Aug. 12, 1969 D. A. BROWNELL 3,460,480

PUMP ASSEMBLY

Filed Sept. 20, 1967 2 Sheets-Sheet 1

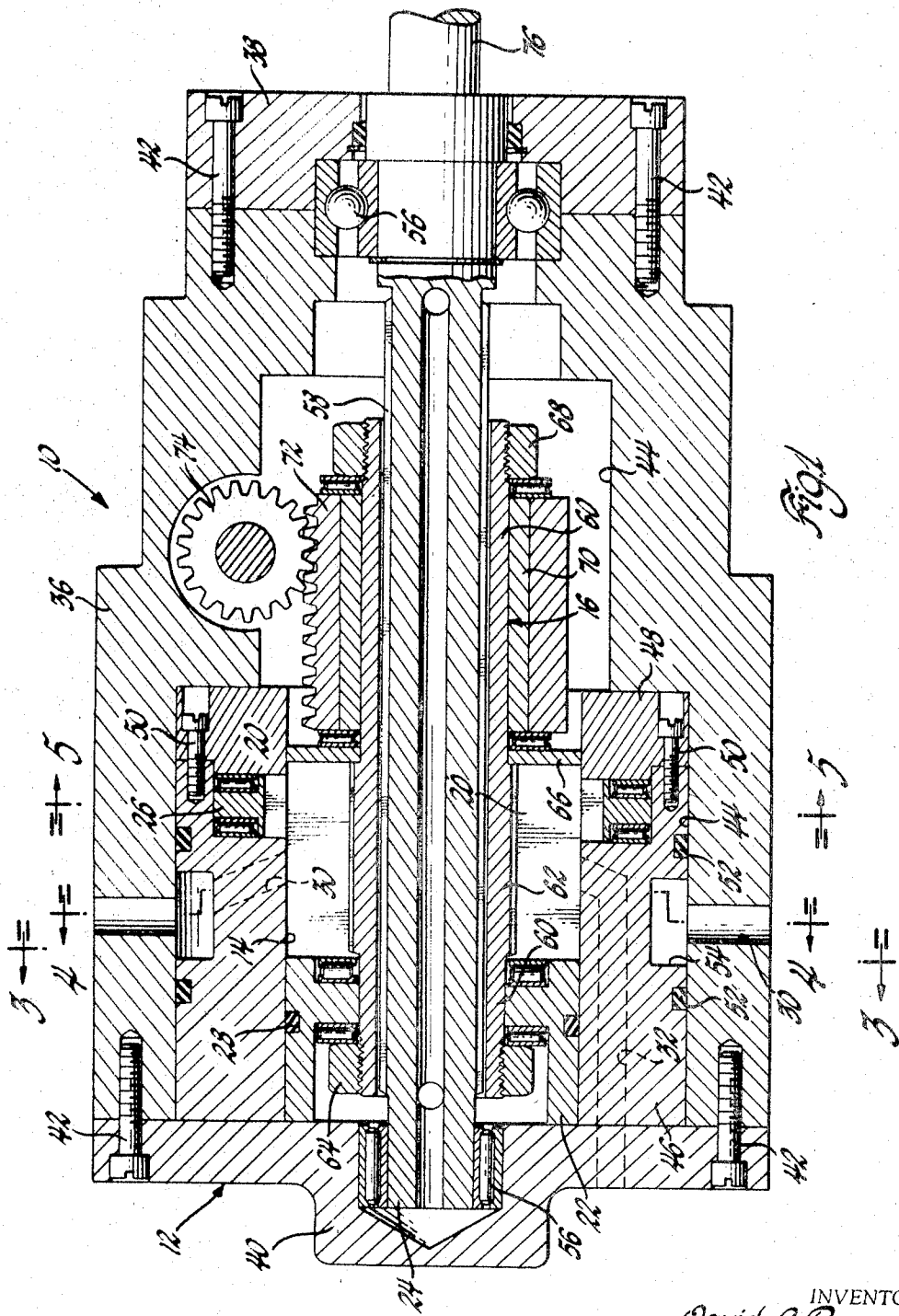

