Title: POWER TAKE-OFF APPARATUS

Abstract: A power take-off apparatus for use on vehicles comprises a pulley (15) connected directly to the end of a vehicle engine crankshaft (14) coaxially with the crankshaft (14). An electrically operated clutch is mounted on the pulley (15). The clutch comprises at least one clutch plate (16) fixed to said pulley (15) and a clutch unit (22) movable to engage and disengage the at least one clutch plate (16). A clutch control circuit (21), when operated, engages the clutch. Said clutch unit (22) is mounted on a mounting plate (20), the mounting plate (20) itself being supported by pillars (18) extending past the clutch and pulley (15) and connected to the vehicle engine block (10). Drive means for taking power from the clutch unit are mounted on the mounting plate (20), the form of a drive pulley (25) or a hydraulic or pneumatic pump (24) to provide fluid under pressure to energise an external fluid operated motor acting as a prime mover for equipment such as a close coupled compressor, generator or water pump.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
POWER TAKE-OFF APPARATUS

This invention relates to a power take-off apparatus for use in a vehicle.

Power take-off apparatuses in general are sold for fitting to vehicles such as trucks or fire engines. Known apparatuses of this kind are bulky and unsuitable for fitting to lighter vehicles such as light lorries, cars and utility vehicles such as vans or those vehicles sold under the registered trade marks Land Rover and Range Rover.

According to the present invention there is provided a power take-off apparatus comprising: a pulley connected directly or indirectly to a vehicle engine crankshaft coaxially with the crankshaft; a clutch mounted on said pulley, said clutch comprising at least one clutch plate fixed to said pulley and a clutch unit movable to engage and disengage said at least one clutch plate; a clutch control arrangement which, when operated, engages said clutch; and drive means for taking power from the clutch unit.

Such an apparatus can readily be mounted on a vehicle, for example by replacing one of the external pulleys provided on the crankshaft to drive a timing belt or the like, by the pulley of the present invention having a clutch mounted thereon. Accordingly the present invention allows a power take-off apparatus to be fitted on a wide range of vehicles including light lorries, cars and utility vehicles.

As the pulley is coaxial with the crankshaft, power may be taken out through the clutch to the drive means without generating any side force on the crankshaft or the pulley. This allows power to be taken out without risking damage to the crankshaft or the pulley. If power taken out by, for example, a belt, significant side force would be generated on the crankshaft at the level of power which might be required from a power take-off apparatus. This would risk damage to the crankshaft or the clutch. Also the belt could whip risking damage or malfunction. This is because a power
take-off apparatus would be desired to deliver relatively high powers, say up to 20 kW which might be a fifth of the output of the engine and which is above the power normally derived from a timing belt.

5 Preferably, the at least one clutch plate is mounted in a recess in said pulley. This provides a very compact arrangement for the power take-off apparatus making it more suitable for application to a small vehicle. The compactness can be further enhanced by the clutch unit being positioned at least in part within said recess in said pulley.

10 The drive means for taking power from the clutch unit may be a pneumatic or hydraulic pump mounted adjacent said pulley to provide fluid under pressure, when the clutch is engaged, for energising an external fluid-operated motor acting as a prime mover for equipment, for example a close coupled compressor, generator or water pump. Alternatively, the output from the pump could be via pipes or hoses themselves provided with hose connectors mounted in a readily accessible position on the exterior of the vehicle, for example near to the bonnet or hood of the vehicle. Alternatively the drive means may be a drive pulley.

20 The clutch can take many forms including a remotely controlled system operated, for example, by a Bowden cable. Preferably, however, it is an electrically operated clutch and the control arrangement is a control circuit.

Preferably, the electrical control circuit includes switch arrangement connectable to the vehicle gearbox selector and/or the vehicle handbrake so as to prevent the clutch being engaged when the vehicle is being driven.

