

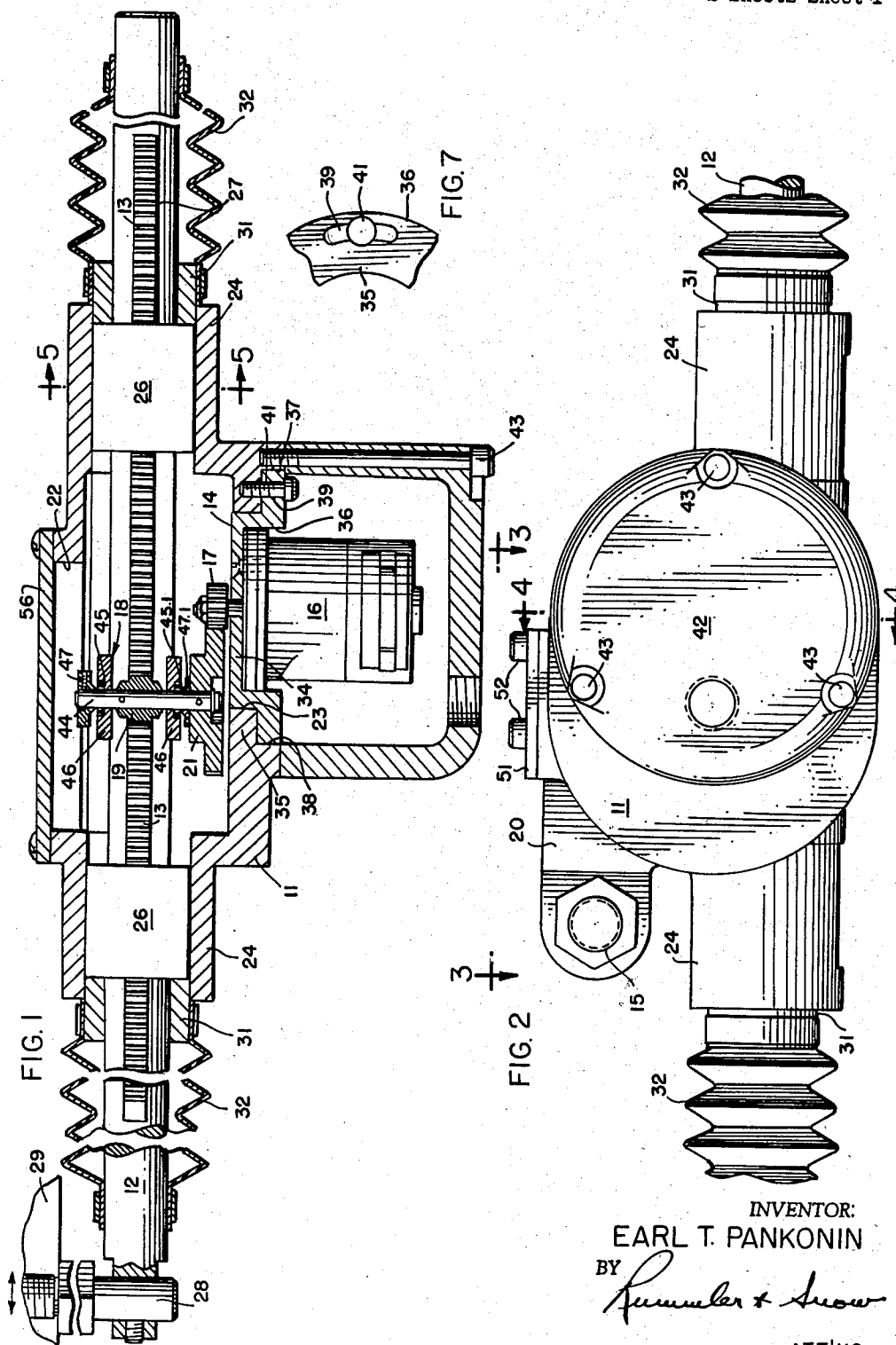
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E. T. PANKONIN
SELSYN DRIVE ASSEMBLY

