Nov. 22, 1960 F. HINZE 2,960,891

GEARING FOR MACHINE DRIVES

Filed July 5, 1957

4 Sheets-Sheet 1

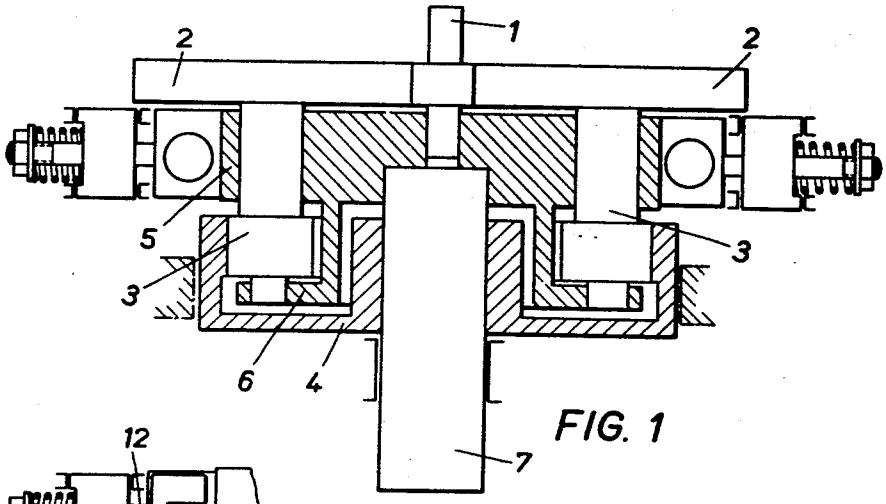


FIG. 1

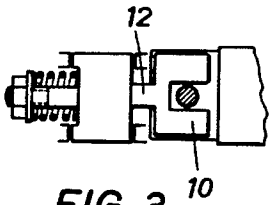


FIG. 3

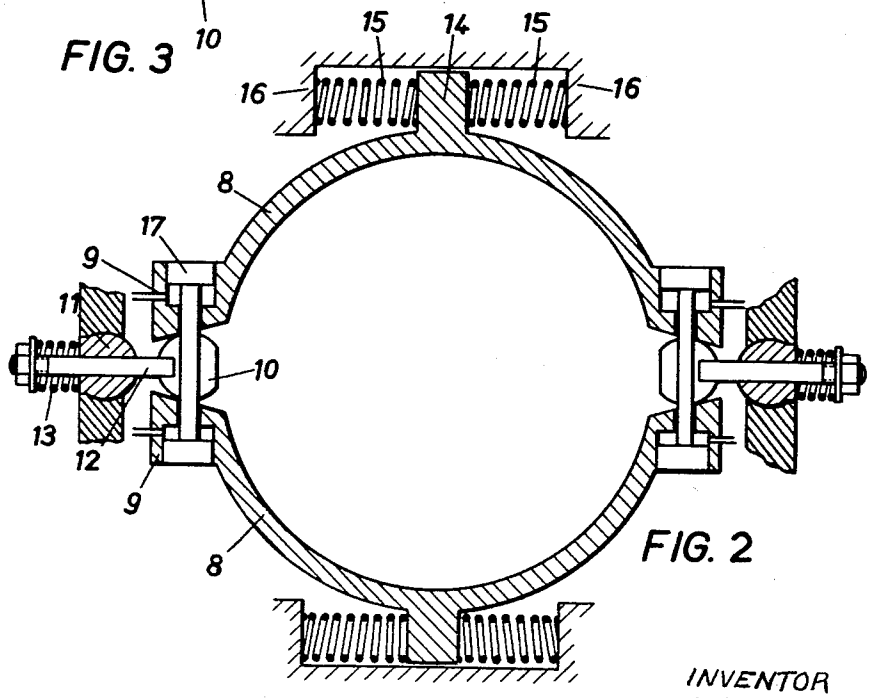


FIG. 2

INVENTOR
Fritz Hinze
BY: Michael L. Striker
agt.

