# United States Patent [19]

**Meier et al.**

[11] **3,863,547**

[45] **Feb. 4, 1975**


[54] **HYDRAULIC DRIVE FOR SWITCHGEAR**


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[22] Filed: **Dec. 11, 1972**

[21] Appl. No.: **314,259**

[30] **Foreign Application Priority Data**

Dec. 13, 1971 Switzerland ..... 18042

[52] **U.S. Cl.** ..... **91/416**, 91/26, 91/405, 91/417, 91/461

[51] **Int. Cl.** ..... **F15b 15/17**, F15b 15/22

[58] **Field of Search** ..... 91/416, 417 R, 405, 321; 92/113, 300



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[57] **ABSTRACT**

A hydraulic drive for controlling switchgear in which a main differential piston having faces of different effective surface areas is subjected to fluid pressure on both faces to cause said piston to move in one direction and a reversing valve which prevents fluid flow to the larger of the faces of the piston while at the same time opening a relief port to permit reduction of pressure of said larger face so that the piston will move in the opposite direction because of the pressure of the smaller face of the main differential piston.


**2 Claims, 5 Drawing Figures**

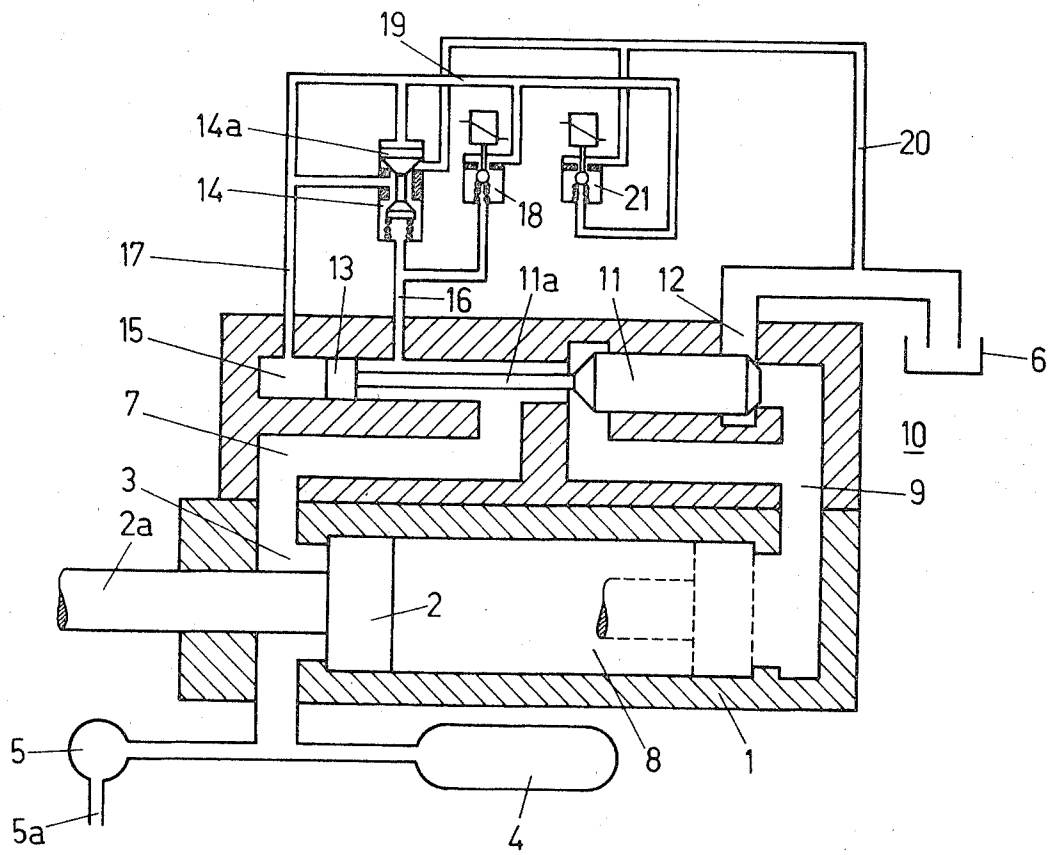
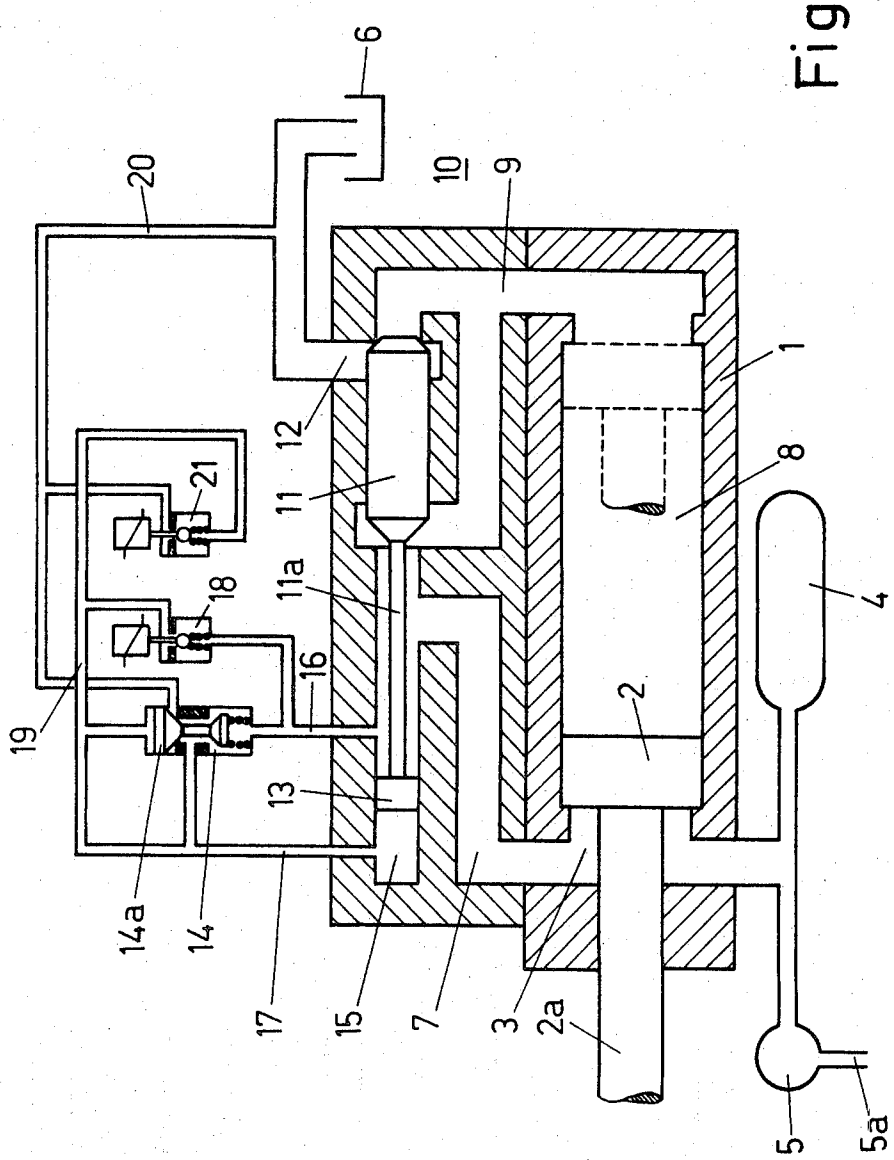


