POWER TAKE-OFF IN A MOTOR DRIVEN VEHICLE

The present invention relates to a power take-off (PTO) of an engine-driven vehicle. The PTO comprises a first unit (2) which incorporates not only a motion-transmitting element (5) connected to a driveline of the vehicle but also a hub (10) with a recess which forms part of a first spline connection, a second unit (7) which incorporates not only connecting means to make it possible to connect an equipment item (8) intended to be driven by the PTO but also a hub (18) with a recess forming part of a second spline connection, and a shaft (6) which extends between the first unit (2) and the second unit (7) and which comprises a first portion (12) forming a complementing part of the first spline connection and a second portion (15) forming a complementing part of the second spline connection. The first portion (12) and second portion (15) of the shaft can be positioned at various angles to the recess of the accommodating hubs (10, 18).
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Power take-off in a motor driven vehicle

BACKGROUND TO THE INVENTION, AND STATE OF THE ART

5 The invention relates to a power take-off on an engine-driven vehicle according to the preamble to claim 1.

Power take-offs (PTOs) are used in many contexts to supply driving power to such items as auxiliary equipment of vehicles of various kinds. The PTO’s driving power is usually obtained from the vehicle’s driveline via a transmission element in the vehicle’s gearbox. The PTO is usually connected to a hydraulic pump which itself drives said auxiliary equipment.

A known PTO on a vehicle incorporates a first unit with a bearing bracket which supports a gearwheel which is mounted in engagement with a gearwheel of the vehicle’s gearbox. The bearing bracket is fastened to a sidewall of the gearbox. The gearwheel of the first unit incorporates a hub which is in engagement with a first end of a shaft via a first spline connection. The other end of the shaft is in engagement with a corresponding hub of a second unit via a second spline connection. The second unit is mounted adjacent to a rear edge of the gearbox and incorporates suitable connecting means for connecting and driving a hydraulic pump. The hub of the gearwheel of the first unit and the hub of the second unit are in line here so that said shaft allows here the transmission of a driving motion.

25 Certain situations, however, require a PTO with an output speed which differs from that usually applied. In such cases the bearing bracket is provided with a gearwheel of a size and a number of teeth as required for providing the PTO with the desired output speed. In cases where a higher output speed is desired, the bearing bracket is thus provided with a smaller gearwheel with a smaller number of teeth. For such a smaller gearwheel to be in engagement with the gearbox’s gearwheel, it has to be situated closer to the gearbox’s gearwheel than the usually applied larger gearwheel. For the hub of the gearwheel of the bearing bracket and the hub of the coupling unit to be in line, a specially adapted bearing bracket is required for the smaller gearwheel.
SUMMARY OF THE INVENTION

The object of the present invention is to provide a PTO on a motor vehicle which incorporates a number of basic components which may substantially always be fitted in the motor vehicle even when PTOs are manufactured with different output speeds.

The object indicated above is achieved with the PTO mentioned in the introduction which is characterised by what is indicated in the characterising part of claim 1. A spline connection allows a certain axial mobility between the constituent parts of the spline connection. The same shaft may therefore be used for bridging the distance between the two hubs which have parallel centrelines even if one hub protrudes laterally relative to the second hub so that the centrelines of the hubs are no longer in line with one another. Appropriate design of the spline connection makes it possible for one shaft to be angled so that it can in this case receive a driving motion from the first hub and transmit it to the second hub. Although the hub of the first unit and the hub of the second unit need not necessarily have parallel centrelines, the shaft can also transmit a driving motion between the first and second units when the hubs have assumed different rotational positions relative to one another. This means that the PTO may incorporate a shaft and a number of basic components which may always be fitted in a vehicle even when PTOs with different output speeds are manufactured, resulting in the position of the first hub being altered. The cost of manufacturing PTOs with different output speeds is thus significantly reduced by the increased possibility of modularisation of the relevant components.

According to a preferred embodiment of the invention, the first portion and second portion of the shaft may be positioned at substantially continuously variable angles to the accommodating recesses in the hub within an angular range. This means that motion-transmitting elements of substantially any desired size may be used for achieving a desired PTO output speed value. The first portion and second portion of the shaft may with advantage be angled within an angular range of at least ±5% to the hubs of the accommodating recesses. The first portion and second portion of the shaft preferably incorporate a peripheral surface which comprises a number of ridges which are mainly axial in extent and which exhibit a peripheral surface which in an axial direction is situated at a variable radial distance from a centreline through the shaft. An appropriate
peripheral shape of the ridges allows the first and second portions of the shaft to be angled in the recesses of the hubs without the ridges leaving the ridge-accommodating grooves in the recesses. The spline connection thus maintains its power-transmitting capacity even with an angled shaft. Alternatively, the first and second portion of the shaft may incorporate a conventional spline design with straight ridges while the recesses of the hubs incorporate grooves with a peripheral surface which is situated at a variable radial distance from a centreline through the recesses of the hubs. Such a shape of the grooves also makes possible a continuous oblique positioning of the first and second portions of the shaft in the recesses.

