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REVERSIBLE DRIVE

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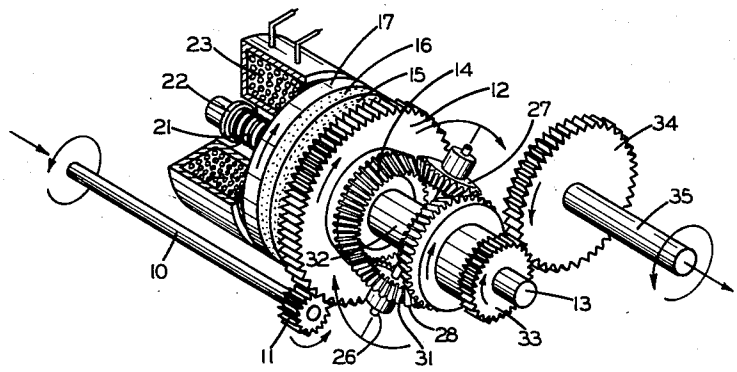


FIG. 1

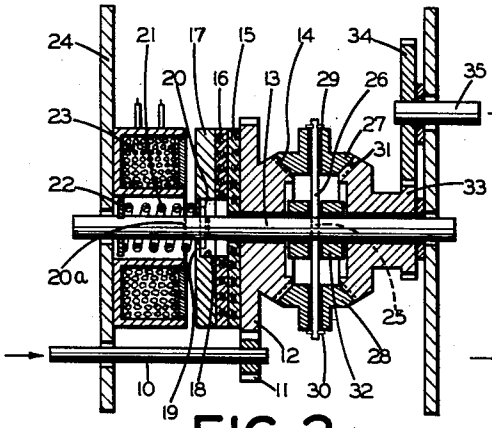


FIG. 2

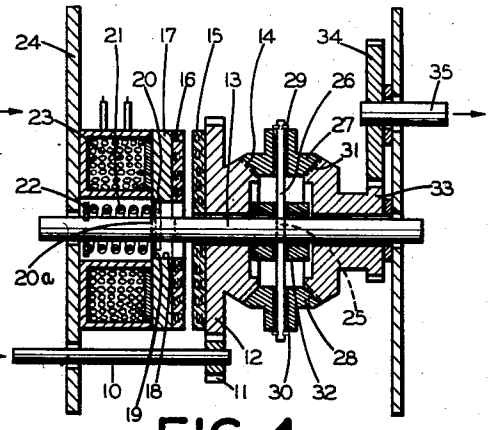


FIG. 4

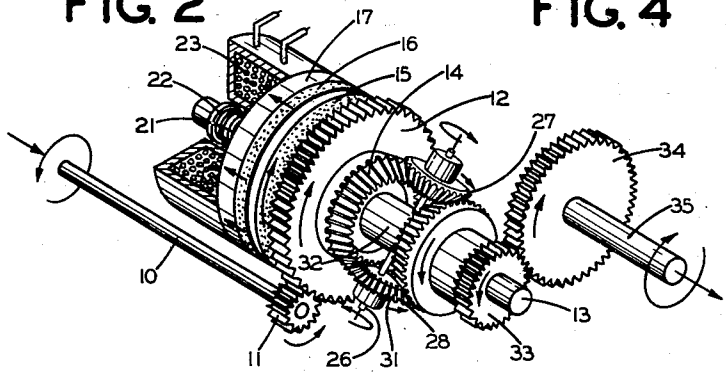


FIG. 3

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REVERSIBLE DRIVE

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This invention relates to a reversible drive.

It is an object of the present invention to provide a novel drive which may be reversed in direction within a very short time interval.

It is also an object of the present invention to provide a novel reversible drive in which the reversing portion of the drive has low inertia, thereby enabling the drive to be reversed with a short time interval.

Although the drive of the present invention is of general utility wherever a drive capable of quick reversal is desired, it has been found to be particularly useful in connection with a motor driven surface roughness analyzer. In the surface roughness analyzer a stylus is moved in very short strokes back and forth across the surface to be analyzed. In one instrument of this type the stroke of the stylus is only 1/16 inch and the stylus moves at a speed of 1/8 inch per second. With such an instrument it is not feasible to use a reversible motor to reverse the direction of movement of the stylus because such motors, due to relatively high inertia, require a time interval of the order of magnitude of 1/4 second to reverse, which is inordinately long for applications of this type. This problem of quick reversal is satisfactorily resolved in the present invention by the provision of a novel reversible drive in which the reversing parts have low inertia, thereby enabling the drive to reverse quickly. Such a reversible drive constructed in accordance with the following description and the accompanying drawing has been found to be capable of reversing within the extremely short time interval of about .015 second, thereby rendering it particularly useful in connection with surface roughness analyzers of the type mentioned above.

