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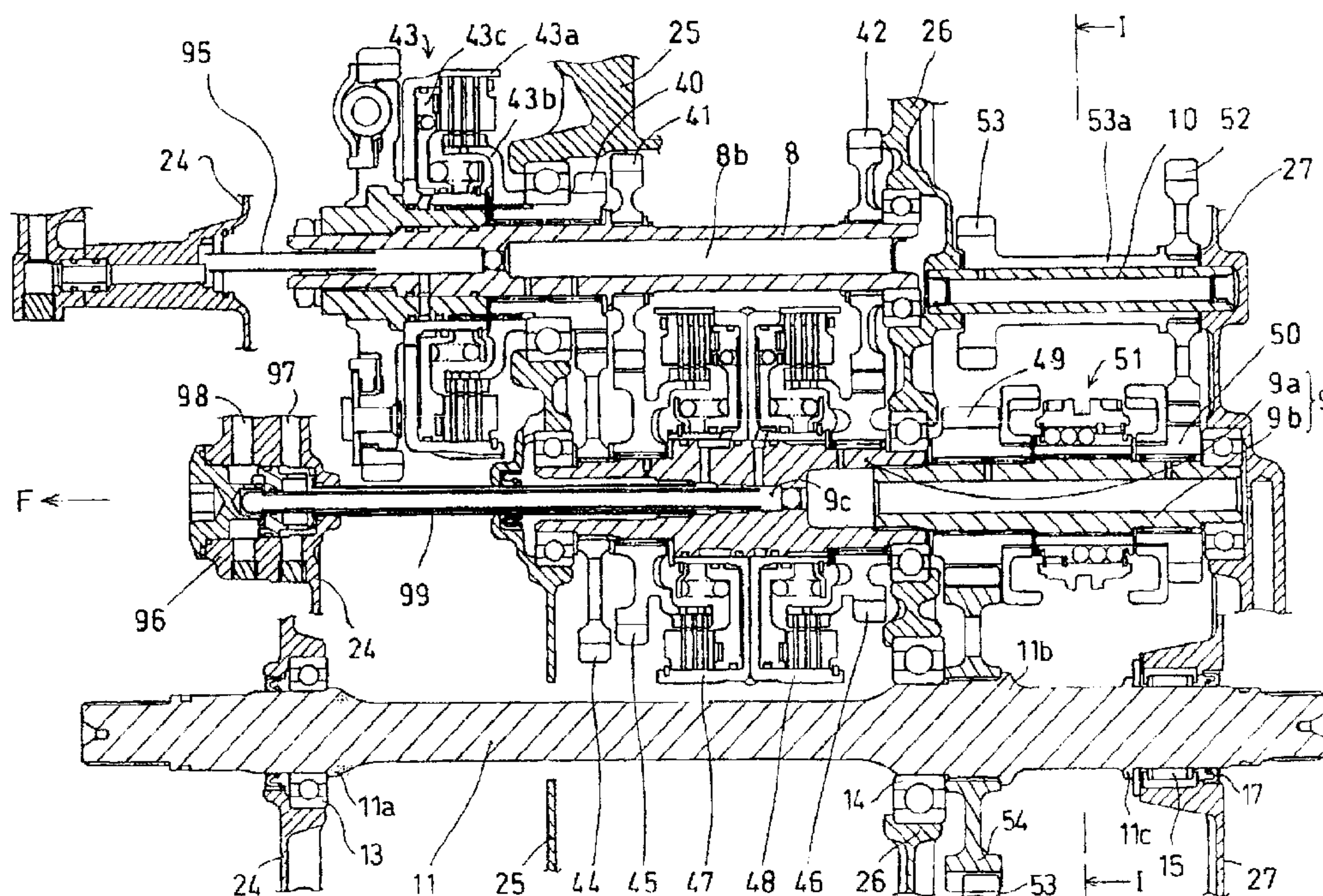
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(54) Title: OUTPUT SHAFT STRUCTURE OF SHAFT DRIVEN VEHICLE



(57) Abrégé/Abstract:

To easily and securely enable the positioning of an output shaft in a shaft driven vehicle. The invention is based upon the structure of an output shaft of a vehicle driven by shafts driven in an internal combustion engine provided with first and second cases 26 and 25 mutually connected on a face perpendicular to a crankshaft and forming a crankcase, a case cover 27 attached to the outside of the first case 26 and the output shaft 11 arranged in the crankcases 26 and 25 and supported by a first bearing 15 provided to the case cover 27 and a second bearing 14 provided to the first case 26 and is characterized in that an input gear 54 to the output shaft 11 is arranged with the input gear touched to the outside face of the second bearing 14 and a first part having a large diameter 11c positioned by touching it to the inside face of the first bearing 15 and a second part having a large diameter 11b positioned by touching it to the outside face of the input gear 54 are provided to the output shaft 11.

ABSTRACT OF THE DISCLOSURE

To easily and securely enable the positioning of an output shaft in a shaft driven vehicle. The invention is based upon the structure of an output shaft of a vehicle driven by shafts driven in an internal combustion engine provided with first and second cases 26 and 25 mutually connected on a face perpendicular to a crankshaft and forming a crankcase, a case cover 27 attached to the outside of the first case 26 and the output shaft 11 arranged in the crankcases 26 and 25 and supported by a first bearing 15 provided to the case cover 27 and a second bearing 14 provided to the first case 26 and is characterized in that an input gear 54 to the output shaft 11 is arranged with the input gear touched to the outside face of the second bearing 14 and a first part having a large diameter 11c positioned by touching it to the inside face of the first bearing 15 and a second part having a large diameter 11b positioned by touching it to the outside face of the input gear 54 are provided to the output shaft 11.

OUTPUT SHAFT STRUCTURE OF SHAFT DRIVEN VEHICLE

5 FIELD OF THE INVENTION

The present invention relates to the structure of an output shaft for transmitting the output of an engine of a shaft driven vehicle to both the front wheel side and the rear wheel side.

10 BACKGROUND OF THE INVENTION

For the structure of the output shaft, there is the structure disclosed in Japanese published unexamined patent application No. 2001-74027 for example. The structure is divided into a shaft on the front wheel side and a shaft on the rear wheel side so that they can be separated or connected.

15 The shaft on the front wheel side is supported via a needle bearing and the shaft on the rear wheel side is supported via a ball bearing and a needle bearing respectively by a crankcase so that they can be rotated. The shaft on the rear wheel side of the output shaft is sealed by an oil seal in a rear cover.

20

In the conventional type output shaft structure, as a bearing support of the output shaft is apart from the oil seal, the run-out of the output shaft in the oil seal becomes large and the sealing performance of the oil seal is bad. Also, as the output shaft is divided into two, the structure is complex,
25 the weight and the cost are not only increased but the assembly is troublesome.

SUMMARY OF THE INVENTION

To solve the problems of the conventional type, the invention is based upon the output shaft structure of a vehicle driven by shafts driven in an internal combustion engine provided with first and second cases mutually connected on a face perpendicular to a crankshaft and forming a crankcase, a case cover attached to the outside of the first case and an output shaft arranged in the crankcase and supported by a first bearing provided to the case cover and a second bearing provided to the first case and is characterized in that a first part having a large diameter positioned by touching it to the inside face of the first bearing and a second part having a large diameter positioned by touching it to the outside face of the second bearing are provided to the output shaft.

In the invention configured as described above with the first part having a large diameter positioned by touching it to the inside face of the first bearing and the second part having a large diameter positioned by touching it to the outside face of the second bearing are provided to the output shaft, the output shaft can be attached from one direction after the first and second cases are connected and in addition, positioning can be also easily and securely made. Also in recombination, a rear crankcase cover has only to be detached and both assembly workability and maintainability are excellent.

In an aspect of the invention the output shaft structure of a vehicle driven by shafts driven in an internal combustion engine is provided with first and second cases mutually connected on a face perpendicular to a crankshaft and forming a crankcase, a case cover attached to the outside of the first case and an output shaft arranged in the crankcase and supported by a first bearing provided to the case cover and a second bearing provided to the second case and is characterized in that first and second parts having a large diameter respectively positioned by touching them to each inside

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face of the first and second bearings are provided to the output shaft.

