

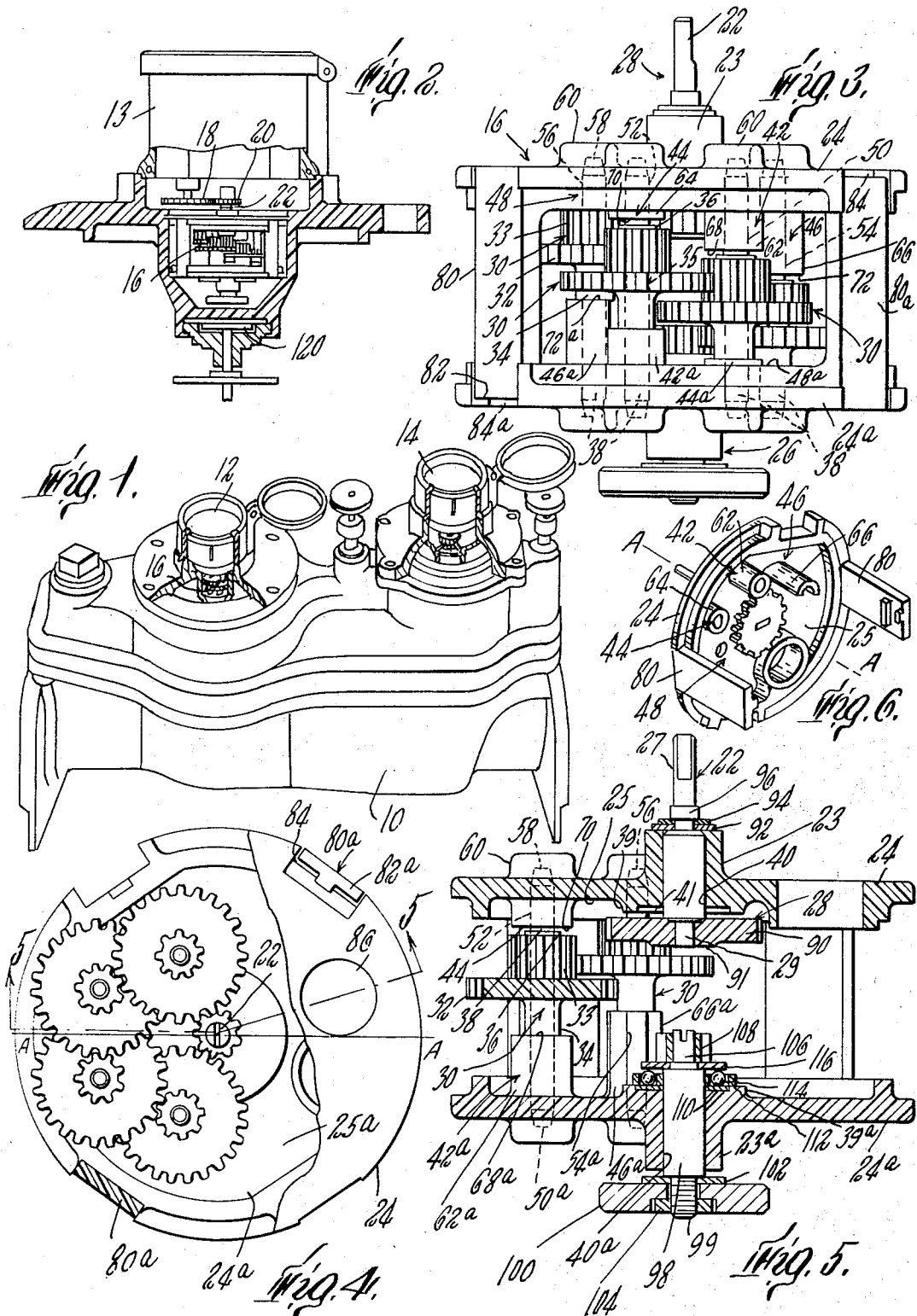
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GEAR TRAIN ASSEMBLY

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GEAR TRAIN ASSEMBLY

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ABSTRACT OF THE DISCLOSURE

Gear train assembly in which gears are supported on spindles between identical opposing train plates, spindle receiving portions (some elevated) are arranged to form opposing pairs for supporting the spindles, and at least one rigid connector holds the plates together.

This invention relates to the structure and assembling of gear train assemblies useful for example in driving water meter registers.

It is a primary object of the invention to provide a gear train assembly in which the component parts are inexpensive, and furthermore have a high degree of interchangeability to minimize the number of different parts that need be manufactured and of reliability to minimize need of maintenance. Other objects are to provide such a gear train assembly that is capable of easy assembly and disassembly (as for servicing) without tools, and that is long lasting, corrosion free, and without lubrication requirements.

The invention features a gear train assembly having a plurality of preferably identical intermediate spindle supported gears disposed between a pair of identical opposing train plates, each train plate having spindle receiving portions arranged in symmetrical pairs about an axis lying in its face. In preferred embodiments each plate carries a connector extending away from its face and adapted to be manually locked into a connector receiving portion in an opposing plate.