The foregoing, as well as other and further objects and advantages of the present invention will be apparent from the following description of the preferred embodiment thereof, which is illustrated in the accompanying drawing.

In the drawing:

Figure 1 is a perspective view of the drive showing the parts arranged to drive the output shaft in the "forward" direction;

Figure 2 is a longitudinal section through the mechanism during the "forward" drive;

Figure 3 is a perspective view of the drive showing the parts arranged to impart a "reverse" drive to the output shaft; and

Figure 4 is a longitudinal section through the drive when the "reverse" drive is imparted to the output shaft.

Referring to the drawings, in the preferred embodiment of the present invention there is provided a rotary input shaft **10** which rotates at all times in the direction indicated by the arrow (counterclockwise in the drawing). Shaft **10** at its inner end carries a pinion **11** which meshes with a relatively large input gear **12** mounted freely on a rotatable shaft **13**. A driving bevel gear **14** is integral with gear **12** at one side thereof and rotates in unison therewith.

At its opposite side, input gear **12** carries a friction

disk **15** positioned to be engaged selectively by a similar friction disk **16** carried by an annular armature **17**. Armature **17** is formed with a central opening **18** through which shaft **13** extends freely. At one end, at the opening **18** the armature is formed with an annular, radially inwardly projecting shoulder **19** to which is secured integrally a cross pin **20** which extends through an elongated narrow slot **20***a* in shaft **13**. With this arrangement armature **17** and shaft **13** are coupled together for rotation in unison, while armature **17** is capable of limited sliding movement axially along shaft **13**. A coil spring **21** is under compression between this shoulder on the armature and a hub **22** carried by shaft **13** and normally biases the armature to the right in the drawing to position friction disk **16** tightly against friction disk **15**, thereby establishing a friction coupling from input gear **12** to shaft **13** to rotate the latter in response to rotation of gear **12**.

For stopping the rotation of shaft **13** and de-coupling it from gear **12** there is provided an electromagnet **23** mounted on a supporting wall **24** and positioned adjacent armature **17**. Electromagnet **23** when energized is capable of attracting armature **17** against the bias of spring **21** to separate friction disk **16** from the friction disk **15**, thereby stopping the rotation of the armature and shaft **13**.

At the front side of driving bevel gear **14** the shaft **13** is formed with a cross drilled hole **25** which snugly receives an elongated cross pin **26** projecting on opposite sides of the shaft. At opposite ends of cross pin **26** there are mounted rotatably a pair of coupling bevel gears **27** and **28**, which are retained on the cross pin by snap rings **29** and **30**, respectively. The bevel gears **27** and **28** both mesh with driving bevel gear **14** and are rotatable about cross pin **26**, which extends perpendicular to the axis of rotation of the driving bevel gear **14**.

At the opposite side of the coupling bevel gears **27** and **28** there is provided a driven bevel gear **31** mounted loosely on shaft **13** to rotate freely thereon. Gear **31** meshes with both of the gears **27** and **28**. An enlarged hub **32**, cross drilled to pass the cross pin **26**, is mounted loosely on shaft **13** and serves as a spacer limiting the movement of bevel gears **14** and **31** toward one another. Integral with the driven bevel gear **31** is a spur gear **33** which drives a spur gear **34** mounted on output shaft **35**.

Operation

In the operation of this mechanism, to drive the output shaft **35** in the "forward" direction (counterclockwise; Figures 1 and 2), the electromagnet **23** is maintained de-energized. Therefore, coil spring **21** maintains the friction disk **16** carried by armature **17** tightly against the friction disk **15** carried by input gear **12**. Since shaft **13** is connected by cross pin **20** to rotate with the armature, through this friction coupling the shaft **13** is rotated in unison with, and in the same direction as, input gear **12** and driving bevel gear **14**. Due to the rotation of shaft **13**, the elongated cross pin **26** and the coupling bevel gears **27** and **28** thereon revolve bodily as a unit about the axis of shaft **13**. The bevel gears **27** and **28**, which at this time do not rotate about cross pin **26**, revolve in unison with driving bevel gear **14** about the axis of shaft **13** and provide a direct coupling from the driving bevel gear **14** to the driven bevel gear **31**, so that the driven bevel gear is rotated in the same direction, and at the same speed, as the driving bevel gear **14**. The spur gear **33** integral with the driven bevel gear **31** in turn drives spur gear **34** to rotate output shaft **35** in the direction indicated in Figure 1.

