

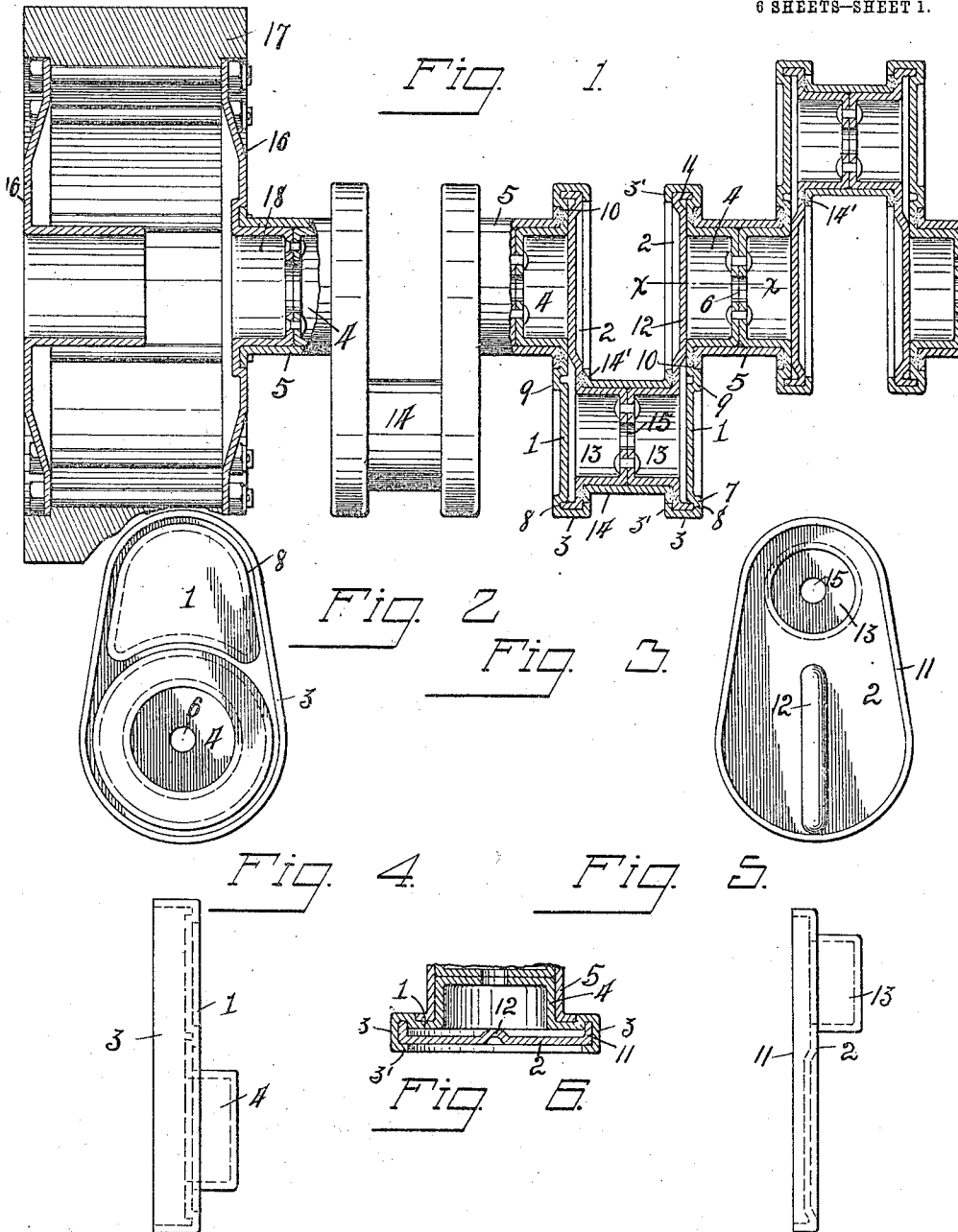
H. L. BOCK.
CRANK SHAFT.

APPLICATION FILED APR. 10, 1911.

Patented June 3, 1913.

6 SHEETS—SHEET 1.

1,063,323.



