Feb. 23, 1960 L. L. ASPELIN 2,925,648

METHOD OF MAKING PUMP COMPONENTS

Filed Aug. 19, 1955 2 Sheets-Sheet 1

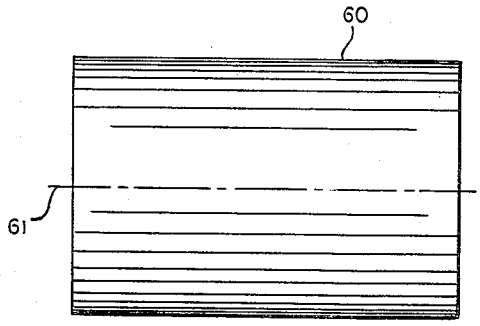


Fig. 1

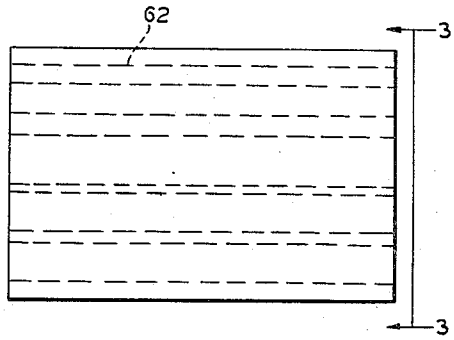


Fig. 2

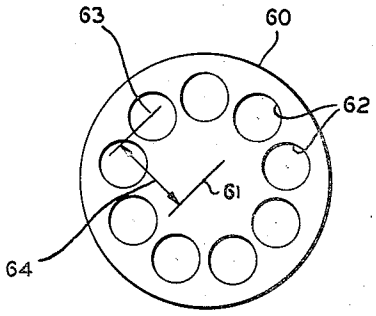


Fig. 3

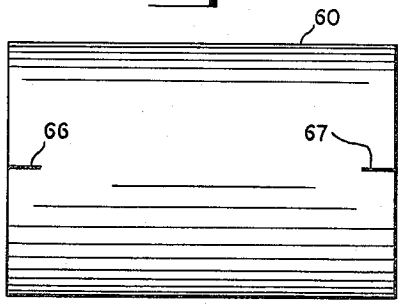


Fig. 4

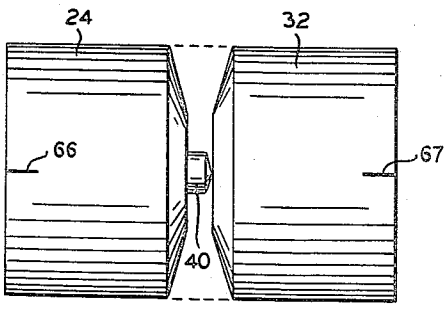


Fig. 5

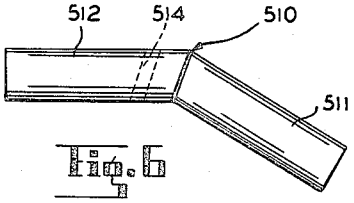


Fig. 6

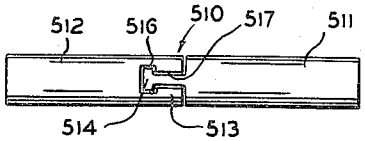


Fig. 7

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Feb. 23, 1960 L. L. ASPELIN 2,925,648

