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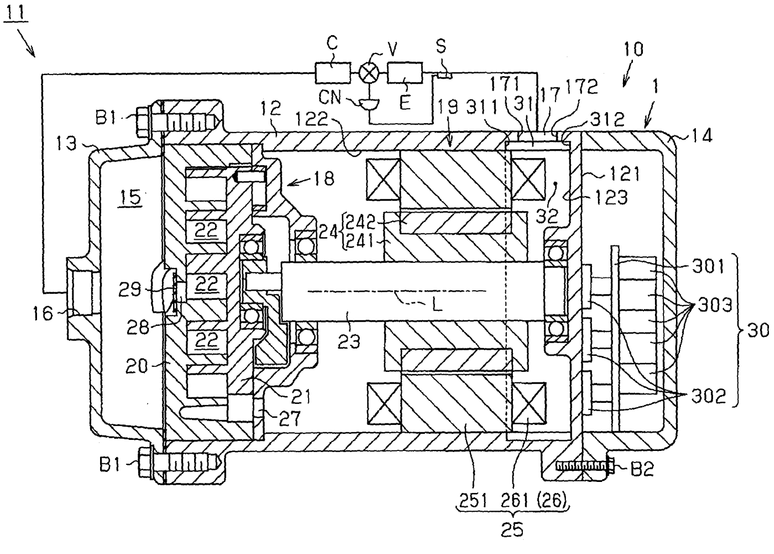
(54) **Motor-driven compressor**


(57) A compressor includes a housing having an inlet port, a compression mechanism for compression of refrigerant introduced via the inlet port into the housing, a motor having a stator core and a coil, an inverter for driving the motor, and a rotary shaft rotated by the motor thereby to drive the compression mechanism. The compression mechanism, the motor and the inverter are aligned in the order in the housing in axial direction of the rotary shaft. The coil has a coil end projecting toward the inverter from the stator core and being disposed adjacent to an inner peripheral surface of the housing. The inlet port is located so as to face the coil end. A recess is formed on the inner peripheral surface of the housing for communicating with the inlet port. The recess extends in the axial direction of the rotary shaft toward the inverter beyond the coil end.


FIG. 1

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## Description

BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to a motor-driven compressor having a compression mechanism, an electric motor and an inverter aligned in a housing in axial direction of a rotary shaft of the compressor.

**[0002]** Such compressor is disclosed, for example, in Japanese Unexamined Patent Application Publication No. 2000-291557. The compressor has a housing assembly (hereinafter referred to as a housing) composed of a front housing, an intermediate housing and a rear housing. The compression mechanism of a scroll-type, the motor and the inverter are aligned in this order in the housing in axial direction of the rotary shaft of the compressor. The motor is controlled by the inverter and drives the compression mechanism for compression of refrigerant gas. A stator of the motor has a coil, and a rotor of the motor is mounted on the rotary shaft. The front housing has a refrigerant inlet port at the periphery. The inlet port is disposed forward of the coil end. In such kind of compressor, there is a need for reduction of its axial length.

**[0003]** In another known compressor disclosed in Japanese Unexamined Patent Application Publication No. 4-80554, the inlet port is disposed at a position radially facing the coil end. Therefore, the axial length of the compressor is small, as compared to the case of the reference No. 2000-291557.

**[0004]** In the compressor of the reference No. 4-80554 wherein the inlet port is radially spaced away from the coil end, so that refrigerant gas flows smoothly from the inlet port into the housing, but the diameter of the housing is enlarged.

**[0005]** The present invention is directed to providing a motor-driven compressor that allows refrigerant gas to flow smoothly from an inlet port into a housing without enlarging the diameter of the housing.

SUMMARY OF THE INVENTION

**[0006]** In accordance with an aspect of the present invention, a motor-driven compressor includes a housing having an inlet port, a compression mechanism for compression of refrigerant introduced via the inlet port into the housing, an electric motor having a stator core and a coil, an inverter for driving the electric motor, and a rotary shaft rotated by the electric motor thereby to drive the compression mechanism. The compression mechanism, the electric motor and the inverter are aligned in the order in the housing in axial direction of the rotary shaft. The coil has a coil end projecting toward the inverter from the stator core and being disposed adjacent to an inner peripheral surface of the housing. The inlet port is located so as to face the coil end. A recess is formed on the inner peripheral surface of the housing for communicating with the inlet port. The recess extends in the axial direction of the rotary shaft toward the inverter beyond the coil end.