Other objects, features, and advantages will appear from the following description of a preferred embodiment of the invention, taken together with the attached drawings thereof, in which:

FIG. 1 is a perspective view, partially broken away, of a water meter embodying a gear train assembly according to the invention;

FIG. 2 is a side elevation, partially broken away, showing the gear train and register assemblies of the meter of FIG. 1;

FIG. 3 is a side elevation of the gear train assembly of the invention;

FIG. 4 is a plan view, partially broken away, of the assembly of FIG. 3;

FIG. 5 is a section taken at 5-5 of FIG. 4; and

FIG. 6 is a perspective view of a train plate.

FIG. 1 shows a water meter comprising a casing 10, main line register 12 and bypass register 14. Cooperating with register 12 is a gear train assembly 16. Register assembly 13 (FIG. 2) is driven by the gear train assembly 16 through gears 18 and 20, the latter carried by output shaft 22 of the gear train assembly.

As best shown in FIGS. 3-5, gear train assembly 16 comprises a pair of identical plates 24, 24a, train drive assembly 26, output gear unit 28, and four identical intermediate gear members 30 carried on spindles 38.

Plate 24 is of ethyl cellulose thermoplastic material (sold by Celanese under the trade designation Celcon),

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generally circular and has a central opening 40 for admitting output shaft 22. A raised portion 39 surrounds opening 40 on the face of the plate, and is centrally depressed at 41 to admit a washer. Sleeve extension 23 defines opening 40 at the rear of plate 24. Spindle receiving portions of each of two pairs of portions 42, 44 and 46, 48, are spaced symmetrically about radial axis A-A lying in face 25 of plate 24. Each spindle receiving portion includes an opening 50, 52, 54, 56 of circular cross section extending into the plate perpendicular to face 25 and having a frusto-conical base, as at 58, closed by a knob on the rear of the plate, as at 60. In addition, portions 42, 44 and 46 each include a bored projection 62, 64, 66 above face 25 providing gear member support surfaces 68, 70, 72. Projections 62 and 64 are of annular cross section and the semiannular cross section of projection 66 allows clearance of output gear unit 28. The sum of the heights of projections 62 and 64 equals the height of projection 66, and projection 64 is shorter than projection 62 by slightly more than the axial length of an intermediate gear member 30.

Plate 24 further includes a pair of connectors 80 extending perpendicularly from face 25 at opposite sides of a diameter and a pair of recesses 84 along the periphery of the plate midway between the connectors. The free ends 82 of connectors 80 are notched to snap into the recesses 84a in the opposite plate. A moisture absorbing silica gel capsule (not shown) may be inserted into opening 86 in plate 24.

Plate 24a corresponds identically with plate 24, the above described details being identified on plate 24a by numerals followed by the letter a.

Each gear member 30 includes a thirty-one toothed gear 32, a coaxial ten toothed pinion 33, and a smooth axial flange 34. Axial bore 35 in member 30 admits spindle 38, the latter having frusto-conical ends to mate with the bases 58 of spindle receiving portions 42, 44, 46, 48 (thereby increasing alignment accuracy). Slight projection 36 at the end of pinion 33 insures its spacing from the adjacent gear support surface (or, in the case of spindle receiving portion 48, plate face 25). Members 30 are made of the same material as plate 24, the self-lubricating characteristics of Celcon eliminating lubrication service requirements for the gear train.

Output gear unit 28 includes a stepped output shaft 22 having reduced diameter portions 27, 29 at opposite ends. Output gear 90 is cast from the same die and material as are gear members 30, except that die inserts are used to eliminate flange 34 and replace pinion 33 with a slight projection 91. Portion 29 of shaft 22 is permanently embedded in gear 90. Washer 92 and retaining ring 94, cooperating with collar 96 of shaft 22, secure unit 28 to plate 24.

Train drive assembly 26 includes a bronze train drive spindle 98 to the outer threaded end 99 of which is secured circular upper face-magnetized 4-pole ceramic magnet 100. The magnet is separated from sleeve 23a by washer 102 and held in place by nut 104. The inner end of 106 of the spindle has permanently secured thereto a bronze ten toothed drive pinion 108. Between pinion 108 and raised portion 39a lie stainless steel bearing washer 110, Celcon ball bearing holder 112, steel ball bearings 114, and stainless steel washer 116.

To assemble the gear train, after an output gear unit and a gear train drive assembly have respectively been installed in identical plates 24 and 24a, intermediate gear spindles 38 are inserted in the four spindle receiving portions of one of the plates. Beginning with receiving portion 48, a gear and pinion unit 30 is slipped over each

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spindle, in order of increasing spindle receiving portion height, with each flange 34 pointing in the direction of plate 24a. Plates 24 and 24a are then easily snapped together by arranging connectors 80, 80a in registry with recesses 84a, 84. The gear 32 and the pinion 33 at the extremities of the train will mesh respectively with output and train drive gears 90 and 108, and each other gear 32 will mesh with an adjacent pinion 33. Each spindle 38 will extend between spindle receiving portions on opposite plates occupying the above described paired positions of symmetry about axis A—A (e.g., portions 42 and 44a). Upon installation into the meter as shown in FIGS. 1, 2, magnet 100 is driven from below by magnet 120. The driving rotation rate is stepped down through the gear train and transmitted to register assembly 13.