Nov. 22, 1960 F. HINZE 2,960,891

GEARING FOR MACHINE DRIVES

Filed July 5, 1957 4 Sheets-Sheet 2

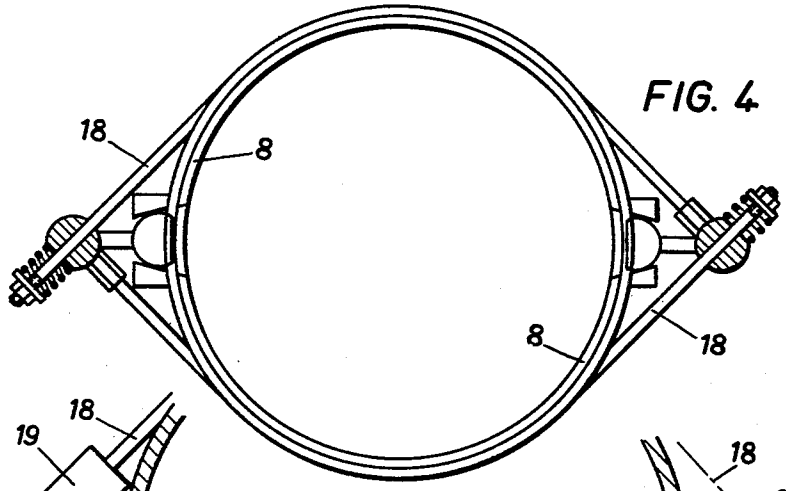


FIG. 4

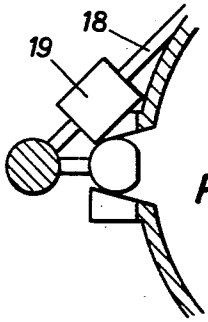


FIG. 5

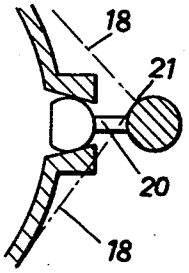


FIG. 6

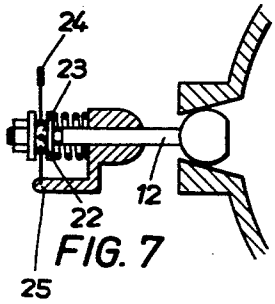


FIG. 7

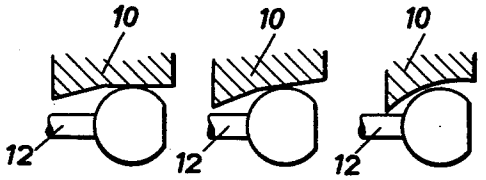


FIG. 8 FIG. 9 FIG. 10

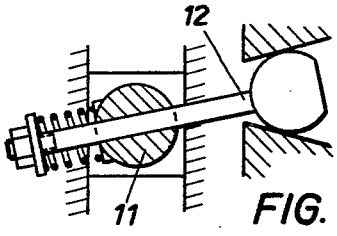


FIG. 11

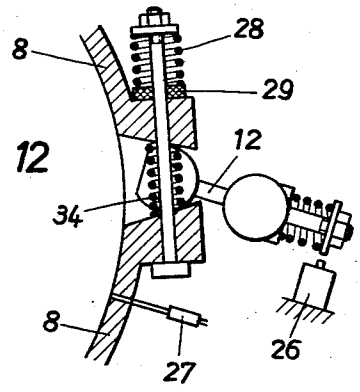
INVENTOR
Fritz Hinze
BY: Michael A. Strikes
agt.

Nov. 22, 1960 F. HINZE 2,960,891

GEARING FOR MACHINE DRIVES

Filed July 5, 1957 4 Sheets-Sheet 3

FIG. 12



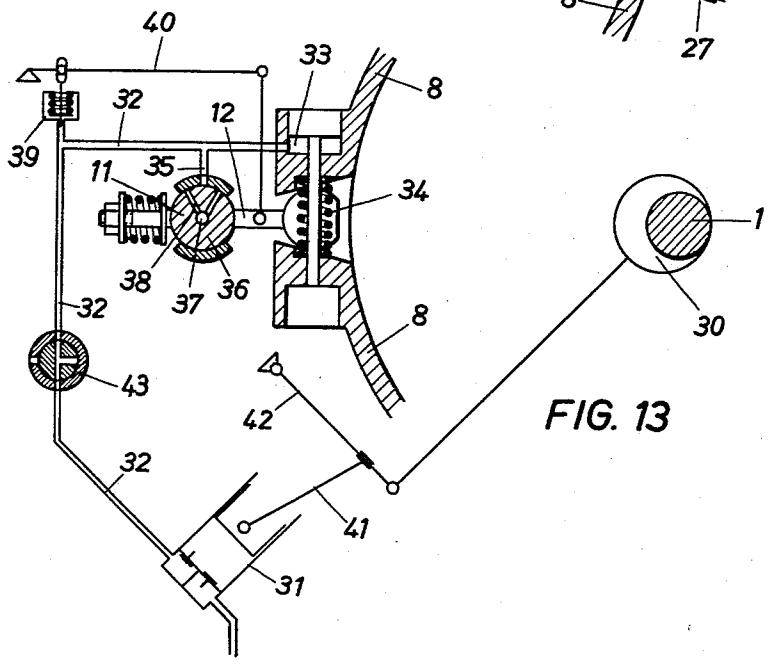


FIG. 13

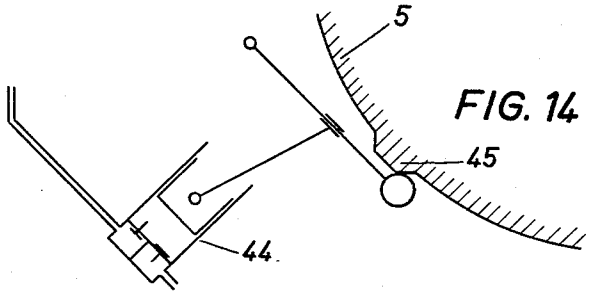


FIG. 14

INVENTOR
Fritz Hinze
By: Michael S. Striker
agt.