According to another preferred embodiment of the present invention, the peripheral surface of the ridges exhibits a maximum distance from the centreline at an axial intermediate position which is situated between the axial end positions of the ridges. When the first and second portions of the shaft are not angled in the recesses, the portion of the ridges which exhibits said maximum radial distance is substantially only in engagement with the grooves of the recesses. In the situation when the first and second portions of the shaft are angled in the accommodating recesses, the engaging portions of the ridges protrude partly from said axial middle position. With advantage, the distance of the peripheral surfaces of the ridges decreases continuously from the axial intermediate position towards the axial end positions. This means that the first and second portions of the shaft can be angled so much that substantially the whole axial extent of the ridges can be used. With advantage, the peripheral surfaces of the ridges exhibit part of a circular path between the axial end positions. This means that the first and second portions of the shaft can be positioned obliquely continuously in the recesses, which may here exhibit a conventional spline design with straight grooves to accommodate said ridges. Only the spline design of the first and second portions of the shaft need be modified relative to a conventional PTO design.

According to another preferred embodiment of the present invention, the motion-transmitting element of the first unit is a gearwheel. As said first and second spline connections also allow power transmission with a substantially continuously obliquely positioned shaft, a gearwheel of substantially any desired size may here be arranged in engagement with a transmission element of the vehicle. Said transmission element is

Enligt en annan föredragen utföringsform av föreliggande uppfintning är nämnda objekt som drivs av krafttuttagen en hydraulpump. Hos fordon som innefattar hjälpputrustning av olika slag är hydraulisk drift ofta att föredra.

KORT BESKRIVNING AV RITNINGARNA

I det följande beskrivs såsom ett exempel en föredragen utföringsform av uppfinningen med hänsynvisning till bifogade ritning, på vilken:

Fig. 1 visar schematiskt ett krafttuttag som är fäst mot en växellåda,
Fig. 2 visar ett krafttuttag enligt föreliggande uppfintning,
Fig. 3 visar en axel med ett splinesformat ändparti enligt föreliggande uppfintning,
Fig. 4 visas axelns ändparti i Fig 3 sett från sidan och
Fig 5 visa en snittvy av ett nav med en splinesformad urtagning för mottagning av nämnda axelparti.

DETALJERAD BESKRIVNING AV EN FÖREDRAGENUTFÖRINGFORM AV UPPFINNINGEN

Fig. 1 visar schematiskt ett krafttuttag som är fäst mot en växellåda 1, ingående i en drivlina i ett motorfordon, och som således drivs av fordonets drivmotor. Krafttuttaget innefattar en första enhet 2 som innefattar en lagerbock 3 som medelst bultar 4 är fäst mot en sidovägg hos växellådan 1. Lagerbocken 3 uppbrar ett kugghjul 5 som är i ingrepp med det främre kugghjulet 1', hos växellådans 1 sidoaxel. Växellådans 1 främre kugghjul 1' visas schematiskt i Fig. 2. Krafttuttaget innefattar därutöver en axel 6 som är cirka 60 cm lång och sträcker sig från den första enheten 2 till en andra enhet 7. Den andra enheten 7 hos krafttuttaget är fäst mot en bakre vägg hos växellådan 1 och innefattar förbindningsmedel för anslutning av en hydraulmotor 8 till krafttuttaget för drift av hjälpputrustning hos fordonet.
The PTO further incorporates a shaft 6 about 60 cm long which extends from the first unit 2 to a second unit 7. The second unit 7 of the PTO is fastened to a rear wall of the gearbox 1 and incorporates connecting means for connecting a hydraulic motor 8 to the PTO in order to drive auxiliary equipment of the vehicle.

Fig. 2 depicts the design of the PTO in more detail. The bearing bracket 3 is thus fastenable to the gearbox 1 by means of bolts 4. The bearing bracket 3 supports the gearwheel 5 for rotation via two bearings 9. The gearwheel 5 incorporates a centrally situated hub 10 connected firmly to the gearwheel 5. The hub 10 incorporates a central recess with a radial internal surface whose shape is such as to form part of a first spline connection of the PTO. The shaft 6 incorporates a first homogeneous section 11 which incorporates a first end portion 12. The first end portion 12 exhibits an external radial surface whose shape is such as to form a complementing part of the first spline connection. The first spline connection thus transmits the rotary motion of the gearwheel 5 and the hub 10 to the shaft 6.

