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(54) **DRIVE COUPLING**

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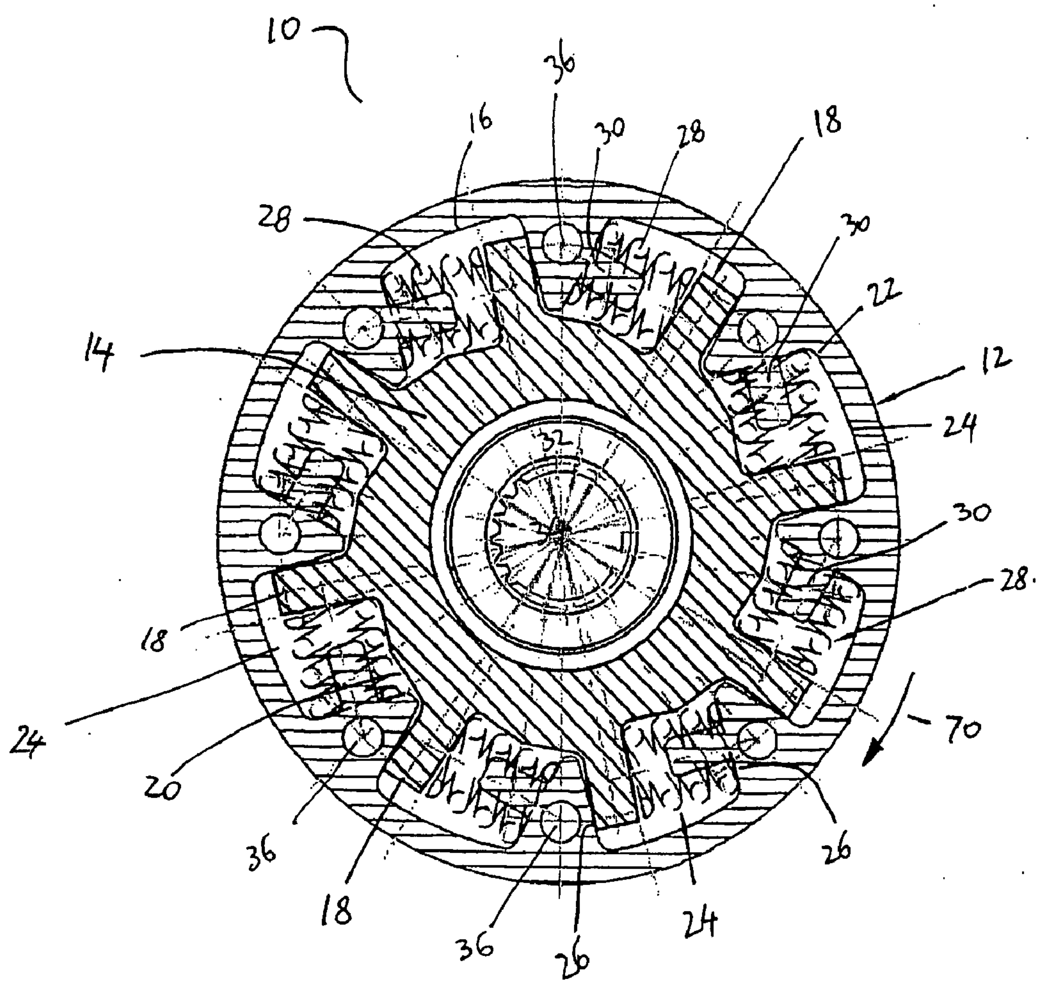
(57) **ABSTRACT**

A drive coupling **10** has an outer plate **12** and an inner plate **14**. Inner plate **14** is positioned within the inner periphery **16** of outer plate **12**. The inner plate **14** includes a plurality of outwardly extending projections **18**. The inner periphery **22** of outer plate **12** includes a plurality of recesses **24.** The drive coupling **10** further comprises a plurality of compression springs **28** arranged between respective projections **18** of inner plate **14** and the respective side wall of the recess **24** of outer plate **12**. A first retaining plate **42** is positioned by passing it over shaft **32**. A spacer ring **48** is positioned such that it abuts one side of the inner plate **14**. A second retaining plate **50** is located on the other of the inner and outer plates. Bolts **56** are used to hold the retaining plates **42** and **50** together. The drive coupling **10** is designed to carry the entire rated torque requirement of the unit on the compression springs, thus providing a continual cushioning action to the drive line whilst allowing a maximum angular movement if an obstruction is encountered.