Nov. 22, 1960 F. HINZE 2,960,891

GEARING FOR MACHINE DRIVES

Filed July 5, 1957 4 Sheets-Sheet 4

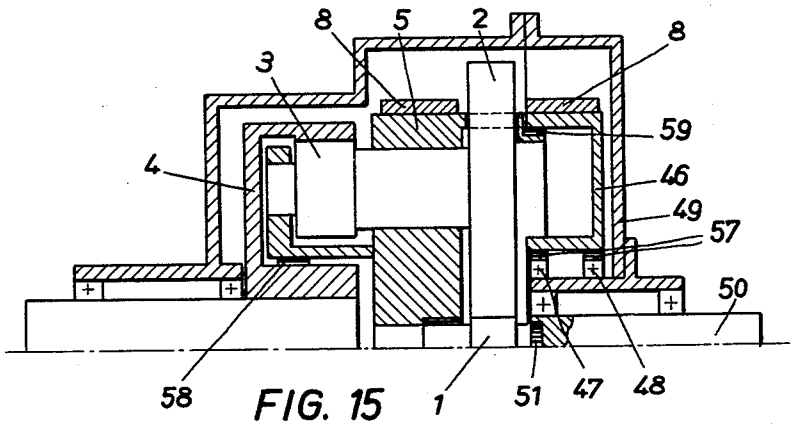


FIG. 15

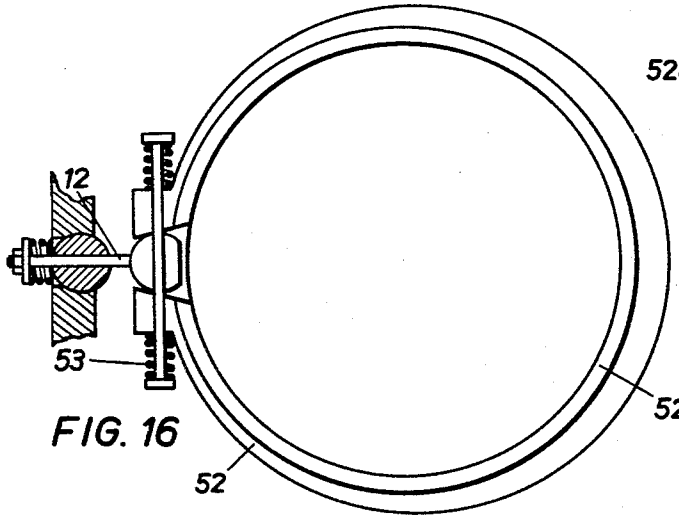


FIG. 16

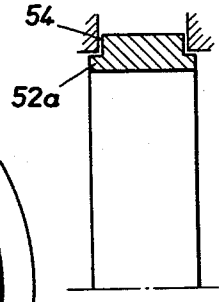


FIG. 17

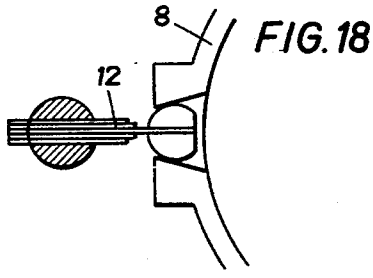


FIG. 18

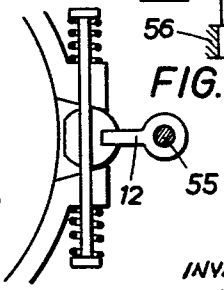


FIG. 19

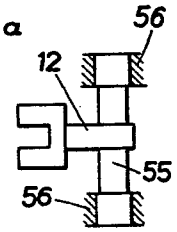


FIG. 20

INVENTOR
Fritz Hinze
By: Michael A. Striker
agt.

United States Patent Office 2,960,891 Patented Nov. 22, 1960

2,960,891

GEARING FOR MACHINE DRIVES

Fritz Hinze, Am Kohlenday 27, Lintorf, Bez. Dusseldorf, Germany

Filed July 5, 1957, Ser. No. 670,002

Claims priority, application Germany July 13, 1956

21 Claims. (Cl. 74—789)

In machine drives, the most varied operating conditions have to be taken into consideration according to the nature of the machine. Accordingly, gearing for machine drives is provided with auxiliary mechanisms for absorbing shocks, starting and stopping the drive, as well as stopping it at overloads, governing the torque, damping oscillations etc. These auxiliary mechanisms are widely known in the art in the form of separate elements and are chosen according to the effects to be achieved. Usually, however, these mechanisms can only achieve one of the desired effects and for this reason it is often necessary to combine various such mechanisms to meet all requirements. This increases the initial cost of machine drives.

The invention solves this problem by providing a single gear assembly for the various purposes mentioned above and which meets all demands made on it despite its simple construction. The gearing employed is a known epicyclic gear having a planet-gear carrier which can be braked. the carrier or another rotating part of the epicyclic gear being braked by continuously applied brake-ring members which are elastically held against rotation and radially yielding and which, when the set maximum torque is exceeded, are released in proportion to the angular displacement of the carrier.

Further details of the invention will be evident from the following description of examples.