Fig.1



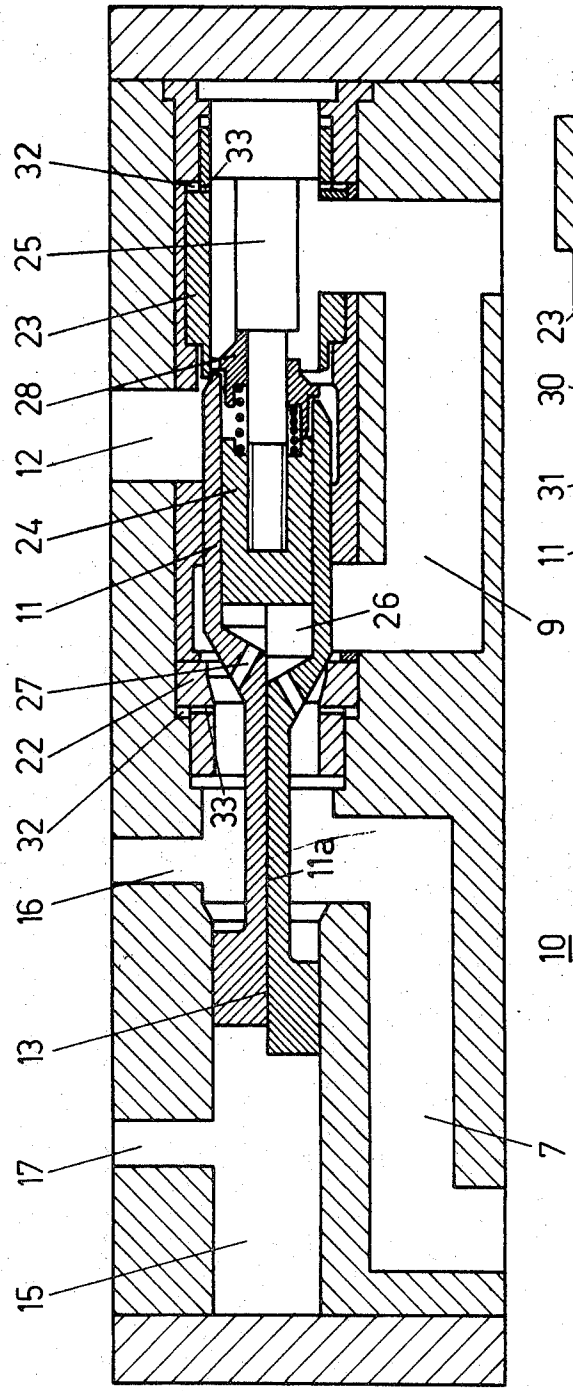

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Fig. 2

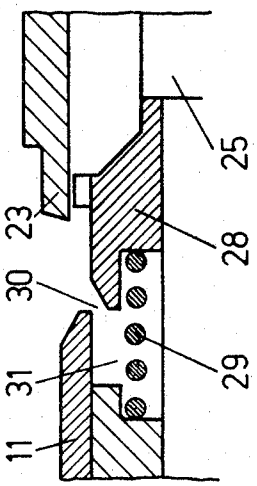
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Fig. 2a

