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(54) **Wet clutch**

(57) The wet clutch has an oil pump (42), for supplying cooling medium to the friction surfaces, arranged in such a manner that its input axis is coaxial with a clutch shaft (14). A clutch cover (20) is provided with a sleeve section (52) driving the pump (42), and comprising a sleeve (52*a*) which forms around the clutch shaft (14) an annular space (54). The annular space 54 is communicated at one end with the inside of the clutch cover (20) within which the friction surfaces to be force cooled are located and at the other end with the exhaust port (36*b*) of the oil pump (42) through an annular space (48) and an opening (46).

In an alternative arrangement the pump is mounted co-axially with the clutch release bearing.

FIG.1

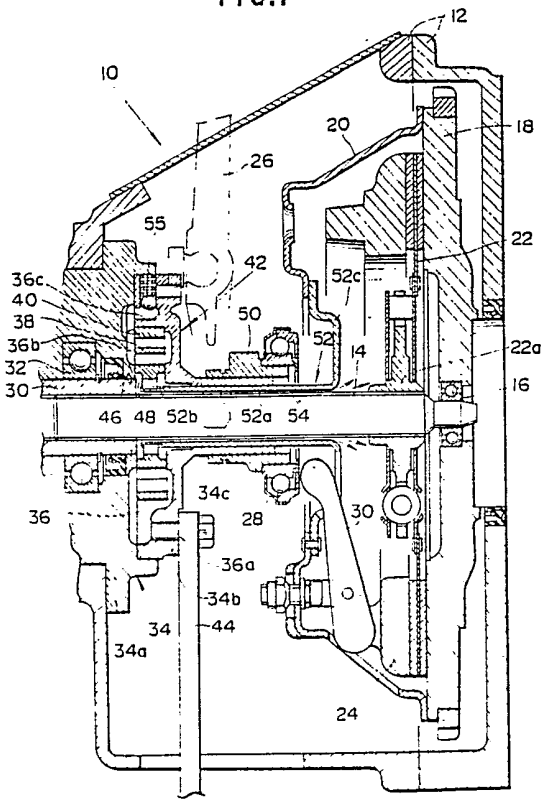

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FIG.1

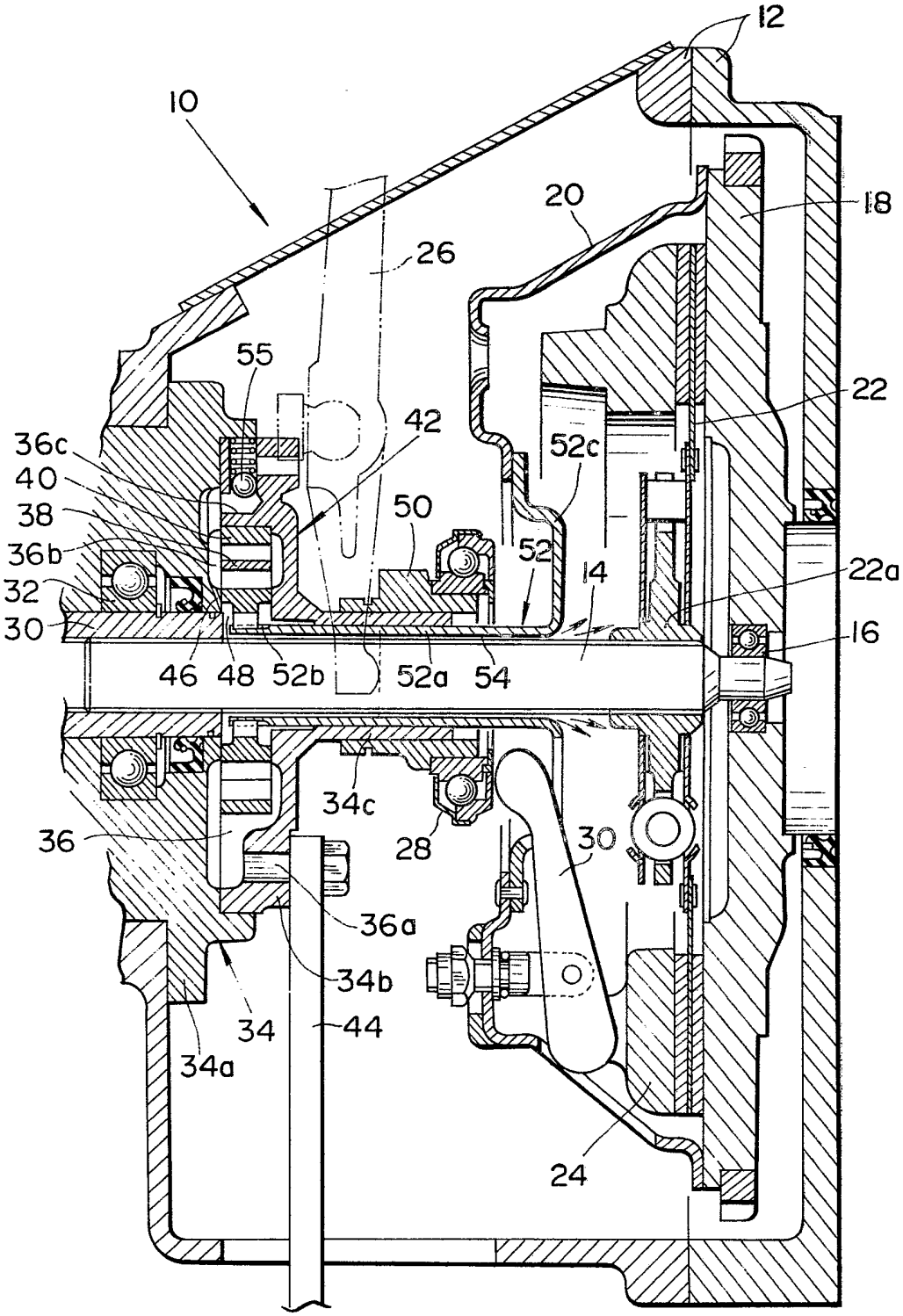

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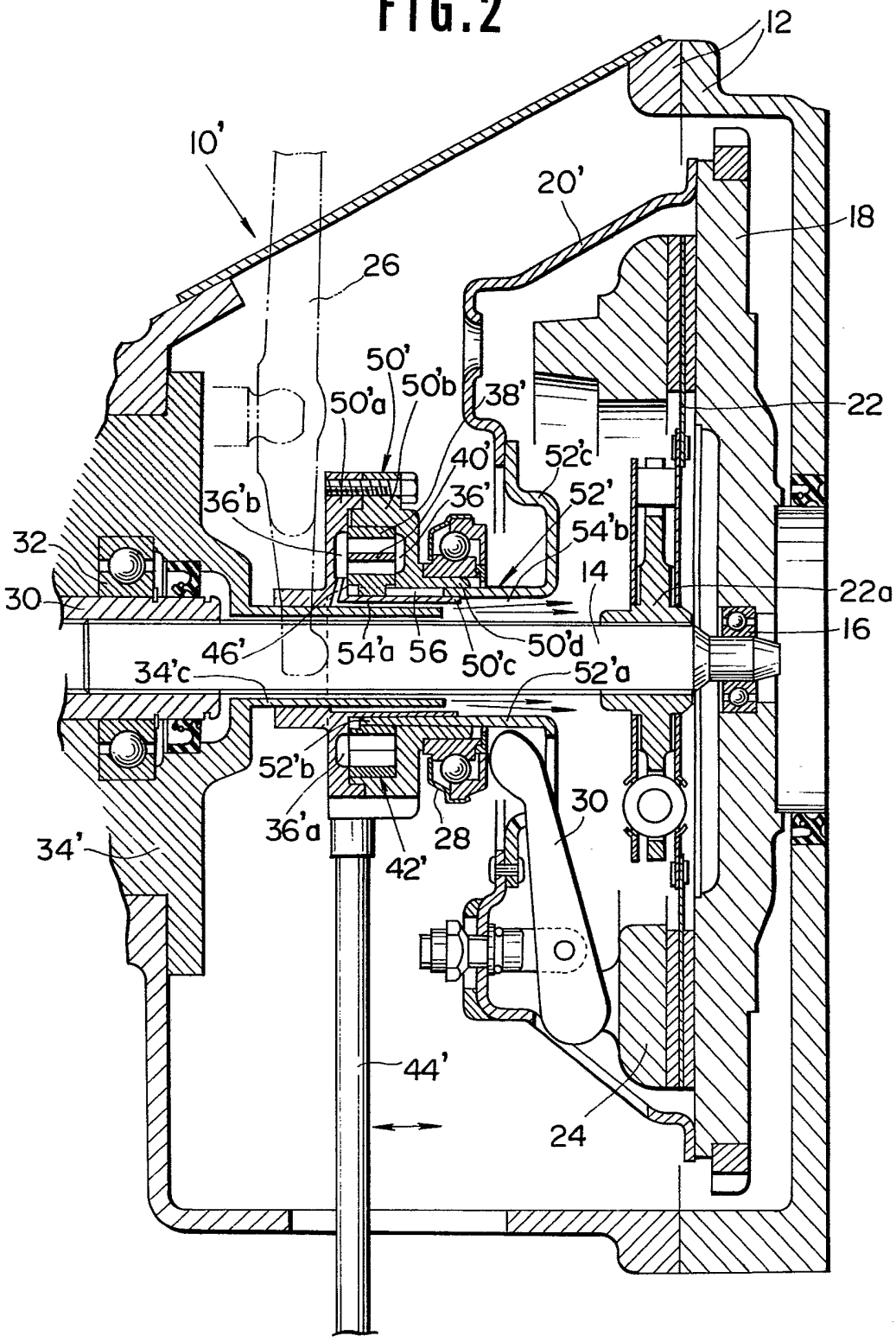
FIG.2



