March 19, 1968 G. D. McKITTRICK 3,373,693

PUMPS

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Fig. 1

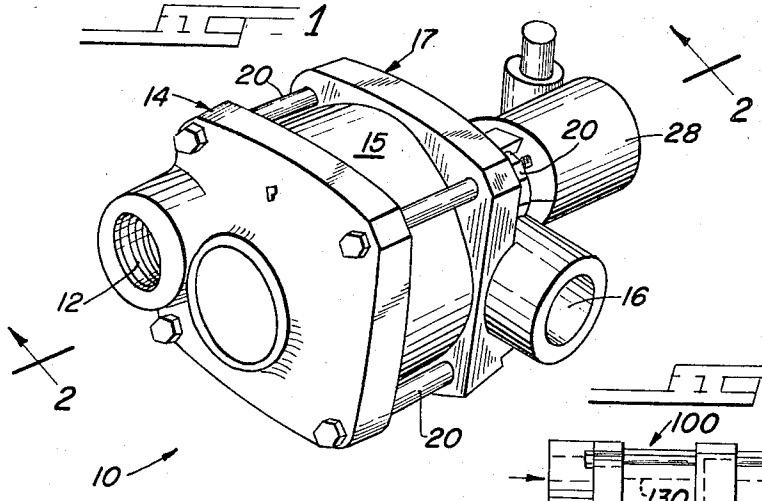

Fig. 6

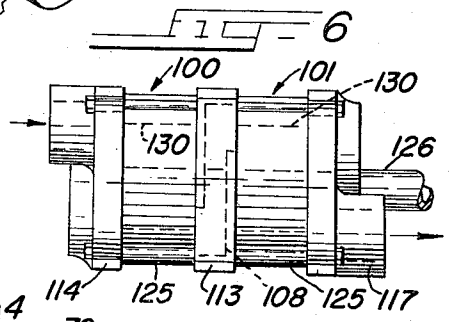

Fig. 2