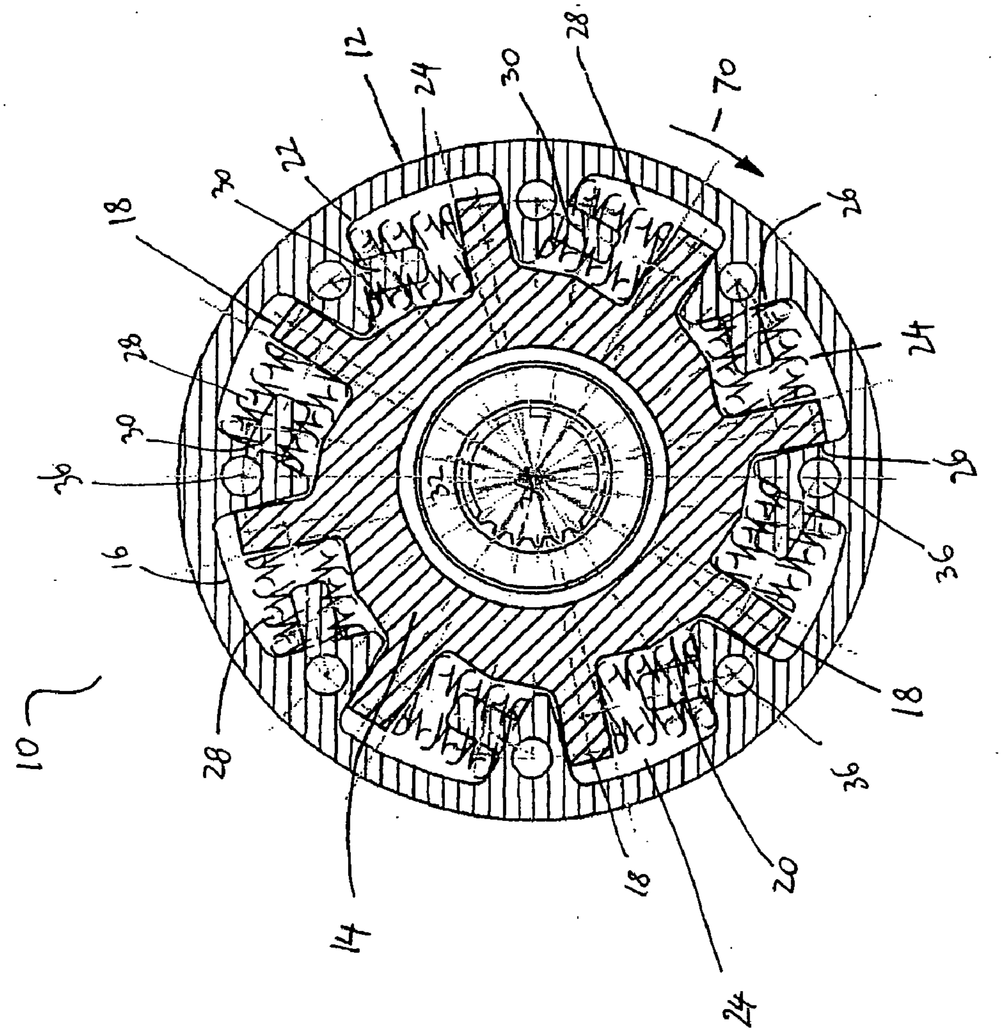


FIGURE 1.

