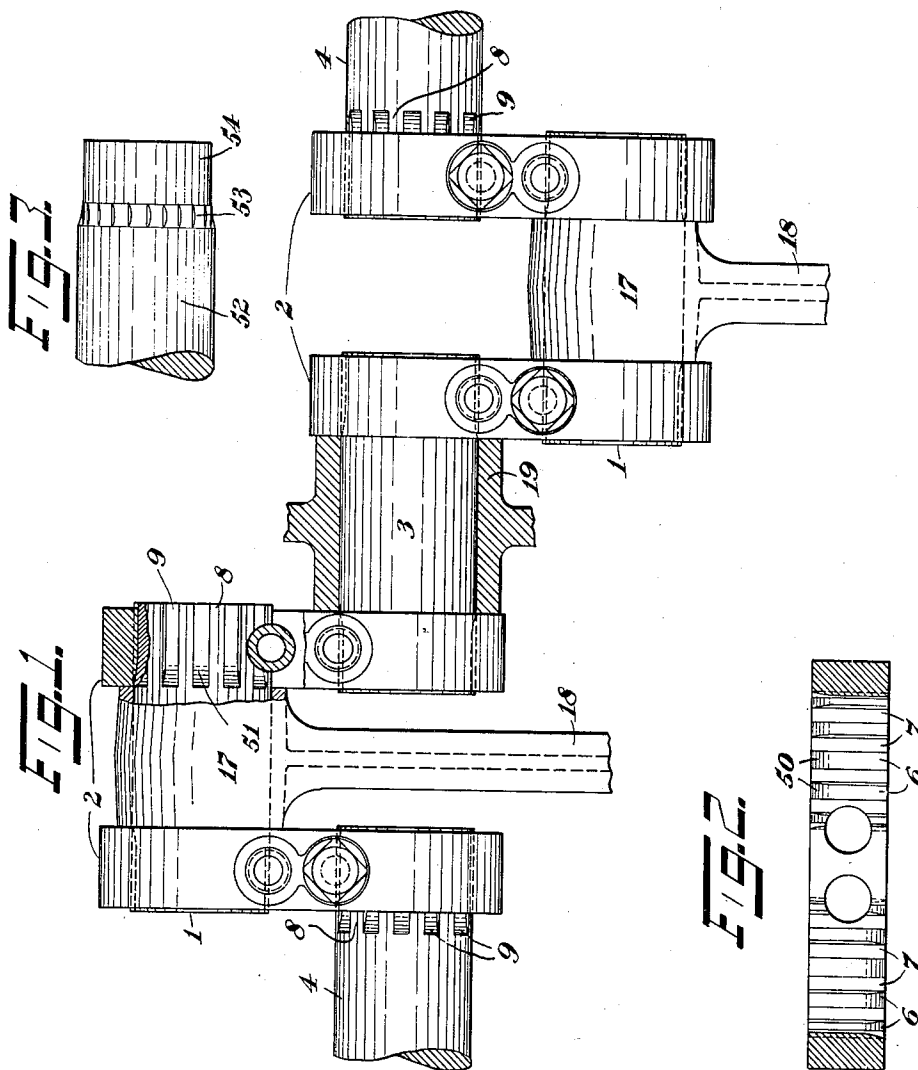


1,024,817.

H. L. ARNOLD.
CRANK SHAFT.
APPLICATION FILED OCT. 7, 1909.

Patented Apr. 30, 1912.
3 SHEETS-SHEET 1.



Witnesses:

L. C. Badaou.
W. B. Mattingly.

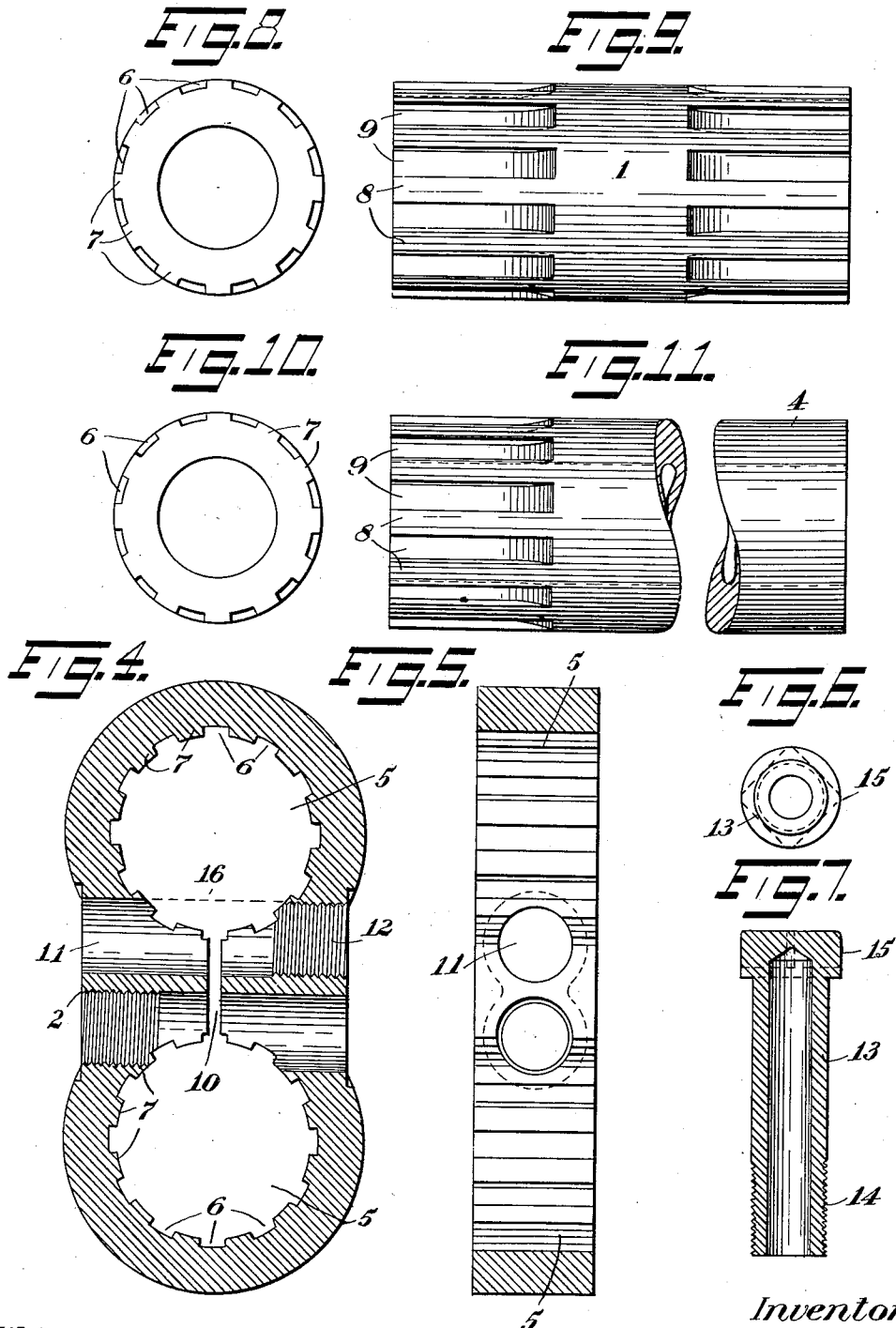
Inventor:

Horace L. Arnold,
By his Attorney, F. A. Richards.

1,024,817.

Patented Apr. 30, 1912.

3 SHEETS—SHEET 2.



Witnesses:

Schuman
A. B. Mattingly

Inventor:

Horace L. Arnold,

By his Attorney,

F. H. Richards,

H. L. ARNOLD.
CRANK SHAFT.

APPLICATION FILED OCT. 7, 1909.

Patented Apr. 30, 1912.

3 SHEETS-SHEET 3.

1,024,817.

FIG. 12.

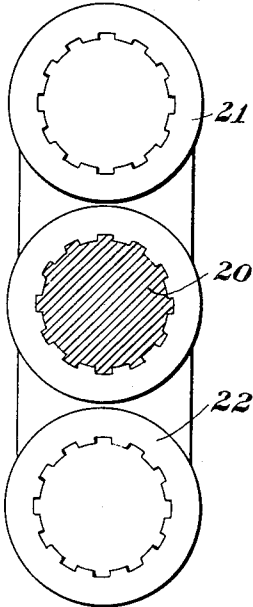


FIG. 13.