The shaft 6 incorporates a tubular middle section 13 which is thus firmly connected on one side to the first homogeneous section 11. The tubular middle section 13 is firmly connected on the opposite side to the other homogeneous section 14. The homogeneous section 14 incorporates a second end portion 15 which exhibits a radial external surface whose shape is such as to form part of a second spline connection. The PTO's second unit 7 incorporates a fastening element 16 designed to be fastened by bolts to a rear wall of the gearbox 1. The fastening element 16 incorporates bearings 17 by means of which a hub 18 is arranged for rotation relative to the fastening element 16. The hub 18 incorporates a central recess with a radial internal surface whose shape is such as to form a complementary part of the second spline connection. The second spline connection thus transmits the rotary motion of the shaft 6 to the hub 18. The hub 18 is connected for rotation with an output shaft 19 and a coupling plate 20 for connecting the hydraulic pump 8.

Fig. 3 depicts a section of the shaft 6 which incorporates the first end portion 12. The first end portion 12 incorporates an external peripheral surface with a multiplicity of ridges 21 which have a substantially axial extent. The ridges 21 are arranged round the
surface of the first end portion 12 at substantially constant intervals. The ridges 21 incorporate a peripheral surface which exhibits along its axial extent a varying radial distance from a centreline 22 through the shaft 6. The peripheral surface of the ridges 21 exhibits at an axially middle position 23 situated substantially halfway between the axial end positions 24,25 of the ridges 21 a maximum radial distance from the centreline 22. The radial distance of the ridges 21 from the centreline 22 decreases continuously along substantially circular paths from the axial intermediate position 23 to the axial end positions 24,25.

Fig. 4 depicts the first end portion 12 of the shaft as seen from the left side in Fig. 3. The first end portion 12 incorporates an intermediate surface 26 which extends between the ridges 21. The intermediate surface 26 also exhibits along its axial extent a varying radial distance from the centreline 22 through the shaft 6. The radial distance of the intermediate surface 26 from the centreline varies in a manner corresponding to the distance of the peripheral surface of the ridges 21. The height of the ridges 21, i.e. the distance between the peripheral surface of the ridges 21 and the intermediate surface 26 situated radially within, is thus substantially constant along the axial extent of the ridges 21. The peripheral surface of the ridges 21 exhibits a maximum radial distance $b_{\text{max}}$ from the centreline 22 at the axial intermediate position 23. The peripheral surface of the ridges 21 exhibits a minimum radial distance $b_{\text{min}}$ from the centreline 22 at the axial end positions 24,25. In a corresponding manner, the intermediate surface 26 of the ridges exhibits a maximum radial distance $s_{\text{max}}$ from the centreline 22 at the axial intermediate position 23 and a minimum radial distance $s_{\text{min}}$ from the centreline 22 at the axial end positions 24,25. The longitudinal side surfaces of the ridges 21 are inclined so that the width of the ridges 21 decreases continuously in a radial direction.

Fig. 5 depicts a sectional view of the centrally situated hub 10 of the gearwheel 5. The hub 10 incorporates a recess which is defined by an internal radial surface substantially corresponding to the external radial surface at the axial intermediate position 23 of the first end portion 12. The internal radial surface of the hub 10 incorporates grooves 27 whose shape corresponds to the shape of the ridges 21. The number and position of the grooves 27 also correspond to those of the ridges 21. The peripheral surface of the grooves 27 is situated at a constant distance from a centreline 28 through the hub 10,
navets 10 centrumlinje 28 och det andra navets 18 centrumlinjer 29 här ligger i linje med varandra. Axeln 6 behöver i detta fall således inte vinkelställas i förhållande till naven 10, 18. Kraftöverföringen sker här i den första och andra splinesförbindningen huvudsakligen via bommarna 21 i det axiella mellanläget 23, eftersom bommarna 21 endast där helt är i ingrepp med spåren 27 i naven 10, 18.


I Fig. 2 bildar axelns 6 centrumlinje 22 en vinkel av cirka 3° i förhållande till navets 10 centrumlinje 28. Axelns 6 centrumlinje bildar en motsvarande vinkel i förhållande till navets 18 centrumlinje 29. Axelns 6 första 12 och andra 15 ändpartier medger här en väsentlig kontinuerlig vinkelställning i förhållande till urtagningarna hos de första 10 och andra 18 navet inom ett vinkelområde av, exempelvis, ±5°. Genom att utnyttja en sådan axel som innefattar bommar 21 med ovan beskriven form i en splinesförbindning kan övriga komponenter hos kraftuttaget utföras väsentlig som standardiserade baskomponenter och användas väsentlig oberoende av kugghjulet 5 storlek och därmed det varvtal uttals från kraftuttaget. Därmed kan kostnaderna för att tillhandahålla kraftuttag med ett utgående varvtal som skiljer sig från det normalt använda varvtalet reduceras avsevärt.