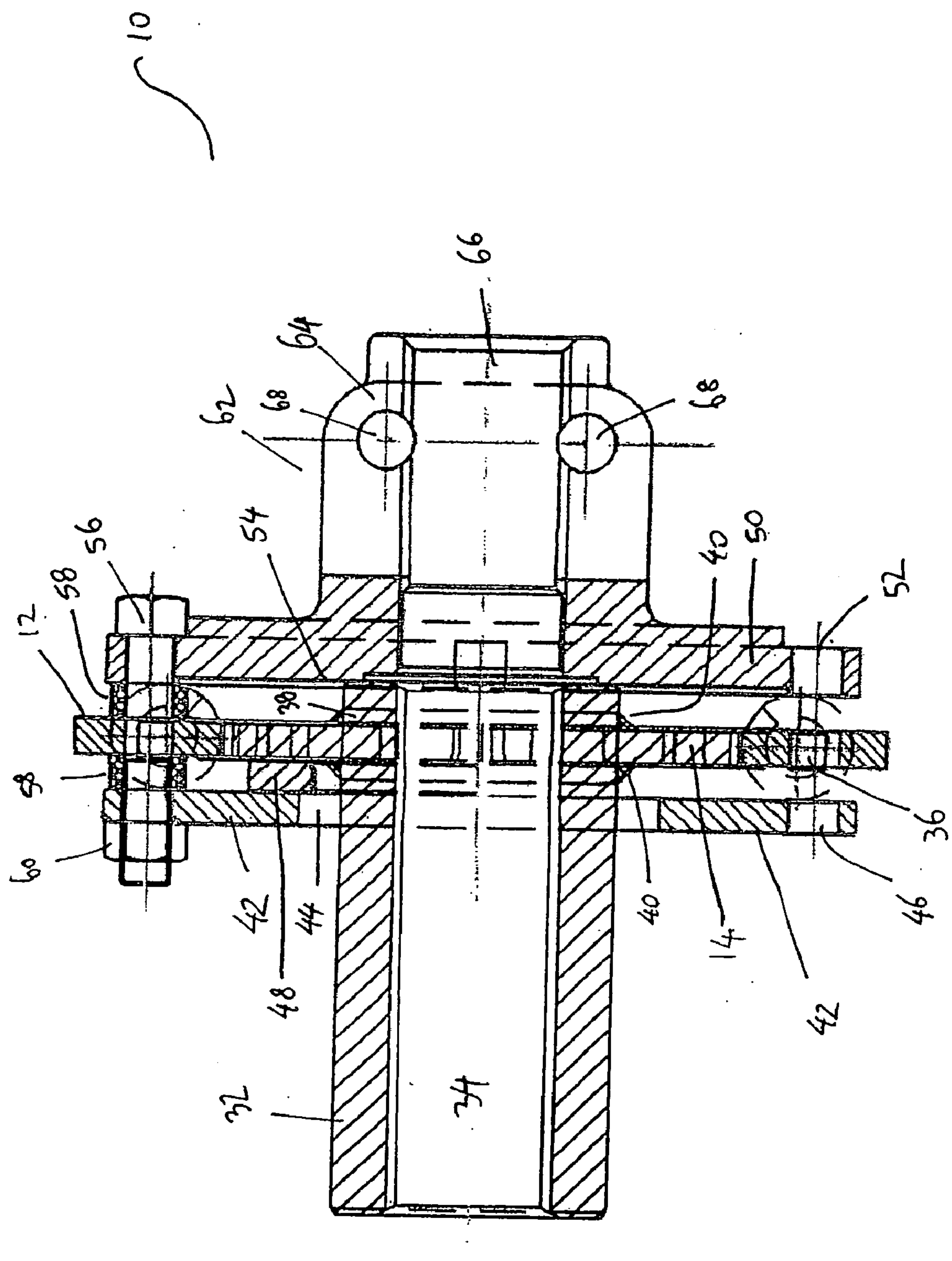

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FIGURE 2

DRIVE COUPLING

BACKGROUND TO THE INVENTION

[0001] Drive couplings are used in a wide variety of applications. Some examples of drive couplings include chain couplings, disc couplings, doughnut couplings, universal joints or clutches. Drive couplings are typically used to transmit drive from one shaft to another shaft. The shafts may be formed with the drive coupling or they may be connectable to the drive coupling.

[0002] In some applications, the equipment being driven by a drive arrangement may be susceptible to sudden shock loads. For example, large multi head grass and scrub cutting machines (termed rotary cutters or slashers) utilise heavy (16 mm to 19 mm thick) cutting blades. To achieve overlap between cutters, the gear boxes which are connected in series by power take off drive shafts are timed so that the blades intersect.