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2 Sheets-Sheet 1



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FIG. 3

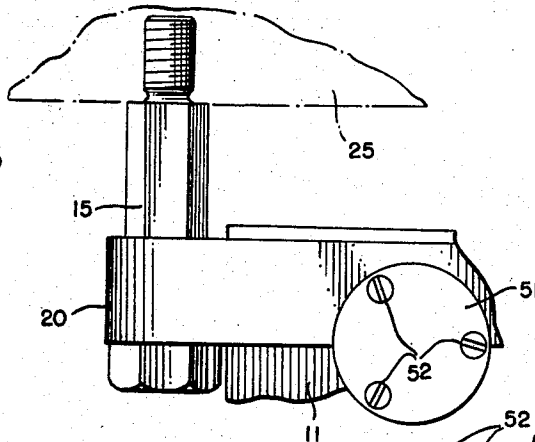


FIG. 4

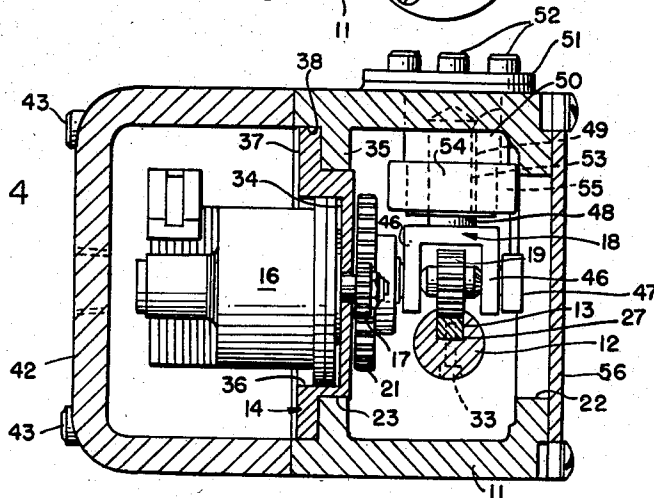


FIG. 5

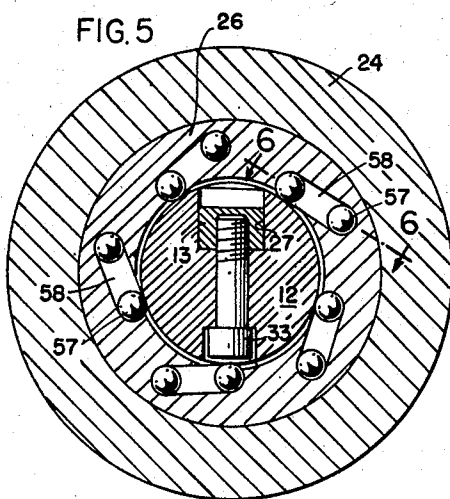
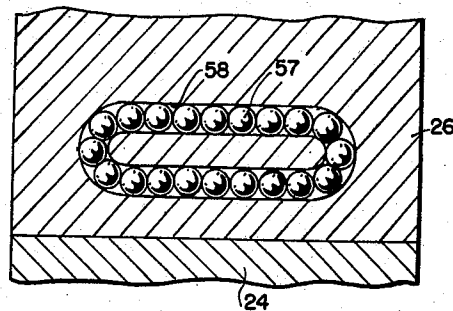


FIG. 6



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SELSYN DRIVE ASSEMBLY

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8 Claims. (Cl. 74—395)

This invention relates to a type of mechanism known as a selsyn system wherein a pair of selsyn assemblies are electrically interconnected so that one assembly being activated by a control means, such as a template follower, results in the governed activation of a remote device, such as a cutting tool, whereby the remote device is precisely responsive to and accurately follows any change or variation of the control means. In particular this invention concerns an improved drive means for a selsyn unit and an improved unit-drive means assembly.

The main objects of this invention are to provide an improved form of selsyn unit-drive means; to provide an improved gear and rack drive for a selsyn unit which insures precise and nearly-frictionless transfer of linear motion for rotation of the selsyn unit; to provide an improved rack and pinion drive assembly which permits adjusting the pinion relative to the rack to effect a precise pitch-line mating of the rack and pinion; to provide an improved arrangement of a selsyn-unit and driving gear therefor which permits precision adjustment of the selsyn-unit relative to the driving gear; to provide an improved selsyn drive assembly of this kind which may be associated with either the controlled or controlling components of a selsyn system; to provide an improved drive assembly of this kind for use with machine tools which eliminates all possibility of misalignment, looseness or backlash, in the route of the controlling motion transfer means; and to provide an improved selsyn unit drive means for operating a selsyn control system with the sensitivity and accuracy comparable to that obtained by the more complicated and expensive electronic tracer-controlled systems.

