No. 870,502. PATENTED NOV. 5, 1907.

T. J. FAY & J. M. ELLSWORTH.

CRANK SHAFT.

APPLICATION FILED APR. 8, 1907.

2 SHEETS—SHEET 1.

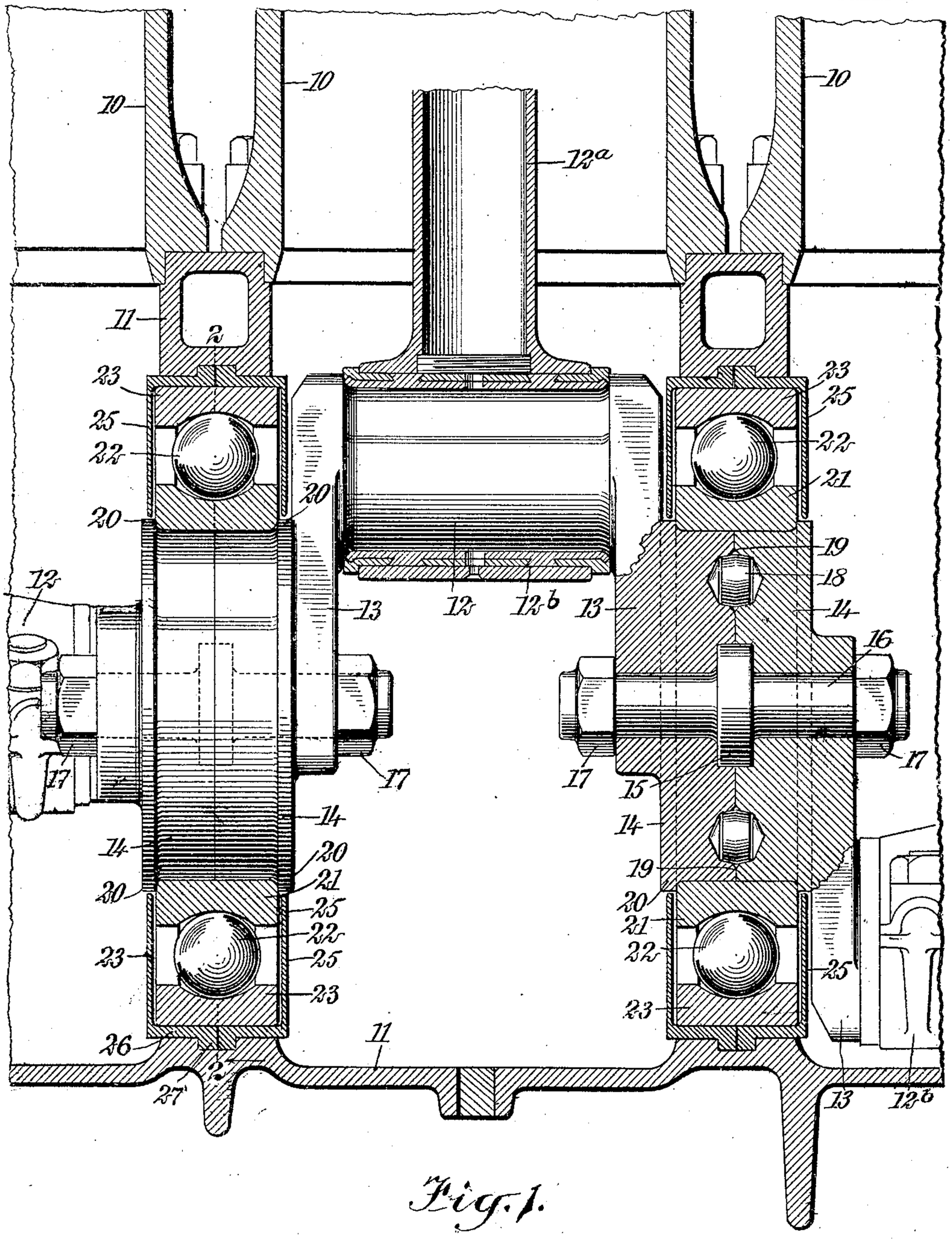

Fig. 1.