[0003] These machines are prone to serious gear box and drive shaft failure. For example, when one individual cutter strikes an obstruction, cumulative forces from the tractor power source, combined with the fly wheel effect (inertia) from all other gear boxes and cutting heads on the machine are transmitted to the individual gear box and shaft coupling involved in the incident.

[0004] Standard friction disc type safety clutches cannot be used on these machines, as the cutting blades can only be paused for a few degrees of rotation before contact occurs with adjacent cutting blades.

[0005] The most common method of coupling these gear boxes is via chain couplings, disc couplings, doughnut couplings or universal joints. None of these devices provide any predetermined rotational shock relief to transmissions.

BRIEF DESCRIPTION OF THE INVENTION

[0006] It is an object of the present invention to provide a drive coupling that overcomes or at least ameliorates one or more of the abovementioned disadvantages.

In a first aspect, the present invention provides a drive coupling comprising

[0007] an inner plate having one or more outwardly extending projections,

[0008] an outer plate having one or more inner peripheral recesses, each of the one or more inner peripheral recesses having two inwardly extending wall portions,

[0009] and one or more coil springs

[0010] each of the one or more outwardly extending projections of the inner plate being positioned within an associated inner peripheral recess of the outer plate, with a coil spring being located between one face of each of the one or more outwardly extending projections of the inner plate and one of the inwardly extending wall portions of the associated inner peripheral recesses of the outer plate, there being an absence of any coil spring between another face of each of the projections on the inner plate and the other inwardly extending wall portion of the associated inner peripheral recess on the outer plate,

[0011] wherein rotation of one of the inner plate and the outer plate causes a reaction force in the at least one coil spring, said reaction force being transmitted to the other of the inner plate and the outer plate to thereby cause rotation of the other plate.

In a second aspect, the present invention provides a drive coupling comprising

[0012] an inner plate having one or more outwardly extending projections,

[0013] an outer plate having one or more inner peripheral recesses, with at least one inner peripheral recesses having two inwardly extending wall portions,

[0014] and one or more coil springs

[0015] at least one of the outwardly extending projections of the inner plate being positioned within an associated inner peripheral recess of the outer plate, with a coil spring being located between one face of the outwardly extending projections of the inner plate and one of the inwardly extending wall portions of the associated inner peripheral recesses of the outer plate,

[0016] wherein the one or more coil springs bias the inner plate to a first position relative to the outer plate when no drive force is applied to the drive coupling and wherein the inner plate can move in only one direction from the first position relative to the outer plate, and

[0017] wherein rotation of one of the inner plate and the outer plate causes a reaction force in the at least one coil spring, said reaction force being transmitted to the other of the inner plate and the outer plate to thereby cause rotation of the other plate.

[0018] Preferably, during normal use of the drive coupling, the at least one coil spring maintains separation between the inner plate and the outer plate. Suitably, the separation between the inner plate and the outer plate is maintained in a circumferential direction.

[0019] The inner plate and the outer plate are preferably in substantial alignment in a longitudinal direction.

[0020] The at least one coil spring may be arranged such that it is positioned close to an outer circumference of the outer plate. This minimises torque loadings on the springs.

[0021] The drive coupling may further comprise a first retaining plate positioned on one side of the inner and outer plates, a second retaining plate positioned on the other side of the inner and outer plates and connecting means to connect the retaining plates together to thereby maintain the inner and outer plates therebetween.

[0022] Preferably, the retaining plates are connected to either the inner plate or the outer plate. More preferably, the retaining plates are connected to the outer plate.

[0023] The connecting means for connecting the retaining plates may suitably be bolts. Where the retaining plates are connected to one of the inner or outer plates, that one of the inner or outer plates is suitably provided with apertures for receiving the bolts. The connection means may suitably be large diameter bolts to allow the rapid replacement of internal parts.

[0024] The at least one coil spring suitably comprises at least one compression spring, more preferably a plurality of compression springs. However, it will be understood that the present invention should not be considered to be restricted solely to using compression springs as the present invention could also function if tension springs were used.

[0025] In one embodiment of the present invention, the inner plate has a plurality of outwardly extending projections and the outer plate has a plurality of inner peripheral recesses, the projections of the inner plate extending into respective recesses of the outer plate, and the at least one coil spring comprises a plurality of coil springs, each positioned between a respective projection of the inner plate and a wall of the corresponding recess of the outer plate.