WITNESSES:

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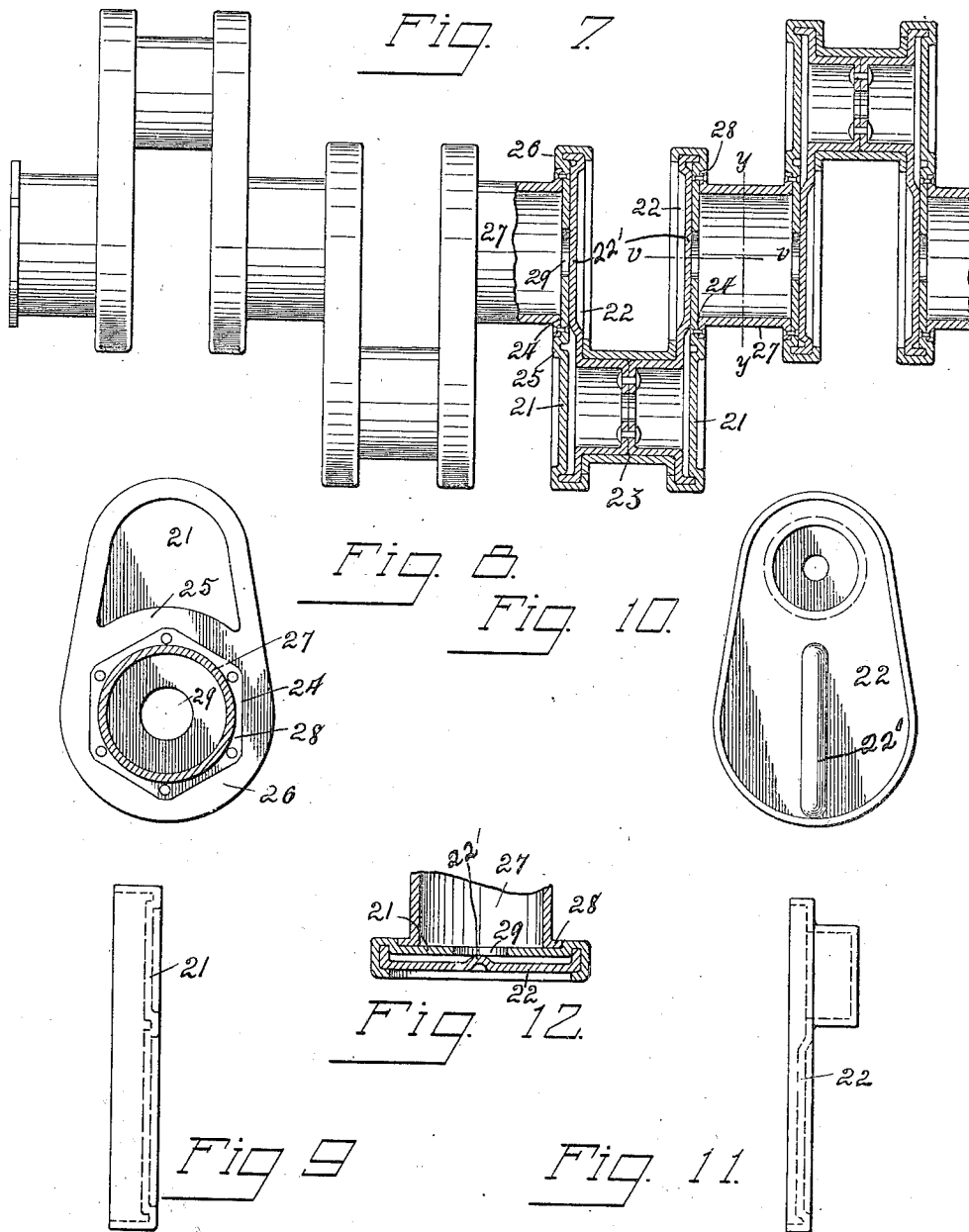
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6 SHEETS—SHEET 2.



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6 SHEETS—SHEET 3.

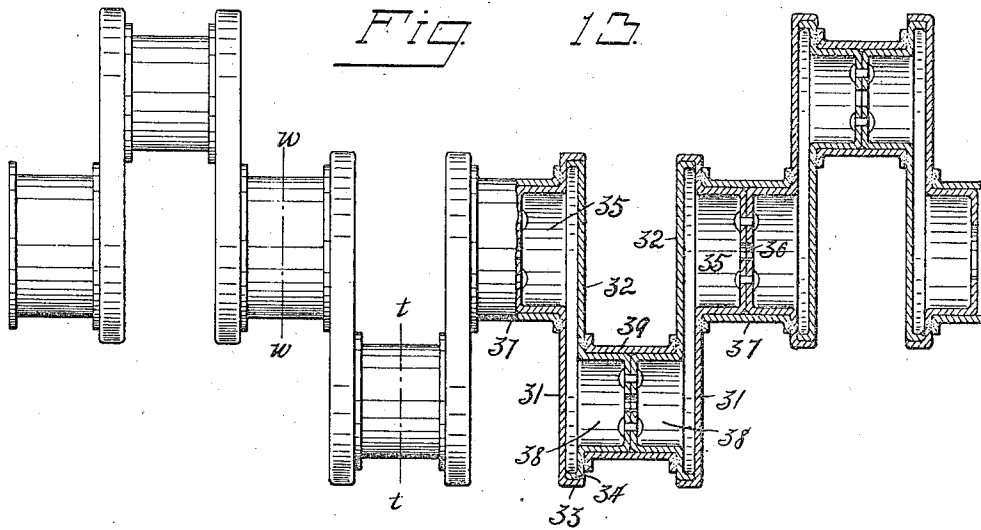


Fig. 14. Fig. 15.