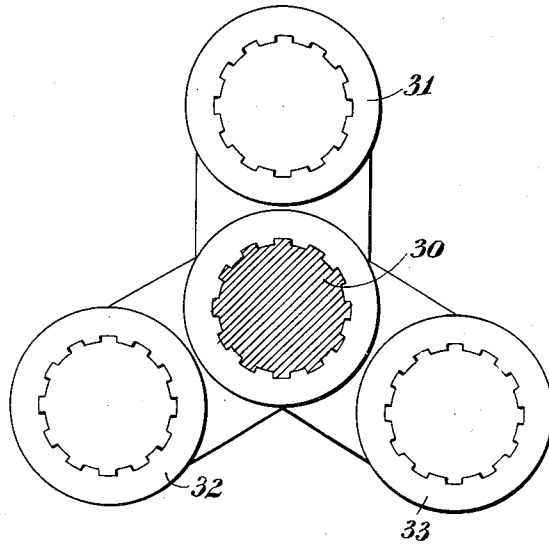
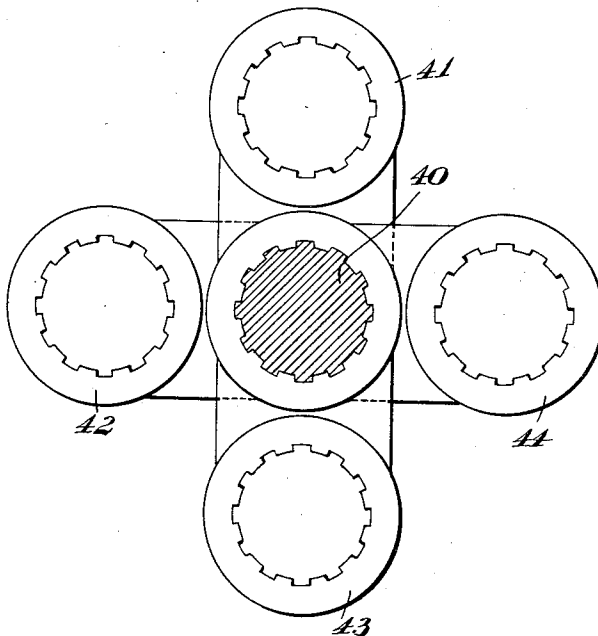


FIG. 14.



Witnesses:

Schuman

W. B. Mattingly

Inventor:

Horace L. Arnold,

By his Attorney,

F. W. Richards,

UNITED STATES PATENT OFFICE.

HORACE L. ARNOLD, OF NEW YORK, N. Y.

CRANK-SHAFT.

1,024,817.

Specification of Letters Patent.

Patented Apr. 30, 1912.

Application filed October 7, 1909. Serial No. 521,506.

To all whom it may concern:

Be it known that I, HORACE L. ARNOLD, a citizen of the United States, residing in the borough of Brooklyn, city of New York, county of Kings, and State of New York, have invented certain new and useful Improvements in Crank-Shafts, of which the following is a specification.

This invention relates to crank shafts and has for its object to provide an improved built up crank shaft and the interchangeable parts for building up the same.

In this present improvement the members of the crank shaft, that is the crank arms, wrist pins, and end portions of the shaft, will be so interchangeable in their character that these parts or members may be taken from stock and readily and accurately assembled in building up a crank shaft having any desirable number of crank wrists and pairs of associated arms disposed at any desirable angle one relative to the other. A stock post may also be used in making repairs to replace another.

In the drawings accompanying and forming a part of this specification, Figure 1 is a side elevation, it being partly broken away, and illustrates a built up crank shaft embodying my invention, wherein there are shown two crank wrists, two pairs of crank arms, two end portions and an intermediate bearing portion similar to the crank wrists, a portion of a connecting rod on each wrist, and a bearing supporting the intermediate bearing portion. Fig. 2 is a longitudinal section of a crank arm, the section being taken at a plane at about right angles to that of Fig. 1, and on a larger scale. Fig. 3 shows a form of reamer to make the eyes in the cranks. Fig. 4 is a longitudinal section through one of the cranks. Fig. 5 is a view similar to Fig. 2, but showing unreamed eyes. Figs. 6 and 7 are end and cross sectional views respectively of a form of key or binding bolt. Figs. 8 and 9 respectively represent the end and the elevation of a wrist pin. Figs. 10 and 11 are similar views of the end or shaft member of the crank shaft. Figs. 12, 13 and 14 are diagrammatic details illustrating shafts having respectively two, three and four wrist pins.