Desirably, said clutch unit is mounted on a mounting plate, the mounting plate itself being supported by pillars extending past the clutch and pulley and connectable to the vehicle engine block.
In order that the present invention may more readily be understood, the following
description is given, merely by way of example, reference being made to the
accompanying drawings in which:

Fig. 1 is a schematic side elevational view, partly in section, of a power take-off
which is a first embodiment to the present invention; and

Fig. 2 is a similar view of a power take-off which is a second embodiment of the
present invention.

A first embodiment is illustrated in Fig. 1 connected to an engine block 10 of an
engine of any suitable vehicle. This may be an in-line engine or a transverse engine.
Nearly all engines will have a timing belt cover and such a cover 12 is illustrated.

As can be seen in the half section, mounted on an end portion of the crankshaft 14 is
a pulley 15 which may itself act as the timing belt pulley for the engine.
Consequently the pulley 15 is coaxial with the crankshaft 14. The outer
circumferential wall 26 of the pulley 15 has a cylindrical surface 27 adapted to
receive a timing belt. The pulley 15 is formed with annular spacer 19 inside the outer
circumferential wall 26. The annular spacer 19 acts a vibration damper and is formed
from rubber or some other suitable material. The spacer 19 is in itself conventional
and not essential to the invention.

The pulley 15 is modified as compared to a normal timing belt pulley. It includes a
fixed clutch plate 16, which is fixed to the pulley so as to rotate when the pulley 15
itself rotates. Alternatively a plurality of clutch plates 16 may be provided

A clutch unit 22 is positioned adjacent the fixed clutch plate 16 which is mounted on
the pulley 15. The clutch unit 22 is mounted on the inner side of a mounting plate
20. The mounting plate 20 is supported by three pillars 18, only two of which can be
seen in the drawing, which extend past the clutch unit 22 and the pulley 15 and are
connected to the engine block 10.

The clutch unit 22 is an electrically operated dog clutch and may have a moving clutch plate or set of plates. It is movable in a direction parallel to the rotational axis of the pulley 15 to engage and disengage the fixed clutch plate 16, whereby the clutch unit 22 and fixed clutch plate 16 together constitute a clutch. The movement of the clutch unit 22 is controlled by a control circuit 21. An electrical (or electromagnetic) clutch is preferred, although other forms of clutch are contemplated. As an alternative to the electrically operated clutch unit 22, the clutch could simply be manually operated or operated remotely by a Bowden cable.

As the pulley 15 is coaxial with the crankshaft 14 power is taken out through the clutch unit 22 without developing any side force on the crankshaft 14 or the pulley 15. This allows power to be taken out without risking damage to the crankshaft 14 or the pulley 15. The pulley 15 is coaxial with the crankshaft by being mounted directly on the crankshaft 14, but it could equally be connected indirectly by a further mechanical connection, such as an additional shaft mounted to between the pulley 15 and the crankshaft 14.

As can be seen in Fig. 1, the pulley 15 is provided with a recess 17 within the centre of pulley 15. The recess 17 is coaxial with the pulley 15. The recess 17 extends from the end face 28 of the pulley 15 inside the outer circumferential wall 26 of the pulley 15 on which is formed the cylindrical surface 27 for receiving a belt. The clutch plate 16 is mounted in the recess 17, in particular on the base of the recess 17. The clutch unit 22 is also positioned partly within the recess 17. Mounting the clutch plate 16 in the recess 17 provides a compact arrangement for the clutch.

The pulley 15 may be manufactured from a conventional pulley in the following way. If, necessary, the recess 17 is formed or enlarged, for example by turning on a lathe. The clutch plate 16 is then mounted within the recess by bolts 11 or any other suitable fixing.
Mounted on the right-hand side of the mounting plate 20 is a hydraulic pump 24, the input drive shaft of which is connected to the clutch unit 22 through a bearing in a bearing housing 23. It has been found that when attached to the engine of a normal car, a hydraulic pump of up to 5kW can comfortably be mounted on the mounting plate 20.

It will be appreciated, therefore, that when the clutch unit 22 is operated, the clutch unit 22 will engage against the fixed clutch plate 16 and will thereby be driven from the vehicle engine by the keyway of the pulley 15, this in turn driving the hydraulic pump 24.