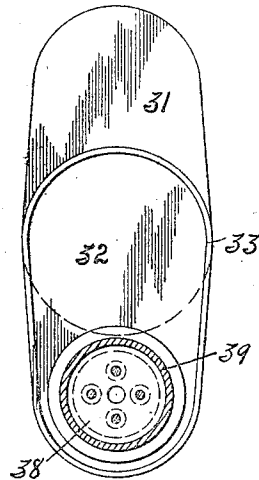
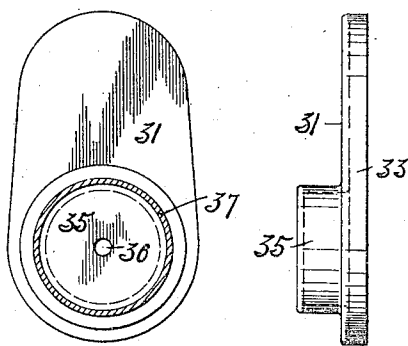


Fig. 16.

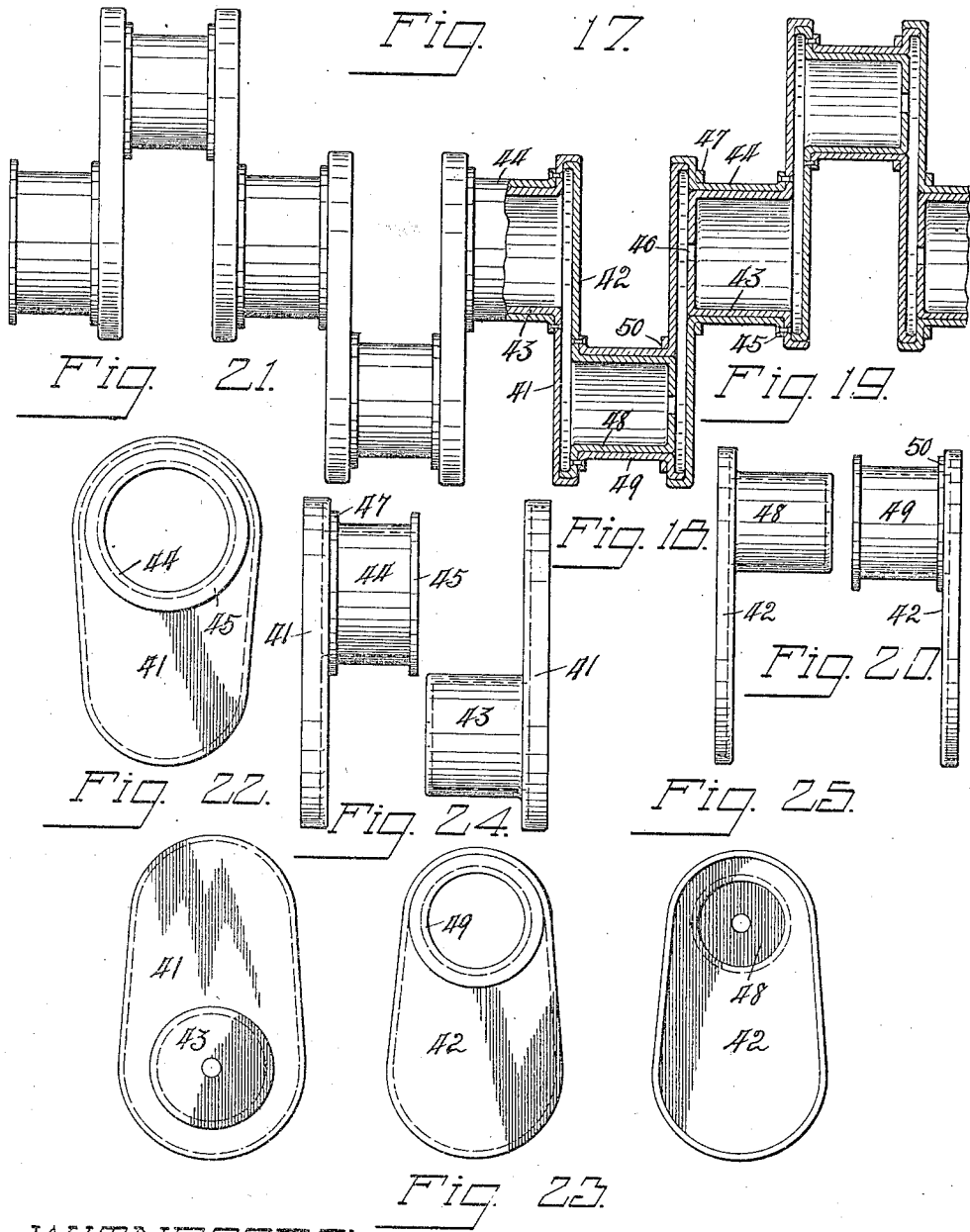
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6 SHEETS—SHEET 5.