In the drawings,

Fig. 1 is a horizontal section through an epicyclic gear according to the invention;

Fig. 2 is a vertical section of Fig. 1;

Fig. 3 is a detail of Fig. 1;

Fig. 4 is a side view of a different mounting for the brake-ring members;

Figs. 5 and 6 are two details of Fig. 4;

Fig. 7 shows a hand switch for the brake-ring members;

Figs. 8 to 10 show arcuate shapes for the end portions of the brake-rings;

Fig. 11 shows a displaced lever for forcing the brake-rings apart;

Fig. 12 is a detail of Fig. 2;

Fig. 13 shows an embodiment of the invention in which the brake-rings are applied by pressure means;

Fig. 14 shows an alternative way of driving the pump for the pressure medium;

Fig. 15 is a horizontal part-sectional view through a further embodiment of the invention;

Fig. 16 shows a one-piece brake-ring;

Fig. 17 is a detail of Fig. 16;

Fig. 18 shows a modified construction of the lever for forcing the brake-rings apart;

Figs. 19 and 20 show an elevation and plan view of a further embodiment of the lever for forcing the brake-rings apart.

The epicyclic gear shown in Figs. 1 and 2 embodies the general principle of the invention. The pinion shaft or input shaft 1 of the gearing drives one or more intermediate gears 2 mounted on intermediate shafts 3. The

latter, which are also formed as pinion shafts, constitute the planet gears and drive the internal sun gear 4 keyed to the output shaft 7 and are mounted in the carrier 5 in such a way that the overhanging intermediate gears 2 can be easily replaced. At their other ends, the intermediate gears 3 are mounted in a cage 6 on the carrier 5. Both mountings are designed as to relative size and spacing so that they are equally loaded, that is, have the same length of life. Further, the mounting in the cage 6 is designed to allow the internal gear 4 to be passed over the cage 6 from the output side.

The carrier 5 is held stationary by means of a brake which is of special design and arrangement with a view to achieving the hereinbefore mentioned various effects. According to Fig. 2 the brake comprises two brake-ring members 8 provided with extensions 9 at their ends which bound a wedge-shaped space which converges radially inwardly. Within this space there is located the roller-like head 10 of a lever 12 which is tiltingly mounted in a fixed bearing 11. The lever 12 cam move lengthwise in the bearing 11 and, by means of a helical spring 13 supported between the bearing 11 and the end of the lever 12, it is held so that at all times the head 10 lies closely against the extensions 9 of the brake-ring members 8 within the wedge-shaped space therebetween. With two-part brake-rings, two levers 12 are also provided so that the arrangement may be symmetrical. Similarly, three— or more—part brake-rings with a corresponding number of levers 12 can be provided.

When the brake-ring members 8 are angularly displaced, the levers 12 are tilted and the heads 10 force the members 8 apart so that the brake is released to a corresponding extent. The levers 12 could at the same time yieldingly secure the brake-ring members 8 against rotation. In that case the springs 13 must have a strength corresponding to the torque to be transmitted. However, the brake-rings could also be held against rotation by a special mechanism. As is also shown in Fig. 2, the members 8 have a central projection 14 held between two springs 15 which in turn abut against fixed stops 16 in the gear housing or the like. In this case the springs 13 need only be strong enough to ensure close abutment of the heads 10 in the wedge-shaped space.

The brake-ring members 8 can be held in the braking position by various means. In Fig. 2 the extensions 9 at the ends of the brake-rings 8 are formed with cylindrical bores in each of which a piston 17 is located. The two pistons are connected by a common drawbar. If pressure means are introduced into the cylinders, then the ends of the brake-rings 8 are forced together. To allow passage of the drawbar of the pistons 17, the head 10 of the levers 12 is centrally recessed (see Fig. 3).

The arrangement as illustrated operates in such a way that, upon starting the driving motor, the carrier 5 is turned to such an extent when the lead is applied during acceleration, that a starting effect is set up even with high reductions—but in any case the gear-teeth flanks come into contact without any jolt. Two separate phenomena should be distinguished during starting. On the one hand, the accelerating motor must overcome the play between teeth. For high reductions the sum of the plays in the individual stages can be so large that even before the total play is overcome the motor has completed one revolution. On the other hand, the motor must set the mass of driven machine into motion. If this requires prolonged starting periods then the engaging force of the brake-ring portions 8—which is applied by the pistons 17—can be gradually increased. One way of achieving this is that, upon starting the motor, a pump begins to work which gradually produces the full engaging pressure, as hereinafter described.

During operation, and when the predetermined torque

is exceeded, the brake-ring members 8 are additionally twisted and thereafter released so that the set torque is maintained and overloads are avoided no matter for what reason they were set up.

The drive arrangement has the following characteristics or possible uses:

(1) Strongly elastic shock absorption.
(2) Torque governing.
(3) Starter-clutch effect.
(4) Disconnection at overloads.
(5) Starting and stopping of the drive under load and during rotation.
(6) Vibration-damping effect.
(7) Continuous slip (adjustable).

The elastic retention of the brake-ring members 8 against rotation could be effected by means of pressure cylinders. These cylinders can act on the projections 14 instead of the springs 15. Further, it is possible to allow the cylinders to act on the extension 9 so that the members 8 are at the same time held together. Instead of pressure cylinders, dash pots or other elastic elements can be used.