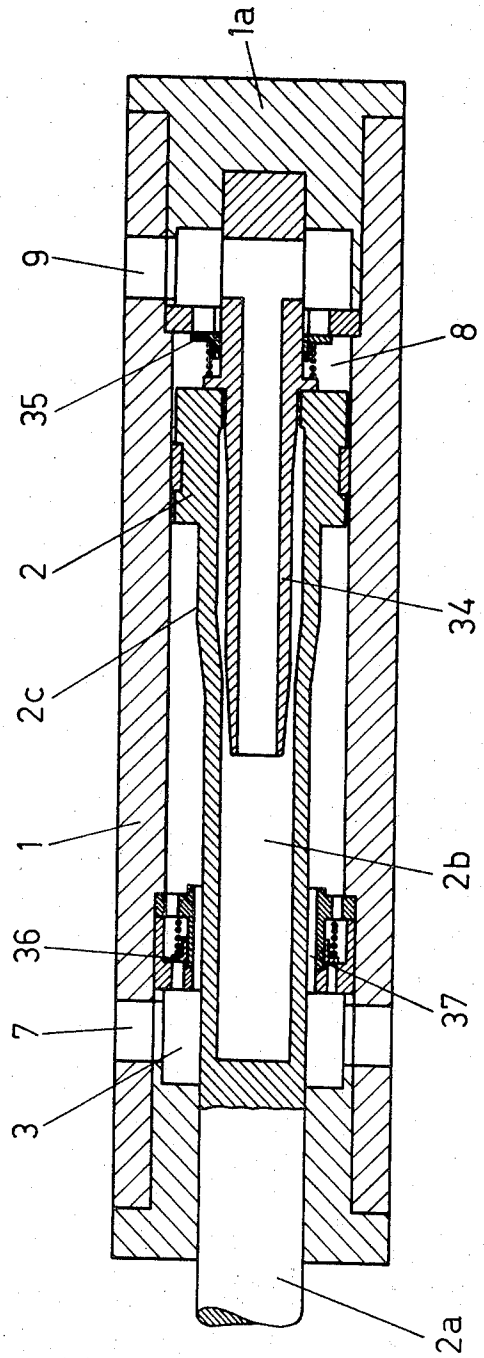


Fig. 3

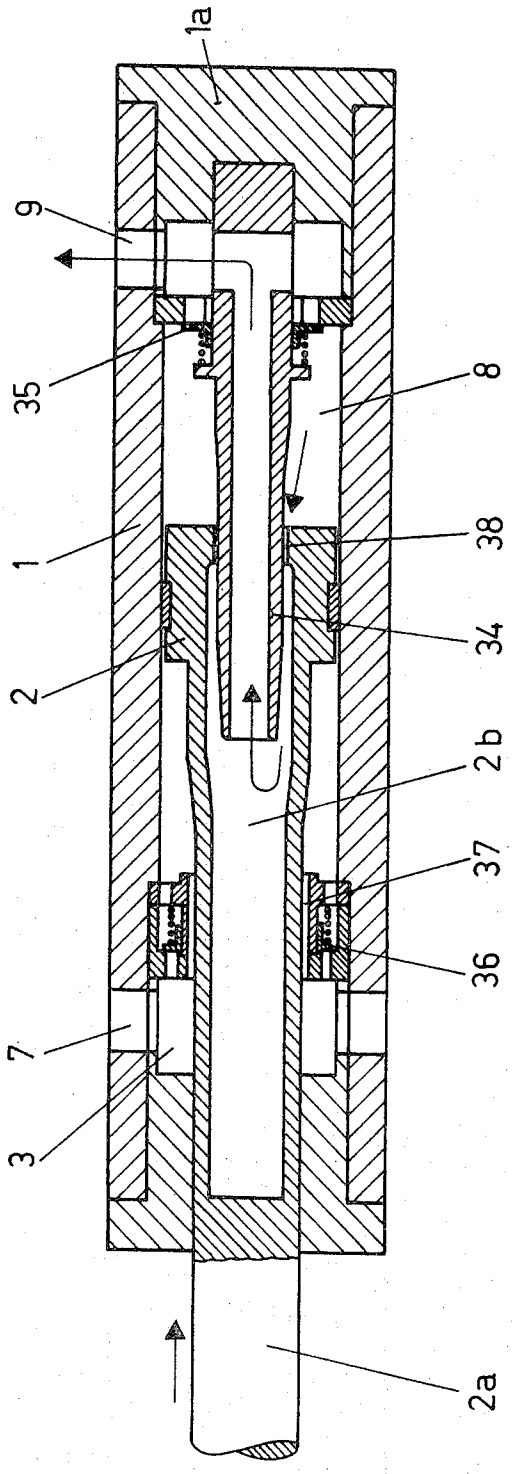


Fig. 4

# HYDRAULIC DRIVE FOR SWITCHGEAR

The invention concerns a hydraulic drive, particularly for electrical switchgear, comprising a main piston, in the form of a differential piston located in the drive cylinder, the movement of which is controlled in both directions by applying pressure to, or removing pressure from, the larger effective face of the piston, with pressure-medium container, main valve, amplifier valve and control valve.

A hydraulic drive for electrical circuit-breakers is known as shown in German published specification **1 171 057** which incorporates a differential piston, pressure being applied to the larger face to close the breaker, and to the smaller face to open it. This drive has two containers for the hydraulic medium. A hydraulic drive is also known with only one container for the hydraulic fluid as shown in Swiss Pat. No. 485 313. In this case the piston is controlled by means of a pawl which engages the contact rod, holding the piston against the force of the smaller piston face which is continuously subjected to pressure when the breaker is in the closed position.

The object of the invention is to create a hydraulic drive of the kind stated initially which requires no pawls to hold the main piston in the extreme position. This object is achieved in that the pressure-medium container is permanently connected to the cylinder space adjacent to the smaller effective face of the main piston, and that the main valve has the form of a reversing valve such that when the moving bobbin of this valve is in one extreme position the cylinder chambers at both ends of the main piston are always linked to each other, while in the other extreme position of the bobbin the chambers are sealed from each other, the chamber adjacent to the larger face of the main piston being connected to a pressure-relief port.