To reverse the direction of rotation of the output shaft **35** while the input shaft **10** continues to rotate in the same direction, the electromagnet **23** is energized to at-

tract armature 17. When this happens (Figures 3 and 4), the friction disk 16 carried by the armature moves away from the friction disk 15 carried by input gear 12 and the electromagnet immediately stops the rotation of armature 17 and shaft 13 and holds them against any further rotation as long as the electromagnet remains energized. Due to the stopping of shaft 13 the elongated cross pin 26 and the bevel gears 27 and 28 thereon cease to revolve about the axis of shaft 13. The rotation of the driving bevel gear 14, which is integral with input gear 12, causes the bevel gears 27 and 28 to rotate about the now stationary cross pin 26. Gears 27 and 28 in turn drive the driven bevel gear 31 in a direction opposite to the direction of rotation of the driving bevel gear 14 and at the same speed as the driving bevel gear. Through spur gears 33 and 34 the output shaft 35 is driven from the driven bevel gear 31 in the reverse direction.

The foregoing mechanism, because of the low inertia of its reversing parts, has been found in practice to be capable of completely reversing the drive to the output shaft within an interval of about .015 second.

It is to be understood that, while there has been disclosed a preferred embodiment of the present invention in the foregoing description and the accompanying drawing, various modifications, omissions and refinements which depart from the disclosed embodiment may be adopted without departing from the spirit and scope of this invention.

We claim:

1. A reversible drive, comprising a rotatable shaft, a rotary driving bevel gear mounted rotatably on said shaft coaxial therewith and extending around the shaft, a cross pin carried by said shaft perpendicular thereto and projecting on opposite sides thereof, a pair of coupling bevel gears carried by said cross pin on opposite sides of the shaft to revolve bodily with said cross pin about the axis of the shaft when the shaft rotates, each of said coupling bevel gears being rotatable about said cross pin, a rotary driven bevel gear mounted rotatably on said shaft coaxial therewith and extending around the shaft, both of said coupling bevel gears meshing with both said driving and driven bevel gears, and selective means, including a clutch acting between said driving gear and said shaft, operable to couple said driving gear to said shaft to rotate said shaft in the same direction as said driving gear and cause said coupling gears to revolve about the axis of said shaft in unison with the rotating driving gear to form direct couplings from said driving gear to said driven gear to rotate the driven gear in the same direction as the driving gear or alternatively to decouple said shaft from said driving gear and hold said shaft against rotation to render said cross pin stationary while said coupling gears are rotated about the cross pin by the driving gear to impart a drive from the driving gear to the driven gear which rotates the driven gear in the reverse direction from the direction of rotation of the driving gear.

2. A reversible drive, comprising a rotatable shaft, a rotary driving bevel gear mounted rotatably on said shaft coaxial therewith and presenting at one end a toothed bevel face which extends around the periphery of the shaft, a first friction disk carried by said driving bevel gear at its opposite end, an armature mounted reciprocably on said shaft adjacent said opposite end of the driving bevel gear and connected to said shaft for rotation in unison therewith, a second friction disk carried by said armature in confronting relation to said first friction disk and positioned to engage said first friction disk in one position of the armature on the shaft, a spring biasing the armature to position said second friction disk tightly against said first friction disk to clutch the armature to said driving bevel gear to thereby couple said shaft to said driving bevel gear for rotation therewith, an electromagnet energizable to attract the armature against the bias of said spring to hold said armature and said shaft against rotation and to separate said friction disks and thereby disconnect the coupling from said driving bevel gear to said shaft, a rotary driven bevel gear mounted rotatably on said shaft coaxial therewith and presenting a toothed bevel face which extends around the periphery of the shaft in spaced confronting relation to the toothed bevel face on the driving bevel gear, a cross pin carried by said shaft perpendicular thereto and projecting on opposite sides of the shaft between the toothed bevel faces on the driving and driven bevel gears, a pair of coupling bevel gears carried by said cross pin on opposite sides of said shaft to revolve bodily with said cross pin about the axis of said shaft when said shaft rotates, each of said coupling bevel gears being mounted rotatably on said cross pin for rotation thereabout, both of said coupling bevel gears meshing with both said driving bevel gear and said driven bevel gear, said spring when the electromagnet is de-energized positioning said second friction disk tightly against said first friction disk to couple said shaft to said driving gear to rotate said shaft from said driving gear in the same direction and cause said coupling gears to revolve about the axis of said shaft in unison with said driving gear to provide a direct coupling from the driving gear to the driven gear to rotate the driven gear in the same direction as the driving gear, and said electromagnet when energized attracting said armature to hold said armature and said shaft against rotation and to separate the friction disks and thereby disconnect the coupling from the driving gear to said shaft, thereby maintaining said shaft and said cross pin stationary so that the rotation of the driving gear rotates the coupling gears about said cross pin to drive the driven gear in the opposite direction from the driving gear.