SPECIFICATION

Wet clutch

The present invention relates to a vehicular wet clutch and more specifically to an arrangement for feeding cooling medium or oil to friction surfaces in such a wet clutch.

A wet clutch is widely used in industrial vehicles such as fork lift trucks and is provided with an arrangement for feeding cooling oil to friction surfaces and thereby force cooling the same. To this end, the cooling oil feeding arrangement includes an oil pump and a delivery passageway for conveying the cooling oil discharged from the oil pump to friction surfaces of a clutch disc or discs, a pressure plate and a flywheel.

As disclosed in the Japanese Utility Model Provisional Publication No. 50-42150, it has been practiced to install the oil pump apart from a clutch shaft, that is, in a manner requiring an independent delivery pipe or pipes for hydraulically connecting the oil pump and the friction surfaces. Such an independent pipe or pipes are undesirable not only from the cost point of view but also from the efficient cooling oil feeding point of view since the pipe or pipes may possibly leak at the connecting portions thereof though sealed at those portions.

It is an object of the present invention to provide a wet clutch which can dispense with such an independent pipe or pipes and therefore can attain a reduction of the cost.

In accordance with the present invention, there is provided a wet clutch having a clutch cover within which friction surfaces to be force cooled are located, a clutch shaft passing through the clutch cover, and an oil pump having an input axis about which it is driven and operable to discharge cooling oil to be delivered to the inside of the clutch cover for force cooling the friction surfaces, characterized in that the oil pump is arranged in such a manner that the input axis is coaxial with the clutch shaft, that the clutch cover has a sleeve section through which the clutch shaft passes and which has a free end drivingly coupled with the oil pump. and that the sleeve section forms around the clutch shaft an annular space through which the cooling oil discharged from the oil pump is delivered to the inside of the clutch cover.

Other objects and advantages of this invention will be made more apparent as this description proceeds, particularly when considered in connection with the accompnaying drawings, wherein:

Fig. 1 is a sectional view of a wet clutch according to a first embodiment of the present invention; and

Fig. 2 is a sectional view similar to Fig. 1 but showing a second embodiment of the present invention.

In Fig. 1, a wet clutch of a single disc type is shown and generally designated by the reference numeral 10. The wet clutch 10 includes a clutch housing 12 and a clutch shaft 14 rotatable therein. On an end of the clutch shaft 14 (the right-hand end in the drawing), by way of a bearing 16, there is rotatably mounted a flywheel 18 to which a clutch cover 20 is bolted to rotate together therewith. Within the clutch cover 20, there is disposed a clutch disc 22 which is splined at the hub portion 22a thereof to the clutch shaft 14. Within the clutch cover 20, there is also disposed a pressure plate 24 which is urged by a plurality of pressure plate springs (not shown) against the flywheel 18. Upon engagement of the clutch, the clutch disc 22 is firmly clamped between the pressure plate 24 and the flywheel 18 under the bias of the pressure plate springs to receive engine rpm from the flywheel 18 and transmit it to the clutch shaft 14. When the clutch is to be disengaged, a clutch pedal (not shown) is depressed, and this movement is transmitted to a withdrawal lever 26 by way of rods or a cable (not shown). The withdrawal lever 26, in turn, moves a release bearing 28 against release levers 30 of the pressure plate 24, relieving the spring pressure on the pressure plate and releasing the clutch disc 22 from the flywheel 18. The other end of the clutch shaft 14 (the left-hand end in the drawing) is rotatably supported on the clutch housing 12 via a main shaft 30 of an associated transmission, a bearing 32 and a front cover 34. The main shaft 30 is splined to the clutch shaft 14 to rotate together therewith, and the front cover 34 is bolted to the clutch housing 12 to constitute part of the same. The foregoing structure substantially follows the conventional fashion.