METHOD OF MAKING PUMP COMPONENTS

Filed Aug. 19, 1955 2 Sheets-Sheet 2

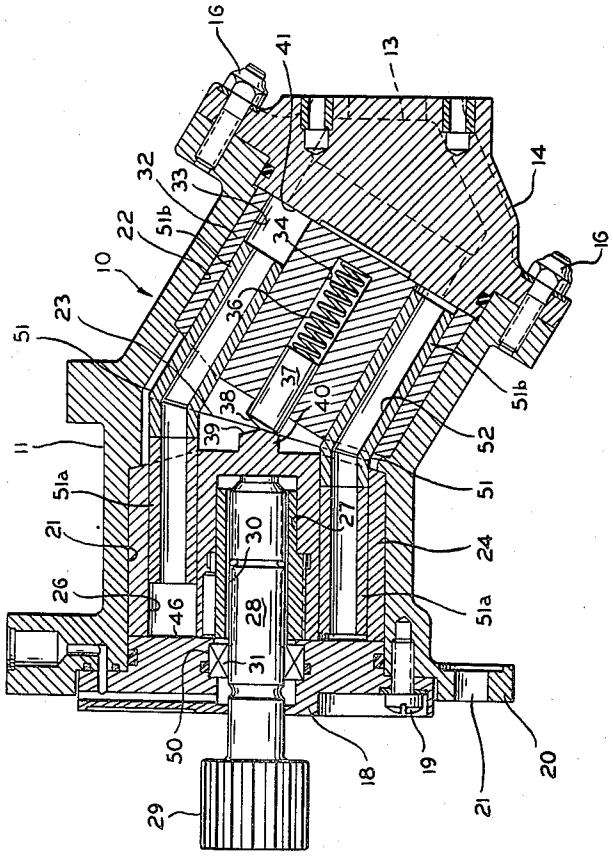


Fig. 8

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METHOD OF MAKING PUMP COMPONENTS

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Application August 19, 1955, Serial No. 529,406

3 Claims. (Cl. 29—156.4)

This invention relates generally to pumps and more particularly to an improved method of manufacturing and fabricating a hydraulic pump of the type including rotors rotatable on angularly intersecting axes and journaling reciprocable sleeves or pistons.

Artisans in the pump field have been familiar for some time with the general principles of a pump wherein a pair of rotors rotatable on angularly intersecting axes journal reciprocable pistons or sleeves and thereby move fluid from an inlet to an outlet. A great deal of difficulty has been encountered in making and using pumps embodying those features, however, because of specific problems which arise in the manufacture and fabrication of the pump components.

For example, each of the pumps includes casing means providing a pair of pumping chambers which are disposed in such a manner as to have angularly intersecting axes. In one of the pumping chambers there is provided a rotor which is generally cylindrical in configuration being complementary in size and shape to the bore or pumping chamber and having its rotational axis coincident with the axis of the bore, while in the other bore or pump chamber there is similarly provided a generally cylindrical rotor which likewise has its rotational axis coincident with the axis of the corresponding bore or pumping chamber.

Each of the rotors has a plurality of circumferentially spaced holes and each respective pair of holes is matched to a piston or sleeve which functions as an impeller-type member since the reciprocation of the piston or sleeve in the holes of the rotor results in the movement of fluid from the inlet of the pump to the outlet of the pump.

In practice, it has been found that it is extremely difficult to provide a plurality of holes in the rotor while maintaining close tolerances and accurate dimensions of parallelism between the holes.

Moreover, it is also extremely difficult to insure that each respective hole in the rotor is spaced at the same radial distance, that is, the distance between the center of the rotor and the center of each respective rotor hole.

Still further, it is exceedingly difficult to maintain proper circumferential spacing of the holes in the rotor so that a pair of rotors will have matching sets of holes.

In the manufacture of rotors for the type of pump herein described, therefore, there are three difficult dimensions to hold:

(1) Parallelism;
(2) Radial hole distance;
(3) Circumferential spacing.

Those versed in the art will readily recognize that variations in the dimensions referred to above seriously affect the operation and efficiency of the pump.

According to the general principles of the present invention, the pump rotors are made from a single block, a plurality of longitudinally extending, circumferentially spaced, parallel, open-ended bores being formed in the

block. Thereafter, the block is provided with witness marks on opposite ends thereof and is subsequently divided into substantially longitudinally symmetrical segments to form pairs of pump rotors.

By aligning the witness marks and the corresponding pairs of holes or cylinder openings, the rotors are assembled with the pistons or sleeves so that each respective cylinder opening journals a corresponding arm or leg of an angled sleeve or piston.

By virtue of such procedure, the three critical dimensions referred to hereinbefore are, in effect, made non-critical since the necessity for close tolerance is minimized.

It is further contemplated, according to the provisions of the present invention, that the pistons or sleeves be made as two piece articles coupled at the point of juncture by a dovetailed coupling joint. Such provision allows for inaccuracies in the critical dimensions referred to and also affords a wider tolerance in the angular disposition of the bore axes.

It is an object of the present invention, therefore, to provide a method of constructing and fabricating a pump of the type herein described which overcomes the deficiencies of the methods and processes hereinbefore provided.

