

The present invention relates to a backlashfree precision reverse gearing including a rotatably mounted drive member and a coaxially disposed, rotatably mounted output member; to the use of this reverse gearing as an adjustment drive for a linearly displaceably mounted measuring rail which has a precision reverse gearing according to the invention.

Normally, toothed-wheel gearing is used as reverse gearing, i.e. as a gearing for rotationwise reversal of a rotational movement. When input- and output member, for example an input shaft driven to rotate and an output shaft driven for reversed rotation, are to be coaxially disposed, a planetary gearing offers itself. These toothed-wheel gearings are robust and, depending on their dimensions, suitable for the transfer of high torques. However, the disadvantage here is that these toothed wheels have to be manufactured in an extremely precise manner if a relatively backlashfree power transmission is to be achieved. Furthermore, the interacting toothed wheels are liable to wear, whereby again play develops during transmission.

Furthermore, friction-wheel-reverse gearings are known wherein play during transmission can be widely excluded. However, here the disadvantage lies in their complicated and consequently expensive construction, if a sufficiently precise performance is aimed at.

From GB-PS 1,192,361, according to the concept of claim 1, a friction gear is known which is integrated in a lawnmower drive, serving primarily as an engageable and disengageable clutch, which includes a first rotatable element and a second coaxially rotatable element with an intermediate member disposed between the opposing

drive surfaces for the purpose of power transfer and, if appropriate, for reduction and reversal of the rotational direction, which intermediate member has caged balls which roll on the mentioned drive surfaces. The frictional contact between drive surfaces and balls is secured in that the drive surfaces are tensioned towards each other by means of a spring force and are thus pressed against the balls. When the first rotatable element is used as a drive member, the second rotatable element is blocked relative to its rotational movement and the intermediate member is used as output member, then a reversal of rotational direction between drive member and output member with a reduction or a torque increase respectively around factor 2 takes place. On the other hand, when under otherwise identical conditions, the intermediate member is blocked and the second rotatable element is used as output member, then a reversal of rotational direction takes place between drive member and output member without reduction or torque increase respectively.

Such a clutch or gearing respectively is easy in its construction, spacesaving as well as extensively play- and maintenancefree; but it only offers the possibility of a change in the a transmission around factor 2 if no additional elaborate constructive measures are taken.

In particular in a drive device for the adjustment of a linearly displaceably mounted measuring rail, as is used in some precision measuring devices, it is often required for constructive reasons that the direction of rotation be reversed in order to guarantee operation of the drive in an intuitively logical way, whilst at the same time affording the possibility of changing the

transmission ratio between drive member and output member by a comparably high factor, whereby such a gear is to be small, wear- and playfree as well as requiring only a minimum of maintenance.

It is, therefore, the aim of the invention to further develop a gearing of this type so that the advantageous features, such as simple construction, low wear, being backlashfree, and minimum maintenance, can be maintained whereas the transmission ratio can be changed in an easy manner by a factor substantially larger than 2.

This aim is achieved with a friction gearing of the type described in the concept of the patent claim 1, by way of the features defined in the characteristics of this claim. Further details and preferred embodiments of the item of the invention are described in the dependent claims 2 to 7.

The reverse gearing according to the invention can be used to advantage in the earlier described drive device for the adjustment of the linearly displaceably mounted measuring rail as used in precision measuring devices. The drive device manifests itself according to the invention in that the drive member is provided with an eccentrically placed, protruding operating pin for the manual rotation of the drive member, and that selectably engageable and disengageable operating means for direct, reduced drive of the output member are provided, whereby the engageable and disengageable operating means have a rotatably mounted drive spindle with conical tip which can be brought into frictional contact with an outer edge of the output member. Furthermore, the drive spindle can be mounted

to be displaceable vertically to the axis of the reverse gearing. If, in addition thereto, the drive spindle, whilst engaged, is affected by a spring which presses the conical tip against the output member, then a fine-adjustment drive has been created in a simple manner which can be used as required for fine adjustments of the measuring rail.