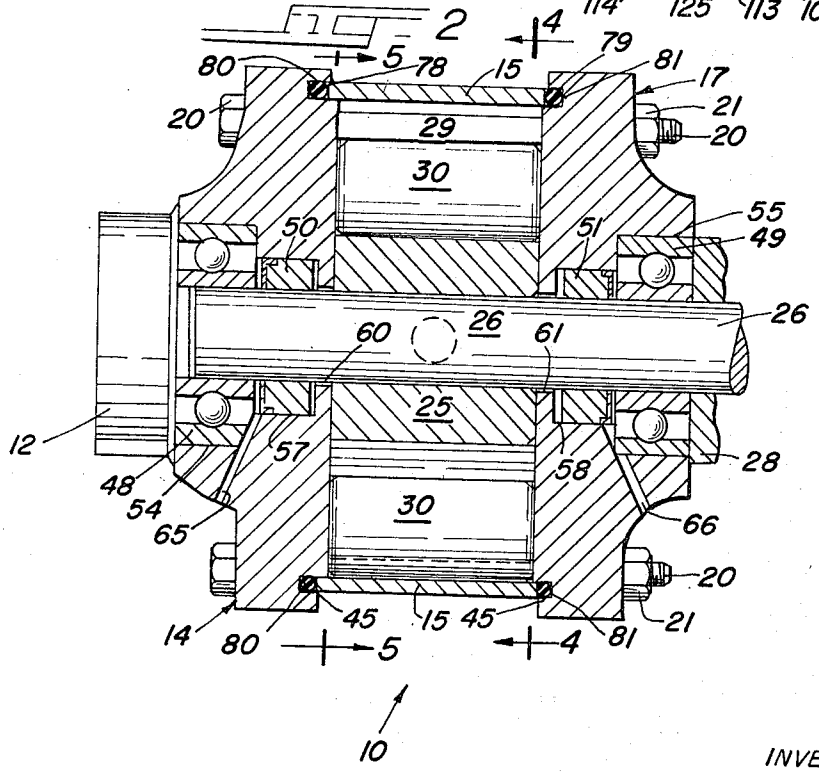

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Fig. 3

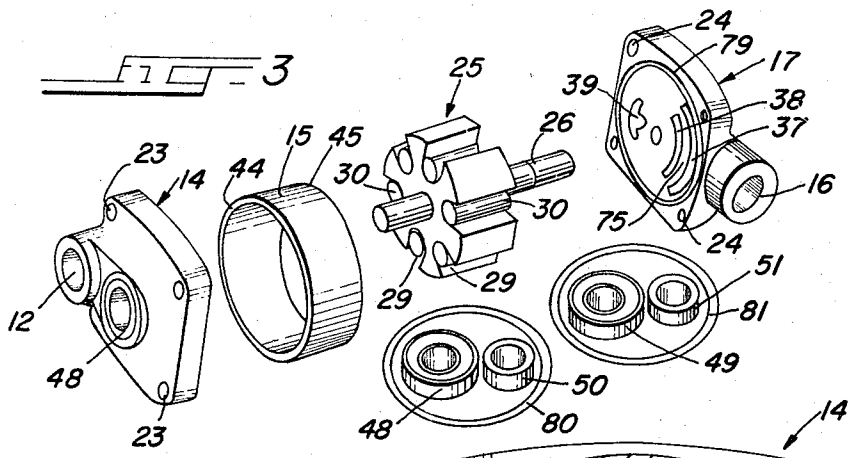


Fig. 4

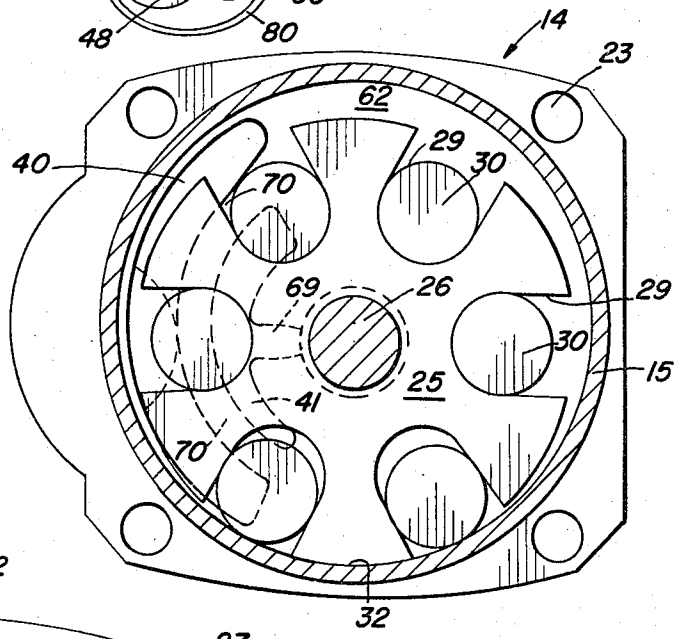
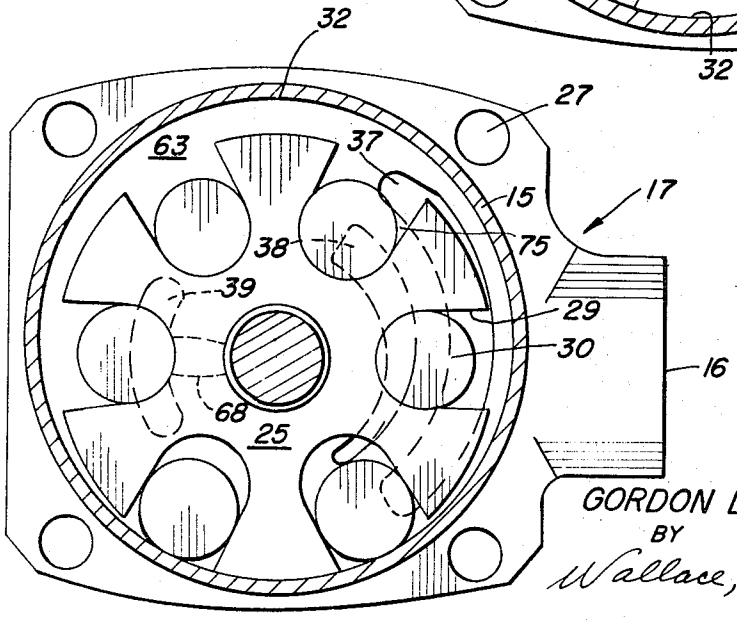