Another object of the present invention is to provide a method of making rotors for pumps of the type herein described which eleminates the necessity of holding close tolerances between the center-to-center radial spacing of the rotor axis and the cylindrical hole centers.

Yet another object of the present invention is to provide a method of making rotors for a pump of the type herein described wherein the necessity for close tolerance is eliminated with respect to the circumferential spacing of the cylindrical holes.

Yet another object of the present invention is to provide a pump which will displace positively a large volume flow of fluid with improved efficiency.

Many other objects, advantages and additional features of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a pump constructed in accordance with the methods of the present invention is shown by way of illustrative example and in which the methods of fabrication with respect to the components of the pump are depicted in illustrated form to clarify an understanding of the methods and processes herein disclosed.

As shown on the drawings:

Figure 1 is an elevational view of a unitary cylindrical block used in accordance with the method of making pump components herein disclosed;

Figure 2 is a view similar to Figure 1 but showing a plurality of circumferentially spaced holes extending longitudinally through the block;

Figure 3 is an end elevational view of the block shown in Figure 2;

Figure 4 is an elevational view of the block shown in Figures 2 and 3 showing how witness marks are formed on the opposite ends of the bore to block;

Figure 5 is a view showing separation of the block of Figure 4 into segments;

Figure 6 is an elevational view of a piston or sleeve provided in accordance with the principles of the present invention;

Figure 7 is a plan elevational view of the piston or sleeve shown in Figure 6; and

Figure 8 is a cross-sectional view with parts shown in elevation illustrating the assembly of a pump incorporating components manufactured in accordance with the principles of the present invention.

As shown on the drawings:

The problems recognized and solved in connection

with the provisions of the present invention can best be appreciated by considering an exemplary form of pump construction. A pump in which the principles of the present invention find particular utility is indicated generally by the reference numeral **10** in Figure 8 and comprises a housing **11** having an inlet (not shown) and an outlet indicated at **13**. The housing **11** includes a cover member **14** fastened to the main body of the housing **11** by a plurality of fasteners **16**. The end of the cover member **14** is formed to provide a mounting pad to facilitate connection of the inlet and the outlet **13**, partly formed by the cover member **14**, with suitable conduit connections.

The opposite end of the housing **11** includes a closure member **18** held in firm assembly with the main body of the housing **11** by a plurality of fasteners **19**. A flange **20** having a plurality of openings **21** is also formed at the end of the housing **11** to facilitate attachment of the pump **10** in a mounting assembly.

As is well known to those versed in the art familiar with this type of pump construction, the cover member **14** and the closure member **18** also constitute end plate means for opposite ends of a bore extending through the housing **11** and including a first bore **21** and a second bore **22**, each of which is generally cylindrical in configuration. The axes of the cylindrical bores **21** and **22** angularly intersect with one another so that there is formed in the interior of the housing **11** a plane of intersection between the bores **21** and **22** indicated generally by the reference numeral **23**.

Within the bore **21** there is provided a rotor **24** which is also cylindrical in configuration, being complementary in size and shape with respect to the bore **21** and journaled for rotation therein. The axis of the rotor **24** is coincident with the axis of the bore **21**. Radially outwardly of the axis of the rotor **24** and circumferentially spaced with respect to one another are a plurality of axially extending cylinders or pumping chambers indicated at **26** formed by through openings extending through the rotor **24**. Inwardly of the pumping chambers **26** and coincident of the axis rotor **24** is an enlarged opening **27** in which is received a shaft member **28** having a splined connecting portion **29** extending outwardly of the pump housing **11** for connection to a driving means. The shaft **28** is connected in driving assembly with the rotor **24** as at **30** and is provided with an additional journaling support by a bearing and seal assembly **31** surrounding the shaft **28** at the locale of the closure member **18**.

In the bore **22**, there is provided a rotor **32** which is generally cylindrical in configuration being complementary in size and shape to the bore **22** and having its rotational axis coincident with the axis of the bore **22**.

The rotor **32** is also provided with a corresponding plurality of pumping chambers or cylinders **33** similar in size and location to the pumping chambers or cylinders **26** in the rotor **24**. A centrally disposed recess **34** is formed in the rotor **32** and bottoms a coil spring **36**.

