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Kikutsugi et al.

[11] **3,791,766**

[45] **Feb. 12, 1974**

[54] **HYDRAULIC PRESSURE GENERATING DEVICE**

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[52] **U.S. Cl.** **417/363,** 417/366, 417/372

[51] **Int. Cl.** **F04b 39/06**

[58] **Field of Search** ... 417/367, 368, 222, 271, 313, 417/363, 366, 372, 435; 165/47; 184/104

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Assistant Examiner—Richard Sher
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[57] **ABSTRACT**

A hydraulic pressure generating device having a housing with air holes formed at least in its upper and lower walls, a partition wall with air holes to divide the housing into upper and lower rooms, a fan located in the upper room of the housing, a pressure compensation variable discharge type pump, a motor mounted in the lower room for driving the pump, and an oil tank disposed in the lower room and having soaked therein the pump. In this case, when the fan is operated, air is sucked into the housing from the air holes bored in the lower wall of the housing and is discharged out of the housing through the air holes bored in the upper wall of the housing to thereby cool the pump and the motor effectively.

9 Claims, 5 Drawing Figures

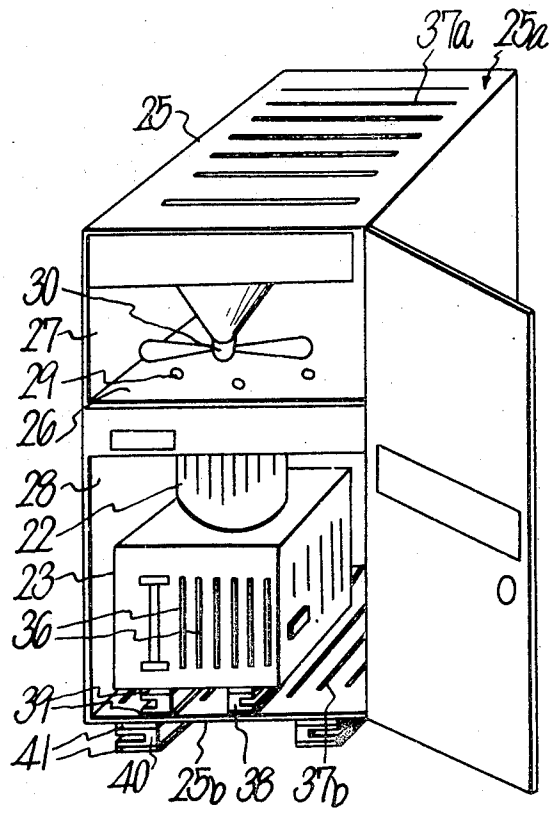


Fig. 1 PRIOR ART

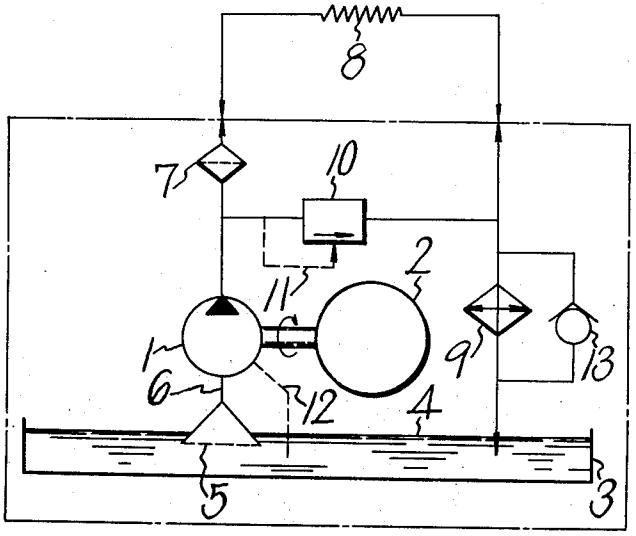


Fig. 2

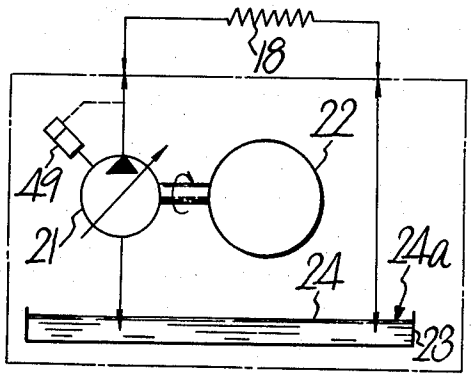


Fig-1

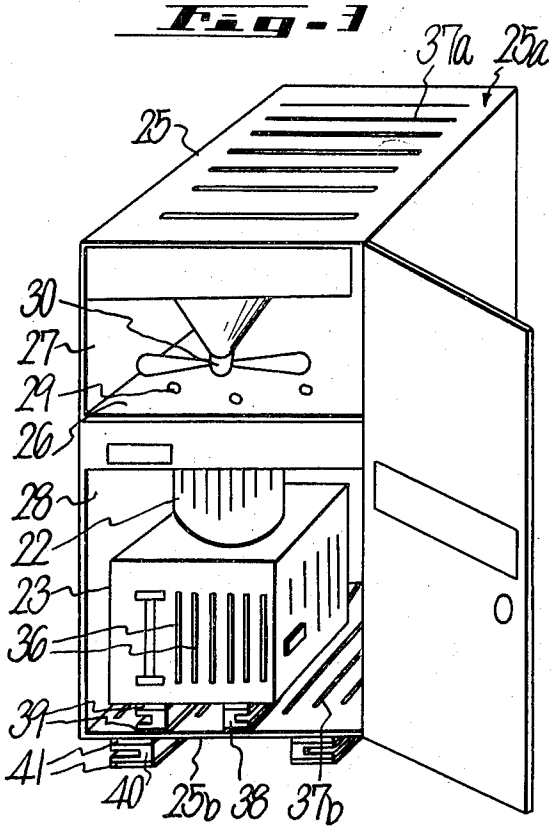

37a
25a
25
30
27
29
26
28
22
23
36
39
41
40
25b
38
37b

Fig-4

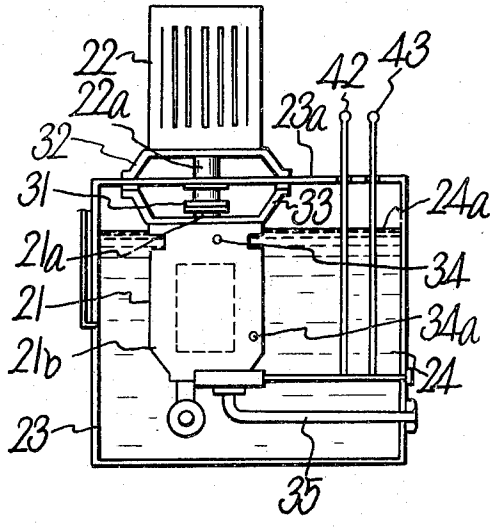
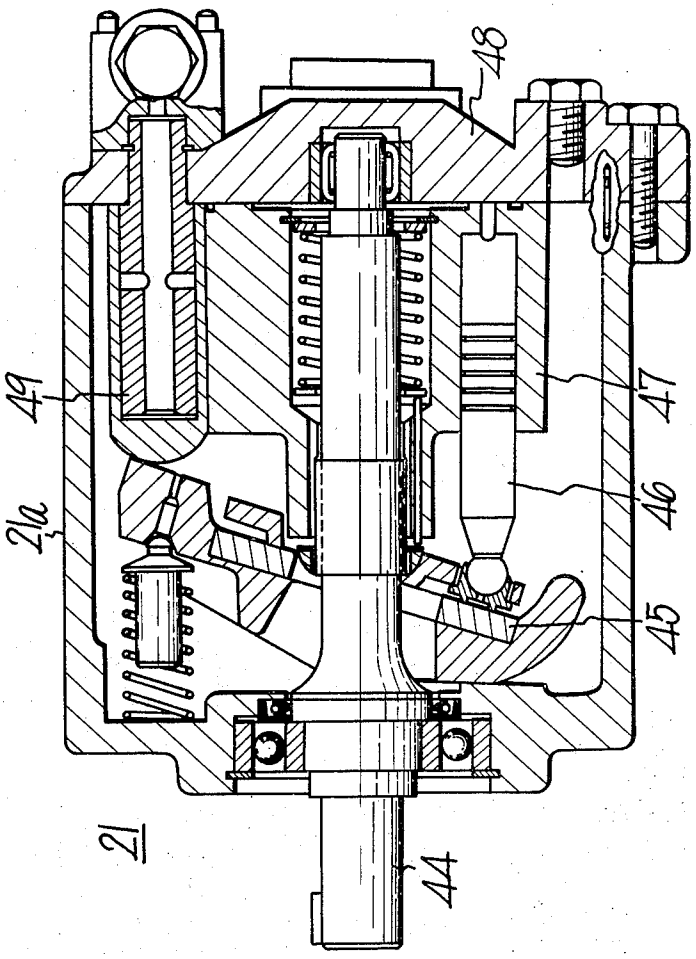