In accordance with the present invention, the front cover 34 is formed from two separate sections 34a and 34b which are separable by a plane extending transversely of the clutch shaft 14, that is, separable axially of the clutch shaft. The first section 34a, which is located more outward than the second section, is bolted to the clutch housing 12. The first and second sections 34a and 34b are partly hollow and secure together by a suitable securing means to form an annular pump chamber 36 around the clutch shaft 14. Within the pump chamber 36, there are installed an inner drive gear 38 and an outer driven gear 40 internally toothed to be driven thereby to constitute an internal gear pump 42 which draws cooling oil thereinto through an entrance port 36a and forces it out through an exhaust port 36b. The entrance port 36a is connected with a suction pipe 44 which provides communication between the entrance port 36a and a cooling oil reservoir (not shown). The exhaust port 36b is communicated through an opening 46 formed in the outer front cover section 34a with an annular space 48 around the clutch shaft 14. The inner drive gear 38 is reduced in thickness at the inner peripheral portion thereof to form the annular space 48. The inner front cover section 34b has a tubular portion 34c which extends inwardly of the clutch housing 12 and toward the clutch cover 20 and through which the clutch shaft 14 and the clutch cover sleeve 52 pass. On the tubular portion 34c of the inner front cover section 34b, there is slidably mounted a release sleeve 50 on which the aforementioned release bearing 28 is fixedly mounted to move together therewith. The aformementioned withdrawal lever 26 is forked at an end and adapted to engage at the forked end with the release sleeve 50 in a manner to prevent the same from rotation.

Further, in accordance with the present invention, the clutch cover 20 is provided with an inner sleeve section 52 having a sleeve 52a through which the clutch shaft 14 passes and which extends along the clutch shaft and toward the front cover 34 to terminate

in a free end 52b (the left-hand end in the drawing) which is received in the pump chamber 28. The sleeve 52a is so sized as to form around the clutch shaft 14 an annular space 54 which is communicated at an end (the left-hand end in the drawing) with the annular space 48 and at the other end (the right-hand end in the drawing) with the inside of the clutch cover 20 where the friction surfaces of the clutch disc 22, the pressure plate 24 and the flywheel 18 are located. The opening 46 and the annular spaces 48 and 54 constitute a cooling oil feeding or delivery passageway which will be described in detail hereinafter. The sleeve 52a is fittingly surrounded or received by the aforementioned tubular portion 34c of the inner front cover section 34b, that is, the sleeve 52a, the tubular portion 34c of the inner front cover section 34b and the clutch shaft 14 are arranged concentrically to overlap one above another in such a manner as to form only the foregoing annular space 54 between the sleeve 52a and the clutch shaft 14. The inner sleeve section 52, in this embodiment, is shown as an independent sleeve member and further has a flange 52c extending radially outward from an end of the sleeve 52a (the right-hand end in the drawing) opposite to the free end 52b to be rivetted as shown or otherwise secured thereat by a suitable securing means to the corresponding inner peripheral portion of the clutch cover 20. The free end 52b of the sleeve 52a is splined to the inner peripheral portion of the inner drive gear 38 to drive the same and therefore the oil pump 42 when the clutch cover 20 is caused to rotate by rotation of the flywheel 18.

In the foregoing, it is to be noted that the inner drive gear 38 of the oil pump 42 is mounted concentrically with the clutch shaft 14, that is, the oil pump 42 is arranged to have an input axis coaxial or concentric with the axis of the clutch shaft 14.

Designated by the reference numeral 55 is a relief valve which is disposed in a relief port 36c formed in the inner front cover section 34b to relieve oil pressure beyond a specific or predetermined limit.

In operation, since engine rpm is transmitted through the flywheel 18 to the clutch cover 20, the oil pump 42 is driven by the clutch cover sleeve 52a in synchronism with the engine rpm, drawing cooling oil thereinto through the entrance port 36a and discharging it through the exhaust port 36b and the opening 46 into the annular space 48. Thenceforth, the cooling oil is delivered through the annular space 54 between the sleeve 52a and the clutch shaft 14 and discharged into the inside of the clutch cover 20 to force cool the friction surfaces of the clutch disc 22, the pressure plate 24 and the flywheel 18.