Fig. 1

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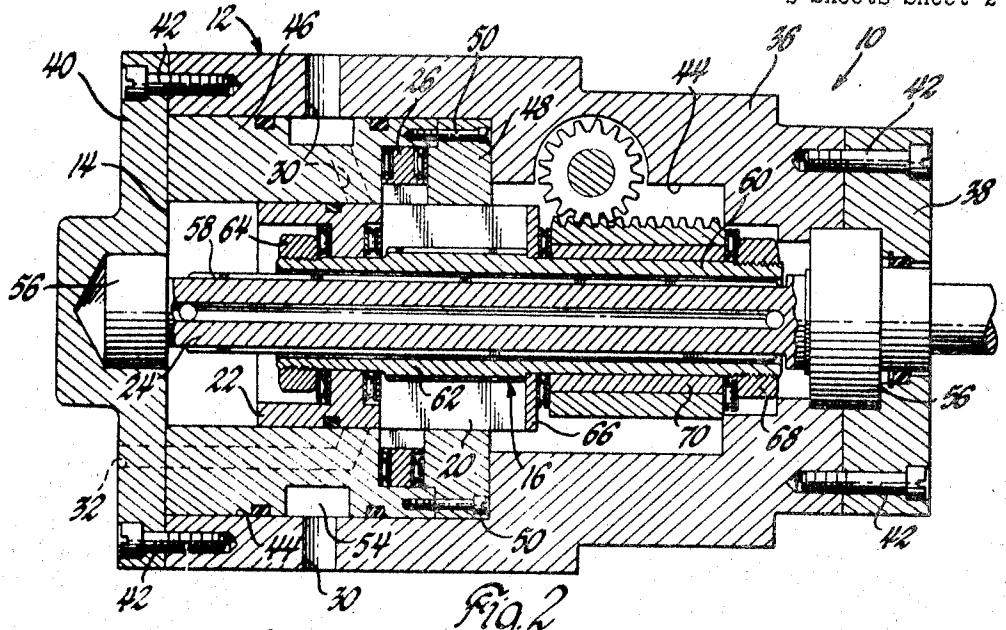