22
22a
32
31
21a
21
21b
23
35
23a
42
43
33
24a
34
34a
24

Fig. 5



HYDRAULIC PRESSURE GENERATING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a hydraulic pressure generating device.

2. Description of the Prior Art

An ordinary hydraulic pressure generating device such as shown in FIG. **1** which is commonly referred to as a power unit for a numerically-controlled machine tool comprises a constant discharge type pump **1**, a motor **2** for driving it, and an oil tank **3** containing an actuating oil **4** (hereinafter referred to as an oil). In this device, when the motor **2** rotates, the oil **4** is introduced through a filter **5** and a hose **6** into the pump **1**, from which a constant amount of oil per unit time is continuously discharged. One part of the discharged oil is returned to the oil tank **3** through a line filter **7**, a load **8** and a cooler **9**. While, the oil discharged from the constant discharge type pump **1** is mostly fed through a relief valve **10** to the input side of the cooler **9** and is thereby cooled together with the oil applied thereto through the load **8** and then returned to the oil tank **3**. Reference numeral **11** indicates a pilot line of the relief valve **10**, **12** a drain pipe of the pump **1** and **13** a safety valve of the cooler **9**.

With such a conventional device, a substantially constant amount of oil is always discharged from the pump **1** irrespective of a variation in the load **8** and the discharged oil is mostly returned to the oil tank **3** through the relief valve **10**. Therefore, the utilization efficient factor of the oil is poor and a loss, viewed from the overall structure of the device, is great and, in addition, the temperature of the oil rises when it passes through the relief valve **10**, which causes large vibration of the overall device. Further, since the oil is compressed by the relief valve **10**, it rapidly deteriorates, which results in various bad influences such as generation of wear, damage and vibration of the instruments using the oil and so on.

SUMMARY OF THE INVENTION

The present invention is to provide a hydraulic pressure generating device which is free from the aforementioned defects experienced in the prior art, and hence is highly efficient, capable of suppressing heat generation of the oil used, extending the lifetime of the instruments and oil and preventing deterioration of the oil and is inexpensive and good in appearance.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a schematic diagram showing a conventional type of hydraulic pressure generating device;

FIG. **2** is a schamatic diagram illustrating a hydraulic pressure generating device of the present invention;

FIG. **3** is a perspective view of the device of this invention;

FIG. **4** is a fragmentary cross-sectional view of the device of FIG. **3**; and

FIG. **5** is a cross-sectional view showing one example of a pump for use in this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIGS. **2** to **5**, one example of the hydraulic pressure generating device of this invention will hereinafter be described. In FIG. **2** reference numeral **21** designates a pressure compensating variable discharge type pump, which is driven a motor **22**. Reference numeral **23** indicates an oil tank and **24** an oil contained therein. Reference numeral **18** identifies a load driven by the pump **21**.