The invention will now be explained in more detail with reference to the accompanying drawings, in which:

FIG. **1** is a schematic view of the hydraulic drive;

FIG. **2** is a longitudinal section through the reversing valve shown in FIG. **1** on a larger scale and showing further details,

FIG. **2***a* is an enlarged detail of FIG. **2**;

FIG. **3** is a section of a modification of the main cylinder with the piston in one extreme position; and,

FIG. **4** is similar to FIG. **3**, showing the piston in momentary intermediate positon.

In FIG. **1**, main piston **2** slides in main cylinder **1**. Piston rod **2***a* slides through one end of cylinder **1**, forming a seal. The switchgear to be actuated is connected to the piston rod in a manner not further described. On the side towards cylinder chamber **3** the main piston **2** has an annular effective surface which, because of the piston rod, is smaller than the opposed full surface of the piston, resulting in a differential piston. Cylinder chamber **3** is, on the one hand, permanently connected to pressure-medium container **4**, which can be pressurised by means of either a membrance or a piston. It is filled by a pump **5** which is powered by a drive not shown, and which supplies container **4** by way of a non-return valve. Pump **5** has an intake pipe **5***a* which, for example, draws oil from overflow tank **6**, thus forming a closed oil circuit. Chamber **3** is, on the other hand, connected via duct **7** to the reversing valve designated as a whole by **10** and then duct **9** to chamber **8**. The reversing valve **10** incorporates a moving bobbin **11** which in one extreme position (as shown) connects duct **7** to duct **9** and hence cylinder chambers **3** and **8** to each other. The pressure-relief port **12** leading to the overflow tank **6** is then closed by bobbin **11**. Owing to its differential action the main piston **2** assumes the left hand position shown, which corresponds to the closed position, for example, of the switchgear. The bobbin **11** of reversing valve **10** is connected by a rod **11***a* to a differential piston **13**. In the position shown, the oil in control chamber **15** to the left of piston **13** is under pressure because the amplifier valve **14** connects the two pipes **16, 17** to each other. The position shown is reached when control valve **18** is opened by a magnetic pulsed instruction, whereupon pipe **16** communicates through valve **18** with pipe **19** so that piston **14**a of amplifier valve **14** is subjected to pressure and assumes its lower position, as shown.

To bring the main piston **2** to its other right hand position, shown by the broken line and corresponding to the open setting of the switchgear, the pressure in chamber **8** is released by way of duct **9** and pressure-relief port **12** to the overflow tank **6**. To achieve this, valve bobbin **11** is moved to its extreme left position, where it blocks communication between ducts **7** and **9** and at the same time connects duct **9** to pressure-relief port **12**. For this, the pressure in chamber **15** is released. This is done by reversing the amplifier valve **14** so that pipe **17** is connected to pipe **20** leading to the overflow tank **6**. Amplifier valve **14** is reversed by removing the pressure applied to the top of its piston **14**a. This is done by an opening pulse from control valve **21**, whereupon pipe **19** is connected to pipe **20** leading to overflow tank **6**, and piston **14**a is thus depressurised.

The reversing valve **10** is shown in more detail in FIGS. **2** and **2***a*, corresponding parts being denoted by the same reference numbers. The valve bobbin **11** is so constructed that the loss of pressure medium during the reversing process is as small as possible. The upper half of bobbin **11** in FIG. **2** shows the position of parts **11**, **11***a*, **13** as indicated in FIG. **1**. The bobbin **11** is here separated from the left-hand valve seat **22**, but is in contact with the right-hand valve seat **23**. Valve bobbin **11** is bell-shaped and surrounds a fixed cylindrical guide piece **24** which is held by a stud **25** provided with a thread for attaching it to guide piece **24**. Between valve bobbin **11** and the left end of guide piece **24** there is a chamber **26** which is connected by way of throttling ports **27** in valve bobbin **11** with the surrounding space, in which duct **7** terminates. The movement of valve bobbin **11** can be influenced as desired by suitably sizing the ports **27**. At the opposite end of bobbin **11**, adjacent valve seat **23** there is a throttling device **28** which is mounted on the stud **25** and can move against spring **29** (see FIG. **2***a*). The effect of this is that when valve bobbin **11** moves to the left (see the lower half of bobbin **11**), pressure-relief port **12** is uncovered relatively late, i.e., towards the end of the travel of valve bobbin **11**. As is shown in more detail in FIG. **2***a*, a small annular gap between parts **11** and **28** becomes wider (enlarged gap **30**) only towards the end of the travel of part **11**, whereupon the oil can flow unhindered from chamber **31**. The throttling device **28** can then move to the left (lower half of bobbin **11** in FIG. **2**) under the influence of the oil forced through duct **9** by the main piston **2**, and as a result the pressure relief port **12** is fully uncovered. As soon as compression of