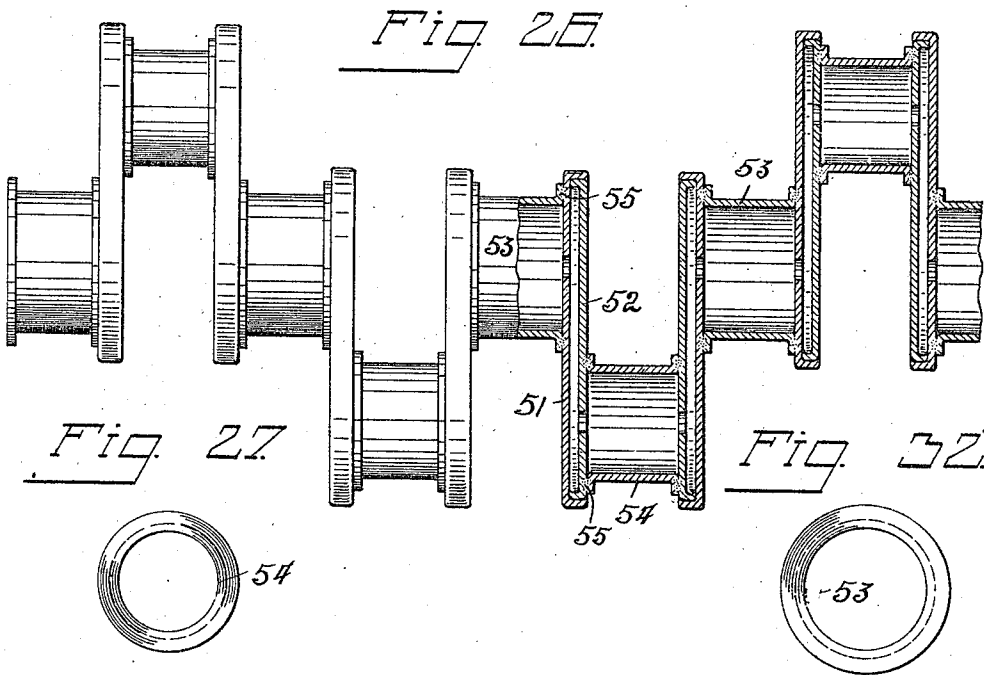
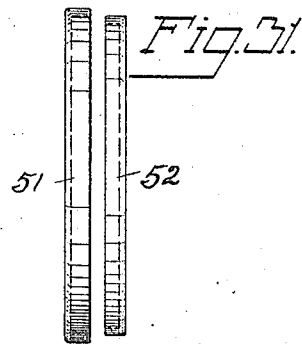
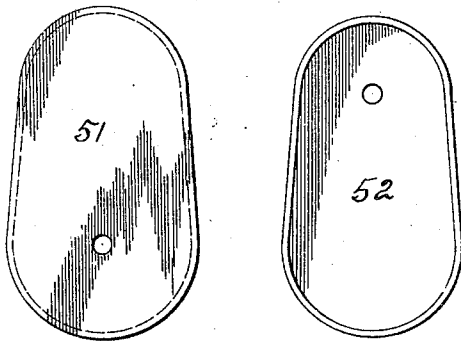


Fig. 28 Fig. 29 Fig. 30



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6 SHEETS—SHEET 6.

