

PATENT SPECIFICATION

(11) 1 430 628

1 430 628

- (21) Application No. 13916/73 (22) Filed 22 March 1973
 (31) Convention Application No. 237 747
 (32) Filed 24 March 1972 in
 (33) United States of America (US)
 (44) Complete Specification published 31 March 1976
 (51) INT CL⁷ F16D 65/22, 55/38; F16F 1/32
 (52) Index at acceptance
 F2S 1E1A 1FX 1H2
 F2E 2N2A2A 2N2C1B 2N2D2A 2N2D8A



(54) APPARATUS INCORPORATING A FRICTION COUPLE

(71) We, CATERPILLAR TRACTOR CO., a corporation organized and existing under the laws of the State of California, United States of America, of 100 N.E. Adams Street, Peoria, State of Illinois 61602, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus, such as a brake or a clutch incorporating a friction couple.

Conical spring washers, commonly called Belleville springs, are commonly used for biasing a pair of relatively movable members of a friction couple. These springs, although relatively inexpensive and compact, have a disadvantage which precludes their use in many applications which would otherwise be desirable.

Springs of this type are generally formed from flat sheet material with their resiliency or spring characteristics being provided by resistance to return to their original flat shape. With the springs disposed in angular relation between the movable members and a compressive force applied thereto, the springs are urged toward their original flat configuration and approach a more parallel relation with respect to the surfaces of the members which are engaged by the spring. This results in sliding movement between the springs and the movable members and can result in considerable wear in frequently actuated mechanisms. The said movable members are frequently precision-machined and relatively expensive, so that frequent replacement of such members due to wear would be highly undesirable.

As heretofore used, springs of this type are generally placed in direct load-bearing sliding contact with the movable members without any protection against wear of those relatively expensive elements.

It is also important to avoid over-stressing of springs of this type due to excessive compression. Normal practice is to provide machined stop surfaces on the relatively

movable members. This is in many instances inconvenient due to the configuration of the movable members and normally requires additional machining.

According to the present invention there is provided apparatus incorporating a friction couple such apparatus comprising a housing connected to a first friction element, a member rotatable relative to said housing and connected to a second friction element engageable with said first friction element to retard or prevent such relative rotation, a pressure plate movable with respect to said friction elements to cause engagement thereof, and a reaction abutment member, said pressure plate and said reaction abutment member having opposed annular surfaces disposed in axially spaced relation, two conical spring washers disposed between said annular surfaces in coaxial oppositely facing relationship so as to form a V-shaped assembly in cross-section, peripheral edges of the washers indirectly engaging said reaction abutment member and said pressure plate respectively so as to resiliently bias the pressure plate away from the reaction abutment member, and a pair of wear washers interposed between said spring washers and the respective annular surfaces to provide replaceable wear surfaces, said wear washers having respective opposed tubular stop portions which are normally axially spaced apart but are interengageable when the spring washers are compressed so as to limit the movement of the pressure plate and the reaction abutment member towards one another.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawing, which is a cross-sectional view of a brake in accordance with the present invention.

Referring to the drawing, an energy storage assembly is generally indicated by the reference numeral 10, embodied in a friction couple in the form of a friction brake generally designated by the reference numeral 11.

The brake 11 includes a tubular housing 12 having a radially outwardly extending

annular mounting flange 13 formed on one end and a radially inwardly directed annular mounting flange 14 integrally formed on the other end of the housing.

The inner surface of the housing 12 is defined by a bore 15, as portion of which includes a counterbore 16 of somewhat larger diameter to define a radially extending shoulder 18.

A ring 19 having a central bore 20 is telescopically disposed in bore 15 and includes a radially extending flange 21 disposed in axial engagement with shoulder 18. The ring 19 provides a reaction abutment member for assembly 10.

An adapter member 22 has an axially extending tubular portion 22a which is telescopically disposed in counter-bore 16 with one end in abutting, axially-confining relation to flange 21.

An annular radially extending flange 22b is formed at the other end of the adapter and is clamped between the flange 13 of housing 12 and a mounting member 23 to which the housing is secured by any suitable means. The adapter further includes an internal spline 24 for engagement with an external spline 25 provided around the outer periphery of a plurality of annular radially-inwardly extending first friction elements in the form of brake discs 26.

An elongate braking and shaft-coupling member 27 is disposed in telescopic substantially concentric relation to housing 12 and has an internal spline 29 for driving connection with the externally splined portion 30 of a rotatable input shaft 31 and the externally splined portion 33 of an output shaft 34.

An external spline 36 is provided on and adjacent one end of the braking member 27 and drivingly engages an internal spline 37 provided at the inner periphery of a plurality of annular radially-outwardly extending second friction elements in the form of brake discs 38.

Brake discs 38 are disposed in radially overlapping, inter-leaved relation to the brake discs 26 so as to provide substantial areas therebetween for frictional engagement under pressure as a friction couple to retard relative rotation of braking member 27 and housing 12.