In the following, an example of embodiment of the item of the invention is explained more in detail, with reference to the enclosed drawings. The drawings show:

- Fig. 1: a vertical section of a precision reverse gearing according to the invention;
- Fig. 2: a front view of the gearing of Fig. 1;
- Fig. 3: a perspective detailed view of the cage disc and balls; and
- Fig. 4: a partially sectional sideview of a drive device for adjusting a measuring rail which includes the reverse gearing according to the invention.

According to Figs. 1 and 2, the friction-reverse gear, in its entirety denoted by 1, comprises a gear housing 2 which can be mounted, for example by means of screws 3, to a not illustrated device. In the housing 2, an output shaft 4 is rotatably mounted, namely with the aid of two ballbearings 5 which are accommodated at a distance to each other in a bore 6 of the gear-housing body 2. Whilst the one end 4a of the shaft 4 protrudes from the gear housing 2 and is intended to be engaged with a further device, the other free end 4b of the

shaft 4 supports an output member 7. The latter is firmly connected with the shaft 4 and secured against turning by means of an adjusting screw 8 which is screwed into a radial threaded bore 9 of the output member 7.

Normally, the output member 7 has the general appearance of a circular disc and is provided with a central, hub-like extension 10 which extends at the side facing away from the ballbearings 5 away from the face surface of the disc. On the extension 10, a ball cage in the shape of a round cage disc 11 is mounted to be rotatable by means of a ballbearing 12.

As can be seen particularly clearly in Fig. 3, the cage disc 11 comprises 3 axis-parallel bores 13, evenly spaced over the circumference and located near the periphery of the disc 11. These bores 13 accommodate balls 14 which roll on the drive- and output member 18 or 7 respectively as will have to be explained more in detail later. The bores 13 correspond in diameter approximately with that of the balls 14 or are negligibly bigger so that the balls 14 can move freely in the bores 13. The thickness of the disc 11 is a little less than the diameter of the balls 14 so that they protrude on both sides from the surfaces of the disc 11. The disc 11 is advantageously made of a plastics material with a low friction coefficient against polished steel and the balls 14 can be quite normal, in the trade readily available ballbearing balls.

Furthermore, the disc 11 has a peripheral notch 15 into which engages a locking pin 16 which is placed on an extension 17 of the gear housing 2, preventing the disc

11 from rotating. In other words, the disc 11 is stationary when the shaft 4, and with it the output member 7, rotates.

Furthermore, a drive member 18 is mounted on the extension 10 by means of a ballbearing 19 which is accommodated in the central bore of a generally disc-shaped drive member 18. The inner ballrace of the ballbearing 19 is fitted onto a slid-on seat of the extension 10 so that the drive member 18 can be displaced in the axial direction. For holding the drive member 18, a securing disc 20 is provided, the outside diameter of which is a little smaller than the diameter of the central bore in the drive member 18 and which has an extension 21 directed against the extension 10 of the output member 7. The securing disc 20 is rigidly connected with the extension 10 of the output member 7 by means of a screw 22.

A cup spring (elastic pressure means) 23 is pushed onto the extension 21 of the securing disc 20, which spring abuts along its inside edge against one shoulder 24 at the base of the extension 21. The outside edge of the cup spring 23 abuts against the edge, protruding over the extension 10, of the inner ballrace of the ballbearing 19.

The two opposingly disposed surfaces of the drive- and output member 18 or 7 respectively include drive surfaces, i.e. planed, axis-normal extending surface areas 25 and 26 on which the balls 14 roll. The surface areas 25 and 26 generally have the shape of a circular surface which is plane-ground and, if appropriate, hardened and polished. Thereby, the arrangement is, or the dimensions of the individual parts are chosen such

that in the assembled state of the gearing 1, as illustrated in Fig. 1, the cup spring 23 is pretensioned so that an axially directed force against the output member 7 is exerted onto the inner ballrace of the ballbearing 19, and thus on the drive member 18, resulting in the balls fully resting on the surface areas 25 and 26.