WITNESSES

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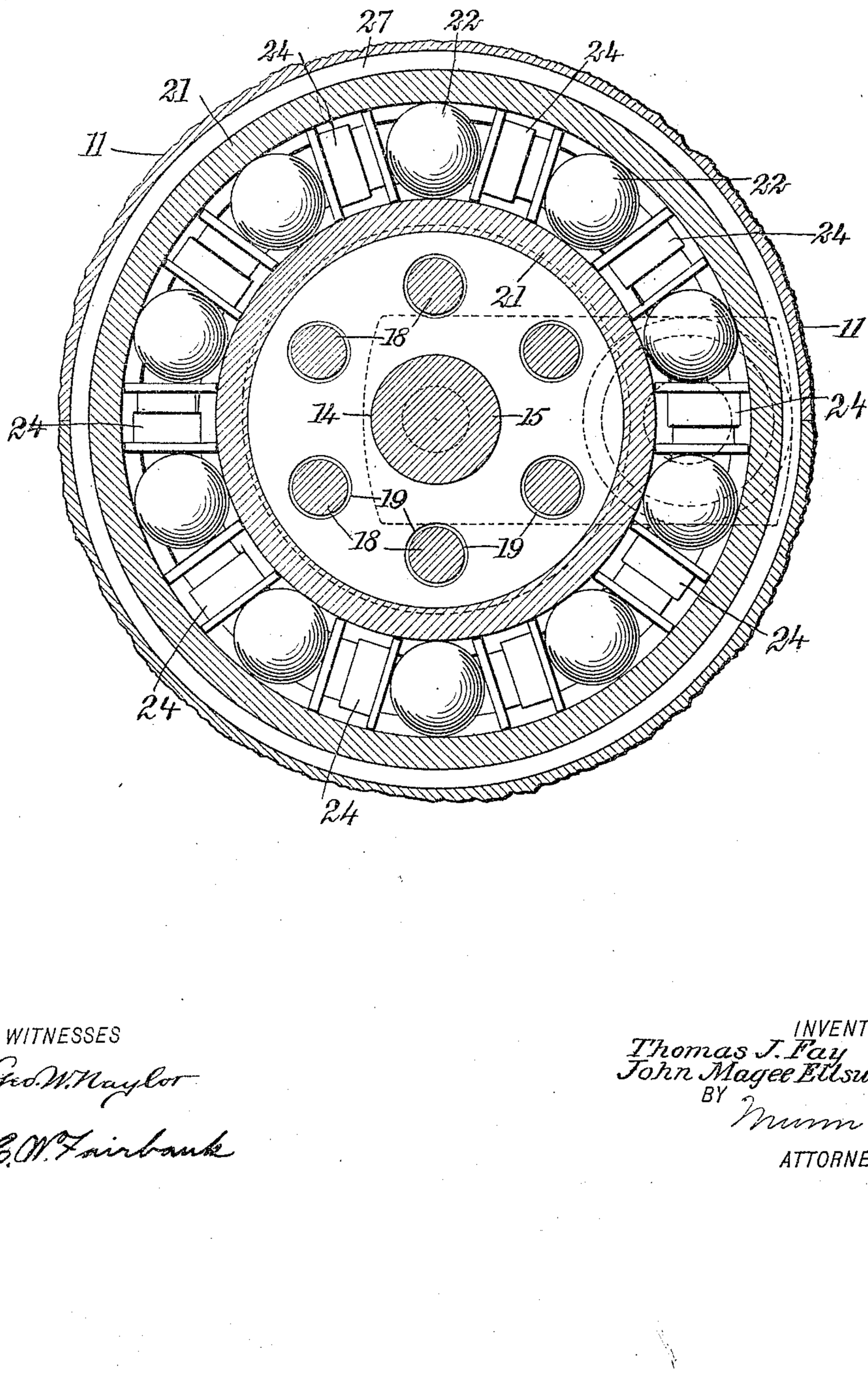
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

THOMAS J. FAY, OF NEW YORK, N. Y., AND JOHN MAGEE ELLSWORTH, OF BERNARDSVILLE, NEW JERSEY.