One end of the coil spring **36** engages against a loading pin **37** which slidably reciprocates in the recess **34** on the axis of the rotor **32** and which has an action surface **38** engaging an adjoining action surface **39** formed on a pin portion **40** integral with the rotor **24** and also located on a corresponding axis of the rotor **24**. Thus, the continuous biasing force exerted by the coil spring **36** acts between the rotors **24** and **32** and tends to retain the rotors in separated relation and loaded against the corresponding cover member **14** and closure member **18**.

Since additional details of construction of the pump **10** do not appear to be necessary to an understanding of the principles of the present invention, it suffices to point out that additional details of construction of the pump **10** can be understood by making reference to my copending application Serial No. 509,529, filed May 19, 1955.

As explained in that disclosure, the cover and closure members **14** and **18** constitute an end plate means providing a sealing surface for sealing and engaging against the adjoining end face of a corresponding rotor **21** and **32**. Additionally, the cover member **14** has a pair of circumferentially extending spaced apart kidney-shaped ports constituting an inlet port and an outlet port, the outlet port communicating with the outlet shown in the cover member **14** and identified by the reference character **13**.

The closure member **18** also has an end plate sealing surface which is indicated at **46** intersected by circumferentially extending spaced apart kidney-shaped ports including an inlet port and an outlet port. The closure member **18** is further provided with a centrally disposed opening **50** to pass the shaft **28** and it will be further appreciated that both the closure member **18** and the cover member **14** are suitably grooved to receive O ring seal members at various places for effecting a sealed assembly between the various components of the pump **10**.

As will be evident from an inspection of Figure 8, the pumping chambers or cylinders **26** in the rotor **24** and **33** in the rotor **32** are generally parallel with the corresponding axis of each respective rotor and each of the pumping chambers or cylinders includes a mouth portion at the corresponding end face which communicates alternately with the adjoining inlet and outlet portions of the end plate sealing surfaces **41** and **46** of the respective rotors **24** and **32** turned.

A piston or sleeve **51** is provided for each respective pair of pumping chambers or cylinders **26** and **33** in the rotors **24** and **32**. The pistons or sleeves **51** are sometimes referred to as impellers because they function to impel or move fluid upon reciprocation thereof whenever the rotors **24** and **32** are rotated. It will be understood that each respective piston or sleeve has angularly offset arm portions such as an arm portion **51*a*** received in a pumping chamber or cylinder **26** of the rotor **24** and an arm portion **51*b*** received in a pumping chamber or cylinder **33** of the rotor **32**. The angularly offset arms or arm portions **51*a*** and **51*b*** are journaled in the corresponding bores or pumping chambers **26** and **33** since the impeller and pumping chambers are complementary in size and shape to facilitate relative rotation and reciprocation between the parts.

The pistons or sleeves **51** are angled by offsetting the axis of each respective arm portion an amount equal to the angle of offset of the bores **21** and **22** and the axes of rotation of the rotors **24** and **32**. It will be appreciated that the amount of angular offset can be varied anywhere between 90° and 180°. Thus, upon rotation of the shaft **28**, the rotor **24** will rotate and the impellers or pistons **51** will effect a driving connection between the rotor **24** and the rotor **32** so that both of the rotors will rotate in unison.

Upon rotation of the rotors **24** and **32**, the arm portions **51*a*** and **51*b*** of the pistons or sleeve **51** will reciprocate in the pumping chambers or cylinders **26** and **33** to alternately produce a suction and a propulsion in each respective bore when the mouth of the bore communicates with the inlet and outlet portions, respectively, of the end plate means.

Each impeller-like piston or sleeve **51** is hollow and has an opening **52** extending therethrough to communicate the respective inlet and outlet ports, thereby insuring a flow of fluid upon operation of the pump.

According to the principles of the present invention, the pump thus far described can be manufactured through the exploitation of modern production techniques and in accordance with a method or process of making pump components which will insure efficient operation of the pump. Referring now more particularly to Figures 1–7, it will be noted that there is shown in Figure 1 a unitary cylindrical block **60**. The block **60** is preferably cylindrical in configuration and has an outside diameter corresponding to the outside diameter required for the

rotors 24 and 32 of the pump 10. The longitudinal axis of the cylindrical block 60 is shown at 61, which axis corresponds to the axis of rotation of the ultimately finished articles, namely, the rotors 24 and 32.