In the invention configured as described above with the first and second parts having a large diameter respectively positioned by touching them to each inside face of the first and second bearings are provided to the output shaft 11, the similar effect to the effect of the invention according to the previously described embodiments can be produced.

In another aspect of the invention the output shaft structure of a vehicle driven by shafts driven in an internal combustion engine is provided with first and second cases mutually connected on a face perpendicular to a crankshaft and forming a crankcase, first and second case covers respectively attached to each outside of the first and second cases and an output shaft arranged in the crankcase and supported by first and second bearings respectively provided to the first and second case covers and is characterized in that first and second parts having a large diameter positioned by touching them to each inside face of the first and second bearings are provided to the output shaft.

As the invention configured as described above with the first and second parts having a large diameter positioned by touching them to each inside face of the first and second bearings are provided to the output shaft 11, the similar effect to the effect of the invention according to the previously described embodiments can be produced. In this case, in recombination, the first case cover is detached.

In yet another aspect of the invention the output shaft structure of a vehicle driven by shafts driven in an internal combustion engine is provided with first and second cases mutually connected on a face perpendicular to a crankshaft and forming a crankcase, a case cover attached to the outside of the first case and an output shaft arranged in the crankcase and supported by a first bearing provided to the case cover and a

second bearing provided to the first case and is characterized in that an input gear to the output shaft is arranged by touching it to the outside face of the second bearing and a first part having a large diameter positioned by touching it to the inside face of the first bearing and a second part having a large diameter positioned by touching it to the outside face of the input gear are provided to the output shaft.

In the invention configured as described above, the input gear to the output shaft is arranged by touching it to the outside face of the second bearing and the first part having a large diameter positioned by touching it to the inside face of the first bearing and the second part having a large diameter positioned by touching it to the outside face of a bearing of the input gear are provided to the output shaft, not only the output shaft but the input gear can be easily and securely positioned.

In yet another aspect of the invention based upon the invention according to the above, is characterized in that the first bearing is a needle bearing and an oil seal is arranged close to the outside of the needle bearing. Therefore, according to this aspect of the invention, the run-out of an output shaft can be inhibited and the sealing performance of the oil seal is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

Fig. 1 is a back view (a view substantially viewed along a line I-I in Fig. 2) showing a rear crankcase of an internal combustion engine in one embodiment of the invention; and

Fig. 2 shows a power transmission mechanism among a main shaft of a transmission, a counter shaft, an intermediate shaft and an output shaft in

the embodiment and is a longitudinal section substantially viewed along a chain line II-II in Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 Fig. 1 is a back view (a view viewed substantially along a line I-I in Fig. 2) showing a rear crankcase 26 of an internal combustion engine in one embodiment of the invention. In Fig. 1, each position of a crankshaft 7, a main shaft 8 of a transmission, a counter shaft 9, an intermediate shaft 10 and an output shaft 11 is shown. A reference number 6 denotes the axis of
10 a cylinder.

Next, Fig. 2 shows a power transmission mechanism among the main shaft 8 of the transmission, the counter shaft 9, the intermediate shaft 10 and the output shaft 11 and is a longitudinal section substantially viewed
15 along a chain line II-II in Fig. 1. In Fig. 2, an arrow F indicates the front.

In this embodiment, a front crankcase 25 and the rear crankcase 26 are mutually connected on a face perpendicular to the crankshaft 7 and the main shaft 8 of the transmission and a crankcase is formed. A front
20 crankcase cover 24 and a rear crankcase cover 27 are attached before and after, that is, outside the front crankcase 25 and the rear crankcase 26.

The main shaft 8 of the transmission is supported by the front and rear crankcases 25 and 26 via a bearing. A first-speed driving gear 40, a second-
25 speed driving gear 41 and a third-speed driving gear 42 respectively different in the number of teeth according to transmission gear ratio are provided to the main shaft 8. The second-speed driving gear 41 and the third-speed driving gear 42 are a fixed gear fixed to the main shaft 8, however, the first-speed driving gear 40 is held via a needle bearing by the
30 main shaft 8 so that the first-speed driving gear can be turned. In the following description, a gear held via a needle bearing so that the gear can be turned around a rotating shaft is called an idle gear.