[0026] The projections of the inner plate may extend in a generally radial direction. The recesses in the inner periphery of the outer plate may be defined by inwardly extending portions of the inner peripheral wall of the outer plate.

[0027] In embodiments where the at least one coil spring comprises a plurality of compression springs, the drive coupling may further comprise positioning means on one of the inner plate or outer plate to position the compression springs. Preferably, the positioning means are formed on or connected to the outer plate.

[0028] The positioning means may comprise spring guide projections extending from one wall of each recess of the outer plate. The spring guide projections may be sized such that the compression springs fit over the projections.

[0029] The drive coupling of the present invention may further comprise a shaft connected to or formed with one of the inner or outer plates. Preferably, the inner plate has a first shaft formed therewith or attached thereto.

[0030] The other plate may also include a shaft formed therewith or connected thereto. In embodiments where retaining means are used to maintain relative axial positioning between the inner plate and the outer plate, one of the retaining plates may include a shaft connecting means for connecting a shaft thereto, or it may have a shaft attached thereto.

[0031] In embodiments where a positively located (or non-floating) drive shaft is required, the coupling may include a male member extending from a solid male shaft and extending into a locating bush housed in the flange end of the retaining plate. Suitably, the male member exrtends through the inner plate and through an opening in the outer plate into the bush.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] FIG. **1** shows a plan view of a drive coupling in accordance with an embodiment of the present invention. In FIG. **1**, the retaining plates have been removed for clarity; and

[0033] FIG. **2** shows a cross-sectional side view of a drive coupling in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0034] It will be appreciated that the drawings attached to the specification have been provided for the purposes of illustrating preferred embodiments of the present invention. Thus, the present invention shall not be considered to be limited to the embodiments shown in the attached drawings.

[0035] The drive coupling **10** shown in FIGS. **1** and **2** comprises an outer plate **12** and an inner plate **14**. As best shown in FIG. **1**, inner plate **14** is positioned within the inner periphery **16** of outer plate **12**. As best shown in FIG. **2**, outer plate **12** and inner plate **14** are in substantial alignment in a longitudinal direction. If the outer plate **12** and inner plate **14** are of differing thicknesses, the inner plate and outer plate may be aligned such that their transverse centre lines are in alignment, or such that one side of each plate is in alignment.

[0036] The inner plate **14** includes a plurality of outwardly extending projections **18**. For the sake of clarity, only some of these projections **18** are numbered in FIG. **1**. The projections **18** extend in a generally radially direction. The outer periphery of inner plate **14** includes regions of relatively smaller diameter **20** located between adjacent outwardly extending projections **18**.

[0037] The inner periphery **22** of outer plate **12** includes a plurality of recesses **24**. For the sake of clarity, only some of the recesses **24** have been numbered in FIG. **1**. The recesses **24** are bounded by inwardly extending projections **26** on the outer plate **12**.

[0038] As can be seen from FIG. **1**, each projection **18** of the inner plate **14** is positioned such that it is within a corresponding recess **24** defined by the outer plate **12**.

[0039] The drive coupling **10** further comprises a plurality of compression springs **28**. Compression springs **28** are in the form of heavy duty coil springs. For the sake of clarity, only some of the compression springs **28** have been numbered in FIG. **1**. As can be seen from FIG. **1**, the compression springs **28** are arranged between respective projections **18** of inner plate **14** and the respective side wall of the recess **24** of outer plate **12**. To assist in positioning the compression springs **28**, the respective walls of recesses **24** are provided with spring guide means **30**. For the sake of clarity, only some of spring guide means **30** are numbered in FIG. **1**. Spring guide means **30** take the form of a projection extending outwardly from the wall of recess **24**, which projection is sized such that the compression spring **28** can be fitted over projection **30**.

[0040] The drive coupling **10** further includes a shaft **32** that is connected to the inner plate **14**. Shaft **32** is suitably connected to inner plate **14** by welding. The shaft **32** has a central cavity **34**, which cavity **34** is arranged to receive and hold a splined shaft (not shown). In this manner, a splined drive shaft can be connected to shaft **32**. The splined shaft that is received within the cavity **34** of shaft **32** may be telescopically movable inside cavity **34**.