CRANK-SHAFT.

No. 870,502. Specification of Letters Patent. Patented Nov. 5, 1907.

Application filed April 8, 1907. Serial No. 367,025.

To all whom it may concern:

Be it known that we, THOMAS J. FAY, a resident of the city of New York, borough of Brooklyn, in the county of Kings and State of New York, and JOHN MAGEE ELLSWORTH, a resident of Bernardsville, in the county of Somerset and State of New Jersey, both citizens of the United States, have invented a new and Improved Crank-Shaft, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in crank shafts, and more particularly to sectional or knockdown crank shafts adapted for use in connection with engines, compressors, and the like, and the object of the invention is to so construct the device that the shaft may be made of the minimum length and the ball bearing support thereof may be brought as close to the throw as possible.

A further object of the invention is to provide a crank shaft having a sectional hub, the sections of which separate upon a plane at an angle to the axis of rotation, and said sections being so connected together that the rotary movement of one section in respect to the other is prevented by a plurality of small locking members and the longitudinal movement of one section in respect to the other prevented by means of suitable clamping mechanism.

A further object of the invention is to provide means whereby one rotatable member may be held rigidly secured to another rotatable member and the resistance to rotation distributed uniformly among a plurality of bearing surfaces.

For securing the objects above referred to, we provide the opposite meeting faces of the adjacent sections with a plurality of conical recesses having double taper buttons floating therein. In forcing the sections together, each of the buttons is free to move longitudinally so as to engage within each of its recesses with equal pressure and is of such a size and shape that it becomes firmly wedged in each of its recesses when the sections are brought into contact. Thus, it is impossible for one of the buttons to be in firmer engagement with one section than with another, and it is also impossible for any of the buttons to fail to be forced into place. Each and all of the buttons receive an equal amount of lateral strain when one of the members is rotated. Were separate clamping bolts employed, it would be impossible to attain such mechanical perfection that all of bolts would receive equal lateral pressure, as the bolts and the holes would vary in size even though this variation be almost infinitesimal. By employing floating double taper buttons, the resistance to the rotation of one member by the other is equally and uniformly distributed, and it is impossible for any one button to receive any more lateral strain than is borne by each of the other buttons.

A further object of the invention is to provide a clamping means for holding the sections in engagement with each other, which clamping means may also be employed for separating the sections when it is desired to take the structure apart. For securing this object, we provide a centrally disposed bolt having an annular flange intermediate its ends and adjacent the meeting surfaces of the two sections, whereby upon moving the bolt longitudinally in respect to one of the sections the other section may be forced out of engagement with the first mentioned section in a manner hereinafter more fully set forth.

The invention consists in certain features of construction and combination of parts, all of which will be fully set forth hereinafter and particularly pointed out in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in both the figures, and in which

Figure 1 is a central vertical section through a portion of a multi-cylinder engine provided with our improved crank shaft; and Fig. 2 is a vertical transverse section on the line 2—2 of Fig. 1.

To more clearly illustrate the construction and operation of our improved crank shaft we have illustrated a portion of an engine having a plurality of cylinders 10 connected to a crank case 11 of any suitable character. The crank case is preferably made up of upper and lower sections, and the portions of the crank are sub-divided into chambers corresponding to the separate cylinders by means of the hubs of the crank shaft and the supporting bearing therefor. The crank shaft is made up of a plurality of sections, and each section preferably comprises a pin 12, crank arms 13 integral therewith, and hub sections 14 integral with the crank arms. The crank pin 12 serves to support a piston rod 12^a having a separable bearing portion 12^b of any suitable construction. The hub sections 14 unite to form the hub of the crank shaft and are provided with means for securing the same together and means for rotatably mounting the same. As illustrated, each hub is made up of two oppositely disposed hub sections each supporting its crank arm, said sections having their adjacent faces meeting upon a plane at right angles to the axis of rotation. Within these meeting faces we provide oppositely disposed axial recesses which together form a chamber for the annular flange 15 of a centrally disposed locking bolt 16. This bolt is axially disposed in respect to the crank shaft, and each end thereof is