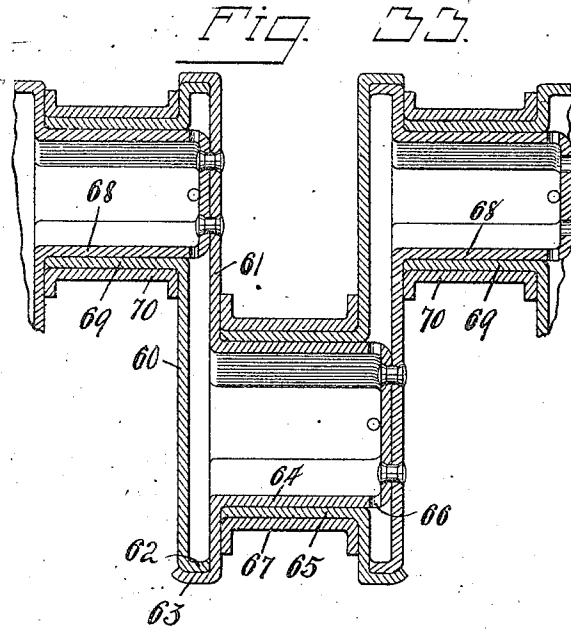
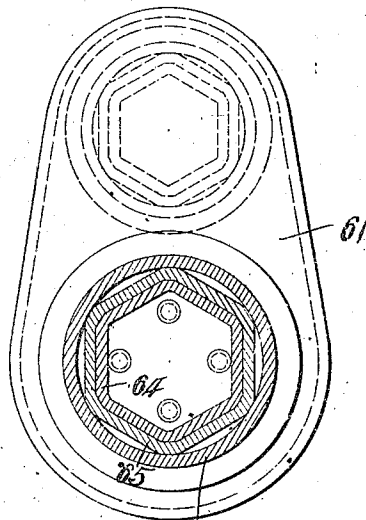


Fig. 34



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UNITED STATES PATENT OFFICE.

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CRANK-SHAFT.

1,063,323.

Specification of Letters Patent.

Patented June 3, 1913.

Application filed April 10, 1911. Serial No. 620,214.

To all whom it may concern:

Be it known that I, HENRY L. BOCK, a citizen of the United States, and a resident of Toledo, in the county of Lucas and State of Ohio, have invented a certain new and useful Crank-Shaft; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to the manufacture and construction of crank-shafts for engines or power transmitting appliances; and has for its object the provision of a stamped or drawn sheet metal crank-shaft, which is strong and durable in its construction, inexpensive of manufacture, and light of weight, and which has the parts thereof so assembled and formed as to combine a maximum of strength and durability with a minimum of lightness and cost of manufacture.

A further object of my invention resides in the interengaging or uniting of a crank-shaft and fly-wheel in such manner as to provide a strong, durable and efficient connection between such parts, which is cheap and simple of construction.

The invention is fully described in the following specification, and while, in its broader aspect, it is capable of embodiment in numerous forms, a few only of such forms are illustrated in the accompanying drawings, in which,—

Figure 1 is a side elevation of a preferred form of my invention with a portion in central longitudinal section. Figs. 2 and 3 are inner face views, respectively, of the outer and inner side members of a crank-arm. Figs. 4 and 5 are edge views thereof, respectively. Fig. 6 is a cross-section on a line *x x* in Fig. 1. Fig. 7 is a side elevation of another form of the invention with a portion in section. Fig. 8 is a section on the line *y y* in Fig. 7. Fig. 9 is an edge view of the outer side piece of a crank arm. Fig. 10 is an inner face view of the inner side piece of a crank-arm. Fig. 11 is an edge view thereof. Fig. 12 is a section on the line *v v* in Fig. 7. Fig. 13 is a side elevation of another form of the invention, with a portion in section. Fig. 14 is a cross-section on the line *w w* in Fig. 13. Fig. 15 is an edge view of the outer side piece of a

crank of such form. Fig. 16 is a cross-section on the line *t t* in Fig. 13. Fig. 17 is a side elevation of another form of the invention with a part in section. Figs. 18 to 25, are details of the parts thereof. Fig. 26 is a side elevation of another form of crank-shaft, with a portion in section. Figs. 27 to 32 inclusive, are details of parts of the same, and Figs. 33 and 34 are a partial longitudinal-section and a cross-section of another form of the invention.

In the form of my invention disclosed in Figs. 1 to 6, inclusive, the cranks are of the double arm type and each of the arms thereof comprises the outer and inner members 1 and 2, respectively, which are preferably stamped or drawn from sheet metal. The members 1 and 2 are shown as being male and female to facilitate a securing of the same together, as hereinafter described, and are of elongated form with the ends thereof rounded and they preferably narrow from their inner or shaft ends outwardly, as the shaft is customarily larger in diameter than the wrist-pin.