A crank shaft built up in accordance with the present invention will be made up of practically three members or their duplication,—the arm, the wrist pin, which will

also be used for the intermediate bearing portions of the shaft, and the end member. By reference to Fig. 1 it will be seen that there is a shaft built up in which there are two crank wrists, designated without preference by the reference character 1, each of which is carried by a pair of arms 2, the pairs of arms being connected together by an intermediate bearing portion 3 similar to the wrist pins, and the ends of the shaft comprise members 4.

The advantage of the present improvement is that the crank shaft, as was before stated, is made up of the duplications of but three members,—the arm, the shaft end, and the wrist pin, which will be made up as interchangeable stock articles, and used indiscriminately in the original assemblage. For repairing by replacing from stock, any worn or broken member of the built up shaft may be removed and a new one substituted without injuring or destroying the other parts or members of the shaft. A shaft may be built up having any desirable number of crank wrists. In the present structure each of the members is provided with a series of grooves and ribs 6 and 7 respectively, the grooves upon the wrist pins and shaft members being constructed and adapted for receiving and mating with the ribs upon the arm members. In the present construction twelve ribs and grooves are illustrated on each. Twelve is the smallest number which will admit of placing the cranks at 180, 120, 90 or 60 degrees apart. By placing the cranks at the distance apart stated the shaft may be provided with two, three, four, or six cranks, which are the only numbers of cranks which at the present time are employed in internal combustion engines.

The crank arm is formed with a pair of eyes, 5—5, one being disposed at each end. The eyes will be formed in some suitable manner, as for instance, by boring, and each eye is provided with a series of grooves 6 and ribs 7, which are disposed parallel with the axis of the eye and the eyes are disposed in axial parallelism. The wrist pins 1 and the shaft ends 4 are provided with ribs 8 and grooves 9 for mating with the grooves and ribs in the crank eyes. There is an opening 10 extending from one side face of the arm to the other side face and extending from one eye to the other, which opening may be a kerf disposed in the plane

of the axes of said eyes. This is for the purpose of permitting the eyes to be clamped upon the ends of the members, the wrist pin or the shaft end, which are adapted to enter such eyes. A transversely disposed key bolt seat is provided in the arm for each of the eyes and extends through the arm from side to side transversely of the said kerf and cuts into the eye. By reference to Fig. 4 it will be seen there is illustrated a cylindrically formed key bolt seat 11, which at one end is provided with raised screw threads 12. This key bolt seat is for receiving the key bolt, a form of which is illustrated in Figs. 6 and 7. The cylindrical portion 13 of such bolt will occupy the portion 11 and its screw threaded end 14 will engage the screw threads 12. There is provided upon the bolt a wrench engaging head 15 whereby the bolt will clamp the sides of the arm together and bind the eye firmly upon the end of the wrist or shaft member as the case may be. In assembling the parts the arm will be mounted upon the shaft member or wrist pin and the key bolt seat will be drilled through the arm and in such drilling will take away a portion of the member which is in the eye, thus forming a key seat in such member. This is diagrammatically illustrated at 16 in Fig. 4. Generally in practice, the head of one bolt will be put upon one side of the arm and the head of the other bolt upon the other side of the arm, thus securing a perfectly balanced structure.

In automobile and motor boat construction it is frequently desirable to make the crank shafts very light, and for this reason many of the parts are made tubular. The present invention is peculiarly adapted for use in connection with tubular shafting and wrist pins. The large number of ribs and grooves, these being located entirely around the circumference of the tubular shaft or wrist pin, will give a firm hold, even if the grooves are comparatively shallow, and when in addition to this the eye of the crank arm is clamped or shrunk upon the member which it embraces the holding power is increased. Not only may the shaft ends and wrist pins be made tubular; but the key or clamping bolt may also be made tubular without reducing its efficiency. It is shown tubular in Fig. 7.