In Fig. 1, chain dotted lines indicate that for example the internal gear 4 can be provided with a conventional brake. This construction is for special purposes, such as for crane hoists. The brake for the internal gear then serves to hold the load when the motor is switched off. The invention ensures that the gear brake and the holding brake influence each other in such a way that, when the motor is started, the holding brake is released or started to be released only when the gearing has begun to transmit a torque sufficient to prevent the load from dropping. The gearing according to the invention therefore permits a squirrel-cage motor to be used for crane construction.

Fig. 4 shows a different way of mounting the brake-ring members 8. By means of longitudinally elastic straps 18 which are spring-influenced at one end which embrace the members 8 one or more times and which are fixed at the other end, the members 8 are pressed against the surface to be braked and are elastically held against rotation. The strap 18 may be steel springs, rubber or textile belts or, as in Fig. 5, ropes or chains having elastic insert elements 19. With this arrangement the securing and braking forces are proportionate to one another.

In Fig. 6 the fixed end 20 of the strap 18 has its point of attachment displaced in relation to that of the other end 21, so that a larger angular displacement of the spider 5 is possible with the same elasticity of the straps 18.

In many cases it is desired that the drive be interrupted and re-established whilst the motor is still running. This is also possible by means of the device according to the invention, as shown in Fig. 7. Here, the operation is by means of a manual switch. The lever 12 has an extension and carries a bolt 22 which engages in the annular groove 23 of the control sleeve of a handle 24. The latter is pivoted at 25, preferably on the fixed bearing 11 for the lever 12. It could, however, be pivoted for the gear housing. If the handle is turned anti-clockwise, then the lever 12 in Fig. 7 is pulled to the left whereby the head 10 forces the members 8 apart and releases the brake. By fixing the handle 24 in this position, the brake can be held released.

Of course the switch could also be operated by means of a screw and hand wheel or electrically or by pressure means.

The ends of the brake-ring members 8 which bound the wedge-shaped space can be formed with differently inclined faces which meet at a corner or merge into each other as a curve or could be entirely curved—as shown in Figs. 8 to 10. This permits the most diverse conditions and all possible applications to be catered for, in that the configuration of the wedge-shaped space, the securing force and the elastic rotary displacement are correspondingly modified. The head 10 and the surfaces on the ends of the levers could also be formed so that during operation rolling-off takes place somewhat similar to the engagement of gear teeth. Further, it is possible to provide the head 10 of the lever 12 with rollers to avoid friction for large forces.

Fig. 11 shows that the bearing 11 for the lever 12 can be offset from the mid-position of the lever 12. This permits a considerably larger displacement to be obtained in one direction without causing the brake-ring members 8 to be released. This offset position of the bearing 11 may be adjustable in that the bearing 11 is fitted to a carriage which can be moved by spindles.

The arrangement of the braking surfaces on the planet carrier 5 can be varied. As well as being strictly cylindrical and having a single or several juxtaposed brakes, the brake surfaces could be formed with wedge-shaped grooves or could be double-cone-shaped. Further, instead of cylindrical surfaces, flat surfaces with or without conical grooves can be used. Finally, inner-jaw brakes may be employed.

For a given torque to be transmitted, the lever 12 is displaced in all cases to an extent depending on the setting of the securing force. As shown in Fig. 12, an adjustable end switch 26 can be provided which cuts off the driving motor when the lever 12 has been displaced to the fullest extent. If, on the other hand, the motor is to be stopped slowly or after a time delay, a temperature senser 27 may be provided for the brake-ring members. Automatic stopping them occurs at a predetermined temperature. This heat-sensitive cut-out could also be produced mechanically in that the springs 28 for obtaining the compressing force, act through fuse rings 29. The rings 29 melt at a certain temperature and have a thickness so that after melting, the springs 28 are uncompressed. Weaker springs 34 then release the ring members 8.

If the compressing force is applied by pressure means, then the brake-ring members 8 may be released by the pressure means themselves. As shown in Fig. 13, a piston pump 31 is driven by an eccentric 30 which is operated by the input shaft 1 of the gearing rotating with the motor. The pump supplies a pressure medium through the conduit 32 to the cylinder 33 whereby, as hereinbefore mentioned, the brake-ring members 8 are applied against the action of the spring 34 which serves to release the brake when the pressure medium is not being supplied. A branch pipe 35 from the conduit 32 leads to a stationary sleeve 36 in which the bearing 11 is pivotally mounted. This bearing here has an axial outlet passage 37 which communicates with two radial branch passages 38 which, when the bearing 11 has been tilted to a suitable extent, are aligned with the branch pipe 35 so that the cylinder 33 is relieved of pressure. This is intended for use with shock loads.

In the conduit 32 of the pump 31, a pressure-adjusting overrun valve 39 is provided which is connected to the lever 12 via a linkage 40 in such a way that, after overcoming a certain free play in the linkage 40, tilting of the lever 12 causes a reduction in the pressure setting of the valve. This reduces the compression force of the brake-ring members and, in the region of a predetermined set torque, they are gradually released and slip; if necessary permanent slipping can take place. This may be used for multimotor drives.

The stroke of the piston of the pump 31 is preferably adjustable so that the time may be regulated when starting. For this purpose, the piston rod 41 is displaceable on a guide 42 one end of which is driven by the eccentric 30 and the other end of which is fixed. By these means the quantity of pressure medium required for fully applying the brake-ring members 8 is produced in a variable period of time, i.e. the starting period is regulatable.