From the foregoing, it is to be understood that the opening 46 and the annular spaces 48 and 54 are adapted to serve as a cooling oil delivery passageway hydraulically connecting the exhaust port 36b of the oil pump 42 to the friction surfaces of the wet clutch 10 and which are attained without requiring independent piping and an additional seal that have been necessitated in the prior art arrangement.

Fig. 2 shows a second embodiment of the present invention, in which elements or parts similar to those of the previous embodiment are designated by the same reference numerals as their corresponding parts and will not be described again for brevity. Other parts, slightly modified, are designated by like reference numerals as their corresponding parts of Fig. 1, with a prime mark added.

This embodiment mainly differs from the previous embodiment in that the oil pump 42' is installed in the release sleeve 50'. To this end, the release sleeve 50' is formed from two separate parts, that is, first and second sections 50'a and 50'b which are separable axially of the clutch shaft 14 and bolted as shown or otherwise secured together by a suitable securing means to form the pump chamber 36' in which the inner drive gear 38' and the outer driven gear 40' are installed to constitute the internal gear pump 42' which draws cooling oil thereinto through the entrance port 36'a and forces it out through the exhaust port 36'b. The first release sleeve action 50'a, which is located remoter from the clutch cover 20', has a tubular portion 50'c formed with a stepped bore (not numeral) at which it is slidably mounted on the tubular portion 34'c of the front cover 34' and at the same time cooperates with the same to form therebetween an annular space 54'a which is communicated at an end thereof (the left-hand end in the drawing) through the opening 46' formed in the first release sleeve section 50'a with the exhaust port 36'b of the oil pump 42'. The second release sleeve section 50'b has a tubular portion 50'd to mount thereon the release bearing 28. The tubular portion 50'd is arranged to overlap the aforementioned tubular portion 50'c of the first release sleeve section 50'a and form therebetween an annular space 56 in which the splined end 52'b of the front cover sleeve 52'a is inserted. The splined end 52'b of the front cover sleeve 52'a, in this embodiment, is adapted to provide such splines that are separated like a fork and joined only at the axially inner ends thereof. Such a splined end 52'b, since held between the aforementioned tubular portions 50'c and 50'd of the first and second release sleeve sections 50'a and 50'b, can exert a necessary strength and be manufactured with economy. The splined end 52'b is engaged with the splined inner peripheral portion of the inner drive gear 38' to drive the same when the engine is in operation. The sleeve 52'a of the front cover sleeve section 52' forms around the clutch shaft 14 an annular space 54'b which is communicated at an end (the left-hand end in the drawing) with the annular space 54'a and at the other end (the right-hand end in the drawing) with the inside of the clutch cover 20'. The annular spaces 54'a and 54'b are thus equated to the annular space 54 of the previous embodiment. The entrance port 36'a of the oil pump 42' is connected with the suction pipe 44' in such a manner that the suction pipe, at least the upper portion of the same, is movable together with the release sleeve 50' or in such a manner that upon movement of the release sleeve the suction pipe 44' does not provide any substantial resistance thereto. For example, a flexible suction pipe or tube may be used for this end.

The front cover 34', in this embodiment, is a single piece and integrally formed with the aforementioned tubular portion 34'c through which the clutch shaft 14 passes.

In operation, the cooling oil discharged from the exhaust port 36'b of the oil pump 42' is delivered

through the opening 46' and the annular space 54'a to the annular space 54'b and then discharged into the inside of the clutch cover 20' to produce the same effect as the previous embodiment.

In the foregoing, while the oil pump 42 or 42' has been described and shown as being an internal gear pump, it is not limited to that type of pump but other types of pumps such as a vane pump may be used.

CLAIMS

1. A wet clutch having a clutch cover within which friction surfaces to be force cooled are located, a clutch shaft passing through the clutch cover, and an oil pump having an input axis about which it is driven and operable to discharge cooling oil to be delivered to the inside of the clutch cover for force cooling the friction surfaces, characterized in that said oil pump is arranged in such a manner that said input axis is coaxial with said clutch shaft, that said clutch cover has a sleeve section through which said clutch shaft passes and which has a free end drivingly coupled with said oil pump, and that said sleeve section forms around said clutch shaft an annular space through which the cooling oil discharged from said oil pump is delivered to the inside of said clutch cover.