A brake backing plate 40 in the form of a ring is disposed in a counterbore 41 provided in the mounting member 23. The backing plate 40 extends axially outward of the mounting member 23 so as to present a circumferential piloting portion 42 for piloting sliding fit engagement with the inner peripheral surface of adapter 22 to establish the concentric relationship of housing 12 with respect to the input shaft 31 and output shaft 34.

A brake actuator 44 includes a radially-

outwardly extending annular pressure plate portion 45 and a tubular axially-extending portion 46 disposed in sealed slidable relation to the bore 20 of the reaction abutment member 19.

An annular piston 47 is disposed in a telescopic sealed relation with the tubular portion 46 of the actuator 44 and is retained thereon by a nut 48 threaded engaging a threaded portion 49 of the actuator 44. The piston 47 has a sliding fit with the bore 15 of the housing 12 and is sealed by a seal 50.

A chamber 53 defined by the bore 15, the piston 47, the actuator 44 and the reaction abutment member 19 may be selectively pressurized by introduction of pressure fluid through a passage 54 and a conduit 55 from a suitable source, not shown, for powered axial movement of the actuator 44.

A passage 56 provided in the housing 12 permits any fluid leakage from the chamber 53 (or a motor, not shown, drivingly attached to the input shaft 31) to be returned to a sump.

The brake 11 is of the spring-engaged, pressure-disengaged type to permit the brake to engage automatically at any time the chamber 53 is not pressurized. For this purpose, the energy storage assembly 10 is disposed between reaction abutment member 19 and the pressure plate portion 45 of actuator 44.

The energy storage assembly 10 includes a pair of conical spring washers 57 and 58. The spring washers are oppositely facing so as to form in radial cross-section a substantially V-shaped assembly wherein the respective outer peripheral portions of the washers are in direct load bearing contact. The inner peripheral portions are disposed in load bearing relation to the annular surfaces of the reaction abutment member 19 and the pressure plate 45.

In the assembled condition illustrated, the spring washers 57 and 58 are compressed a predetermined amount so as to urge the actuator 44 towards backing plate 40 and thus bring the brake discs 26 and 38 into loaded frictional engagement to retard relative rotation between the braking member 27 and the housing 12.

The conical spring washers 57 and 58 are manufactured by forming flat annular rings to the conical shape illustrated which results in the washers being angularly disposed with respect to each other and to the opposing surfaces of the members to be actuated. With this arrangement as the springs are compressed toward their original flat condition the points of load bearing contact with the members associated therewith must necessarily move radially inwardly.

As the springs are again extended or relaxed the point of load bearing contact shifts radially outward such that relative

sliding movement occurs between the spring washers and their points of contact with the relatively movable members. In a frequently actuated apparatus incorporating a friction couple, such as a brake or a clutch, such heavily loaded sliding movement can result in excessive wear.

Since the actuator 44 and reaction abutment member 19 are relatively large, precision-machined components, excessive wear could require frequent, expensive replacement of those components. In order to avoid such undesirable wear on the actuator and reaction abutment member a pair of hardened annular wear washers 60 and 62 are interposed respectively between the inner peripheral portions of the spring washers 57 and 58 and the opposed annular surfaces of pressure plate 45 and reaction abutment member 19.

The wear washers further include integrally-formed tubular stop portions 63 and 64 individually axially extending to an opposed predetermined spaced relation so as to limit movement of pressure plate 45 toward reaction abutment member 19. Maximum compression of the conical spring washers 57 and 58 is thus limited to avoid excessive compression and resultant damage.

The wear washers 60 and 62 provide replaceable relatively inexpensive wear surfaces for direct load bearing sliding contact with the inner peripheral portions of the spring washers 57 and 58. With this arrangement, as wear on the washers becomes excessive so as to change the preload of spring washers 57 and 58 (and thereby the engaging force on the brake discs), the washers may be inexpensively replaced to restore the energy storage assembly to its original condition.

Operation

While the operation of the present apparatus is believed clearly apparent from the foregoing description, further amplification will subsequently be made in the following brief summary of such operation.

As previously mentioned, the brake is normally engaged since the energy storage assembly 10 resiliently biases the pressure plate 45 toward the backing plate 40 to generate loaded frictional contact between the brake discs 26 and 38. This engaged condition of the brake results in the braking member 27 being locked in relative non-rotative relation to housing 12 so as to avoid unintentional relative rotation therebetween.

When it is desired to allow the braking

member 27 to rotate relative to the housing 12 it is necessary to disengage the brake by compressing the energy storage assembly and thus to reduce the frictional engagement between the discs 26 and 38. This is accomplished by introducing fluid pressure to the chamber 53 which urges the piston 47 and hence the actuator 44 to the left (as viewed in the drawing) to compress the conical spring washers 57 and 58 and to relieve the axially loaded engagement of the brake discs.