As shown in FIG. **3**, a housing **25** as of iron or like material is provided, which is divided by a partition wall **26** into upper and lower rooms **27** and **28** and a plurality of air holes **29** are formed in the partition wall **26**. In the upper room **27** an exhaust fan **30** is disposed, which is driven by a motor, though not shown. In the lower room **28** the pump **21**, the motor **22** and the oil tank **23** are housed. In this case, the pump **21** is disposed below the oil level **24***a* in the oil tank **23**. In the illustrated example the motor **22** is attached to an upper wall **23***a* of the oil tank **23** with its rotary shaft **22***a* being held vertically and the pump **21** is disposed in the oil **24** and a rotary shaft **21***a* of the pump **21** is coupled by a coupling **31** with that **22***a* of the motor **22**. Reference numeral **32** designates a fixture of the motor **22**, **33** a fixture of the pump **21**, **34** an air escape bored in a case **21***b* of the pump **21** near the end of the shaft **21***a* at such a position as not to affect the bearing support, **34***a* an ordinary drain port and **35** a hose for supplying the oil discharged from the pump **21** to the outside, which hose is preferred to be formed of rubber or like elastic material.

The horizontal area of the oil tank **23** is selected to be relatively smaller than that of the lower room **28** of the housing **25**, many radiation fins **36** are mounted on the outside of the oil tank **23** and slit-like air holes **37***a* and **37***b* are formed in the upper and lower walls **25***a* and **25***b* of the housing **25**. Reference numeral **38** indicates support legs for supporting the oil tank **23**. Between the legs **38** and the oil tank **23** the legs legs **38** and the lower wall **25***b* of the housing **25** are interposed vibration-proof members **39** as of rubber to prevent transmission of the vibration of the motor **22** and the pump **21** to the housing **25** and, further, vibration-proof rubber members **41** may be interposed between the housing **25** and its legs **40**. In FIG. **4** reference numerals **42** and **43** designate adjusting levers respectively one ends of which project from the upper wall **23***a* of the oil tank **23**,the former being used for adjustment of a pressure compensator and the latter for adjustment of the amount of the oil discharged by adjusting the inclination of an inclined plate of the pump **21**.

FIG. **5** illustrates one example of the discharge type pump **21**, in which reference numeral **44** indicates its drive shaft, **45** a swash-plate (inclined plate), **46** a piston, **47** a cylinder block, **48** a valve plate and **49** a pressure compensator. If necessary, filters may be provided before and after the pump **21**.

With the present device described above, the hydraulic pressure of the oil discharged from the pump **21** and the amount of the oil discharged therefrom per unit time can be independently adjusted by manual operation of the adjusting levers **42** and **43** and even when the pump **21** is soaked in the oil and, further, these values can be set at minimum values corresponding to the load, so that ineffective power can be theoretically minimized and the required capacity of the motor **22** can be decreased. Further, although this device is applied to many kinds of apparatus, the number of the kinds thereof in view of the capacity of the pump **21** can be decreased and the hydraulic pressure generating device can be standardized and mass produced.

As will be apparent from FIG. 3, by the rotation of the fan 30, air enters the housing 25 from the air holes or slits 37*b* bored in the lower wall 25*b* to cool the oil tank 23, the pump 21 and the motor 22 and flows into the upper room 27 from the air holes 29 of the partition wall 26 and is then discharged from the housing 25 to the outside thereof through the air holes or slits 37*a* of the upper wall 25*a*. Accordingly, the oil tank 23, that is, the oil 24 is forcibly cooled, in which case the fins 36 formed on the outside of the oil tank 23 enhances the cooling effect. In accordance with the present device the pump 21, the motor 22, the oil tank 23 and so on are covered with the housing 25, so that the fins 36 on the oil tank 23 cannot be seen from the outside and do not defile the appearance of the device. Further, the shapes of the air holes 29 and slits 37*b* are selected and a pressure-reduced air layer is produced by the operation of the exhaust fan 30 in the housing 25. The air layer and the housing 25 effectively suppress propagation of mechanical vibration. In addition, the fins 36 serve to reinforce the oil tank 23.

By positioning the pump 21 below the oil level 24*a* of the oil 24, the suction resistance of the pump 21 is decreased to improve conditions for the generation of cavitation, which results in an increase in the efficiency of the pump 21 to alleviate the generation of vibration. When the pump 21 is soaked in the oil 24 as in the illustrated example, the drain pipe 12 depicted in FIG. 1 is unnecessary and accordingly the manufacturing cost can be curtailed and, at the same time, vibration of the pump 21 and propagation of its echo can be suppressed because the pump 21 is entirely enveloped in the oil. Further, the air escape 34 formed in the pump 21 facilitates deflation of the pump 21, which enables a supply of oil to internal lubricating units such as bearings of the pump 21 and so on to provide for prolonged lifetime thereof.