At the upper section of the gear housing 2, a bushing 25 is placed, for example with the aid of screws, which holds a drive spindle 29. The latter includes an operating knob 30 which is axially mounted with the aid of a grub screw 31 to be both rotatable and displaceable in the axial direction. The tip 32 of the drive spindle 29 narrows conically and, with the spindle engaged, abuts against the outside edge of the output member 7, as shown in Fig. 1. A ball 33, accommodated in a pocket bore 35, extending transversely to the axis of the drive spindle 29, and under the influence of a pressure spring 34, abuts against a cone-shaped shell section 36 of the drive spindle 29 and thus presses the tip 32 against the outside-circumferential edge of the output member 7. The drive spindle 29 can be disengaged by pulling the operating knob 30 upwards so that the tip 32 releases the outer-circumferential edge of the output member 7.

The reverse gearing functions as follows: It is assumed that the drive spindle 29 is initially disengaged. The drive member 18 is rotated by way of an eccentrically placed operating pin 37, namely in the direction of the arrow P, in Fig. 2. As the drive member 18 is pressed, by means of the spring cup 23, against the balls 14, the latter are rotated around a radially orientated (imaginary) axis by rolling on the drive-surface area

25 of the drive member 18. The cage disc 11 does not rotate as it is prevented from doing so by the locking pin 16 which enters into the notch 15. The rotating balls 14, driven by the drive member 18, roll with their opposite side on the drive surface 26 of the output member 7 and drive the latter to perform a rotational movement in the direction opposite to that of arrow P₁. Thus, the shaft 4, firmly connected with the output member 7, is also put into rotation.

For a direct, reduced drive of the output member 7, the drive spindle 29 is placed into its engaged state as is shown in Fig. 1, wherein its tip 32, under the influence of the springloaded ball 33, abuts against the outer-circumferential edge of the output member 7. If the operating knob 30 is now turned, then the shell surface of the conical tip 32 rolls along the outer edge of the output member 7 and puts same into rotation. Due to the difference in diameters (smaller effective diameter of the conical tip 32 and large diameter of the outer edge of the output member 7), a strong reduction results so that the output member can be extremely fine-adjusted relative to its rotational disposition.

Due to the influence of the cup spring 23, which presses the drive member 18 against the balls 14 and the latter against the output member 7, any play is cancelled out, and yet allowing smooth running since the balls 14 in the cage disc 11 only have a negligible amount of friction and, in any case, roll practically frictionfree on the drive-surface sections 25 and 26. A lubrication between the balls 14 and the drive-surface sections 25 and 26 or the cage disc 11 respectively is not required, thus guaranteeing a

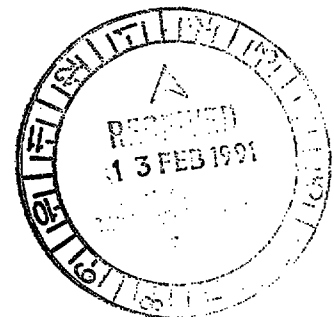
practically maintenancefree, precise operation of the gearing for extended periods. The balls 14 as momentum-transferring elements do not require separate, elaborate bearings apart from the simple and cheap plastics-material cage, and standardised, economical bearing types can be used as ballbearings. In all, the gearing according to the invention is thus very simple in construction and cost-effectively producible without entering into a compromise regarding the precision.

In Fig. 4, an example of application of the precision reverse gearing according to the invention is shown, namely in a drive device for the adjustment of a linearly displaceable measuring rail. On a column 40, a slide 41, which can be height-adjusted by a not illustrated means, is displaceably mounted. The slide holds a measuring rail 42, sectionally shown, which is displaceable perpendicularly to the drawing level. To guide the measuring rail 42, a thereto attached moveable guide rail 43 is provided which is mounted by means of balls 45 in stationary guide rails 44. Such linear ball guides are already known and do not have to be explained here any further.