threaded and provided with a suitable nut 17, whereby the bolt may be tightened from either end. The annular flange 15 is very slightly less in thickness than the chamber formed by the two oppositely disposed recesses, whereby upon tightening the two nuts 17, the hub sections may be brought into firm engagement with each other.

The bolt 16 and its flange 15 serves as means whereby the sections may be forced apart. This is accomplished by first removing the crank from the engine and then inserting a spacing member between the two crank arms of one section and contacting with one of the nuts 17. The nut on the opposite end of the same bolt is removed and the nut in contact with the spacing means is rotated. As the nut is held from longitudinal movement the bolt is caused to move endwise, and the flange 15 engaging with the opposite hub section forces the latter out of contact with the first mentioned one and draws each of the buttons out of one of its recesses.

Within the contacting face of each of the hub sections we provide a plurality of conical recesses, preferably six in number and arranged concentrically in respect to the locking bolt 16. The recesses of one hub section exactly correspond with the recesses of the adjacent hub section, and within these recesses we provide a plurality of small metal dowel buttons 18 in the form of double truncated cones and having exactly the same taper as the recesses in the hub section. The dowel buttons are preferably slightly shorter than the combined depth of the oppositely disposed recesses but are of such a size that they become tightly wedged in place within both recesses when the hub sections are forced together. In order to accommodate for any slight amount of metal displaced or shaved off by the forcing of the buttons into their recesses, we provide each of the recesses with a slightly beveled edge 19 which forms a very small annular recess around the button at its greatest diameter. This recess is shown in the drawings upon a slightly exaggerated scale to more clearly disclose the same.

In bringing the sections together, the floating dowel buttons are free to move longitudinally so as to engage the walls of the opposed recesses with equal pressure at all times, and the buttons are of such size in respect to the recesses that they engage the walls of the recesses before the meeting surfaces of the sections contact. The sections are then forced into firm engagement and all of the buttons become wedged in place, any metal shaved or scraped off entering the recesses 19. Thus minute variations in the size of the recesses or the buttons which the most accurate workmanship cannot overcome, do not cause any one button to bear more shearing strain as one section is rotated than is sustained by each of the other buttons, and no button can firmly engage the recess of one section without engaging with exactly equal pressure the opposite recess of the other section. No button can possibly work loose and an even and uniform distribution of the lateral strain is secured. The recesses are preferably spaced a uniform distance apart, whereby the angular adjustment of the cranks may be varied at will dependent only upon the distance between the adjacent recesses. The advantages of the special form of connecting means above described is especially apparent when it becomes necessary to vary this angular adjustment. Were bolts or other clamping means employed, it might be mechanically possible to so space the holes and arrange the bolts whereby the strain could be uniformly distributed among the several bolts, yet when one shaft is adjusted to a definite angle in respect to the adjacent shaft different openings are brought opposite to each other and the perfect alinement which may have been possible before may be thus destroyed. By connecting the parts in accordance with our invention, the slight inaccuracies in construction impossible to avoid are remedied by the wedging action of the buttons as they are forced into place, and the equal distribution of the strain is secured irrespective of whether or not the recesses are specially bored for one particular annular adjustment of the cranks.