**[0007]** Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

**[0008]** The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a longitudinal cross-sectional view of a compressor according to a first embodiment of the present invention;

Fig. 2 is a partial enlarged view of a groove of the compressor of Fig. 1; and

Fig. 3 is a partial enlarged view of a groove of a compressor according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0009]** The following will describe the first embodiment of the present invention with reference to Figs. 1 and 2. Fig. 1 shows a motor-driven compressor 10 of the first embodiment. The compressor 10 is used in a refrigeration circuit 11 of a vehicle air conditioner. It is noted that the right-hand side as viewed in Fig. 1 is the front side of the compressor 10 and the left-hand side is the rear side of the compressor 10.

**[0010]** Referring to Fig. 1, the refrigeration circuit 11 includes a condenser C, an expansion valve V and an evaporator E, as well as the compressor 10. In the refrigeration circuit 11, high-pressure and high-temperature refrigerant gas discharged from the compressor 10 is cooled and condensed by the condenser C. The flow of the refrigerant from the condenser C is controlled by the expansion valve V. The refrigerant from the expansion valve V is evaporated in the evaporator E. The refrigeration circuit 11 is provided with a temperature sensor S and a controller CN. The temperature sensor S detects the temperature of the refrigerant from the evaporator E. The controller CN is connected to the expansion valve V for controlling the opening of the expansion valve V in response to a signal from the temperature sensor S.

**[0011]** The compressor 10 has a housing assembly 1 (hereinafter referred to as a housing 1) composed of an intermediate housing 12, a rear housing 13 and a front housing 14. The intermediate housing 12 is connected at the rear end thereof to the rear housing 13 via five bolts B1 (only two bolts are shown in Fig. 1), and at the front end thereof to the front housing 14 via five bolts B2 (only one is shown).

**[0012]** The rear housing 13 forms therein a discharge chamber 15. The rear housing 13 has a discharge port 16 at the rear end. The discharge chamber 15 is connected via the discharge port 16 to the condenser C. The intermediate housing 12 has an inlet port 17 at the periphery thereof adjacent to the front housing 14. The inner space of the intermediate housing 12 is connected via the inlet port 17 to the evaporator E. The intermediate housing 12 accommodates therein a compression mechanism 18 and an electric motor 19 driving the compression mechanism 18 for compressing refrigerant gas.

**[0013]** The compression mechanism 18 includes a fixed scroll 20 and a movable scroll 21. The fixed scroll 20 is mounted on the intermediate housing 12. The movable scroll 21 is disposed so as to face the fixed scroll 20 to form a compression chamber 22 therebetween, the volume of which is variable. The movable scroll 21 is coupled to a rotary shaft 23 supported by the intermediate housing 12.

**[0014]** The electric motor 19 (hereinafter referred to as the motor 19) includes a rotor 24 and a cylindrical-shaped stator 25. The rotor 24 is mounted on the rotary shaft 23 for rotation therewith in the intermediate housing 12. The rotor 24 has a rotor core 241 mounted on the rotary shaft 23 and permanent magnets 242 mounted on the rotor core 241. The stator 25 has a stator core 251 and a coil 26. The stator core 251 is mounted on an inner peripheral surface 122 of the intermediate housing 12. The coil 26 is wound on the teeth (not shown in the drawing) of the stator core 251. The coil 26 is located adjacent to the inner peripheral surface 122 of the intermediate housing 12. In the embodiment, the coil 26 has a radial clearance H1 of about 1 mm from the inner peripheral surface 122 (see Fig. 2). The coil 26 has coil ends 261 projecting both forward and rearward from the stator core 251 along the axis L of the rotary shaft 23.