WHAT WE CLAIM IS:—

1. Apparatus incorporating a friction couple, such apparatus comprising a housing connected to a first friction element, a member rotatable relative to said housing and connected to a second friction element engageable with said first friction element to retard or prevent such relative rotation, a pressure plate movable with respect to said friction elements to cause engagement thereof, and a reaction abutment member, said pressure plate and said reaction abutment member having opposed annular surfaces disposed in axially spaced relation, two conical spring washers disposed between said annular surfaces in co-axial oppositely facing relationship so as to form a V-shaped assembly in radial cross-section, peripheral edges of the washers indirectly engaging said reaction abutment member and said pressure plate respectively so as to resiliently bias the pressure plate away from the reaction abutment member, and a pair of wear washers interposed between said spring washers and the respective annular surfaces to provide replaceable wear surfaces, said wear washers having respective opposed tubular stop portions which are normally axially spaced apart but are inter-engageable when the spring washers are compressed so as to limit the movement of the pressure plate and the reaction abutment member towards one another.

2. Apparatus as claimed in claim 1, wherein the arrangement is such that movement of the said pressure plate away from the said reaction abutment member causes interengagement of said friction elements, and further comprising a fluid motor operatively connected to said pressure plate for powered movement of the pressure plate towards said reaction abutment member.

3. Apparatus incorporating a friction couple, substantially as hereinbefore described with reference to the accompanying drawing.



23 (24)

sliding movement occurs between the spring washers and their points of contact with the relatively movable members. In a frequently actuated apparatus incorporating a friction couple, such as a brake or a clutch, such heavily loaded sliding movement can result in excessive wear.

Since the actuator 44 and reaction abutment member 19 are relatively large, precision-machined components, excessive wear could require frequent, expensive replacement of those components. In order to avoid such undesirable wear on the actuator and reaction abutment member a pair of hardened annular wear washers 60 and 62 are interposed respectively between the inner peripheral portions of the spring washers 57 and 58 and the opposed annular surfaces of pressure plate 45 and reaction abutment member 19.

The wear washers further include integrally-formed tubular stop portions 63 and 64 individually axially extending to an opposed predetermined spaced relation so as to limit movement of pressure plate 45 toward reaction abutment member 19. Maximum compression of the conical spring washers 57 and 58 is thus limited to avoid excessive compression and resultant damage.

The wear washers 60 and 62 provide replaceable relatively inexpensive wear surfaces for direct load bearing sliding contact with the inner peripheral portions of the spring washers 57 and 58. With this arrangement, as wear on the washers becomes excessive so as to change the preload of spring washers 57 and 58 (and thereby the engaging force on the brake discs), the washers may be inexpensively replaced to restore the energy storage assembly to its original condition.

Operation

While the operation of the present apparatus is believed clearly apparent from the foregoing description, further amplification will subsequently be made in the following brief summary of such operation.

As previously mentioned, the brake is normally engaged since the energy storage assembly 10 resiliently biases the pressure plate 45 toward the backing plate 40 to generate loaded frictional contact between the brake discs 26 and 38. This engaged condition of the brake results in the braking member 27 being locked in relative non-rotative relation to housing 12 so as to avoid unintentional relative rotation therebetween.

When it is desired to allow the braking

member 27 to rotate relative to the housing 12 it is necessary to disengage the brake by compressing the energy storage assembly and thus to reduce the frictional engagement between the discs 26 and 38. This is accomplished by introducing fluid pressure to the chamber 53 which urges the piston 47 and hence the actuator 44 to the left (as viewed in the drawing) to compress the conical spring washers 57 and 58 and to relieve the axially loaded engagement of the brake discs.

WHAT WE CLAIM IS:—

1. Apparatus incorporating a friction couple, such apparatus comprising a housing connected to a first friction element, a member rotatable relative to said housing and connected to a second friction element engageable with said first friction element to retard or prevent such relative rotation, a pressure plate movable with respect to said friction elements to cause engagement thereof, and a reaction abutment member, said pressure plate and said reaction abutment member having opposed annular surfaces disposed in axially spaced relation, two conical spring washers disposed between said annular surfaces in co-axial oppositely facing relationship so as to form a V-shaped assembly in radial cross-section, peripheral edges of the washers indirectly engaging said reaction abutment member and said pressure plate respectively so as to resiliently bias the pressure plate away from the reaction abutment member, and a pair of wear washers interposed between said spring washers and the respective annular surfaces to provide replaceable wear surfaces, said wear washers having respective opposed tubular stop portions which are normally axially spaced apart but are inter-engageable when the spring washers are compressed so as to limit the movement of the pressure plate and the reaction abutment member towards one another.

2. Apparatus as claimed in claim 1, wherein the arrangement is such that movement of the said pressure plate away from the said reaction abutment member causes interengagement of said friction elements, and further comprising a fluid motor operatively connected to said pressure plate for powered movement of the pressure plate towards said reaction abutment member.

3. Apparatus incorporating a friction couple, substantially as hereinbefore described with reference to the accompanying drawing.



1,430,628

4

For the Applicants,
FRANK B. DEHN & CO.,
Imperial House,
15—19 Kingsway,
London WC2B 6UZ.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1976.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from
which copies may be obtained.