[0041] In another embodiment, shaft **32** may be in the form of a solid shaft which may be positively inserted located within a bush within retaining plate **50** by means of a spigot extending from the internal end of shaft **32**. This is useful in situations where positive, or non-floating, location of the drive is required.

[0042] The outer plate **12** further includes a plurality of apertures **36**. For the sake of clarity, only some of the apertures **36** have been numbered in FIG. **1**. Apertures **36** receive the shanks of bolts that are used to connect the retaining plates to each other. This will be described in greater detail with reference to FIG. **2**.

[0043] In order to assemble the drive coupling shown in FIG. **1**, the compression springs **28** are placed on the spring guide projections **30**. The compression springs are then compressed by placing inner plate **14** into position such that projections **18** abut on the ends of springs **28** and thereafter rotating inner plate **14**. The inner plate **14** can then fit into place within outer plate **12**. Alternately, spring compressors may be used to compress the springs and fit the inner plate **14**, but this would involve extra steps during assembly of the drive coupling **10**. It will be appreciated that the compression springs are retained in place by the respective parts of the outer peripheral wall of inner plate **14** and the inner peripheral wall of outer plate **12** and the spring guides **30**.

[0044] In order to maintain the axial positioning of the outer plate **12** and the inner plate **14**, an assembly as shown in FIG. **2** may be used. Before explaining the assembly shown in FIG. **2**, reference will be made to FIG. **2** to show that the shaft **32** extends through a central aperture in inner plate **14** such that a small portion **38** of shaft **32** extends beyond the other side of inner plate **14**. Weld metal **40** is used to connect the inner shaft **32** to the inner plate **14**.

[0045] The assembly shown in FIG. **2** includes the outer plate **12** and inner plate **14** arranged as shown with reference to FIG. **1**. A first retaining plate **42** having a central opening **44** that is large enough to fit over shaft **32** is positioned by passing it over shaft **32** such that it reaches the position shown in FIG. **2**. First retaining plate **42** includes a plurality of apertures **46**. Apertures **46** are positioned such that they can be brought into alignment with the apertures **36** in the outer plate **12**.

[0046] Prior to positioning first retaining plate **42** as shown in FIG. **1**, a spacer ring **48** is positioned such that it abuts one side of the inner plate **14**.

[0047] The assembly shown in FIG. **2** further includes a second retaining plate **50** that is located on the other side (to the side on which first retaining plate **42** is positioned) of the inner and outer plates. Second retaining plate **50** includes a plurality of apertures **52**. The plurality of apertures **52** are arranged on second retaining plate **50** such that they can be brought into alignment with the apertures **36** of the outer plate **12**.

[0048] As shown in FIG. **2**, an inner surface **54** of second retaining plate comes into contact with the end of small portion **38** of shaft **32** which is attached to inner plate **14**.

[0049] In order to connect the first and second retaining plates, bolts **56** are inserted through the respective apertures **52**, **36** and **46**. Spacers **58** are positioned on either side of the outer plate **12** to properly space the first and second retaining plates from the outer plate **12**. Nuts **60** are subsequently placed over the threaded ends of bolts **56** and tightened to thereby hold the retaining plates **42** and **50** together. It will be appreciated that the bolts **56** pass through the apertures **36** in the outer plate **12**. Furthermore, the spacer ring **48** and the small portion **38** of the shaft **32** are in contact with the respective retaining plates. In this fashion, the retaining plates act to retain the inner plate in position relative to the retaining plates (and relative to the outer plate **12**). However, the inner plate **14** is only lightly clamped against the retaining plates **42** and **50**, and a degree of rotational movement between the inner plate **14** and the retaining plates is possible.

[0050] The second retaining plate **50** forms part of a larger structure **62**. Structure **62** includes a half split sleeve **64** that is welded to or formed with the second retaining plate **50**. Half split sleeve **64** has a cavity **66** that is able to receive a splined shaft (not shown). Bolt holes **68** are provided so that, after inserting a splined shaft into cavity **66**, bolts (not shown) can be used to tighten the half split sleeve **64** to thereby prevent axial removal of the splined shaft from the cavity **66**. In this manner, the half split sleeve **64** can be connected to a splined shaft, such as a splined drive shaft of a power take off from a tractor, with the splined shaft being constrained against rotational and axial movement relative to the half split collar **64**.