A specific embodiment of this invention is shown in the accompanying drawings in which:

Figure 1 is a longitudinal, sectional view of a selsyn unit drive assembly constructed in accordance with this invention;

Fig. 2 is an exterior side view of the assembly;

Fig. 3 is a fragmentary, plan view, taken on the plane of the line 3—3 of Fig. 2, showing how the assembly is secured to a machine where it is to be used;

Fig. 4 is a transverse sectional view of the assembly, taken on the plane of the line 4—4 of Fig. 2;

Fig. 5 is another transverse view, taken on the plane of the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary section detail of one of the linear ball-bearings, taken on the plane of the line 6—6 of Fig. 5; and

Fig. 7 is a fragmentary detail showing the bolt and slot arrangement for locking the selsyn-unit eccentric-mounting in adjusted position.

The essential concept of this invention comprises providing a gear-rack rigidly secured on a shaft reciprocally mounted in a gear case on fixed linear ball-bearing bushings, within which gear case a rack-engaging pinion and a coaxial selsyn-unit drive gear are journaled on a clevis adjustable normal to the plane of the points or crowns of the rack teeth to insure perfect pitch-line mat-

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ing of the pinion and rack, and the selsyn unit is mounted for precision adjustment in the plane of the drive gear to insure pitch-line mating of the drive gear with a pinion on the selsyn unit shaft, both such pitch-line matings being effective to insure practically perfect meshing of both pinions with the rack and the driving-gear respectively, whereby lost motion, back-lash, and misalignment in the motion transfer train are obviated.

A selsyn drive assembly embodying the foregoing concept comprises a gear case 11 reciprocally mounting a shaft 12 having a gear rack 13 thereon, a rotatively supported selsyn unit mounting plate 14 on which is eccentrically mounted a selsyn unit 16 with its pinion 17, and means for adjustably positioning a clexis 18 journaling a co-axially-arranged pinion 19 and driving gear 21 respectively meshing with the rack 13 and selsyn-unit pinion 17.

The gear case 11 is of generally rectangular cross-section in its main or middle part with openings 22 and 23 in opposite side walls and having oppositely-aligned integral cylindrical extensions 24 at its ends wherein are fixed precisely aligned linear ball-bearing bushings 26. A suitable machine bolt 15, extending through a lug 20, integral with the gear case 11, mounts the assembly on a suitable part of a frame 25 of the machine with which the assembly is to be used.

The shaft 12 here is shown of circular cross-section. However, under some conditions such a shaft might be of rectangular cross-section. The shaft 12, as shown, is formed with a longitudinal peripheral slot or recess 27 to receive the rack 13 and is reciprocally mounted in the bushings 26 so as to be in axial alignment therewith at all times. At one end the shaft 12 is attached by a suitable bolt means 28 to a tool carriage 29 which is movable relative to the frame 25 in the direction of the shaft 12. Collars 31 are seated in the opposite ends of the extensions 24 and the extensions of the shaft 12, outwardly of these collars 24, are enclosed in dust proof bellows 32 the ends of which are fastened respectively to the shaft extremities and the collars 31. These bellows 32 serve to seal off the shaft and the gear casing from dust, metal chips, and other matter that might cause misadjustment or mismating of the motion transfer mechanism.

The gear rack 13 is a precision cut bar of conventional toothed form and is anchored in the shaft recess 27, with the points or crowns of the teeth lying in a plane normal to a plane common to the shaft axis and the center-line pitch line of the rack, by a series of Allen-head screws 33 (Figs. 4 and 5) extending in from the diametrically opposite side of the shaft 12. Where the rack 13 is thus set in a recessed round shaft the points or crowns of the rack teeth, as near as practical, are wholly within the shaft circumference (see Fig. 5). Also the heads of the screws 33 are countersunk into the shaft so that the periphery of the shaft is wholly unobstructed.

The rotary mounting plate 14 is annularly cup-shaped and is formed so that its closed end or bottom part 34 will fit into the annular opening 23 in wall 35 of the casing or housing 11 and so that its open recessed part will provide an annular seat 36 for the selsyn unit 16. Also the disc 14 is provided with a flange 37 of a diameter to rotatively fit in an annular counterbore 38 in the outer face of the gear-case wall 35 and concentric with the wall opening 23. This flange 37 has an arcuate slot 39 formed therein (Fig. 7) concentric with the axis of the opening 23 and through such slot 39 extends a machine bolt 41 threaded into the wall 35 whereby the disk 14 may be locked in an angularly adjusted position, for a reason which will be explained more fully.