Other embodiments will occur to those skilled in the art and are within the following claims.

What is claimed is:

1. A gear train assembly comprising
a plurality of intermediate gear units,
a plurality of spindles for rotatably supporting said intermediate gear units,
a pair of identical train plates, each plate having on its face a plurality of spindle receiving portions arranged in at least one symmetrical pair about an axis lying in said face,
and at least one connector for rigidly connecting said train plates in relative orientation with one plate rotated about said axis to face said other plate and each said spindle extending between receiving portions on opposite plates occupying paired positions of symmetry about said axis, each of said spindle receiving portions including a surface for supporting an intermediate gear unit, at least one of said receiving portions in each said pair of portions being elevated above the face of its plate, and the sum of the elevations of each of said surfaces above said face being substantially the same for each said pair of receiving portions.
2. The assembly of claim 1 wherein each plate has an opening for admitting one of a train drive assembly and an output gear unit.
3. The assembly of claim 2 wherein at least one of said spindle receiving portions is adjacent said opening and includes a semi-annular projection extending above the face of its plate whereby clearance is provided between said one portion and said one of said train drive assembly and said output gear unit.
4. The assembly of claim 1 wherein at least one of said spindle receiving portions includes a bored projection extending above the face of its plate.
5. The assembly of claim 1 wherein at least one of said surfaces is said face.
6. The assembly of claim 5 wherein each said gear further includes a smooth flange concentric with said gear and pinion and on the opposite side of said gear from said pinion.
7. The assembly of claim 1 wherein said intermediate gear units are identical and each includes a gear and a pinion integral and concentric with and of smaller diameter than said gear.
8. The assembly of claim 1 wherein said plates and intermediate gear units are made of a self-lubricating organic substance.
9. The assembly of claim 1 wherein there are two of said connectors integral with each said connector extending generally perpendicularly away from said plate, and two connector receiving portions on each plate for receiving said connectors.
10. The assembly of claim 9 wherein said connectors are notched at their free ends and said connector receiving portions are recesses into which said notched ends can snap.
11. A gear train assembly comprising

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- a plurality of identical intermediate gear units, each including a gear and in concentric arrangement on opposite sides of said gear a pinion of diameter smaller than that of said gear and a smooth flange,
- a plurality of spindles for rotatably supporting said intermediate gear units, each spindle having frusto-conical ends, and
- a pair of identical generally circular train plates, each plate having
 - a central opening for admitting one of a train drive assembly and an output gear unit,
 - a plurality of spindle receiving portions arranged on its face in at least two symmetrical pairs about an axis lying in said face, each of said receiving portions including a frusto-conical based opening through said face and a surface parallel to said face for supporting said intermediate gear units, all but one of said receiving portions including bored projections extending from said face in registry with said openings through said face and providing said surfaces, one of said projections being semi-annular to provide clearance for said one of said train drive assembly and said output gear unit when installed in said central opening, said surface of said one receiving portion not having a projection being said face, the sum of the elevations of each of said surfaces above said face being substantially the same for each said symmetrical pair of receiving portions,
- a pair of connectors extending generally perpendicular to said face from the periphery of said plate at opposite ends of a first diameter and having notched free ends,
- and a pair of connector receiving recesses into which the notched ends of said connectors on an opposing plate can snap, said recesses arranged at the periphery of said plate at opposite ends of a second diameter perpendicular to said first diameter, whereby said connectors can connect said train plates in relative orientation with one plate rotated about said axis to face said other plate and each spindle extending between receiving portions on opposite plates occupying paired positions of symmetry about said axis.
12. A gear train assembly comprising
a plurality of intermediate gear units,
a plurality of spindles for rotatably supporting said intermediate gear units,
a pair of identical train plates, each plate having on its face a plurality of spindle receiving portions arranged in at least one symmetrical pair about an axis lying in said face,
and at least one connector for rigidly connecting said train plates in relative orientation with one plate rotated about said axis to face said other plate and each said spindle extending between receiving portions on opposite plates occupying paired positions of symmetry about said axis, each plate having an opening for admitting one of a train drive assembly and an output gear unit,
at least one of said spindle receiving portions being adjacent said opening and including a semi-annular projection extending above the face of its plate whereby clearance is provided between said one portion and said one of said train drive assembly and said output gear unit.
13. A gear train assembly comprising
a plurality of intermediate gear units,
a plurality of spindles for rotatably supporting said intermediate gear units,
a pair of identical train plates, each plate having on its face a plurality of spindle receiving portions arranged in at least one symmetrical pair about an axis lying in said face,

two connectors integral with each plate and extending generally perpendicularly away from said plate, and two connector receiving portions on each plate for receiving said connectors to rigidly connect said train plates in relative orientation with one plate rotated 5 about said axis to face said other plate and each said spindle extending between receiving portions on opposite plates occupying paired positions of symmetry about said axis.

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