Fig. 5



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PUMPS

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ABSTRACT OF THE DISCLOSURE

A rotary roller pump in which the main portion of the housing encompassing the roller impeller is a simple sleeve of right circular cross-sectional configuration and uniform inside and outside diameters. The end bells or covers of the pump are each formed with a flat planar internal surface and are each provided with an annular groove of right circular configuration in which a resilient O-ring or other sealing gasket is disposed. The sleeve constituting the central portion of the pump housing is clamped between the two end cover members with its end surfaces in engagement with the O-rings to afford a fluid-tight seal at each end of the pump housing. The impeller of the pump is journalled in the end cover members, being eccentrically mounted with respect to the sleeve, the impeller including six or more radially movable impeller rollers that are approximately equal in length to the length of the casing member between the planar surfaces of the end cover members. The inlet and outlet ports are formed in the end cover members so that there are no apertures, passageways, or other deformations in the central sleeve member of the pump housing and the length of the pumping chamber can be increased simply by using a longer sleeve with an appropriately dimensioned impeller. Capacity of the pump can also be increased by mounting additional sections in end-to-end relation, again using simple sleeves of right circular cross-sectional configuration and uniform inside and outside diameters as the principal central elements in the pump housings.

This invention relates to pumps and more particularly to improvements in the construction of rotary roller pumps.

This invention relates to a construction of rotary roller pumps having a plurality of rollers disposed within cavities of an impeller rotatable within a pump body. Heretofore, the pump body of such rotary roller pumps has included a one-piece central sleeve portion and an integrally attached end wall. This one-piece pump body construction imposes serious limitations on the machining of the bore and end wall surfaces, which are at right angles to one another, from the standpoints of tolerances and roughness of finish. Moreover, considerable difficulty is found in machining a sharp and definite right angle corner for receiving the sharp corners of the rollers. Accordingly, an object of the present invention is to eliminate the foregoing difficulties and to obtain improved performance and wear characteristics in rotary roller pumps. Another object of the invention is to construct pump bodies from separate cylindrical sleeves readily machinable to close tolerances and finishes and from separate end walls adapted to be secured to a cylindrical sleeve.

Another object of the present invention is to reduce the cost of manufacturing small rotary roller pumps and to facilitate assembly of such pumps adapted to be produced on a large scale. More particularly, an object of the present invention is the elimination of the complex shape of the pump bodies, i.e., pump casings having a cylindrical body portion formed integrally with a pump end wall.

Another object of the invention is to improve the performance of rotary roller pumps by affording more fluid flow and high pump pressures.

As a further aid to the reduction of cost and of the amount of inventories necessary for producing pumps, the present invention has, as a further object thereof, a modular design of pump wherein the end castings and other components may be used with central pump sleeves of different lengths, the pump sleeves being formed to the desired length.

Another advantage in employing a separate sleeve for the pumping casing or body is that the pump body undergoes considerable wear and may also subject to internal damage necessitating replacement of the pump body. Thus, another object of the invention is a readily replaceable sleeve element constituting the casing or pump body of a pump. It is preferred that the pump body be a "sintered" metal cylinder or sleeve which can be produced to relatively close tolerances compared to the usual casting for the more complex pump bodies of the prior art. With the use of the sleeve for the central pump body, the end covers may have relatively flat end surfaces for cooperation with the pump body and thus the amount of machining and the complexity of the end castings may also be reduced.

Since the pump operates at relatively high pressures and must be sealed between the sleeve and the end covers, a further object of the invention is a novel manner of drawing together the ends of the sleeve and covers by bolts or other fasteners extending between said end covers and this constitutes a further object of the invention.

Another object of the invention is to construct a tandem pump of modular design having a central dividing plate through which the fluid driven from one rotary roller pump module is directed into the second module to afford two pumps on a single drive shaft.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and the principles thereof and what is now considered to be the best modes contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention.