**[0015]** The front housing 14 accommodates therein an inverter 30. The inverter 30 is electrically connected to the motor 19 via a harness (not shown in the drawing) and supplies power to the motor 19. The inverter 30 includes a circuit board 301 and electronic components 302 and 303. The circuit board 301 is mounted on the front housing 14. The electronic components 302 are heat-generating components such as switching devices, and mounted on one side of the circuit board 301 adjacent to the intermediate housing 12 while being in contact with an outer end surface 121 of the intermediate housing 12. The electronic components 303 are known components such as electrolytic capacitors, transformers, driver ICs and resistors, and mounted on the other side of the circuit board 301. In the embodiment, the compression mechanism 18, the motor 19 and the inverter 30 are aligned in this order in the housing 1 in the axial direction of the rotary shaft 23.

**[0016]** Referring to Fig. 2, the inlet port 17 of the intermediate housing 12 is located so as to face the coil end 261 projecting forward from the stator core 251. A groove 31 is formed on the inner peripheral surface 122 of the intermediate housing 12 along its entire circumference in facing relation to the coil end 261. The groove 31 serves as a recess of the present invention. The groove 31 and the inlet port 17 are formed through the wall of the intermediate housing 12 so that the groove 31 directly communicates with the inlet port 17. The width W1 of the groove 31 in the axial direction of the rotary shaft 23 is larger than the width W2 of the inlet port 17. A rear end 311 of the groove 31 is positioned rearward of a rear end 171 of the inlet port 17, and a front end 312 of the groove 31 is positioned forward of a front end 172 of the inlet port 17. The width W1 of the groove 31 is larger than the length L1 of the coil end 261. The rear end 311 of the groove 31 is positioned rearward of a front end of the stator core 251, and the front end 312 of the groove 31 is positioned forward of a front end of the coil end 261. The front end 312 of the groove 31 coincides with an inner end surface 123 of the intermediate housing 12. The groove 31 thus extends beyond the coil end 261 in the axial direction of the rotary shaft 23 toward the inverter 30 so that part of the groove 31 does not face the coil end 261. In the embodiment, the groove 31 is formed by cutting the inner peripheral surface 122 with a depth H2 of about 1 to 2 mm that allows refrigerant gas to flow from the inlet port 17 smoothly and to spread toward the front end 312 and the rear end 311 of the groove 31. The groove 31 is formed, for example, by rotating a side-milling cutter in the intermediate housing 12. A flow space 32 defined between the inner end surface 123 of the intermediate housing 12 and the coil end 261 is formed in the intermediate housing 12. In the embodiment, the flow space 32 has a length L2 of about 3 mm as measured in the axial direction of the rotary shaft 23, allowing refrigerant gas to flow smoothly from the inlet port 17 into the flow space 32. The flow space 32 faces the wall of the intermediate housing 12 of which the outer end surface 121 is in contact with the electronic components 302, and therefore the electronic components 302 are cooled via the wall by cool refrigerant gas flowing through the flow space 32.

**[0017]** In the above-described compressor 10, when power is supplied to the motor 19 from the inverter 30, the rotor 24 of the motor 19 is rotated with the rotary shaft 23 thereby to drive the compression mechanism 18. While the compression mechanism 18 is in operation, the volume of the compression chamber 22 between the scrolls 20 and 21 is varied, and refrigerant gas is introduced from the evaporator E via the inlet port 17 and the groove 31 into the intermediate housing 12. Since the refrigerant gas flows from the inlet port 17 spreading toward the front end 312 and the rear end 311 of the groove 31, part of the refrigerant gas flows around the coil end 261 and into the flow space 32, while the rest of the refrigerant gas flows directly into the flow space 32. The refrigerant gas then flows via an inlet passage 27 into the compression chamber 22 and compressed therein. After being compressed, the refrigerant gas is discharged via a discharge passage 28 into the discharge chamber 15 while pushing open a discharge valve 29, and flows out of the compressor 10. The refrigerant then flows through the condenser C, the expansion valve V and the evaporator E, flowing back into the intermediate housing 12.