Output hoses (not shown) can be connected from the hydraulic pump 24 to an external hydraulic motor (not shown) which may be used, upon engagement of the clutch, to drive any piece of equipment such as a close coupled compressor, a generator or water pump by way of example. In this way, the hydraulic pump acts as a drive means to take power from the clutch unit 22.

Reference has been made in this description to a hydraulic pump and hydraulic motor. These could, of course, be replaced by a pneumatic pump and motor.

The control circuit 21 associated with the electrically operated clutch will include a control switch for turning the clutch on and off. It will preferably also include a switch arrangement which is connectable to the vehicle gearbox selector and either additionally or alternatively to the vehicle handbrake, whereby the circuit remains open unless the vehicle gearbox is in neutral and the handbrake is on. In this way operation of the apparatus of the invention is prevented unless the vehicle is stationary.

A second embodiment is illustrated in Fig. 2 and comprises in most part elements which are identically constructed and arranged to the first embodiment. The same reference numerals are used for like elements and a detailed description of the
common elements is omitted for brevity. The only difference is that the hydraulic pump 24 of the first embodiment is replaced by a toothed drive pulley 25 for taking power from the clutch unit 22. A belt (not shown) may be arranged around the drive pulley to drive external equipment when the clutch is engaged. The drive pulley 25 and belt may be used to drive an external hydraulic (or pneumatic) pump itself connected to drive an external hydraulic (or pneumatic) motor for driving further equipment. This is a particularly advantageous arrangement when driving a hydraulic pump which is too large to mount on the mounting plate 20.
CLAIMS

1. A power take-off apparatus comprising:
   a pulley connected directly or indirectly to a vehicle engine crankshaft
   coaxially with the crankshaft;
   a clutch mounted on said pulley, said clutch comprising at least one clutch
   plate fixed to said pulley and a clutch unit movable to engage and disengage said at
   least one clutch plate;
   a clutch control arrangement which, when operated, engages said clutch; and
   drive means for taking power from the clutch unit.

2. An apparatus according to any one of the preceding claims, wherein the
   pulley is connected directly to the end of the crankshaft.

3. An apparatus according to claim 1 or 2, wherein said drive means is a
   pneumatic or hydraulic pump mounted adjacent said pulley to provide fluid under
   pressure, when said clutch is engaged, for energising an external fluid-operated motor
   acting as a prime mover for equipment.

4. An apparatus according to claim 1 or 2, wherein said drive means is a drive
   pulley.

5. An apparatus according to any one of the preceding claims, wherein said
   clutch is an electrically operated clutch and wherein said control arrangement
   comprises a control circuit.

6. An apparatus according to claim 5, wherein said control circuit includes a
   switch arrangement which is connectable to the vehicle gearbox selector and/or the
   vehicle handbrake so as to prevent the clutch being engaged when the vehicle is
   being driven.
7. An apparatus according to any one of the preceding claims, wherein said clutch unit is mounted on a mounting plate, the mounting plate itself being supported by pillars extending past the clutch and pulley and connectable to a vehicle engine block.

8. An apparatus according to any one of the preceding claims, wherein said at least one clutch plate is mounted in a recess in said pulley.

9. An apparatus according to claim 8, wherein the clutch unit is positioned at least in part within said recess in said pulley.

10. An apparatus according to claim 8 or 9, wherein said recess extends inside the outer circumferential wall of the pulley, on which wall is formed a cylindrical surface for driving a belt.

11. An apparatus according to any one of the preceding claims, wherein said pulley drives an engine timing belt.

12. An engine block for an engine, the engine block mounting a crankshaft and a power take-off apparatus according to any one of the preceding claims.
## INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

| IPC    | 7   | B60K25/02 |

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

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**EPO-Internal, WPI Data, PAJ**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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**Date of the actual completion of the international search**

19 January 2001

**Date of mailing of the international search report**

26/01/2001

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