In the drawings:

FIG. 1 is a perspective view of a pump constructed in accordance with the preferred embodiment of the invention;

FIG. 2 is a sectional view taken along the lines 2—2 of FIG. 1 in the direction of the arrows showing the internal construction of the pump of FIG. 1;

FIG. 3 is an exploded view of the pump of FIG. 1;

FIG. 4 is a sectional view showing the inlet cover;

FIG. 5 is a sectional view showing the outlet cover; and

FIG. 6 is a diagrammatic view of tandem pumps separated by a divider plate and constructed in accordance with another embodiment of the invention.

Referring now to the drawings, and more particularly to FIG. 1, there is illustrated a pump **10** constructed in accordance with a preferred embodiment of the invention. The pump **10** has a threaded inlet port **12** formed in an inlet cover or casting **14** through which fluid enters into the pump **10** and moves through a cylindrical sleeve **15**, forming a central body portion of the pump, before exiting from an outlet port **16** in an outlet cover or casting **17**. The inlet cover **14** and outlet cover **17** are secured in fluid tight engagement with the sleeve **15** by four

spaced bolts 20 extending across the outer peripheral surface of the sleeve 15. A nut 21 is threaded on each of the respective bolts 20 to draw the end covers 14 and 17 into the fluid tight sealing relationship with the sleeve 15. The end cover 14 has at its corner four apertures 23 for receiving the bolts 20 and likewise the end cover 17 has four apertures 24 for receiving the bolts 20 to align the end covers 14 and 17.

An impeller means is provided for the purpose of forming a pressure differential to pump the fluid from the inlet port 12 and through the outlet port 16. More specifically, the impeller means includes a rotor 25, FIG. 3, secured to a rotatable spindle or shaft 26, which is adapted to be connected to appropriate drive means such as a motor or the output shaft of a tractor. In the preferred embodiment of the invention as illustrated in FIG. 1, the shaft 26 is secured to a hollow, cylindrical coupling 28 which is adapted to receive the power takeoff shaft of a tractor. However, it is to be understood that the present invention is capable of use with a separate motor or other driving means.

The rotor 25 has a plurality of U-shaped pockets 29, each of which receives therein a cylindrical roller 30. The cylindrical rollers 30 are adapted to move freely within the receiving openings 29 between an outward position adjacent the cylindrical sleeve 15, as best seen in FIGS. 4 and 5, and an inward position closer to the spindle 26.

Heretofore, known rotary roller pumps have had a long cylindrical or sleeve portion of the pump integrally formed with one of the end covers, thereby presenting a number of difficulties from a machining and assembly standpoint. More specifically, the interior of a cylindrical body is more difficult to machine with an attached end cover. Moreover, the end cover also is more difficult to machine. Typically, an end cover of the prior art construction would have machined therein cavities similar to the cavities 37, 38 and 39 in the outlet cover 17, of the present invention, or cavities such as the cavities 40 and 41 formed on the inlet cover of the present invention. Manifestly, with a relatively long cylindrical center body portion of the pump integrally formed with either the outlet or inlet cover, the casting was relatively more complex to cast as well as machine.

The present invention obviates the aforementioned difficulties and reduces the cost and manufacture of assembly of the pump or employing a separate cylindrical sleeve 15, the interior annular surface 32 of which may be readily machined separately from the machining of either the end covers 14 or 17. Also, it is preferred practice under the present invention to form the sleeve 15 as a centrifugally cast sleeve of "sintered" metal which affords a stronger casting and which can be held to relatively closer tolerances for the interior bore of the sleeve 15 than is possible with most other conventional casting process. Consequently, the amount of machining of the interior annular surface 32 of the sleeve 15 is minimized, resulting in a lower cost pump housing.

Another aspect of the present invention is that of modular construction of the pump, that is, the inlet covers 14 and 17, bearings, etc., are capable of being used with sleeves 15 of different lengths. That is, the same inlet and outlet covers 14 and 17 may be employed with sleeves 15 which have different lengths between the end walls 44 and 45 of the sleeve 15. The production of sleeves of different lengths is readily facilitated in the present invention by forming a long sleeve member during a casting operation and then cutting the sleeve into a plurality of sleeve members 15 of the desired lengths.

Manifestly, with changes in the length of the sleeve 15, it is desirable to employ a different length of rotor 25 and shaft 26. However, in many instances, the same bearings 48 and 49 have shaft seals 50 and 51 which can be employed so long as the shaft diameter 26 remains the same.