2. A wet clutch as set forth in claim 1, further having a front cover rotatably supporting the clutch shaft, characterized in that said oil pump is mounted in said front cover.

3. A wet clutch as set forth in claim 1, further having a release sleeve movable along the clutch shaft, characterized in that said oil pump is mounted in said release sleeve.

4. A wet clutch as set forth in claim 1, characterized in that said oil pump is an internal gear pump having an inner drive gear and an outer driven gear, and that said free end of said sleeve section is splined to the inner peripheral portion of said inner drive gear.

5. A wet clutch as set forth in claim 4, characterized in that said clutch cover sleeve section is an independent member and comprises a sleeve through which said clutch shaft passes and a flange extending radially outward from an end of said sleeve opposite to said free end thereof to be secured thereat to the inner peripheral portion of said clutch cover.

6. A wet clutch as set forth in claim 5, further having a clutch housing, said clutch shaft being rotatable within the clutch housing, a flywheel rotatably mounted on an end of the clutch shaft, said clutch cover being secured to the flywheel to rotate together therewith, a clutch disc disposed within the clutch cover and splined to the clutch shaft to rotate together therewith, a pressure plate disposed within the clutch cover and operable to cooperate with the flywheel to firmly clamp therebetween the clutch disc, and a front cover supporting the other end of the clutch shaft on the clutch housing, characterized in that said front cover is formed from two separate sections which are separable axially of said clutch shaft and adapted to form an annular pump chamber around said clutch shaft, said inner drive gear and said outer driven gear being installed within said pump chamber to constitute said oil pump.

7. A wet clutch as set forth in claim 6, further having a release sleeve and a release bearing fixedly mounted thereon, characterized in that one of said front cover sections has a tubular portion which extends inwardly of said clutch housing and toward said clutch cover and through which said clutch shaft and said clutch cover sleeve are extended, and that said release sleeve is slidably mounted on said tubular portion of said one front cover section.

8. A wet clutch as set forth in claim 7, characterized in that said inner drive gear is reduced in thickness at the inner peripheral portion thereof to define around said clutch shaft an annular space in communication with said annular space between said clutch shaft and said front cover sleeve, and that the other front cover section is formed with an opening providing communication between the exhaust port of said oil pump and said annular space formed by said inner drive gear.

9. A wet clutch as set forth in claim 5, further having a clutch housing, said clutch shaft being rotatable within the clutch housing, a flywheel rotatably mounted on an end of the clutch shaft, said clutch cover being secured to the flywheel to rotate together therewith, a clutch disc disposed within the clutch cover and splined to the clutch shaft to rotate together therewith, a pressure plate disposed within the clutch cover and operable to cooperate with the flywheel to firmly clamp therebetween the clutch disc, a front cover supporting the other end of the clutch shaft on the clutch housing, a release sleeve slidable along the clutch shaft, and a release bearing mounted on the release sleeve, characterized in that said release sleeve is formed from two separate sections which are separable axially of said clutch shaft and adpated to form around said clutch shaft a pump chamber within which said inner drive gear and said outer driven gear are installed to constitute said oil pump.

10. A wet clutch as set forth in claim 9, characterized in that said front cover has a tubular portion which extends inwardly of said clutch housing and toward said clutch cover and through which said clutch shaft passes, and that one of said release sleeve sections has an opening leading to the exhaust port of said oil pump and a tubular portion formed with a stepped bore at which it is slidably mounted on said tubular portion of said front cover and at the same time cooperates with the same to form therebetween an annular space which is communicated at an end thereof through said opening with said exhaust port of said oil pump. said annular space between said tubular portion of said one release sleeve section and said tubular portion of said front cover being communicated at the other end thereof with the inside of said clutch cover through said annular space between said clutch cover sleeve and said clutch shaft.

11. A wet clutch as set forth in claim 10, characterized in that the other one of said release sleeve sections has a tubular portion to mount thereon said release bearing, and that said tubular portion of said other release sleeve section is arranged to overlap said tubular portion of said one release sleeve section and form therebetween an annular space in which said free end of said front cover sleeve is inserted.

12. A wet clutch as set forth in claim 11, characterized in that said free end of said front cover sleeve is formed with such splines that are separated like a fork and joined only at the axially inner ends thereof.

13. A wet clutch substantially as described with reference to and as illustrated in Fig. 1, or Fig. 2 of the accompanying drawings.

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