The male member 1 is shown as being formed with a marginal inwardly projecting flange 3, within which the female part 2 is intended to fit, and has at the shaft end thereof an outwardly drawn cylindrical cup-shaped portion 4, which coöperates with a like part of the adjoining crank and with a sleeve 5 to form the portion of the crank-shaft connecting two adjoining cranks. The ends of the adjoining drawn shaft parts 4 are riveted, welded or otherwise rigidly secured together, and are preferably closed except for registering openings 6 therein through which oil may circulate. The flange 3 preferably projects from an outwardly drawn marginal portion 7 of the member 1, which portion strengthens said member and provides an inner marginal channel or recess 8 therein. The member 1 also has a curved transverse ridge 9 drawn outwardly therefrom adjacent to the part 4 and concentric thereto to coöperate with a portion of the ridge 7 to form a recess around said part 4 for the associated flanged end of the sleeve 5 to snugly seat in, as shown.

The inner or female member 2 is provided with a marginal flange 11, which projects toward the outer side of the crank-arm of which it is a part, and is of suitable size and shape to telescope snugly within the flange 3 of the companion member 1 with its free

edge preferably seating in the marginal recess 8 of the member 1, as shown. The members 1 and 2 are retained in rigid engagement by an inward rolling or pressing of the edge of the flange 3 over the exposed edge of the member 2, as shown at 3'. The flange 11 of the member 2 is of sufficient depth to hold the body portions of the two members separated from each other to provide an oil circulating space therebetween. For the purpose of strengthening the crank-arm the member 2 preferably has a longitudinally-extending centrally-disposed rib 12 struck inwardly therefrom relative to the companion member in position to span the open end of the shaft part 4 thereof and to abut against the body of said member at opposite sides of said part. From the outer or small end of the member 2 is drawn, stamped or otherwise suitably formed a laterally projecting cup-like part 13, which is cylindrical in form, or substantially so, and coöperates with a similar part of the opposing crank-arm of the pair and with the encircling sleeve 14 to form the wrist-pin of the crank. The adjacent ends of the coöperating parts 13 abut and are preferably closed except for registering oil-circulating openings 15 therethrough to strengthen the pin and facilitate a riveting, electric welding or otherwise securing of the two parts together, as is apparent. The sleeve 14 is equal in length to the combined lengths of the parts 13, and has its ends flanged outwardly, as at 14', against the members 2.

Secured to the crank-shaft in a manner similar to the connection of the sets of crank-arms thereof is a fly-wheel, which is shown in the present instance as comprising the opposing stamped sheet metal side or web portions 16, 16 and the cast rim portion 17 rigidly secured thereto. If the fly-wheel is attached at only one side to the crank-shaft, as in the present instance, the side 16 thereof which is adjacent to the crank-shaft end is provided with an outwardly drawn or otherwise suitably formed axial projection 18, which is similar to the part 4 of the adjoining crank-arm and coöperates therewith and with the associated sleeve 5 to form a crank-shaft section in the same manner as do the parts 4 of adjoining crank-arms and the incasing sleeve 5. The projection 18 is also secured to the adjoining arm part 4 by riveting, welding, or in any other suitable manner. It is evident that this forms a simple, strong, durable and rigid means of connecting a crank-shaft and fly-wheel, and that in case of an extension of the crank-shaft from both sides of the wheel the shaft can be attached to both sides 16 thereof in the same manner.

In the crank-shaft shown in Figs. 7 to 12, inclusive, 21 and 22 designate the male and female members, respectively, of a crank-

arm and telescope one within the other, being secured together in the same manner as described for Figs. 1 to 6 inclusive. The form of the female member 22 and wrist-pin 23 of a crank are also the same as described for said figures. In this form of the invention the male member 21 is not drawn at its inner or shaft end to provide an integral shaft part corresponding to the part 4 of the former construction, but is provided in lieu thereof with a socket or depression 24, the wall of which is formed by the cross ridge 25 and inner end portion of the marginal ridge 26 on the outer side of said member.

The shaft sections 27, which are disposed between the cranks, are of tubular form and have their ends flanged outwardly, as at 28, and fitting snugly within the sockets 24 of the respective members 21, being rigidly united thereto by riveting electric welding, or in any other suitable manner. To strengthen the point of union of the parts 21 and 27 against shearing stresses, the edge of the flange 28 and wall of the socket 24 are of like polygonal form, or of other than a true circle, so that one must turn with the other irrespective of the uniting means, as is apparent. An opening 29 is provided in the member 21 in register with the interior of the associated shaft section 27 for oil to circulate through.

The ribs 22' on the members 22, which ribs correspond to the ribs 12 in the form shown in Figs. 1 to 6, inclusive, extend across the openings 29, in abutment with the members 21 and permit the oil to flow at either side thereof through said openings and between the members 21, 22, as best shown in Fig. 12.