The end covers 14 and 17 are each provided with an outer bearing cavity 54 and 55, FIG. 2, of suitable size to receive the respective bearings 48 and 49, which are preferably sealed ball bearings. Likewise, the respective end covers 14 and 17 are provided with inner and smaller diameter cavities 57 and 58 for receiving shaft seals 50 and 51. Preferably, the shaft seals 50 and 51 each have a stainless steel garter spring for engaging the shaft 26 to prevent the movement of fluid along the shaft and into the bearing cavities 54 and 55. The shaft seals 50 and 51 may be of other suitable constructions and materials.

When the shaft 26 is mounted on the bearings 48 and 49, the shaft 26 is centered and is closely spaced in relationship to the circular shaft openings 60 and 61 formed in the end faces 62 and 63 of the inlet and outlet covers 14 and 17. These shaft openings 60 and 61, permit a small amount of fluid to move along the shaft 26 and into the cavities 57 and 58 wherein the shaft seals 50 and 51 serve to prevent the movement of fluid into the bearings 48 and 49.

To protect against the possibility of leakage of fluid beyond the shaft seals 50 and 51, small diameter passageways 65 and 66 are drilled or otherwise formed to provide outlets for eliminating accumulations of any fluid behind the shaft seals 50 and 51 which would tend to flood the bearings 48 and 49. These small passageways 65 and 66 extend from the outer surfaces of the respective end covers 14 and 17 to the juncture of the cavities 54, 55, 57 and 58. The passageways 65 and 66 are commonly termed as "weep holes" and should be kept from clogging as a part of the maintenance of the pump.

It is preferred practice to return the fluid at the shaft seals 50 and 51 and within the shaft seal cavities 57 and 58 to the interior of the sleeve 15. For this purpose return passageways 68 and 69, as seen in FIGS. 4 and 5, lead from the cavities 57 and 58 to the respective arcuate grooves 39 and 41 in the interior faces 62 and 63 of the respective pump bodies 14 and 17. Thus, fluid accumulating at the shaft seals moves through the respective passageways 68 and 69 and returns from the shaft seals into the lower pressure side of the pump 10.

As can best be understood in conjunction with FIG. 4, the inlet port 12 opens into the end face 62 of the inlet cover 14 and into an elongated arcuate groove 40. The smaller arcuate groove 41, is formed in the end face 62 and is connected to inlet port 12, but is separated from the groove 41 by an arcuate rib 70. Thus, fluid coming from the inlet port 14 is divided at the arcuate rib 70 and flows through the arcuate grooves 40 and 41 into the bore of the pump 10. Since the passageway 69 is in fluid communication with the inlet opening groove 41, fluid from the shaft seal cavity 59 may flow back into the bore 15.

In the outlet cover 17, a separate arcuate groove 39 is disposed on the low pressure side of the pump and is in fluid communication with the passageway 68 so as to permit the flow of fluid from the shaft seal cavity 58 back into the bore within the sleeve 15. The arcuate grooves 37 and 38 are separated by an arcuate rib 75 and both of the grooves 37 and 38 are in fluid communication with the outlet port 16.

The respective inlet and outlet covers 14 and 17 are formed with small annular grooves 78 and 79, respectively, FIG. 2, for receiving the end walls 44 and 45 of the sleeve 15. Annular O-ring gaskets 80 and 81, of a suitable material, are disposed in the respective grooves 78 and 79 and are compressed when the nuts 21 are tightened on the bolts 20 to effect the fluid tight seal between the sleeve 15 and the respective end covers 14 and 17. It should be noted that when the sleeve 15 is assembled in the grooves 80 and 81, the central axis and bore of the sleeve 15 is offset with respect to the centerline of the shaft 26. Hence, the rotor 25 and rollers 30 move closer to the inner surface 32 of the sleeve at one portion of their rotation, i.e., a high pressure side of the pump, and

move further from the inner surface 32 at the diametrically opposite portion of the sleeve 15, i.e., the low pressure side of the pump.