[0051] In use of the assembly shown in FIGS. **1** and **2**, the drive shaft (not shown) attached to half split sleeve **64** rotates. The direction of rotation is shown by arrow **70** in FIG. **1**. Rotation of the drive shaft will, of course, cause rotation of outer plate **12** in the direction shown by arrow **70** in FIG. **1**. This causes compression of the compression springs **28**. Compression of the compression springs causes a reaction force to be imparted from the compression springs onto the projections **18** of the inner plate **14**. When this reaction force equals the resistance to rotation that is felt by the inner plate **14**, the inner plate **14** starts to rotate as well. Thus, it can be seen that the drive coupling shown in FIGS. **1** and **2** provides for the continual rated working load of a machine to be transmitted by the compression springs **28**. If there are any sudden shocks felt by the machinery being driven by the drive coupling, the sudden shock loads are absorbed by the springs which allow for a predetermined amount of relief rotation of the coupling input shaft.

[0052] To assemble drive couplings requiring reverse rotation to that shown in FIG. **1**, outer plate **12** and inner plate **14** are inverted during assembly.

[0053] The drive coupling shown in the embodiment of the present invention of FIGS. **1** and **2** is designed to carry the entire rated torque requirement of the unit on the compression springs, thus providing a continual cushioning action to the drive line. When a sudden shock load is encountered, the compression springs compress to a predetermined torque value, and a predetermined angular value to provide a maximum angular movement. If the drive coupling is to be used on a multi head grass and scrub cutting machine, this maximum angular movement can be set such that interaction of the output cutting blades is avoided. Using coil springs to carry the normal torque load of the shaft allows a cushioned drive to be obtained whilst also allowing predetermined maximum angular movement in the event that an obstruction is encountered.

[0054] The maximum angular movement allowed for by the drive coupling can be explained by reference to FIG. **1**. When the drive coupling is undergoing normal use, the springs **28** are compressed to a small degree in response to the resistance to rotation felt by the inner plate **14**. If a shock load is felt, the springs **28** can compress to a maximum extent (in which either the coils of the springs come into full contact with each other or the respective ends of spring guides **30** contact respective projections **18**). Further rotation of the inner plate relative to the outer plate is thereafter not possible, thereby providing for a maximum amount of angular rotation between the inner and outer plates.

[0055] It will be appreciated that the present invention may be subjected to variations and modifications that are not shown. For example, rather than using compression springs, tension springs may be used. If tension springs are used, the tension springs will need to be firmly connected to the walls **26** of outer plate **12** and the projections **18** of inner plate **14**. Further, the direction of rotation **70** shown in FIG. **1** will need to be reversed. In this fashion, as the outer plate is rotated (in the opposite direction to the direction **70** shown in FIG. **1**), the tension springs will extend slightly until the force imparted by the tension springs equals the resistance to rotation of the inner plate. Although such an arrangement is possible, it is not preferred as it would entail a more complex assembly procedure.

[0056] The present invention provides a simple yet rugged drive coupling that enables cushioning of shock loads. Embodiments of the invention utilise circumferentially mounted coil springs to transmit a cushioned torque load to the output shaft while providing overload travel to a predetermined figure. Torque is transmitted to the springs by one piece inner and outer drive plates obviating the need for multi spring holders and pins. The springs are located (externally and internally) by one piece plates eliminating the possibility and danger of spring dislodgement from the rotating coupling. Both male and female output shafts can be incorporated with accommodation for telescopic power takeoff shafts without fear of coupling separation. The drive coupling is able to accept high axial loads by use of the retaining plate arrangement shown in FIG. **2** to prevent the unit from separating under axial loads.

[0057] Those skilled in the art will appreciate that the present invention may be subject to variations and modifications other than those specifically described. It is to be understood that the invention encompasses all such variations and modifications that fall within its spirit and scope.