3. A reversible drive, comprising, in combination, a rotatable shaft, a rotary driving bevel gear mounted freely on said shaft for rotation about the axis of the shaft and extending around the shaft, means for rotating said driving gear in one direction, means selectively coupling said driving gear to said shaft or disconnecting said driving gear from said shaft and holding said shaft against rotation, a rotary driven bevel gear mounted freely on said shaft for rotation about the axis of the shaft and extending around the shaft in spaced confronting relation to said driving bevel gear, and a coupling bevel gear having a connection to said shaft to revolve about the axis of the shaft when the shaft rotates and disposed between the driving and driven gears and meshing with both the driving gear and the driven gear to couple the driven gear directly to the driving gear for rotation in unison therewith when the driving gear is coupled to said shaft and to drive the driven gear from the driving gear in the reverse direction when said shaft is held against rotation and is disconnected from the driving gear.

4. The combination of claim 2, wherein said coupling bevel gears are mounted freely on said cross pin to adjustably engage the beveled tooth faces on the driving and driven gears, and wherein there are provided snap rings on the cross pin adjacent either of its ends to retain the coupling bevel gears on the cross pin.

5. The combination of claim 2, wherein there are additionally provided an input spur gear attached to the driving bevel gear between the toothed bevel face thereon and said first friction disk, drive input means meshing with said input gear to impart rotation to the driving bevel gear, and an output spur gear attached to said driven bevel gear in spaced relation from the toothed bevel face thereon.

6. A reversible drive comprising a rotatable shaft, a rotary driving bevel gear mounted rotatably on said shaft coaxial therewith and presenting a toothed bevel face which extends around the periphery of the shaft, a rotary driven bevel gear mounted rotatably on said shaft coaxial therewith and presenting a toothed bevel face which extends around the periphery of the shaft in spaced

confronting relation to the toothed bevel face on said driving gear, a cross pin carried by said shaft perpendicular thereto and located on opposite sides of the shaft between the toothed bevel faces on the driving and driven bevel gears, a pair of coupling bevel gears carried by said cross pin on opposite sides of the shaft to revolve bodily with the cross pin about the axis of the shaft when the shaft rotates, each of said coupling bevel gears being rotatable on the cross pin and each meshing with the toothed bevel faces on the driving and driven bevel gears, and selective means, including a clutch acting between said driving gear and said shaft, operable selectively to couple said driving gear to said shaft to rotate said shaft in the same direction as said driving gear and cause said coupling gears to revolve about the axis of said shaft in unison with the rotating driving gear to form direct couplings from said driving gear to said driven gear to rotate the driven gear in the same direction as the driving gear or alternatively to decouple said shaft from said driving gear and hold said shaft against rotation to render said cross pin stationary while said coupling gears are rotated about the cross pin by the driving gear to impart a drive from the driving gear to the driven gear which rotates the driven gear in the reverse direction from the direction of rotation of the driving gear.

7. A reversible drive comprising, in combination, a rotatable shaft, a rotary driving bevel gear mounted rotatably on said shaft coaxial therewith and presenting a toothed bevel face which extends around the shaft, means for rotating said driving bevel gear in one direction, selective means coupling said driving bevel gear to

said shaft or alternatively disconnecting said driving bevel gear from said shaft and holding said shaft against rotation, a rotary driven bevel gear mounted rotatably on said shaft coaxial therewith and presenting a toothed bevel face which extends around the shaft in spaced confronting relation to the toothed bevel face on the driving bevel gear, a cross pin carried by said shaft extending perpendicular thereto and projecting on opposite sides of the shaft between the toothed bevel faces on the driving and driven bevel gears, a pair of coupling bevel gears mounted rotatably on said cross pin on opposite sides of the shaft and each meshing with the toothed bevel faces on the driving and driven bevel gears to couple the driven gear directly to the driving gear for rotation in unison therewith when the driving gear is coupled to said shaft and to drive the driven gear from the driving gear in the reverse direction when said shaft is held against rotation and is disconnected from the driving gear.

References Cited in the file of this patent

UNITED STATES PATENTS

1,830,941	Hild	Nov. 10, 1931
2,209,980	Johnson	Aug. 6, 1940
2,347,099	Gridley	Apr. 18, 1944
2,464,129	Goettisheim	Mar. 8, 1949

FOREIGN PATENTS

342,379	Germany	Oct. 17, 1921
583,119	Great Britain	Dec. 10, 1946