In the conduit 32, a three-way valve 43 is included

which is intended for manual operation at will. When this valve is turned, the conduit 32 is blocked and the cylinder 33 is relieved of pressure.

According to Fig. 14, a pump 44 is provided for supplying pressure medium, the pump being driven by the planet carrier 5 through a cam 45. The pressure required for producing and maintaining the compressive force is here obtained in proportion to the slip. This type of pressure production is preferably used in cases where a small permanent slip is required. The pump 44 can have a fixed or variable slip.

When putting the invention into practice it is possible to provide a construction which hardly requires any more space than is necessary for the gearing itself. This advantage is obtained in that the space in front of the pinion on the input shaft 1 and the gear 2 of the gearing is used for accommodating the brake. Such a construction is shown in Fig. 15. Here a lateral brake drum 46 is combined with the planet carrier 5, the brake drum also serving to mount the carrier on the bearings 47 and 48. To serve as friction surfaces and for assembling purpoes, the brake-ring portions 8 and their mountings including the levers 12 are located near the cover 49 of the housing. The drive shaft 50 is joined to the pinion shaft 1 by means of a geared coupling 51 so that the brake may be easily dismantled. For still further accessibility, the cover 49 is preferably split in a horizontal plane. The pinion shaft 1 and the gear 2 are also easily replaceable in the construction as illustrated.

To ensure self-positioning of all the teeth when several intermediate shafts 3 are used as in Fig. 15 so that all gears necessarily participate in the transmission of torque, the planet carrier 5—with or without brake disc 46—is mounted to be centered radially yieldingly by devices 57 on the bearings 47 and 48, the arrangement being such that, by means of the resilience of the carrier 5, the teeth of the intermediate shafts 3 can lie against the internal gear 4 to participate in the transmission of forces.

The devices 57 may be elastic-rings or ring segments of rubber or plastic or elastic metallic elements such as corrugated spring strips or helical springs.

The same arrangement can be provided at the bearing 58 for a support for both sides. By virtue of the radially yielding mounting of the carrier 5 and levers 12 to the brake-rings 8, self adjustment of the planet carrier according to the positions of the teeth is not prevented.

Except for the weight, the forces balance each other out because of the abutment between the flanks of the teeth of the gears 3 and 4 and because of the reaction forces at the levers 12. To balance the weights as far as is important for the forces acting, to effect a certain amount of centering when the carrier rotates but the drive is shut off and to take up any residual forces occasioned by workshop inaccuracies, the component of the gearing which is to be held, preferably the carrier 5, is mounted to yield radially. Alternatively, the bearings 11 could be mounted in a ring at fixed mutual spacings, each bearing or all bearings together having the above-mentioned features and the ring being secured radially yieldingly against rotation, for example through geared couplings.

By means of a radially yieldingly centred mounting for the pinion 1, it is possible for the latter to adjust its position to conform to that of the carrier 5 by constraining the teeth of the gears 3 and 4 to abut. The drive shaft 50 is for this purpose connected to the shaft 1 by resilient means such as the geared coupling 51.

The central bearings of the gearing need merely withstand axial forces from bevel gearing. If spur gearing is used then, basically, the central bearings, preferably those of the drive shaft 1 or 50, may be dispensed with.

As well as the carrier 5 being self-adjustingly mounted together with the brake disc 46, the planet carrier 5 alone may be self-adjustingly mounted, the brake disc 46 being rigidly mounted. In this case the brake disc 46 is connected to the carrier 5 through a geared coupling 59 in the sense of a possible self-adjustment of the carrier 5.

To permit a permanent slip, the brake-ring members 8 may be so mounted, applied and formed according to the invention, that a lubricating-film formation with practically wear-free operation is obtained. The wedge-shaped gap required for this purpose can be formed by appropriately positioning and constructing the support for the brake-ring member. The formation of the wedge-shaped gap and loading of the brake-ring portions, their support and mounting can be assisted by a large number of brake-ring portions 8.

The illustrated mounting for the brake-ring members 8 against rotation by means of the levers 12, operates against the compressing force. It is possible, however, to form the members so that the securing force and compressing force act in like directions.

The gearing as described and illustrated does not permit load applications over a set maximum value. However, internal loads such as those caused by errors in the teeth are shock-absorbingly received. Such gearings therefore do not have to be made larger than to suit the average loading even during operation with shocks. Apart from reliable operation and long life with very few interruptions, such gearings can also be built easily and cheaply.

According to Fig. 16, a one-piece brake-ring 52 is provided which applies the braking force principally by means of its own resilience and which may also have pressure springs 53. Because of its resilience, the ring 52 functions as does a multi-part ring. For a roughly constant stress, the ring 52 has a changing cross-section. In order that when it is released by a displacement of the lever 12 it lifts off evenly from the brake disc, it is formed with concentric side rims 52*a* which come to lie against annular stops 54 (Fig. 17) on the gear housing when the brake is fully released. Such rings 52 are preferably used in mutually offset pairs, either singly or a number of them.