For constructive reasons, the friction drive, formed by the shaft end 4a, can only engage the upper edge of the movable guide rail 43 so that an intuitively wrong, illogical adjustment method of the measuring rail would result, because when rotating the shaft 4a clockwise, the measuring rail 42 is displaced towards the left, and vice versa.

This is where the reverse gearing 1 according to the invention offers a remedy. When the drive member 18 is rotated clockwise by means of the operating pin 37,

then the output member 7, and with it the shaft 4a, rotate anticlockwise so that the measuring rail 42 is adjusted (intuitively correct) towards the right. For a rough adjustment, the drive spindle 29 is disengaged by pulling the operating knob 30 out until the measuring rail 42 has arrived approximately at the required position. Then, the operating knob 30 can be pushed in so that the conical tip 32 of the drive spindle 29 abuts against the outer-circumferential edge of the output member 7. By subsequent turning of the operating knob 30 in the clockwise direction, the measuring rail 42 will also move at creeping speed towards the right since a reversal in the rotational direction occurs again due to the co-acting of drive-spindle- and output member. Due to it being play-free and poor in friction, the reverse gearing according to the invention is particularly suitable for such an adjustment drive as the moments to be transferred are comparably small.

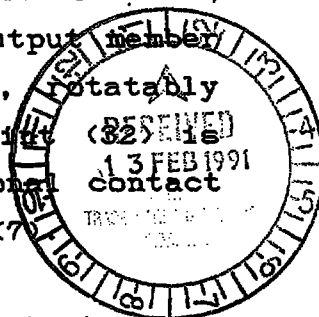


P A T E N T C L A I M S

1: Backlashfree, shiftable friction reverse gearing including a rotatably mounted drive member (18) and a coaxially disposed, rotatably mounted output member (7) with axis-normal drive surfaces (25, 26) positioned opposite to and at a distance from each other and having between them at least two caged balls (14) which roll on the drive surfaces whereby at least one of these members (18, 7) is movable in the axial direction in relation to the other member and is affected by an elastic pressure member (23) which aims to slide the two members (18, 7) against each other, characterised in that the drive member (18) is provided with an eccentrically positioned protruding operating pin (37) for manual rotation of the drive member (18); and that for direct reduced drive of the output member (7) an either engageable or disengageable, rotatably mounted drive spindle (29) with conical point (32) is provided which can be brought into frictional contact with an exterior edge of the output member (7).

2: Friction reverse gearing according to patent claim 1, characterised in that the engageable and disengageable drive spindle (29) is mounted vertically to the axis of the reverse gearing (1) and movable in the direction of its axis.

3: Friction reverse gearing according to patent claim 1 or 2, characterised in that the drive spindle (29) when engaged stands under the influence of a spring (34)



which presses the conical point (32) against the output member (7).

4: Friction reverse gearing according to patent claim 1, characterised in that the output member (7) has a cylindrical extension (10) facing the drive member (18) onto which extension the drive member (18) is mounted to be rotatable and axially movable.

5: Friction reverse gearing according to one of the aforementioned patent claims, characterised in that the rotatable mounting of the drive member (18) is achieved by way of a ballbearing (19) its inner ball ring with sliding seat being disposed on the extension (10) to protrude beyond the end face of said extension; and that a mounting disc (20), rigidly connected with the extension (10), is provided which presses the plate spring (23) at the edge against the protruding edge of the inner ball ring of the ballbearing (19).

6: Friction reverse gearing according to one of the aforementioned patent claims, characterised in that three balls (14) are provided which are disposed freely movable in three holes (13) evenly spaced out over the circumference of the cage disc (11).

7: Friction reverse gearing according to one of the aforementioned patent claims, characterised in that the cage disc (11) is positioned axially unmovable at a close distance from the drive surface (26) of the output member (27) by way of a ball bearing (12).