The selsyn unit 16, of the well-known construction,

is mounted on the disk 14, in the open or recessed part 36, with the axis of the unit 16 offset eccentrically from the axis of the disk 14 and for this purpose the recessed part 36 is preferably made eccentric and of a size to receive the mounting flange of the unit 16. Thus the disk 14 is constituted an eccentric mounting for the selsyn unit 16, the purpose of which will be explained presently. As shown, the mounted unit 16 is enclosed in a hood or cover 42 secured to the gear case by bolts 43.

The pinion 19 and the driving gear 21, within the gear case 11, are each suitably secured to a cross shaft 44 which is journaled in microbearings 45 and 45.1 mounted in suitable openings in the parallel arms 46 of the clevis 18. The shaft 44, in turn, is held against axial shifting by a collar 47 (see Fig. 1) secured to the outer end of the shaft and having a conical axial projection adapted to engage the inner race of the adjacent microbearing 45. A washer 47.1 of similar form and disposed to bear between the gear 21 and the opposite microbearing 45.1 holds the shaft 44 against axial movement in the opposite direction, the washer 47.1 being held by the gear 21 which in turn is suitably secured to the shaft 44.

The clevis 18 is formed with an integral hub 48 which is axially received in a socket 49 of an axially split bonnet 50 extending inwardly through an opening in the top wall of the gear case (as viewed in Fig. 4). The bonnet 50 has an integral flanged end plate 51 at its outer end by which it is secured to the gear case, with the cap screws 52, and the clevis hub 48 is secured against rotation in the socket 49 by means of a suitable key 53 extending lengthwise of the hub through a sidewall slot in the bonnet. A collar clamp 54, of slightly larger diameter than the bonnet 50, embraces the bonnet and carries a set screw 55 which, when set against the edge of the key 53, compresses the split wall of the bonnet about the hub 48 and clamps the hub against axial movement to secure the clevis 18 in the desired position for proper meshing of the pinion 19 with the rack 13.

Adjustment of the clevis 18 is had by way of the opening 22 in the gear case sidewall by first loosening the set screw 55 and then shifting the clevis up or down, as the case may be, until proper mesh of the pinion 19 with the rack 13 is obtained at which time the set screw 55 is tightened to lock the parts in the adjusted position. As shown, the opening 22 is normally closed by means of a cover plate 56.

The linear ball-bearing bushings 26 are conventional items commonly known in the trade as "Thompson" bushings. As shown in Fig. 5, these bushings 26 are precision made with the bearing balls 57 arranged in axially-extending raceways 58 on the inner face of the bushings, each raceway path being oval and continuous.

The plane of each raceway 58 is disposed at an angle parallel to a tangent with the inner periphery of the bushing and the inner wall of the radially innermost side of the raceway is open to permit slight projection of the balls 57 for contact with the shaft 12. These Thompson bushings have five continuous raceways 58 arranged in equal angularly spaced relation around the bushing, and as shown in Fig. 5, the bushing is positioned so that the rack 13 will lie midway between the shaft contacting balls of a pair of raceways.

Adjustment and pitch-line mating of the pinion 17 with the gear 21 is effected by loosening the bolt 41 and then rotating the eccentric disk 14 one way or another until the desired pitch-line mating has been achieved, whereupon the screw 41 is tightened to lock the eccentric plate 14 in its shifted position. The mating of the pinion 17 with the gear 21 is done after the pinion 19 has been first adjusted relative to the rack 13, and observation for both mating operations is had through the opening 22 with the cover 56 removed.

The shiftable, clevis-mounted, co-axially-arranged pin-

ion 19 and gear 21 and the shiftable, eccentrically-mounted selsyn unit 16 makes it possible to so adjust and fix the meshing of the pinion 19 with the gear rack 13 and the meshing of the pinion 17 with the driving gear 21, as to insure a nearly perfect pitch-line mating of all of these elements; and the rigid mounting of the rack bar and shaft preclude any looseness, backlash or misalignment in the entire motion transmission train. Thus, such selsyn-drive assembly, as here shown, and described, will produce as accurate response to guiding template contour changes as is currently obtained with the more complicated and expensive tracer-controlled systems.

The main advantages of this invention reside in the rigidly mounted, precisely adjustable motion transfer components of the selsyn unit drive assembly whereby any movement of the main actuating shaft 12 is instantly and fully transmitted to the selsyn device, whether the shaft be connected with the controlling or the controlled elements of the machine with which the unit is used; and in the relatively simple construction of the drive assembly whereby its parts can be readily adjusted and are yet fully protected against dirt, dust, and any other factors which, in the ordinary drive arrangements, cause lost motion and inaccurate correlation of selsyn rotation with the motion of the controlled or controlling machine elements.