In Figs. 13 to 16, inclusive, is illustrated a simpler, but not so strong and durable, a form of the invention as those above described. In this form 31 and 32 designate the male and female members or outer and inner parts, respectively, of a crank-arm. The member 31 has the marginal flange 33 within which the marginal flange 34 of the female member fits, the edge of the flange 33 being rolled around the edge of the female member to unite the two members, as shown. The member 31 is provided at its inner end portion with the outwardly drawn cylindrical cup-shaped part 35, which has its outer end closed, except for an oil circulating opening 36 therein, and rigidly secured in a suitable manner to the outer end of a similar part on the member 31 of the adjoining crank-arm to coöperate therewith and with an encircling sleeve 37 to form a crank connecting shaft section, as described for the form first above described. The wrist-pins of the cranks are also formed in a manner similar to, said first shaft form by rigidly connecting the drawn parts 38 of the coöperating crank-arm, members 32 and

encircling such parts with a sleeve 39. It will be noted that in this form of the invention the members 31 and 32 lack the reinforcing ribs or depressions provided on the members 1 and 2 of the first form.

In the form of the invention shown in Figs. 17 to 25, inclusive, the crank-arm members 41 and 42 are similar in shape to and secured together in the same manner as the members 31 and 32 of the preceding form, but the construction of the shaft sections and wrist-pins differs from those of the above described forms. In this form a member 41 of one crank has a shaft part 43 drawn outwardly or otherwise suitably formed thereon and telescoping within a similarly drawn part 44 of the adjacent member 41 of the adjoining crank, said parts 43 and 44 being each substantially equal in length to the shaft section formed thereby. The outer end of the outer part 44 is outwardly flanged, as at 45, and riveted, welded or otherwise suitably secured to the portion of the member 41 against which it abuts, while the outer end of the part 43 is preferably closed except for an oil circulating opening 46 therein, which opening is in communication with the space between the members 41 and 42 of the adjoining crank-arm, as shown. A ring or collar 47 encircles the inner end of each part 44 in abutment with its member to reinforce such end of the shaft section and render it similar in appearance to the opposite flanged end of the section. The wrist-pin is similarly constructed in that one member 42 of a crank is provided with the laterally drawn or otherwise suitably formed tubular part 48 which is nearly closed at its outer end and telescopes within a similar open ended part 49. The parts 48 and 49 are substantially equal in length to the length of the wrist-pin, and the latter has its outer end flanged and suitably secured to the abutting member 42. A ring 50 encircles the part 49 at the inner end thereof.

In Figs. 26 to 32, inclusive, the shaft sections and wrist-pins of the crank-shaft are shown as being formed of tubular parts, which are separate from the crank-arm members but secured to the respective ones thereof by electric welding or in any other suitable manner. In this form, 51 and 52 are the outer and inner crank-arm members, respectively, which are flanged at their edges to enable them to be secured together as described for the above forms, 53 the parts forming the shaft sections, and 54 the parts forming the wrist-pins. Each of the parts 53 and 54 comprises a tubular section, which has its ends radially flanged, preferably outwardly, and electrically spot or seam welded to the abutting face of the member 51 and 52, as the case may be, as shown at 55, or secured thereto in any other suitable manner.

In the form illustrated in Figs. 33 and 34

the crank-arms, the wrist-pins and the crank-shaft sections are substantially the same in construction as shown in Figs. 17 to 25 except that the telescoping parts of the wrist-pins and crank-shaft sections are of corresponding polygonal form in cross-section to lock them against relative turning movements and are encircled by cylindrical sleeves to provide circular exteriors. In these figures the crank-arms are shown as comprising the inner and outer members 60 and 61, respectively, which are formed on their respective edges in the present instance, with the interlocking male and female flanges 62 and 63. The outer members 61 of the contiguous arms of adjoining crank-arm sets are formed adjacent one end with the outwardly drawn telescoping parts 64 and 65, which are of corresponding polygonal shape in cross-section and fit closely one within the other, as shown, to prevent a relative turning of such parts. The inner part 64 has its outer end preferably closed and abutting against the inner side of the member 60 of the adjacent crank-arm and riveted or otherwise rigidly secured thereto. The closed end of such parts also has openings 66 opening into the oil-circulating space within the crank-arms. A sleeve 67 encircles the parts 64 and 65 to give the shaft section thus formed a circular exterior. The wrist-pins are similarly formed by providing the outer ends of the adjacent crank-arm members with the polygonal telescoping parts 68 and 69, the inner of which has its end preferably closed and rigidly secured in abutment with a coacting crank-arm member 61. A sleeve 70 encircles said parts.