Fig. 2

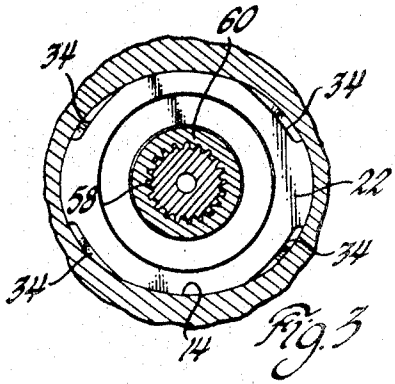

Fig. 3

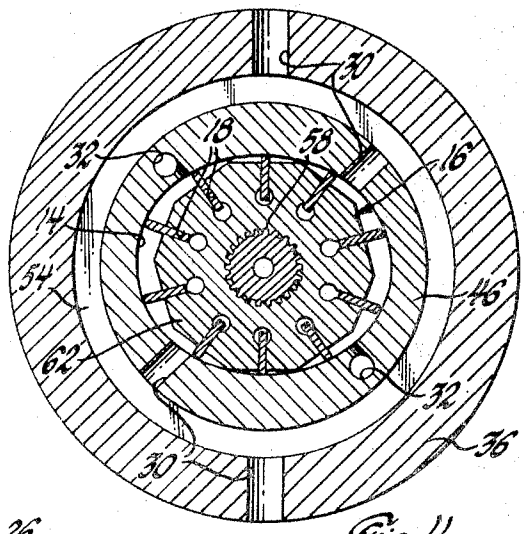

Fig. 4

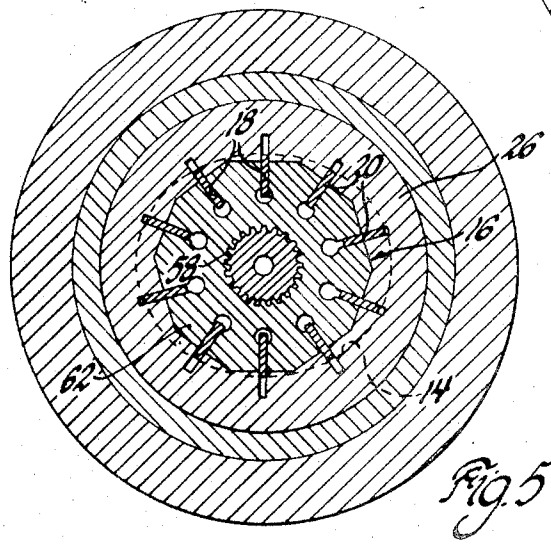

Fig. 5

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PUMP ASSEMBLY

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ABSTRACT OF THE DISCLOSURE

A pump assembly including a housing means having an elongated chamber therein with the elongated chamber having a substantially elliptical shape as viewed in cross section. A rotor means with vanes disposed in radial slots therein is disposed in the elongated chamber so that the vanes coact with the walls thereof. The rotor means comprises an elongated tubular portion and a hub portion disposed along the tubular portion with the vanes being disposed in the hub portion. A plug means is slidably disposed in the elliptically shaped chamber and is retained on one end of the tubular portion and in abutting engagement with the hub portion and one end of the vanes. A washer like element is disposed on the tubular member and abuts the other end of the hub portion and the other end of the vanes. A sleeve is rotatably disposed in the housing and is in sealing engagement about the hub portion of the rotor means and the vanes so that a pumping chamber is defined between the plug means and and the sleeve. The rotor means is axially movable so as to move the plug means axially between a first maximum pumping position where the plug means is spaced from the sleeve and a minimum pumping position where the plug means abuts the sleeve, i.e., where the pumping chamber is of zero volume. The specific improvements being that the plug means has recesses therein for providing fluid communication between the pumping chamber and inlet and outlet passages in the housing when the plug means is axially positioned in close proximity to or abutting the sleeve and that the hub portion of the rotor means has a polygonal periphery and the sleeve is contiguous therewith so that the force for rotating the sleeve is not transmitted through the vanes.

As alluded to above, this invention relates to an improved variable capacity pump and more particularly to a rotary vane type pump.

It is an object and feature of this invention to provide an improved rotary vane type pump which is relatively simple in construction, inexpensive to manufacture, easy to install and operate, compact, and efficient and durable in use.

Another object and feature of this invention is to provide a rotary vane type pump with vanes disposed in slots in the hub of a rotor means, both of which are slidable through an axially fixed rotatable sleeve, which is contiguous with the vanes and the hub of the rotor means, so as to vary the capacity of the pump and including a plug means abutting one end of the hub and axially movable toward and away from the sleeve and wherein the plug means includes recesses to provide fluid communication between the pumping chamber and inlets and outlets in the housing and/or wherein means interconnects the periphery of the hub and the sleeve to prevent relative rotation therebetween while allowing relative axial movement therebetween.

Other objects and attendant advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed

description when considered in connection with the accompanying drawings wherein:

FIGURE 1 is a cross sectional view of a preferred embodiment of the instant invention and showing the components in the maximum pumping position;

FIGURE 2 is a cross sectional view similar to FIGURE 1 but of reduced scale and showing the components in the minimum pumping capacity position;

FIGURE 3 is a fragmentary cross sectional view of reduced scale taken substantially along line 3—3 of FIGURE 1;

FIGURE 4 is a cross sectional view of reduced scale taken substantially along line 4—4 of FIGURE 1; and

FIGURE 5 is a cross sectional view of reduced scale taken substantially along line 5—5 of FIGURE 1.

Referring now to the drawings, wherein like numerals indicate like or corresponding parts throughout the several views, a preferred embodiment of the pump assembly of the instant invention is generally shown at **10**.