Fig. 18 shows an embodiment of the lever 12 in the form of a leaf spring. In this construction, a securing force is exerted on the brake-ring members 8 even in the undisplaced position of the lever 12.

In Figs. 19 and 20 the lever 12 is carried by a torsion bar 55 which forms the pivotal axis of the lever 12 and which is mounted in bearings 56 of the housing. Here too, a securing force is set up in the undisplaced position of the lever.

The elastic mounting against rotation of the brake-ring members 8 can also be used as a torque-measuring means in that a marking at the front of the brake-rings traverses a scale which is calibrated according to the spring, lies within the housing and is made visible by means of a window. The measuring means could also be outside the housing if a suitable transmission is used. Further, by various known means it can be used for control purposes such as by operating the regulator of a continuous gearing.

Instead of braking the planet carrier 5, the brake-ring members 8 could act on another rotating member of the epicyclic gearing, for example on the internal gear according to Fig. 1, the output shaft 7 then being connected to the planet carrier 5.

I claim:

1. For use in a machine drive, in combination, a support; a rotary member forming part of the machine drive and having an annular surface, said member being mounted on said support turnable about the axis of said annular surface; brake means for braking rotation of said rotary member and having a braking surface directed toward said axis, said brake means being mounted turnably about said axis and movable toward and away from said axis between an inner braking position in which said braking surface engages said annular surface of said

rotary member to prevent rotation thereof and an outer non-braking position, said brake means being turned about said axis by said rotary member when the latter applies a torque of a given magnitude to said brake means; means operatively connected to said brake means and tending to keep the same in said inner braking position; and releasing means mounted on said support and cooperating with said brake means for automatically moving the same from said inner braking position to said outer non-braking position during turning of said brake means by said rotary member in such a manner that the outward movement of said brake means is proportionate to the angular displacement of said brake means about said axis so that said brake means automatically assumes a non-braking position when angularly displaced by said rotary member.

2. For use in a machine drive, in combination, a support; a rotary member forming part of the machine drive and having an annular surface, said member being mounted on said support turnable about the axis of said annular surface; annular brake means for braking rotation of said rotary member and having a braking surface directed toward said axis, said brake means being mounted turnably about said axis and movable toward and away from said axis between an inner braking position in which said braking surface engages said annular surface of said rotary member to prevent rotation thereof and an outer non-braking position, said brake means being turned about said axis by said rotary member when the latter applies a torque of a given magnitude to said brake means, said annular brake means having a pair of control portions spaced from but located adjacent to each other and respectively having control surfaces each of which has an inner end nearer to said axis than an outer end thereof, said outer ends of said control surfaces being nearer to each other than said inner ends thereof; means operatively connected to said brake means and tending to keep the same in said inner braking position; a control member engaging said control surfaces; and mounting means mounting said control member on said support turnable about an axis spaced from said first mentioned axis, whereby when said annular brake means is turned about said first mentioned axis by said rotary member said control member will be radially shifted along said control surfaces so as to change the distance between said control portions to move said brake means automatically from said inner braking position to said outer braking position in such a manner that the outward movement of said brake means is proportionate to the angular displacement of said brake means about said first mentioned axis so that said brake means automatically assumes a non-braking position when angularly displaced by said rotary member.

3. The combination of claim 1 and including temperature sensitive means cooperating with said brake means for sensing the temperature thereof to automatically turn off the drive when the brake means reaches a certain temperature.

4. For use in a machine drive, in combination, annular brake means having a pair of control portions spaced from but located adjacent to each other and respectively having control surfaces each of which has an inner end nearer to an axis about which sadi brake means extends than an outer end thereof, said outer ends of said surfaces being nearer to each other than said inner ends thereof; a control member engaging said control surfaces and being radially shiftable therealong for changing the distance between said control portions so as to move said brake means from a braking to a non-braking position; and yieldable means in the form of yieldable bands each extending at least partly around said brake means and cooperating with said brake means for yieldably maintaining the same in said braking position thereof.

5. For use in a machine drive, in combination, brake means having a braking position and adapted to be angularly displaced when a certain maximum force is applied thereto; and means cooperating with said brake means for automatically moving the same to an extent proportional to the angular displacement of said brake means to a non-braking position when said force is applied to said brake means.

6. For use in a machine drive, in combination, annular brake means having a pair of control portions located adjacent but spaced from each other and respectively having a pair of control surfaces each of which has opposite ends one of which is nearer to an axis about which said brake means extends than the other, said one end of said control surfaces being spaced from each other at a distance different from that between said other ends of said control surfaces; a control member engaging said control surfaces and being radially movable therealong for changing the distance between said control portions and for moving said brake means from a braking to a non-braking position to an extent proportional to the displacement of said brake means when said control member moves in one radial direction; and means cooperating with said control member for moving the same in said one radial direction when said brake means is angularly displaced.

7. For use in a machine drive, in combination, annular brake means having a pair of control portions located adjacent but spaced from each other and respectively having a pair of control surfaces each of which has an inner end located nearer to an axis about which said brake means extends than an outer end thereof and said outer ends of said control surfaces being nearer to each other than said inner ends thereof; a control member engaging said control surfaces and being radially movable therealong for changing the distance between said control portions and for moving said brake means from a braking to a non-braking position when said control member moves in one radial direction; and a lever turnable about a stationary axis spaced from the axis about which said brake means extends, said lever carrying said control member so that when said brake means is angularly displaced said lever will turn to shift said control member radially along said control surfaces in said one direction for automatically placing said brake means in said non-braking position thereof.