Another embodiment of the present invention is illustrated in FIG. 6, wherein a tandem pump is afforded by two pump modules 100 and 101 having a common drive shaft 126 effective to drive the respective impellers 125 and their respectively associated rollers 130. A first cylindrical sleeve 115 is in engagement with a separate inlet cover 114 and the fluid through this first module is directed through a central dividing plate 113 to the second module 101. Thus, it will be seen that the divider plate 113 functions to receive the output of the module 101 and direct the fluid through internal passageways 108 to the inlet side of the pump module 101. The fluid exists in the module 101 at the outlet cover 117. The shaft bearings, seals, and operation of the pump modules 101 and 102 are similar to the pump hereinbefore described with reference to FIGS. 1 and 5. An important aspect of this embodiment of the invention is that the tandem pump has an output which is equal to or in excess of twice that of a single pump module of FIGS. 1–5.

From the foregoing, it will be seen that the present invention affords a unique and low cost pump with modular design and also affords a pump of low cost construction. Moreover, the sleeve member 15 is readily separable and replaceable apart from the end covers or castings 14 and 17.

It is to be understood that the present invention in its broader aspects, is not to be limited to only roller pumps having the usual six or eight rollers but is applicable to other similar pumps. Also, the principles of the present invention are manifestly applicable to pumps having their inlet and outlet ports in different positions from those illustrated and described hereinbefore.

Hence, while preferred embodiments of the invention have been described and illustrated, it is to be understood that they are capable of variation and modification.

I claim:

1. A rotary roller pump comprising: first and second end cover members each having a flat planar internal surface and each including an annular groove of circular configuration in said internal surface, said grooves being of substantially identical dimensions; a pair of annular sealing members, disposed in respective ones of said annular grooves in said end cover members; a cylindrical casing member consisting of a simple sleeve of right circular cross-sectional configuration and uniform inside and outside diameters, extending between said end cover members and projecting to the annular grooves of said end cover members; fastener means, extending between said end covers, for clamping said casing member between said end cover members to afford a pump housing and to cause said casing member to engage said sealing members in compressive sealing engagement; and a rotary pump impeller eccentrically mounted within said casing member and journalled in said end cover members, said impeller including a plurality of radially movable impeller rollers approximately equal in length to the length of said casing member between said planar end cover surfaces; said end cover members having inlet and outlet ports formed therein and communicating with the interior of said pump housing through apertures in said planar internal surfaces thereof.

2. A rotary roller pump according to claim 1 in which said casing member is a section of a centrifugally cast metal sleeve, cut to the desired length for the pump chamber.

3. A rotary roller pump according to claim 1 in which said sealing members each constitute a resilient O-ring and in which said fastener means constitutes a plurality of retainer bolts extending between said end cover members.

4. A rotary roller pump comprising: first and second end cover members each having a flat planar internal surface and each including an annular groove of circular configuration in said internal surface, said grooves being of substantially identical dimensions; at least one divider member having opposed flat planar surfaces each including an annular circular groove substantially identical dimensionally with said end cover member grooves; a plurality of annular sealing members, individually disposed in respective ones of said annular grooves in said end cover and divider members; a plurality of cylindrical casings each consisting of a simple sleeve of right circular cross-sectional configuration and having uniform inside and outside diameters, one of said casings extending between each adjacent pair of said end cover and divider members and projecting to the annular grooves of said end cover and divider members; fastener means for clamping said end cover and divider members and said casings together to afford a plural chamber pump housing, one chamber for each casing, and to cause said casings to engage said sealing members in compressive sealing engagement; an impeller shaft extending through all of said pump chambers in eccentric relation to said casings and journalled in said end cover and divider members; a plurality of impellers mounted on said shaft, one in each pump chamber, and each including a plurality of radially movable impeller rollers approximately equal in length to the length of the associated casing intermediate the planar surfaces at opposite ends of the casing; said end cover and divider members having inlet and outlet ports formed therein communicating with the interior of said chambers in said pump housing through apertures in said planar internal surfaces thereof.

5. A rotary roller pump according to claim 4 in which said pump chambers are coupled in tandem through said divider member.

6. A rotary roller pump according to claim 1 in which said casing member is a section of a sintered metal sleeve, cut to the desired length for the pump chamber.

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