**[0018]** The motor-driven compressor 10 according to the first embodiment offers the following advantages.

(1) The inlet port 17 of the intermediate housing 12 is disposed at a position facing the coil end 261 in order to reduce the axial length of the intermediate housing 12 (or the housing 1). The coil end 261 (coil 26) is adjacent to the inner peripheral surface 122 of the intermediate housing 12 in order to reduce the diameter of the intermediate housing 12 (or the housing 1). The groove 31 is formed on the inner peripheral surface 122 of the intermediate housing 12 for communicating with the inlet port 17. Since the groove 31 extends beyond the coil end 261 in the axial direction of the rotary shaft 23 toward the inverter 30, part of refrigerant gas flows from the inlet port 17 beyond the coil end 261. As a result, refrigerant gas flows smoothly from the inlet port 17 into the intermediate housing 12 with less interfering with the coil end 261. The compressor 10 thus allows refrigerant gas to flow smoothly from the inlet port 17 into the housing 1 with less enlarging the axial length and the diameter of the housing 1.

(2) The groove 31 is formed along the entire circumference of the inner peripheral surface 122 of the intermediate housing 12. Therefore, refrigerant gas smoothly flows from the inlet port 17 into the intermediate housing 12 through the circumferential space, as compared to a case, for example, wherein the groove 31 is formed at a position only adjacent to the inlet port 17. As a result, since refrigerant gas flowing into the intermediate housing 12 is less affected by the coil end 261, refrigerant gas flows from the inlet port 17 into the intermediate housing 12 more smoothly. In addition, the groove 31 can be formed only by rotating a side-milling cutter in the intermediate housing 12.

**[0019]** The following will describe the second embodiment of the present invention with reference to Fig. 3. In Fig. 3, same reference numbers are used for the common elements or components in the first and second embodiments, and the description of such elements or components for the second embodiment will be omitted.

**[0020]** Referring to Fig. 3, a groove 50 is formed on the inner peripheral surface 122 of the intermediate housing 12. A rear end 501 of the groove 50 coincides with the rear end of the inlet port 171, and a front end 502 of the groove 51 is positioned forward of the front end 172 of the inlet port 17. The width W3 of the groove 50 in the axial direction of the rotary shaft 23 is larger than the length L1 of the coil end 261. The rear end 501 of the groove 50 is positioned forward of the front end of the stator core 251, and the front end 502 of the groove 50 is positioned forward of the front end of the coil end 261. The front end 502 of the groove 50 coincides with the inner end surface 123 of the intermediate housing 12. The groove 50 thus extends beyond the coil end 261 in the axial direction of the rotary shaft 23 toward the inverter 30 so that part of the groove 51 does not face the coil end 261.

**[0021]** The second embodiment offers the advantages similar to those of the first embodiment. The above embodiments may be modified in various ways as exemplified below.

**[0022]** In each embodiment, the groove 31 or 50 may be a hole shape partially formed at the inner peripheral surface 122 of the intermediate housing 12 so as to communicate with the inlet port 17.

**[0023]** In each embodiment, the compression mechanism 18 is of a scroll type having the fixed and movable scrolls 20 and 21, but it may be of a piston type or a vane type.

**[0024]** Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein but may be modified within the scope of the appended claims.

**[0025]** A compressor includes a housing having an inlet port, a compression mechanism for compression of refrigerant introduced via the inlet port into the housing, a motor having a stator core and a coil, an inverter for driving the motor, and a rotary shaft rotated by the motor thereby to drive the compression mechanism. The compression mechanism, the motor and the inverter are aligned in the order in the housing in axial direction of the rotary shaft. The coil has a coil end projecting toward the inverter from the stator core and being disposed adjacent to an inner peripheral surface of the housing. The inlet port is located so as to face the coil end. A recess is formed on the inner peripheral surface of the housing for communicating with the inlet port. The recess extends in the axial direction of the rotary shaft toward the inverter beyond the coil end.