The outer circumferential surface of each hub section is preferably cylindrical in form and provided with an outwardly directed flange 20 serving to rigidly hold in place an annular race ring 21 for the series of balls 22 constituting the ball bearing. The crank case supports a similar race ring 23, and the balls may be inserted and spaced in any suitable manner. As illustrated, we provide a plurality of telescoping spacing members 24 a provision which by holding the raceways 21 and 23 eccentric in respect to each other and collapsing each spacing member to the limiting amount, permits of the insertion of the balls and the spacing members and permits of their adjustment to the position shown in Fig. 2 to positively prevent the accidental escape of any of the balls. It is, of course, understood that the balls may be secured and spaced by various other means, as that shown constitutes no portion of our invention.

Supported by the crank case and adjacent each of the race rings 23, means for retaining oil or other lubricant within the bearings is preferably provided. As shown, this means comprises two oppositely disposed annular plates 25 lying substantially parallel and closely adjacent the opposite sides of the race rings 21 and 23, each plate being held in place by a cylindrical portion 26 terminating in an annular flange 27 secured between the race ring 23 and the supporting crank case. These plates 25, lying closely adjacent the ball bearing on opposite sides, serve to effectively subdivide the crank case into separate compartments, one for each crank and piston, whereby the crank case may be used as an air or explosive mixture compression chamber, as is common in two-cycle engines.

Having thus described our invention, we claim as new and desire to secure by Letters Patent:

1. A crank shaft made up of a plurality of sections having surfaces facing each other, said surfaces being provided with oppositely disposed recesses and dowel buttons seated within said recesses but out of engagement with the bottoms thereof.

2. A crank shaft made up of a plurality of sections having surfaces facing each other, said surfaces being provided with oppositely disposed recesses and tapered dowel buttons within said recesses, seated and centered by the bringing of the sections together.

3. A crank shaft made up of a plurality of sections having surfaces facing each other, said surfaces being provided with oppositely disposed tapered recesses and tapered dowel buttons within said recesses, and seated and centered by the bringing of the sections together.

4. A crank shaft made up of a plurality of sections having surfaces facing each other, said surfaces being provided with an annular row of recesess and a centrally dis-

posed passageway, a plurality of dowel buttons seated within said recesses, and a centrally disposed bolt extending through said passageway.

5. In a crank shaft, a hub made up of a plurality of sections meeting in a plane at an angle to the axis of rotation, the meeting faces of the adjacent hub sections being provided with a plurality of pairs of oppositely disposed recesses, a button located within each pair of recesses, and means for locking the sections together.

6. In a crank shaft, a hub made up of a plurality of sections, the meeting faces of said sections being provided with a plurality of pairs of oppositely disposed recesses, buttons located within each pair of opposed recesses and adapted to float to positions of equal pressure, and an axially disposed bolt rigidly securing said sections together.

7. In a crank shaft, a hub made up of separate sections, the meeting surfaces of said sections being provided with oppositely disposed conical recesses, a plurality of double conical buttons located within said recesses, and an axial bolt rigidly securing said sections together.

8. A crank shaft made up of a plurality of sections having the meeting faces thereof lying in a plane at an angle to the axis of rotation, and each of said meeting faces being provided with a plurality of conical recesses, and means lying within said recesses and in engagement with the oppositely disposed sections for preventing rotary movement of one section in respect to the other.

9. A crank shaft made up of a plurality of sections, each of said sections having a recess in the face thereof, and a locking bolt having an annular flange in engagement with the recesses of the adjacent faces, and having locking nuts at each end thereof.

10. A crank shaft made up of a plurality of sections, each of said sections having a recess in the face thereof, and a locking bolt having a projection extending into the recesses of the adjacent faces, said locking bolt serving to hold the sections in engagement with each other.

11. A crank shaft made up of a plurality of sections, and a locking bolt for holding the adjacent sections in engagement with each other, said bolt being provided with means adapted to engage with the sections, whereby they may be forced out of engagement with each other by the longitudinal movement of the bolt.

12. In combination, a ball bearing including a race-ring having an outer circumferential bearing face, and two cranks each having a hub portion extending into said race ring from the opposite ends thereof and engaging with the race ring to prevent movement thereof in the line of the axis of rotation and the inner ends of said hubs facing each other and lying in planes substantially at right angles to the axis of rotation.