The pump assembly includes a housing means generally indicated at **12** and having an elongated chamber **14** therein. There is also included a rotor means generally indicated at **16** and having radial slots **18** disposed therein. Vanes **20** are disposed in the slots **18** for pumping coaction with the walls of the elongated chamber **14**. There is also included means, which includes plug means **22** and a shaft **24**, for rotatably supporting the rotor means **16** and the vanes **20** and for axially moving the rotor means **16** and vanes **20** in unison. An axially fixed sealing means comprising the sleeve **26** is rotatably supported in the housing means **12** and is disposed about the rotor means **16** and the vanes **20** for rotation therewith. Hence, the pumping capacity of the pump is varied as the rotor means **16** and the vanes **20** are moved axially relative to the sleeve **26**, i.e., the volume of the pumping chamber between the plug means **22** and the sleeve **26** is varied.

The elongated chamber **14**, as best illustrated in FIGURE 3, has a pair of lobes so that it is substantially elliptical as viewed in cross section. The plug means **22** is movable with the rotor means **16** and conforms to and is slidably disposed in the elongated chamber **14**. A seal or O-ring **28** is disposed about the plug means **22** to provide a seal between the plug means **22** and the walls of the elongated chamber **14**. The plug means **22** is in sealing engagement with the rotor means **16** and abuts a first end of the vanes **20**. Thus, the pumping chamber is formed between the sleeve **26** and the plug means **22**. The pumping chamber is shown at maximum volume in FIGURE 1 whereas the pumping chamber is reduced to no volume in FIGURE 2 wherein the plug means **22** is shown abutting the sleeve **26**. In other words, the rotor means **16** is axially movable between a maximum pumping position where the plug means **22** is axially spaced from the sleeve **26**, as illustrated in FIGURE 1, and a minimum pumping position where the plug means **22** abuts the sleeve **26**, as illustrated in FIGURE 2.

The housing means **12** has inlet passages **30** and outlet passages **32** therein and communicating with the elongated chamber **14** adjacent the sleeve **26**. As best illustrated in FIGURE 4, there is an inlet passage **30** and an outlet passage **32** in communication with each lobe of the elongated chamber **14**. The plug means **22** has recesses **34** therein for providing fluid communication between the pumping chamber and the inlet and outlet passages **30** and **32** when the plug means **22** is axially positioned in close proximity to and/or abutting the sleeve **26**.

The sleeve **26** is disposed between the extremities of the elongated chamber **14** so that the vanes **20** may coact with the walls of the elongated chamber **14** on each side of the sleeve **26**. Preferably, in operation, the vanes **20** are

at all times coacting with the walls of the elongated chamber 14 on both sides of the sleeve 26, such coaction prevents cocking or askewed positioning of the vanes.

The housing means 12 may take many forms but as illustrated includes an outer casing 36 having end caps or plates 38 and 40 held in position by the bolts 42. The casing has a cavity 44 therein and a cylinder comprising the members 46 and 48 is disposed in the cavity 44. The elongated chamber 14 extends through the members 46 and 48 of the cylinder. The members 46 and 48 of the cylinder define annulus in which the sleeve 26 is rotatably disposed. The members 46 and 48 are connected together by fastening means comprising the bolts 50. The sleeve 26 is supported in the annulus between the members 46 and 48 by roller bearings. The first member 46 has seals or O-rings 52 disposed thereabout for sealing the cylinder in the cavity 44 of the casing 36. In addition, the first member 46 has an annular groove 54 extending circumferentially thereabout for providing a fluid chamber. The inlet passages 30 provide fluid communication between the pumping chamber and the annular groove 54.

The shaft 24 is rotatably supported in the housing through the bearings 56 and extends through the elongated chamber 14. A spline arrangement 58 forms a means connecting the rotor means 16 to the shaft 24 so that the rotor means 16 rotates with the shaft 24 but is axially movable therealong.

The rotor means 16 includes an elongated tubular portion 60 and a hub portion 62 disposed therealong. The vanes 20 are disposed in the hub portion 62. A first end of the tubular portion 60 is rotatably supported in the plug means 22. A first retainer means comprising the nut 64 is threadably disposed on the first end of the tubular portion 60 for retaining the plug means 22 in abutting relationship with the first end of the vanes 20 and in abutting relationship with a first side of the hub portion 62 to prevent axial movement of the plug means 22 relative to the rotor means 16. A bearing is disposed between the nut 64 and the plug means 22 and a bearing is disposed between the plug means 22 and the hub portion 62.