Uppfinningen är på intet sätt begränsad till den beskrivna utföringsformen utan kan varieras fritt inom patentkravens ramar. Möjligheten finns även att utforma navens 10, 18 spår, i en axiell riktning, så att de istället följer en väsentlig cirkulär bana mellan sina ändlägen. Sådana spår medger en motsvarande vinkelställning av en axel med konventionella raka bommar. Bommarnas tvärsnittsform liksom de mottagande spårens tvärsnittsform kan variera väsentlig godtycklig så länge som den
centreline 29 of the hub 18. The first end portion 12 and second end portion 15 of the shaft 6 here allow substantially continuous angular positioning relative to the recesses of the first hub 10 and the second hub 18 within an angular range of, for example, ±5°. Using such a shaft which incorporates ridges 21 with the shape described above in a spline connection means that other components of the PTO can take the form substantially of standardised basic components and be used substantially independently of the size of the gearwheel 5 and hence the speed extracted from the PTO. This means that the cost of providing PTOs with an output speed which differs from the speed normally used can be reduced considerably.

The invention is in no way limited to the embodiment described but may be varied freely within the scopes of the claims. There is also the possibility of the grooves of the hubs 10,18 being formed in an axial direction so that they follow instead a substantially circular path between their end positions. Such grooves allow a corresponding angling of a shaft with conventional straight ridges. The cross-sectional shape of the ridges and the cross-sectional shape of the accommodating grooves may be varied substantially to any extent allowed by the desired oblique positioning of the shaft 6 in the spline connection, subject to continuing to be able to transmit a driving motion.

Nor is the invention limited to PTOs which drive a hydraulic pump, since PTOs can be used analogously to drive auxiliary equipment of vehicles by purely mechanical means.
Claims

1. A power take-off (PTO) on an engine-driven vehicle whereby the PTO comprises a first unit (2) which incorporates not only a motion-transmitting element (5) connected to a transmission element of a driveline of the vehicle but also a hub (10) with a recess which forms part of a first spline connection, a second unit (7) which incorporates not only connecting means to make it possible to connect an equipment item (8) intended to be driven by the PTO but also a hub (18) with a recess which forms part of a second spline connection, and a shaft (6) which extends between the first unit (2) and the second unit (7) and which comprises a first portion (12) which forms a complementing part of the first spline connection and a second portion (15) which forms a complementing part of the second spline connection, characterised in that said first and second spline connections are so designed that the first portion (12) and second portion (15) of the shaft can be positioned at at least two different angles to the recesses of the accommodating hubs (10,18).

2. A PTO according to claim 1, characterised in that the first portion (12) and second portion (15) of the shaft can be positioned at substantially continuously variable angles to the recesses of the accommodating hubs (10,18) within an angular range.

3. A PTO according to claim 1 or 2, characterised in that the first portion (12) and second portion (15) of the shaft exhibit a peripheral surface which incorporates a multiplicity of ridges (21) with a mainly axial extent, which ridges (21) exhibit a peripheral surface which in an axial direction is situated at a variable radial distance from a centreline (22) through the shaft (6)

4. A PTO according to claim 3, characterised in that the peripheral surface of the ridges (21) exhibits a maximum distance from the centreline (22) at an axially intermediate position (23) situated between the axial end positions (24,25) of the ridges.
5. A PTO according to claim 4, characterised in that the distance of the peripheral surface of the ridges (21) from the shaft (6) decreases continuously from the axial intermediate position (23) towards the axial end positions (24,25).

6. A PTO according to claim 5, characterised in that the peripheral surface of the ridges (21) follows part of a circular path between the axial end positions (24,25).

7. A PTO according to any one of the foregoing claims, characterised in that the motion-transmitting element of the first unit (2) is a gearwheel (5).

8. A PTO according to any one of the foregoing claims, characterised in that the first unit (2) incorporates a bearing bracket (3) which supports a gearwheel (5).

9. A PTO according to claim 8, characterised in that the bearing bracket (3) is fastened to a gearbox (1) of the vehicle and that the gearwheel (5) is in engagement with a gearwheel (1') in the gearbox (1).

10. A PTO according to any one of the foregoing claims, characterised in that said equipment item driven by the PTO is a hydraulic pump (8).
A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B60K 17/28, B60K 25/06, F02B 67/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B60K, F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

Date of the actual completion of the international search 1 July 2002

Date of mailing of the international search report 29-07-2002

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