13. In combination, a ball bearing having a race ring having an outer circumferential bearing face, two cranks each having a hub portion extending into said race ring from the opposite ends thereof and engaging with the race ring to prevent movement thereof in the line of the axis of rotation, and frictionally engaging therewith to prevent the rotation thereof independent of the hub portions, and the inner ends of said hubs facing each other and lying in planes substantially at right angles to the axis of rotation, and means for securing the simultaneous rotation of said hub portions.

14. In combination, a plurality of cranks, each having two hub portions and the hub portions of the adjacent cranks lying in planes at right angles to the axis of rotation, a ball bearing common to said adjacent hub portions, said bearing including a race ring surrounding the hub portions in the plane of the opposed faces, and means for rigidly securing together the hub portions of the adjacent cranks the hub portions being constructed to bind the race ring in place under the influence of said securing means.

15. In combination, a plurality of cranks, each having two hub portions, the hub portions of the adjacent cranks having opposed faces lying in planes at right angles to the axis of rotation, means for securing the simultaneous rotation of the cranks, and a ball bearing common to both hub portions, said bearing including a race ring surrounding the adjacent hubs and held by frictional engagement from rotation in respect to the hub portions.

16. A crank shaft made up of a plurality of sections, each section terminating in a face lying substantially at right angles to the axis of rotation of the shaft and adjacent the face of a similar section, independent and detachable fastening means each in engagement with both of said sections, one of said fastening means serving to prevent longitudinal movement of one section in respect to the other and the other of said fastening means being disposed within said sections and serving to secure the simultaneous rotation of both sections, and a ball bearing surrounding the said sections in the plane of the opposed faces.

17. In combination, a plurality of cranks, each having two hub portions, the hub portions of the adjacent cranks having opposed faces lying in planes at right angles to the axis of rotation, means for securing the simultaneous rotation of the cranks, a ball bearing common to both hub portions, said bearing including a race ring surrounding the adjacent hubs, and a locking bolt extending through the adjacent hubs for locking them together, said hub portions being provided with means for binding said race ring in place under the influence of said locking bolt.

18. In combination, a plurality of cranks, each having two hub portions, the hub portions of the adjacent cranks facing each other in a plane at right angles to the axis of rotation, and each having an annular flange, a race ring surrounding said hub portions and between said flanges, and means for rigidly securing together the adjacent hub portions and simultaneously binding said race ring in place between said flanges.

19. A device of the class described comprising a plurality of sections each having a plurality of conical recesses in its meeting face, and a plurality of double conical buttons adapted to frictionally engage with the walls of said recesses without contacting with the bottoms thereof, and be forced into place by the bringing together of the sections, said buttons being longitudinally movable to float to positions of equal pressure.

20. A device of the class described comprising a plurality of sections each having a plurality of conical recesses in its meeting face, and a plurality of double conical buttons adapted to float to positions of equal pressure within said recesses without contacting with the bottoms thereof when said sections are forced together.

21. A device of the class described comprising a plurality of sections each having a plurality of conical recesses in its meeting face, a plurality of double conical buttons adapted to frictionally engage with the walls of said recesses without contacting with the bottoms thereof, and be forced into place by the bringing together of the sections, said buttons being longitudinally movable to float to positions of equal pressure, and a clamping bolt having a projection adapted to engage with one of said sections for forcing said sections apart.

22. A device of the class described comprising a plurality of sections each having a plurality of conical recesses in its meeting face, a plurality of double conical buttons adapted to float to positions of equal pressure within said recesses without contacting with the bottoms thereof when said sections are forced together, and a clamping bolt having a projection adapted to engage with one of said sections for forcing said sections apart.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

THOMAS J. FAY.
JOHN MAGEE ELLSWORTH.

Witnesses:
CLIVE W. FAIRBANK,
EVERARD B. MARSHALL.