There is also included means independent of the vanes 20 interconnecting the periphery of the hub 62 of the rotor means 16 and the female portion of the sleeve 26 for preventing relative rotation therebetween while allowing relative axial movement therebetween. More specifically, this last-mentioned means is defined by a noncircular perphery of the hub 62 with the female portion of the sleeve 26 being contiguous therewith, as best illustrated in FIGURE 5. The periphery of the hub 62 is polygonal and as illustrated in FIGURE 5 there are ten (10) sides to the polygonal periphery of the hub 62. Additionally, the number of sides of the polygonal periphery of the hub 62 is equal to the number of vanes 20 disposed therein. This provides a very efficient and economical means for rotatably interconnecting the hub and the sleeve so that driving forces are not transmitted through the vanes 20.

The rotor means 16 also includes a washer like element 66 which is disposed about the tubular portion 60 and abuts the second end of the vanes 20 and abuts the second side of the hub portion 62. Axial movement of the vanes 20 relative to the hub portion 62 of the rotor means 16 is therefore limited by engagement with the plug means 22 and the washer like element 66. This axial movement is very small, however. A second retainer means comprising the nut 68 is threadably disposed on the second end of the tubular portion 60 for retaining the washer like element 66 in abutting relationship with the other side of the hub portion 62. A bushing 70 is disposed on the tubular portion 60 of the rotor means 16 and a rack means 72 is disposed about the bushing 70. A bearing is disposed between the nut 68 and the end of the bushing 70 and the rack 72. Another bearing is disposed between the washer like element 66 and the other end of the bushing 70 and the rack 72. Another bearing is disposed between the washer-like element 66 and the other end of the bushing 70 and the rack means 72. A pinion means 74 is rotatably supported by the casing 36 and engages the rack means 70 for moving the rotor means 16 axially to vary the capacity of the pump assembly.

Although the rack means 72 and pinion means 74 have been illustrated for axially moving the rotor means 16, it will be understood by those skilled in the art that other devices may be utilized for axially moving the rotor means 16. For example, a fluid pressure responsive device may coact to the rotor means 16 for axially moving the rotor means 16 in response to pump outlet pressure. An appropriate power means is operatively connected to the shaft 76 for rotating the shaft which in turn rotates the rotor means 16 to accomplish a pumping function.

Assuming it is desirable to operate the pump at full capacity, the rotor means 16 is moved axially to the left as viewed in FIGURE 1 to provide a pumping chamber of maximum volumetric capacity. The pumping chamber as illustrated in FIGURE 1 is that portion of the elongated chamber 14 between the plug means 22 and the sleeve 26, the sleeve 26 being in contiguous sliding engagement with the vanes 20 and the hub portion 62 of the rotor means 16. Thus, as illustrated in FIGURE 1, only those portions of the vanes 20 between the plug means 22 and the sleeve 26 are performing a pumping action.

If it is desirable to reduce the capacity of the pump assembly, the rotor means 16 is moved axially to the right as viewed in FIGURE 1 so that the hub portion 62 and the vanes 20 slide through the rotating sleeve 26 to reduce the volume of the pumping chamber. The rotor means 16 may be moved to the right until the pumping capacity of the pump is completely terminated. In other words, once the plug means 22 abuts the sleeve 26, the pumping chamber is reduced to zero, i.e., eliminated as illustrated in FIGURE 2.

As the rotor means 16 is moved to the right and the plug means 22 approaches abutting relationship with the sleeve 26, the recesses 34 allow fluid flow between the pumping chamber and the inlet and outlet passages 30 and 32.

Although the instant invention has been described as a pumping assembly, it will be understood by those skilled in the art that in some environments it may satisfactorily be used as a motor.

The invention has been described in an illustrative manner and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

The embodiments of the invention in which an exclusive properly or privilege is claimed are defined as follows.