8. The combination of claim 7 and wherein a yieldable means cooperates with said brake means for yieldably maintaining the same in said braking position thereof.

9. For use in a machine drive, in combination, annular brake means extending around a predetermined axis and having a braking surface directed toward sadi axis, said brake means having at least one pair of control portions located adjacent but spaced from each other and respectively having control surfaces directed toward each other, each control surface having an inner end located nearer to said axis than an outer end thereof and said outer ends of said control surfaces being nearer to each other than said inner ends thereof; a control member located between and engaging said control surfaces so that when said control member shifts radially away from said axis said control portions will move furthre apart from each other to spread said brake means and locate said braking surface thereof further from said axis so that the radial movement of said control member away from said axis moves said brake means from a braking to a non-braking position; and means cooperating with said control member for shifting the same radially away from said axis when said brake means is angularly displaced.

10. For use in a machine drive, in combination, annular brake means extending around a predetermined axis and having a braking surface directed toward said axis, said brake means having at least one pair of control portions located adjacent but spaced from each other and respectively having control surfaces directed toward each other, each control surface having an inner end

located nearer to said axis than an outer end thereof and said outer ends of said control surfaces being nearer to each other than said inner ends thereof; a control member located between and engaging said control surfaces so that when said control member shifts radially away from said axis said control portions will move further apart from each other to spread said brake means and locate said braking surface thereof further from said axis so that the radial movement of said control member away from said axis moves said brake means from a braking to a non-braking position; means cooperating with said control member for shifting the same radially away from said axis when said brake means is angularly displaced; and yieldable means cooperating with said brake means for yieldably maintaining the same in a braking position.

11. For use in a machine drive, in combination, a rotary member forming part of a machine drive and having an annular surface, said member being turnable about the axis of said annular surface; annular brake means having a braking position engaging said annular surface of said rotary member to prevent rotary movement thereof and being mounted for turning movement with respect to said axis, said brake means being angularly displaced about said axis by said rotary member when the latter applies a torque of a given magnitude to said brake means; and means cooperating with said brake means for automatically moving the same away from said annular surface of said rotary member to an extent proportional to the displacement of said brake means when the latter angularly displaces said brake means so that the latter automatically assumes a non-braking position when angularly displaced from its braking position by said rotary member.

12. The combination of claim 11 and wherein a yieldable means cooperates with said brake means for yieldably maintaining same in said braking position thereof.

13. The combination of claim 12 wherein said rotary member is part of a differential drive.

14. The combination of claim 11 wherein said rotary member is a planetary gear carrier of a differential drive so that said brake means cooperates with said carrier to have therewith frictional engagement so as to slip upon angular displacement of said brake means by said carrier.

15. The combination of claim 2 wherein said mounting means is in the form of a lever carrying said control member and a bearing carrying said lever to support the same for turning movement about said axis spaced from said first-mentioned axis, and wherein a spring means cooperates with said lever for urging said control member against said control surfaces.

16. The combination of claim 2 wherein said mounting means includes a lever carrying said control member and a bearing supporting said lever for turning movement about said axis spaced from said first-mentioned axis, the turning axis of said lever being displaced from the radial path of movement of said control member.

17. The combination of claim 2 and wherein a manually operable means cooperates with said control member for moving the same in a direction which frees said control portions for movement toward each other.

18. The combination of claim 2 and wherein said mounting means includes a turnable lever carrying said control member, and wherein a switch is located in the path of turning movement of said lever to be actuated thereby.

19. For use in a machine drive, in combination, annular brake means having a pair of control portions spaced from but located adjacent to each other and respectively having control surfaces each of which has an inner end nearer to a first axis about which said brake means extends than an outer end, said outer ends of said control surfaces being nearer to each other than said inner ends thereof, said control surfaces being directed toward each other; a control member located between and engaging said control surfaces; and a lever turnable about a second axis spaced from said first axis and carrying said control member for shifting same along said control surface upon angular displacement of said brake means, said lever turning upon angular displacement of said brake means; hydraulic means cooperating with said control portions for urging the same toward each other and including a hydraulic circuit; and valve means cooperating with said hydraulic circuit and said lever for controlling the pressure of the hydraulic fluid according to the angular position of said lever.

20. The combination of claim 2 wherein said support means is in the form of a leaf spring.

21. The combination of claim 2 wherein said support means is in the form of a lever and a torque bar carrying said lever.

References Cited in the file of this patent

UNITED STATES PATENTS

1,456,956	Williams	May 29, 1923
1,668,338	Sanford	May 1, 1928
1,685,523	Dodge	Sept. 25, 1928
2,259,437	Dean	Oct. 21, 1941
2,277,554	McCoy	Mar. 24, 1942
2,279,433	Logan	Apr. 14, 1942
2,696,365	King	Dec. 7, 1954
2,736,395	Keeler	Feb. 28, 1956
2,823,325	Stephen	Feb. 11, 1958