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A hydraulic multiple disc clutch for first speed 43 is provided between the main shaft 8 and the first-speed driving gear 40. For this clutch, a clutch outer 43a is fixed to the main shaft and a clutch inner 43b is connected to the first-speed driving gear 40 which is the idle gear. When hydraulic fluid is supplied between the clutch outer 43a of this clutch and a pressure plate 43c to pressurize them and the pressure plate 43c is moved, the clutch is connected and the first-speed driving gear 40 is fixed to the main shaft 8.

10

The counter shaft 9 is an integrated counter shaft acquired by connecting a front part 9a and a rear part 9b. The counter shaft 9 is supported by the front crankcase 25, the rear crankcase 26 and the rear crankcase cover 27 respectively via a bearing. A first-speed driven gear 44, a second-speed driven gear 45 and a third-speed driven gear 46 respectively always engaged with the first-speed driving gear 40, the second-speed driving gear 41 and the third-speed driving gear 42 respectively of the main shaft 8 are provided to the front part 9a of the counter shaft 9.

20 The first-speed driven gear 44 is a fixed gear fixed to the counter shaft, however, the second-speed driven gear 45 and the third-speed driven gear 46 are an idle gear. A hydraulic multiple disc clutch for second speed 47 and a hydraulic multiple disc clutch for third speed 48 are provided between the counter shaft 9 and either of these idle gears. The respective clutch outers of these clutches are fixed to the counter shaft 9 and the respective clutch inners are connected to the idle gears. When hydraulic fluid is supplied between the clutch outer of this clutch and the pressure plate to pressurize them, the pressure plate is moved and the clutch is connected, these idle gears are fixed to the counter shaft 9 and the transmission of power at second or third speed is enabled.

30

A driving gear for normal rotation 49 and a driving gear for reverse

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rotation 50 are provided to the rear part 9b of the counter shaft 9. These are both an idle gear, the gear with which a manual dog clutch 51 provided in a medium is engaged is fixed to the rear counter shaft.

5 An intermediate shaft 10 is supported by the rear crankcase 26 and the rear crankcase cover 27. A first intermediate gear 52 always engaged with the driving gear for reverse rotation 50 and a second intermediate gear 53 connected to the first intermediate gear 52 via a long sleeve 53a are held by the intermediate shaft 10 so that they can be turned.

10

The output shaft 11 is supported by the front crankcase cover 24, the rear crankcase 26 and a rear crankcase cover 27 via ball bearings 13 and 14 and a needle bearing 15. The output shaft 11 pierces the front crankcase 25 without coming in contact with the front crankcase 25. Further, a driven
15 gear 54 always engaged with the driving gear for normal rotation 49 and the second intermediate gear 53 is touched to the outside face of the ball bearing 14 and is fixed to the output shaft 11.

This driven gear 54 is normally or reversely driven via the gear with
20 which the dog clutch 51 is engaged and rotates the output shaft 11 in a direction suitable for the forward travel or the backward travel of the vehicle. Therefore, this driven gear 54 functions as an input gear when the gear is viewed from the side of the output shaft 11. Reverse rotation is controlled so that connection is made only when the counter shaft is
25 rotated at first speed.

The gears in the transmission are all constant-mesh gears and it is determined depending upon which clutch of the hydraulic multiple disc clutches 43, 47, 48 is to be connected that any transmission gear ratio is
30 executed. Hydraulic control is made by a hydraulic control unit not shown.

That is, hydraulic fluid fed into a fluid passage from the hydraulic control unit toward the hydraulic multiple disc clutch for first speed is fed into a main shaft central hole 8b from the rear face of the front crankcase cover 24 via a pipe 95 for supplying hydraulic fluid and is supplied to the
5 hydraulic multiple disc clutch for first speed 43.