It will be seen from the foregoing that not only is this invention advantageous in that it affords interchangeability of parts, not only admitting ready assemblage, but also ready repair. It also provides a remarkably strong, durable and light weight crank shaft, one which may be made of any material, as for instance from tubular stock, which is not the case with a one piece crank shaft.

If the crank wrist is made in the form

shown in Fig. 9 and with the grooves of the length there illustrated and the arm is made in the size and form illustrated in Fig. 5, the inner ends of the grooves 9 will project into the bearing portion of the wrist pin. But by means of the construction illustrated in Figs. 1, 2 and 3, the grooves in the wrist pin will be made shorter than those illustrated in Fig. 9 and the inner ends of the ribs upon the arm will be cut off or beveled, as for instance by means of a reamer. A form of reamer 52 is illustrated in Fig. 3. By this means a close fit will be had between the ribs and grooves of the two members, since the ribs 7 in the eye will be beveled off at 50 to correspond with the beveled ends 51 of the grooves 9 in the wrist pin. This will leave a perfectly smooth bearing surface upon the crank pin between the arms for the engagement of the eye 17 of the connecting rod and for the intermediate bearing 19. The contour of the cutting portion 53 of the reamer will correspond with the groove ends 51. The reamer may have a guide portion 54.

An advantage not heretofore alluded to of the present form of construction is that the eye 17 of the connecting rod 18 may be made of one solid and integral piece. The wrist pin 1 will be placed in the eye 17 and the arms 2 then applied to the wrist pin in assembling the device. This is another element which adds to the lightness of the structure, because a connecting rod eye so made will, of course, be much lighter than one which is made of parts which have to be bolted together.

In Fig. 12 there are illustrated in end view the end portion 20 of a crank shaft, and two crank arms 21 and 22 disposed at an angle of 180 degrees one to the other. In Fig. 13 there is similarly shown a crank shaft end 30 and three arms 31, 32 and 33, disposed at angular distances apart of 120 degrees. In Fig. 14 there is shown a shaft 40 which is provided with crank arms 41, 42, 43 and 44 disposed quarteringly upon the shaft or at angular distances apart of 90 degrees. This showing is merely diagrammatical and is intended to illustrate the adaptability and interchangeability of the parts, illustrating how, by the same stock parts, a crank shaft may be built up having any desired number of cranks. The eye of the crank arms will all be similar in stock articles, and the reaming of the rib ends and the drilling of the key bolt seats may be done on each piece at the time it is used. A crank shaft having one crank wrist and a pair of crank arms will take a given number of kinds of parts. To increase the number of crank wrists upon the shaft will not increase the number of kinds of parts employed. It does not require any greater number of kinds of parts to make a

crank shaft having six crank wrists than to make a shaft having one crank wrist.

Having thus described my invention, I claim:

5 1. In a crank shaft, the combination with a pair of crank shaft end members, each having at one end a series of longitudinally disposed ribs and grooves, a series of wrist pins each having at each end a series of
10 longitudinally disposed ribs and grooves, and a series of pairs of crank arms, each arm being provided with a pair of bores disposed in axial parallelism and in the portion between said bores with a kerf extending from one to the other in substantially the plane of the axes and a pair of
15 combined key and binding bolt seats in said portion disposed perpendicularly to said kerf and each opening into the adjacent
20 bore, each of the bores having a series of grooves and ribs mating with the ribs and grooves on the shaft member and pins.

2. As an article of manufacture, a crank
25 arm having a pair of eyes each provided with a series of grooves and ribs disposed

parallel with the axis of the eye, there being an opening connecting the eyes disposed in the plane of the axes of said eyes, and a pair of transversely disposed key bolt seats passing through said intervening portion 30 of the arm intersecting the said opening and cutting into the eyes.

3. As an article of manufacture, a crank arm having a pair of eyes disposed in axial parallelism, each eye having a series of uni- 35 form grooves and uniform ribs disposed parallel with its axis, the portion of the arm between the eyes being provided with a kerf connecting the eyes and disposed in about the plane of the said axes, and a pair 40 of combined key and binding bolt seats in said between portion of the arm disposed transversely of said kerf one of said seats opening into one of the eyes and the other 45 of said seats opening into the other eye.

HORACE L. ARNOLD.

Witnesses:

JOHN FLANNIGAN,
FRED. J. DOLE.