I claim:

1. A pump assembly comprising: housing means having an elongated chamber therein; rotor means having radial slots therein; vanes disposed in said slots for pumping coaction with the walls of said chamber; means rotatably supporting said rotor means and vanes for axially moving said rotor means and vanes in unison; an axially fixed sealing means rotatably supported in said housing means and having an internal female portion disposed about said rotor means and said vanes for rotation therewith whereby the pumping capacity is varied as said rotor means and said vanes are moved axially relative to said sealing means; and means independent of said vanes interconnecting the periphery of said rotor means and said female portion of said sealing means for prevent relative rotation therebetween while allowing relative axial movement therebetween.

2. An assembly as set forth in claim 1 wherein said

last-mentioned means is defined by a noncircular periphery of said rotor means with the female portion of said sealing means being contiguous therewith.

3. An assembly as set forth in claim 2 wherein the periphery of said rotor means is polygonal.

4. An assembly as set forth in claim 3 wherein the number of sides of the polygonal periphery of said rotor means is equal to the number of vanes therein.

5. A pump assembly comprising: housing means having an elongated chamber therein, said chamber having at least one lobe as viewed in cross section; rotor means having radial slots therein; vanes disposed in said slots for pumping coaction with the walls of said chamber; means rotatably supporting said rotor means and vanes for axially moving said rotor means and vanes in unison and including plug means movable with said rotor means and conforming to and slidably disposed in said elongated chamber; and an axially fixed sealing means rotatably supported in said housing means and disposed about said rotor means and said vanes for rotation therewith whereby the pumping capacity is varied as said rotor means and said vanes are moved axially relative to said sealing means; said plug means being in sealing engagement with said rotor means and abutting a first end of said vanes thereby forming a pumping chamber between said sealing means and said plug means; said housing means having inlet and outlet passages therein and communicating with said elongated chamber adjacent said sealing means; said rotor means being axially movable between a maximum pumping position where said plug means is axially spaced from said sealing means and a minimum pumping position where said plug means is adjacent said sealing means; said plug means including recesses therein for providing fluid communication between said pumping chamber and said inlet and outlet passages when said plug means is axially positioned in close proximity to said sealing means.

6. A pump assembly as set forth in claim 5 wherein said sealing means comprises a sleeve disposed between the extremities of said elongated chamber so that said vanes may coact with the walls of said elongated chamber on each side of said sleeve.

7. A pump assembly as set forth in claim 6 wherein said means supporting said rotor means further includes a shaft rotatably disposed in said housing means and extending into said elongated chamber, means connecting said rotor means to said shaft for rotation thereby and axial movement therealong.

8. A pump assembly as set forth in claim 7 wherein said elongated chamber has two lobes and is substantially elliptical as viewed in cross section, said housing means having an inlet and outlet passage communicating with each of said lobes.

9. A pump assembly as set forth in claim 8 wherein said rotor means includes an elongated tubular portion and a hub portion disposed therealong, said vanes being disposed in said hub portion, a first end of said tubular portion being rotatably supported in said plug means, first retainer means disposed on said first end of said tubular portion for retaining said plug means in abutting relationship, with said first end of said vanes and a first side of said hub portion and to prevent axial movement of said plug means relative to said tubular portion.

10. A pump assembly as set forth in claim 9 wherein said rotor means further includes a washer-like element disposed about said tubular portion and abutting the second end of said vanes and the second side of said hub portion, second retainer means disposed on the second end of said tubular portion for retaining said washer-like element in abutting relationship with said hub portion.

11. A pump assembly as set forth in claim 10 wherein said housing means includes an outer casing having a cavity therein and a cylinder disposed in said cavity, said elongated chamber extending through said cylinder, said cylinder comprising first and second members coacting to define an annulus and connected together by fastening means, said sleeve being rotatably disposed in said annulus, said first member having annular groove extending circumferentially thereabout for providing a fluid chamber, one of said inlet and outlet passages providing communication between said pumping chamber and said annular groove.

12. A pump assembly as set forth in claim 11 including a rack means disposed along said tubular portion between said washer-like element and said second retainer means, pinion means rotatably supported by said housing means and engaging said rack means for moving said rotor means axially to vary the capacity of the pump assembly.

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