## Claims

**1.** A motor-driven compressor (10), comprising:

a housing (12) having an inlet port (17);
a compression mechanism (18) for compression of refrigerant introduced via the inlet port (17) into the housing (12);
an electric motor (19) having a stator core (251) and a coil (26);

an inverter (30) for driving the electric motor (19); and

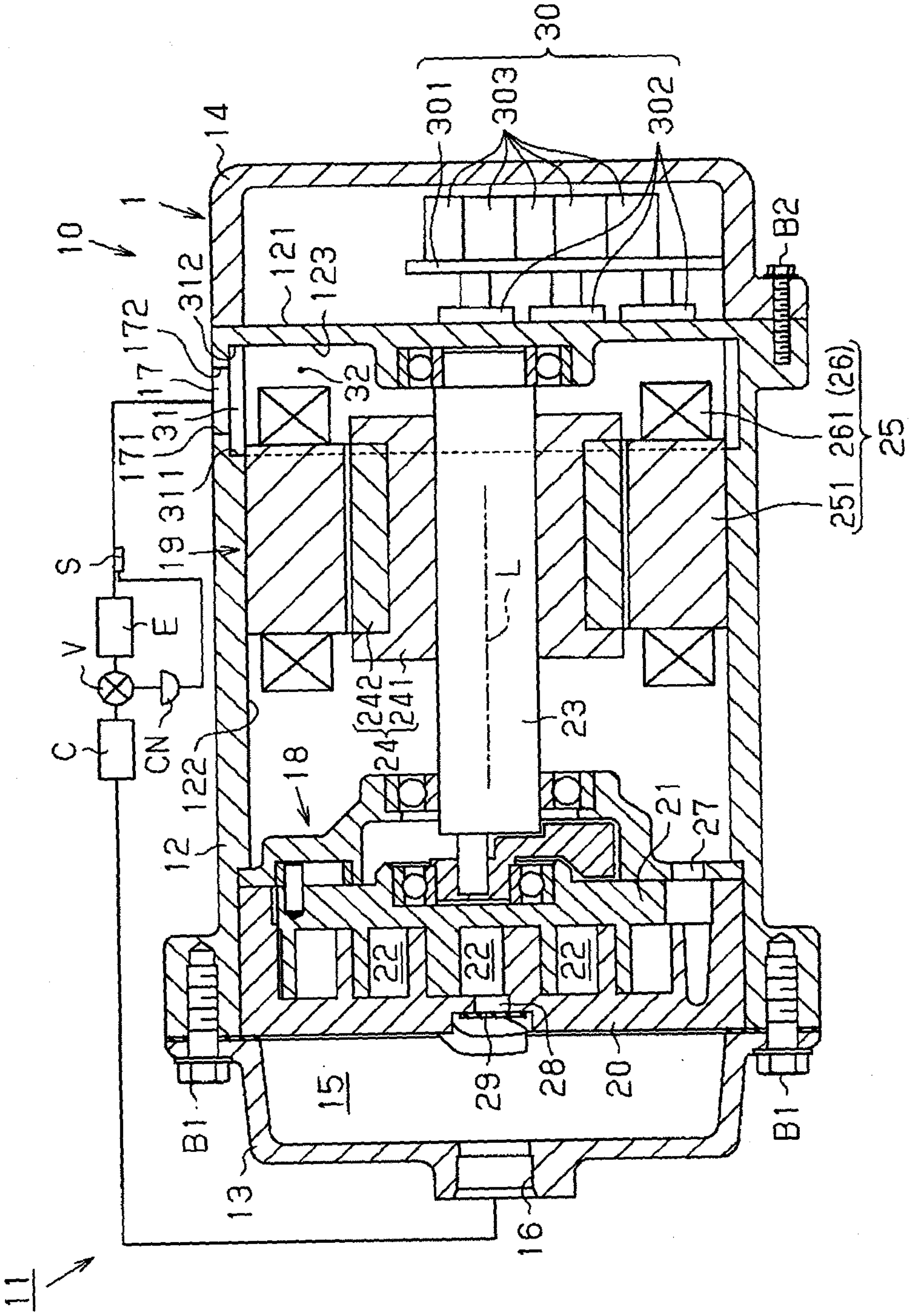
a rotary shaft (23) rotated by the electric motor (19) thereby to drive the compression mechanism (18),

wherein the compression mechanism (18), the electric motor (19) and the inverter (30) are aligned in the order in the housing (1) in axial direction of the rotary shaft (23), and the coil (26) has a coil end (261) projecting toward the inverter (30) from the stator core (251) and being disposed adjacent to an inner peripheral surface (122) of the housing (12),
**characterized in that** the inlet port (17) is located so as to face the coil end (261), and a recess (31) is formed on the inner peripheral surface (122) of the housing (12) for communicating with the inlet port (17) and the recess (31) extends in the axial direction of the rotary shaft (23) toward the inverter (30) beyond the coil end (261).