According to the principles of the present invention, the block 60 is provided with a plurality of longitudinally extending, circumferentially spaced parallel, open-ended bores 62. In the exemplary form illustrated, the bores 62 are cut by drilling or boring the block 60 lengthwise. The number of bores 62 corresponds to the number of pistons or sleeves to be used as impellers in the pump 10. It will be appreciated that each respective center of each respective bore 62, such center being indicated at 63, is spaced from the axis 61 by a radial dimension indicated at 64 (Figure 3). Moreover, the bores 62 are circumferentially spaced to provide an annular row of bores 62 around the axis 61.

The next step of the process is indicated in Figure 4 wherein a pair of longitudinally spaced witness marks 66 and 67 are shown on the peripheral surface of the block 60 towards opposite ends of the block 60.

The block 60 is then divided by machining, as shown in Figure 5, into a plurality of longitudinally symmetrical segments, thereby to form the rotor 24 and the rotor 32. The rotors 24 and 32 are placed in assembly with a plurality of pistons or sleeves 51. The pistons 51, the witness marks 66 and 67 and the respective pairs of pumping chambers or cylindrical openings 26 and 33 are matched so that a corresponding arm portion 51*a* matches a corresponding cylindrical opening 26, while the arm portion 51*b* of the corresponding piston or sleeve 51 fits into a cylindrical opening or pumping chamber 33 in the rotor 32.

By following the procedures outlined in the process or method of making the rotors 24 and 32, the criticality of parallelism, radial spacing and circumferential spacing of the pumping chambers or cylindrical openings 26 and 33 is minimized.

Although it will be understood that the rotors 24 and 32 are conveniently employed with one piece pistons or sleeves 51, it is further contemplated according to the principles of the present invention, that the impeller-like pistons or sleeves 51 can be made as two piece articles. For example, as shown in Figures 6 and 7, a two piece impeller-like piston or sleeve is illustrated at 510 and includes a first leg or arm-like portion 511 and a second leg or arm-like portion 512. The portion 511 has a tongue 513 which is enlarged as at 514 to dovetail with an enlarged recess 516 formed inwardly of a slot 517 formed in the part 512.

By interfitting the tongue and slot portions of the parts 511 and 512, the two part piston or sleeve 510 is coupled together as a unitary article. It will be appreciated, however, that the coupling arrangement of the two piece or two part piston affords greater tolerance insofar as the parallelism, radial and circumferential spacing of the cylinder openings is concerned and also insofar as the angular relationship of the angularly intersecting axes of the bores 21 and 22 and of the rotors 24 and 32 are concerned.

Although various modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. The method of making a pump having a pair of rotors disposed on angularly intersecting axes and journaling a plurality of reciprocable angled pistons or sleeves which includes the steps of forming a plurality of longitudinally extending, circumferentially spaced, parallel, open-ended bores in a unitary cylindrical block, forming circumferentially aligned witness marks on opposite ends of said block, dividing the block between said witness marks into two substantially longitudinally symmetrical segments to form two pump rotors each with a separate set of similar bores, and assembling a corresponding plurality of angled pistons in the rotors with the witness marks and the respective pairs of bores of each rotor in matched relation, thereby placing the pump rotors in assembled relationship to accommodate the angled pistons.

2. The method of making a pump which includes the steps of forming a plurality of longitudinally extending, circumferentially spaced, parallel, open-ended bores in a unitary cylindrical block, forming circumferentially aligned witness marks on opposite ends of said block, dividing the block between said witness marks into two substantially longitudinally symmetrical segments to form two pump rotors, each with a separate set of similar bores, forming a corresponding plurality of pistons each having two arm portions disposed on intersecting axes and assembling the pistons with one arm portion thereof in each respective rotor and with the witness marks and the respective pairs of bores of said rotors in matched relation, thereby placing the pump rotors in assembly.

3. The method of claim 2 wherein the step of forming the piston comprises forming a two part piston with each of the arm portions constituting a separate part, forming tongue and slot coupling means at adjoining ends of the parts, and assembling the parts to provide a unitary piston.

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