A fluid passage connecting part 96 is provided to a part of the front crankcase cover 24 located on an extended line of the central axis of the counter shaft 9 and fluid passages 97 and 98 toward the hydraulic multiple
10 disc clutch for second speed and the hydraulic multiple disc clutch for third speed are formed. Hydraulic fluid fed from the hydraulic control unit not shown is supplied to the hydraulic multiple disc clutch for second speed 47 or the hydraulic multiple disc clutch for third speed 48 via either of an outside or inside passage of a double pipe for supplying hydraulic
15 fluid 99 from the fluid passage connecting part 96 to a central hole 9c of the counter shaft 9.

Oil seals 16 and 17 are arranged close to the respective outside faces of the ball bearing 13 and the needle bearing 15 on the output shaft 11 and
20 prevent fluid in the crankcase 25 and 26 including the front and rear crankcase covers 24 and 27 from leaking outside. Parts having a large diameter 11a, 11c and 11b are also provided to the output shaft 11 with the parts touched to the inside faces of the ball bearing 13 and the needle bearing 15 and the outside face of the driven gear (the input gear) 54. The
25 outer diameter of the part having a large diameter 11a is smaller than the inner diameter of the ball bearing 14.

When the output shaft 11 is mounted, the output shaft 11 to which the driven gear (the input gear) 54 is attached is inserted from the rear after
30 the front crankcase cover 24, the front crankcase 25 and the rear crankcase 26 are mutually connected. Then, the output shaft 11 including the driven gear 54 is positioned by the part having a large diameter 11a touched to the

inside face of the ball bearing 13 and the part having a large diameter 11b touched to the further outside face of the driven gear 54 touched to the outside face of the ball bearing 14. Afterward, when the rear crankcase cover 27 is fitted to the rear of the output shaft 11, the part having a large diameter 11c is touched to the inside face of the needle bearing 15 and positioning is further secured.

As described above, in this embodiment, after the front crankcase cover 24, the front crankcase 25 and the rear crankcase 26 are connected, the output shaft 11 can be attached from one direction and in addition, positioning including the driven gear 54 can be also easily and securely made. In recombination, the rear crankcase cover 27 has only to be detached, and assembly workability and maintainability are both excellent. Further in this embodiment, as the oil seal 17 is arranged close to the outside of the needle bearing 15, the run-out of the output shaft 11 is inhibited and the sealing performance of the oil seal 17 is enhanced.

In the embodiment, the parts having a large diameter 11a, 11b and 11c are provided to three locations of the output shaft 11, however, they are not necessarily required to be provided to three locations and parts having a large diameter may be also provided to only two locations including the aftermost part having a large diameter 11c.

For example, the part having a large diameter 11a touched to the ball bearing 13 is not provided and only the parts having a large diameter 11b and 11c may be also provided. In this case, a first case is equivalent to the rear crankcase 26, a second case is equivalent to the front crankcase 25 and a case cover is equivalent to the rear crankcase cover 27. A first bearing is equivalent to the needle bearing 15 and a second bearing is equivalent to the ball bearing 14.

Further, when the position of the driven gear (the input gear) 54 is

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dislocated in another location and a part having a large diameter directly touched to the outside face of the ball bearing 14 is provided to the output shaft 11, it is equivalent to the embodiment of the invention described above.

5

In a preferred embodiment of the invention a bearing is provided to the front crankcase 25 shown in Fig. 2 and a part having a large diameter touched to the inside face is provided to the output shaft 11. Also in this case, a first case is equivalent to the rear crankcase 26, a second case is
10 equivalent to the front crankcase 25 and a case cover is equivalent to the rear crankcase cover 27.

Another preferred embodiment of the invention presents the parts having a large diameter 11a and 11c shown in Fig. 2 as a prerequisite. In
15 this case, the existence of both first and second case covers and a bearing provided to the respective case covers is a prerequisite of the invention.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the
20 art, that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

**THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE
PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:**

1. Output shaft structure of a vehicle driven by shafts driven in an
5 internal combustion engine provided with first and second cases mutually
connected on a face perpendicular to a crankshaft and forming a crankcase,
a case cover attached to the outside of the first case and an output shaft
arranged in the crankcase and supported by a first bearing provided to the
case cover and a second bearing provided to the first case, wherein a first
10 part having a large diameter positioned by touching it to the inside face of
the first bearing and a second part having a large diameter positioned by
touching it to the outside face of the second bearing are provided to the
output shaft.
- 15 2. Output shaft structure of a vehicle driven by shafts driven in an
internal combustion engine provided with first and second cases mutually
connected on a face perpendicular to a crankshaft and forming a crankcase,
a case cover attached to the outside of the first case and an output shaft
arranged in the crankcase and supported by a first bearing provided to the
20 case cover and a second bearing provided to the second case, wherein first
and second parts having a large diameter positioned by touching them to
each inside face of the first and second bearings are provided to the output
shaft.
- 25 3. Output shaft structure of a vehicle driven by shafts driven in an
internal combustion engine provided with first and second cases mutually
connected on a face perpendicular to a crankshaft and forming a crankcase,
first and second case covers respectively attached to each outside of the
first and second cases and an output shaft arranged in the crankcase and
30 supported by first and second bearings provided to the first and second case
covers and a second bearing provided to the second case, wherein: first and
second parts having a large diameter positioned by touching them to each

inside face of the first and second bearings are provided to the output shaft.

4. Output shaft structure of a vehicle driven by shafts driven in an
5 internal combustion engine provided with first and second cases mutually
connected on a face perpendicular to a crankshaft and forming a crankcase,
a case cover attached to the outside of the first case and an output shaft
arranged in the crankcase and supported by a first bearing provided to the
case cover and a second bearing provided to the first case, wherein an
10 input gear to the output shaft is arranged with the input gear touched to
the outside face of the second bearing; and a first part having a large
diameter positioned by touching it to the inside face of the first bearing
and a second part having a large diameter positioned by touching it to the
outside face of the input gear are provided to the output shaft.

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5. Output shaft structure of a vehicle driven by shafts according to any
of Claims 1 to 4, wherein the first bearing is a needle bearing; and an oil
seal is arranged close to the outside of the needle bearing.

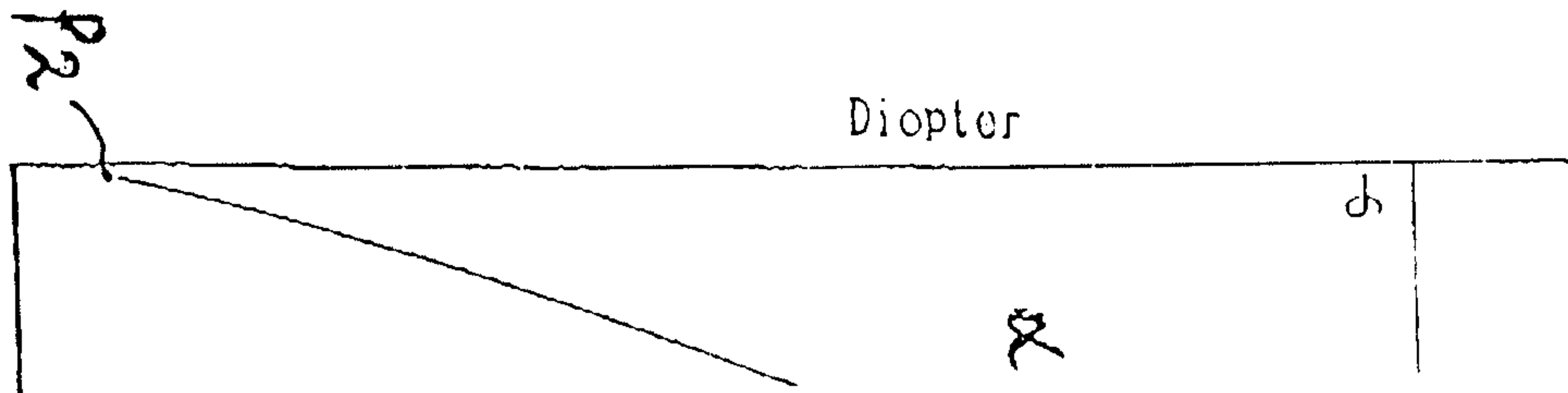


Fig. 1