The claims defining the invention are as follows:

1. A drive coupling comprising

an inner plate having one or more outwardly extending projections,

an outer plate having one or more inner peripheral recesses, each of the one or more inner peripheral recesses having two inwardly extending wall portions,

and one or more coil springs

each of the one or more outwardly extending projections of the inner plate being positioned within an associated inner peripheral recess of the outer plate, with a coil spring being located between one face of each of the one or more outwardly extending projections of the inner plate and one of the inwardly extending wall portions of the associated inner peripheral recesses of the outer plate, there being an absence of any coil spring between another face of each of the projections on the inner plate and the other inwardly extending wall portion of the associated inner peripheral recess on the outer plate,

wherein rotation of one of the inner plate and the outer plate causes a reaction force in the at least one coil spring, said reaction force being transmitted to the other of the inner plate and the outer plate to thereby cause rotation of the other plate.

2. A drive coupling as claimed in claim 1 wherein the inner plate has a plurality of outwardly extending projections and the outer plate has a plurality of inner peripheral recesses, the projections of the inner plate extending into respective recesses of the outer plate, and the one or more coil springs comprise a plurality of coil springs, each positioned between a respective projection of the inner plate and a wall of the corresponding recess of the outer plate.

3. A drive coupling as claimed in claim 2 wherein the projections of the inner plate extend in a generally radial direction and the recesses in the inner periphery of the outer plate are defined by the inwardly extending wall portions of the inner peripheral wall of the outer plate.

4. A drive coupling as claimed in any one of the preceding claims wherein the inner plate and the outer plate are in substantial alignment in a longitudinal direction.

5. A drive coupling as claimed in any one of the preceding claims wherein the one or more coil springs are positioned in a generally circumferential direction.

6. A drive coupling as claimed in any one of the preceding claims further comprising a first retaining plate positioned on one side of the inner and outer plates, a second retaining plate positioned on the other side of the inner and outer plates and connecting means to connect the retaining plates together to thereby maintain the inner and outer plates therebetween.

7. A drive coupling as claimed in claim 6 wherein the retaining plates are connected to the outer plate.

8. A drive coupling as claimed in claim 7 wherein the connecting means for connecting the retaining plates comprise bolts and the outer plate is provided with apertures for receiving the bolts.

9. A drive coupling as claimed in any one of the preceding claims wherein the one or more coil springs comprise one or more compression springs.

10. A drive coupling as claimed in claim 9 further comprising positioning means on one of the inner plate or outer plate to position the one or more compression springs.

11. A drive coupling as claimed in claim 10 wherein the positioning means comprises spring guide projections extending from one wall of each inner peripheral recess of the outer plate.

12. A drive coupling as claimed in claim 11 wherein the spring guide projections are sized such that the compression springs fit over the projections.

13. A drive coupling as claimed in any one of the preceding claims further comprising a shaft connected to or formed with one of the inner or outer plates.

14. A drive coupling as claimed in claim 13 wherein the inner plate has a first shaft formed therewith or attached thereto.

15. A drive coupling as claimed in claim 13 or claim 14 wherein the outer plate has a shaft formed therewith or connected thereto.

16. A drive coupling as claimed in claim 6 wherein one of the retaining plates has a shaft connecting means for connecting a shaft thereto, or has a shaft attached thereto.

17. A drive coupling as claimed in any one of the preceding claims wherein during normal use of the drive coupling, the at least one coil spring maintains separation between the inner plate and the outer plate in a circumferential direction.

18. A drive coupling comprising

an inner plate having one or more outwardly extending projections,

an outer plate having one or more inner peripheral recesses, with at least one inner peripheral recesses having two inwardly extending wall portions,

and one or more coil springs,

at least one of the outwardly extending projections of the inner plate being positioned within an associated inner peripheral recess of the outer plate, with a coil spring being located between one face of the outwardly extending projections of the inner plate and one of the inwardly extending wall portions of the associated inner peripheral recesses of the outer plate,

wherein the one or more coil springs bias the inner plate to a first position relative to the outer plate when no drive force is applied to the drive coupling and wherein the inner plate can move in only one direction from the first position relative to the outer plate, and

wherein rotation of one of the inner plate and the outer plate causes a reaction force in the at least one coil spring, said reaction force being transmitted to the other of the inner plate and the outer plate to thereby cause rotation of the other plate.

19. A drive coupling substantially as hereinbefore described with reference to the accompanying drawings.

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