Experiment has demonstrated that a crank-shaft of the nature described and illustrated will withstand very much greater twisting or crank-shaft stresses than will the crank-shafts commonly employed in automobile engines or the like. A shaft of this nature, however, in addition to being exceedingly strong in construction is also inexpensive to manufacture and is very much lighter than the ordinary shaft, thus materially enhancing its practicability and commercial value. The hollow form of the shaft also enables oil to be freely circulated therethrough.

It is apparent that any one of the forms shown and described provides a crank-shaft which is not only strong, durable and simple in its construction, but light of weight and inexpensive of manufacture, thus admirably adapting it for use in the engines of automobiles, power boats, or for other purposes where lightness, strength and durability are essential. It is also apparent that the cost of repair of a shaft of this nature is reduced to a minimum, as a broken crank-arm, wrist-pin or shaft section may be replaced with

little trouble and expense, whereas the breaking of a part of a crank-shaft of ordinary form usually requires the substitution of an entirely new shaft therefor.

- 5 While I have shown a particular arrangement, construction and manner of uniting the parts of each form of the invention, I wish it understood that such forms are merely illustrative of the broad idea of the invention and that the invention is not limited to any specific construction, arrangement or manner of securing the parts together, except in so far as such limitations are specified in the claims, and also that a fly-wheel and crank-arm can be connected in the same manner as illustrated in the modifications for the connecting of the crank-arms of adjoining sets.

Having thus described my invention, what I claim as new and desire by Letters Patent, is,—

1. A crank-shaft having a crank-arm composed of inner and outer rigidly connected sheet metal members, one having a portion drawn outwardly to form a shaft part and the other having a portion drawn outwardly to form a wrist-pin part.

2. A crank-shaft having a multiple section sheet metal crank-arm, the sections being secured together to form a space therebetween, and one section having an outwardly drawn hollow wrist-pin part in communication with such space.

3. A crank-shaft having a multiple section sheet metal crank-arm, the sections being secured together to form a space therebetween, and one of said sections having an outwardly drawn hollow shaft part in communication with such space.

4. A crank-shaft having a multiple section sheet metal crank-arm, the sections being secured together to form a space therebetween, one of said sections having an outwardly drawn hollow shaft part and another having an outwardly drawn hollow wrist-pin part, with each of said parts in communication with said space.

5. A crank-arm comprising an inner member of sheet metal, and an outer member of sheet metal partially inclosing said inner member, one of said members being provided with a tubular portion integral with it and constituting a shaft-part, the other member being provided with a tubular portion integral with it and forming a wrist-pin part.

6. A crank-shaft having a pair of sheet metal crank-arms each provided with tubular portions extending outwardly from it, said tubular portions being secured directly together, and a member of sheet metal en-

circling said parts and forming therewith a wrist-pin.

7. The combination of a composite crank-arm built up of sheet metal members, one of said members partially inclosing another, said crank-arm thus formed being provided with a passage extending throughout its length for the purpose of promoting a flow of oil therethrough, said crank-arm being provided with a portion extending from it and formed into a shaft part, said crank-arm being further provided with another portion extending from it and formed into a wrist-pin part, said wrist-pin part and said shaft part being provided with holes communicating with said passage in said crank-arm for the purpose of promoting the flow of oil into and out of said passage.

8. A crank shaft provided with a crank arm, said crank arm being built up of an inner portion of sheet metal and an outer portion of sheet metal partially inclosing said inner portion, one of said portions being provided with a wrist pin part and the other of said portions being provided with a shaft part, said shaft part and said wrist pin part being provided with openings to facilitate the travel of a lubricant through said crank arm, said shaft part and said wrist pin part.

9. A crank arm for a composite crank shaft comprising a pair of interfitting plates providing a chamber therebetween, each plate having an outwardly hollow projection in communication with said chamber, each projection being adapted to abut and to be secured to the corresponding projections of adjacent crank arms whereby to provide shaft and wrist pin parts, said projections having openings through their outer ends whereby to provide an open passage through the crank arm.

10. A composite crank shaft comprising a plurality of hollow crank arms, each one of which being provided at its opposite ends with integral oppositely extending hollow projections communicating with the interior of the crank arm, said projections being secured together in pairs whereby to provide the shaft and wrist pin parts of the crank shaft and having openings in their outer ends whereby to establish communication between all of the crank arms of the crank shaft.

In testimony whereof, I have hereunto signed my name to this specification in the presence of two subscribing witnesses.

HENRY L. BOCK.

Witnesses:

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