The hose 35 directly connected to the discharge port of the pump 21 is formed of an elastic or flexible material such as rubber and disconnected from the hose used on the side of the load. This allows ease in the fabrication of this device, enables prevention of mixing of a foreign substance into the oil and effectively absorbs pulsation of the discharged oil.

With the present invention, a minimum amount of oil can be circulated only to the load and since no relief valve is required, heat generation does not occur. Further, the oil is not sheared by the relief valve, so that deterioration of the oil is suppressed and heat generation is low to provide for enhanced efficiency of the cooling achieved when necessary and facilitate control of the oil temperature. Namely, this invention is capable of controlling the temperature and viscosity of the oil and maintenance of its quality which are important for lubrication of this kind of apparatus. Further, when employed in the hydraulic pressure system, wear of the pump shown in FIG. 5 is further reduced. The present invention dispenses with the line filter disposed understream of the pump which causes wear of the pump, permitting simplification of the construction of the device, coupled with the nonuse of the relief valve.

It will be apparent that many modifications and variations may be effected without departing from the scope of the novel concepts of this invention.

We claim as our invention:

1. In a hydraulic pressure generating device including a housing having air holes formed at least in upper and lower walls thereof, a partition wall dividing the housing into upper and lower rooms and having air holes, a fan disposed in the upper room of the housing, a pressure compensation variable discharge type pump, a motor disposed in the lower room of the housing for driving the pump, and an oil tank disposed in the lower room of the housing and having the pump immersed therein, the improvement therein, wherein the shapes of the air holes formed in the partition wall and in the lower wall of the housing are selected to provide a pressure-reduced room in the housing, so that when the fan is operated, air is sucked into the housing from the air holes formed in its lower wall and is discharged out of the housing from the air holes formed in its upper wall, so as to cool the pump and the motor.

2. A hydraulic pressure generating device as claimed in claim 1, wherein radiation fins are provided on the oil tank.

3. A hydraulic pressure generating device as claimed in claim 1, wherein an air escape is formed in the case of the pump.

4. A hydraulic pressure generating device as claimed in claim 1, wherein a vibration-proof member is interposed between the oil tank and the housing.

5. A hydraulic pressure generating device as claimed in claim 1, wherein the housing is supported with a vibration-proof member.

6. A hydraulic pressure generating device comprising:

a. a housing having air holes at least in upper and lower walls thereof;
b. a partition wall dividing the housing into upper and lower rooms and having air holes;
c. an exhaust fan disposed in the upper room of the housing;
d. a first motor disposed in the upper room for driving the fan;
e. a pressure compensation variable discharge type pump disposed in the lower room of the housing;
f. a second motor disposed in the lower room of the housing for driving the pump; and,
g. an oil tank disposed in the housing and having the pump immersed therein, whereby when the fan is operated, air is sucked into the housing from the air holes formed in the lower wall and then is exhausted out of the housing from the air holes formed in the upper wall.

7. A hydraulic pressure generating device comprising:

a. a housing having air holes at least in upper and lower walls thereof;
b. a partition wall dividing the housing into upper and lower rooms and having air holes;
c. an exhaust fan disposed in the upper room of the housing;
d. a first motor disposed in the upper room for driving the fan;
e. a pressure compensation variable discharge type pump disposed in the lower room of the housing;
f. a second motor disposed in the lower room of the housing for driving the pump; and,
g. an oil tank disposed in the housing and having the pump immersed therein, wherein the shapes of the air holes formed in the partition wall and in the lower wall of the housing are so selected as to provide a pressure-reduced room in the housing.

8. A hydraulic pressure generating device as claimed in claim 7, wherein said pump includes a casing in which an air escape is formed in the casing of the pump.

9. A hydraulic pressure generating device as claimed in claim 7 in which an adjusting means is provided for adjusting a setting pressure of the pump from the outside of the tank.

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