp said crank sleeve securely in place on said crankshaft. 5

7. An adjustable eccentric crankshaft assembly as defined in claim 6 wherein:

said first holding sleeve is coupled at its inner end to said drive collar and serves as said coupling means between said adjusting plate and said drive collar. 10

8. An adjustable eccentric crankshaft assembly as defined in claim 5 wherein:

said adjusting plate has graduations thereon calibrated to show eccentric displacement in predetermined increments for particular angular positions of said crank sleeve relative to said crankshaft; a pointer positioned against the outside face of said adjusting plate and coupled to the end of said crankshaft; and 15 20

said fastening means is a bolt threaded into said one end of said crankshaft with its head being outside of said pointer and adjusting plate and normally securing said pointer and plate together, the rotation of said adjusting plate when said bolt is loosened permitting the setting of a desired eccentric increment graduation on said adjusting plate relative to said pointer, which remains stationary with said crankshaft during the rotational adjustment of said plate and said crank sleeve. 25 30

9. An adjustable eccentric crankshaft assembly as defined in claim 5 wherein:

there is a radial clearance space between said crank sleeve and said crankshaft; eccentric recesses are formed in opposite ends of said 35

crank sleeve; and a pair of eccentric collar means are seated within said recesses around said crankshaft at opposite ends of said crank sleeve and coupled to said crankshaft for rotation therewith, said crank sleeve being rotatably supported on said eccentric collar means and rotatably adjustable thereon between a first position wherein the eccentrics of said crank sleeve and eccentric collar means neutralize each other to produce substantially zero eccentricity on said crankshaft and a second position wherein the eccentrics of said crank sleeve and said eccentric collar means are at the same angular position on said crankshaft and combine to produce maximum eccentric displacement thereon.

10. An adjustable eccentric crankshaft assembly as defined in claim 9 wherein:

a first holding sleeve is affixed to said adjusting plate and slideably shiftable therewith on said crankshaft, said first holding sleeve bearing at its inner end against one of said eccentric collar means;

a second holding sleeve is affixed to an opposite end portion of said crankshaft and bears at its inner end against the other one of said eccentric collar means; and

said fastening means comprises a threaded member engaging said one end of said crankshaft outside of said adjusting plate, with the tightening of said threaded member drawing said adjusting plate and said crankshaft longitudinally together, whereby the inner ends of said holding sleeves urge said pair of eccentric collar means tightly against the opposite ends of said crank sleeve within said recesses to tightly clamp said crank sleeve in place between said holding sleeves on said crankshaft. 40 45 50 55 60 65

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