the oil ceases when main piston 2 has completed its movement, spring 29 returns throttling device 28 to its original position. Throttling device 28 remains stationary when valve bobbin 11 moves to the right. The valve seats 22, 23 are themselves rigid but are mounted on shock absorbing mountings. The end of the movement of valve bobbin 11 is cushioned by means of small fluid-filled cavities 32 which can empty or fill through throttling ports 33 in the sleeve-shaped valve seats 22, 23. The effective areas of these ports 33 are of such a size that valve seats 22, 23 return to the positions shown after valve bobbin 11 has completed its movement.

FIG. 3 shows a modified form of main cylinder 1 and main piston 2 which allows the movement of the main piston to be influenced as desired. For this, piston 2 and piston rod 2*a* are provided with a blind hole 2*b* into which a hollow needle 34 projects. The needle 34 is mounted in a fixed position in one endcover of the main cylinder 1. Chamber 8 to the right of piston 2 can be sealed off from duct 9 by a spring-loaded nonreturn valve 35. At the left-hand end there is another nonreturn valve 36 between chamber 3 and piston 2, although in this case an annular gap 37 is left open round the piston rod 2a and parallel to non-return valve 36. When the piston 2, starting from its extreme right-hand position as shown in FIG. 3, moves to the left, pressurised oil passes through needle 34 into hole 2*b*, and at the same time through the open non-return valve 35 into chamber 8, whereupon piston 2 is set in motion towards the left. Towards the end of its travel the divergent portion 2*c* of piston rod 2*a* largely seals off the annular gap 37, having the effect of damping the movement. FIG. 4 shows how in the other direction the oil forced out of chamber 8 with non-return valve 35 closed has to pass through the annular gap 38 between piston 2 and needle 34, and through the inside of needle 34 to duct 9 and thence to pressure-relief port 12 (FIG. 1). By suitably sizing the relevant parts it is possible within broad limits to achieve the pattern of movement required.

We claim:

1. A hydraulic drive for controlling switchgear comprising a main cylinder, a main differential piston slidable therein for controlling the switchgear, the opposed effective faces of said differential piston having different effective surfaces areas, a source of a pressure medium connected to one end of said cylinder to supply pressure to the smaller face of said differential piston, first closeable passage means connecting the opposed ends of said main cylinder, a main reversing valve for controlling flow of the pressure medium through said first passage means, whereby when said main reversing valve is open to permit the flow of pressure fluid to the larger face of said main differential piston, said main differential piston is moved in one direction, and a pressure relief port in said first passage means is opened when said main reversing valve closes said first passage means to permit reduction of fluid pressure against the larger face of said differential piston whereby said differential piston moves in the opposite direction, a second cylinder, a second differential piston connected to said reversing valve and slidably mounted in said second cylinder, the smaller effective face of said second differential piston being subject at all times to the pressure of the pressure medium, second passage means connecting opposed ends of said second cylinder, a control valve means disposed in said second passage means for controlling the flow of pressure medium in said second passage means to the larger effective face of said second differential piston, means for controlling said control valve means to actuate said main reversing valve, said main differential piston including an axial recess and a hollow needle valve means in communication with said first passage means and slidably disposed in said recess and cooperating therewith, said hollow needle valve means being fixed to said main cylinder, whereby said needle valve means is open to permit flow of the pressure fluid against the larger effective face of said main differential piston when said main differential piston moves in the one direction and closes when said main differential piston has moved in the opposite direction.

2. A hydraulic drive as claimed in claim 1 wherein said main reversing valve includes a valve member and opposed valve seats for said valve member when in its two extreme positions and further comprising shock absorbing mountings for said seats to cushion the movement of said valve member.

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