**2.** The motor-driven compressor (10) according to claim 1, wherein the recess (31) is formed along the entire circumference of the inner peripheral surface (122) of the housing (12).

**3.** The motor-driven compressor (10) according to claims 1 or 2, wherein the recess (31) overlaps with and extends around an opening of the inlet port (17).

**4.** The motor-driven compressor (10) according to claims 1 or 2, wherein the recess (31) partially faces with a flow space (32) defined between an inner end surface (123) of the housing (12) and the coil end (261).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32
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171
311
19
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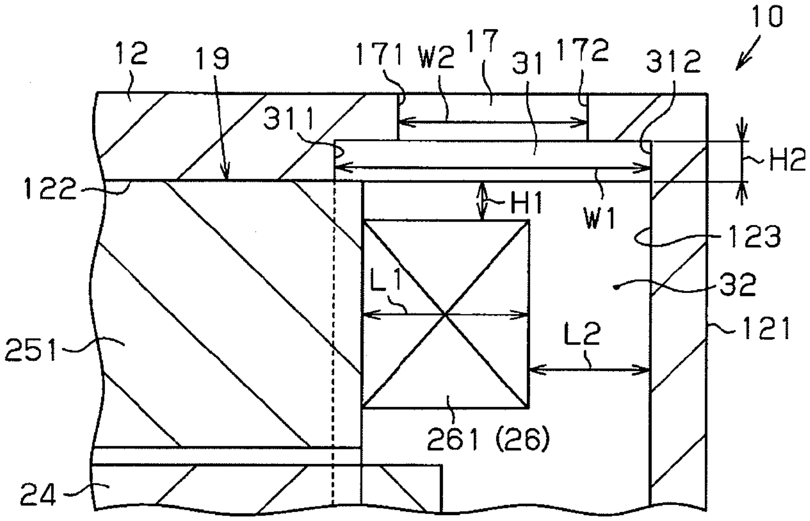
E
V
CN
C
122
18
12
24
242
241
23
L
261 (26)
251
25
21
27
22
22
22
B1
B1
B2
15
29
28
20
13
16
11

FIG. 1

FIG. 2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12
19
171
W2
17
31
172
312
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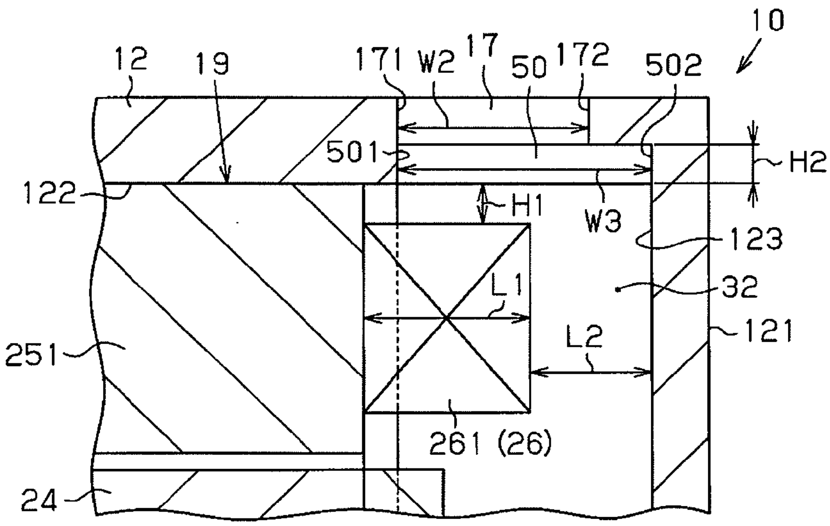
H2
122
H1
W1
123
32
L1
121
L2
251
261 (26)
24

FIG. 3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W2
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H2
122
H1
W3
123
32
L1
121
L2
251
261 (26)
24

## REFERENCES CITED IN THE DESCRIPTION

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