Although but one specific embodiment of this invention is herein shown and described it will be understood that details of the construction shown may be altered or omitted without departing from the spirit of the invention as defined by the following claims.

I claim:

1. A selsyn unit drive assembly comprising, a gear case, a shaft reciprocally mounted on the gear case and extending thereinto, a longitudinally extending gear rack on said shaft, a coaxially connected pinion and drive gear mounted in said gear case on an axis normal to a plane common to the axis of said shaft and the center pitch line of the rack teeth and parallel with the plane of the tips of rack teeth, said pinion being meshed with said rack, means in said gear case for adjusting said pinion and gear in the direction normal to the plane of said rack teeth tips, a selsyn unit mounted on said gear case on an axis parallel with the axis of the pinion and drive gear and having a pinion extending into said gear case and meshed with said drive gear, and means for shifting the axis of said selsyn unit toward and away from the axis of said pinion and drive gear.

2. A selsyn drive assembly comprising, a gear case, a pair of axially-spaced linear ball-bearing bushings fixed on the gear case, a shaft reciprocally mounted in the said bushings, a gear rack on the shaft, a coaxially connected pinion and driving gear mounted in the gear case on an axis normal to a plane common to the axis of the shaft and the center pitch line of the rack teeth and with the pinion meshing with the said rack, a selsyn unit mounted on said gear case in axially parallel relation with said pinion and gear, said selsyn unit having a pinion thereon in mesh with said driving gear, means for adjusting the connected pinion and driving gear in the direction normal to the plane of the tooth tips of said rack, and means for independently shifting said selsyn unit on said gear case to adjust the selsyn unit pinion toward and away from said driving gear in the plane thereof.

3. A selsyn drive assembly comprising, a gear case, a pair of linear ball-bearing bushings fixed on the gear case in axially spaced and aligned relation with each other, a shaft of circular cross-section reciprocally mounted in the said bushings and having a longitudinally extending peripheral recess, a gear rack rigidly anchored in the shaft recess and extending therealong, a coaxially connected pinion and driving gear mounted in the gear case on an axis normal to a plane common to the axis of said shaft and the center pitch line of the rack teeth and with the

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pinion meshing with the rack, means on said gear case for supporting said pinion and driving gear for adjustment in the direction normal to the plane of the tooth tips of said rack, a selsyn unit mounted on a side wall of said gear casing in axially parallel relation with said connected pinion and drive gear, said selsyn unit having a pinion extended into said casing to mesh with said driving gear, and means for shifting said selsyn unit parallel with the plane of said driving gear to adjust the mating of the selsyn unit pinion therewith.

4. A selsyn drive assembly comprising, a gear case, a pair of axially-spaced and aligned linear ball-bearings fixed on the gear case, a shaft reciprocatingly mounted in the bushings and extending into said casing, a gear rack on said shaft, a coaxially connected pinion and driving gear, a clevis journalling the pinion and gear on an axis parallel with the plane of the tooth tips of said rack and normal to a plane common to the axis of said shaft and the center pitch line of the rack teeth and with the said pinion in mesh with the rack, means for supporting said clevis on said casing for adjustment normal to the plane of the tooth tips of said rack, a selsyn unit mounted on the gear case and having a pinion extended thereinto in mesh with the driving gear, and means for shifting said selsyn unit parallel with the plane of said driving gear to adjust the pitch-line mating of the selsyn-unit pinion and the driving gear.

5. A selsyn unit drive assembly comprising, a gear case, a shaft reciprocatingly mounted on the gear case and extending thereinto, a longitudinally extending gear rack on said shaft, a coaxially connected pinion and drive gear mounted in said gear case on an axis normal to a plane common to the axis of said shaft and the center pitch line of the rack teeth and parallel with the plane of the tooth tips of said rack, means in said gear case for adjusting said pinion and gear in the direction normal to the plane of the tooth tips of said rack, a selsyn unit mounted on a side wall of said gear casing in axially parallel relation with said connected pinion and driving gear, said selsyn unit having a pinion thereon extended into said casing and meshed with said driving gear, and means for shifting said selsyn unit about an eccentric axis parallel with the driving gear axis for adjusting the engagement of the said selsyn pinion with said driving gear.

6. A selsyn drive assembly comprising, a gear case, a pair of axially-spaced and aligned linear ball-bushings fixed in the gear case, a shaft reciprocatingly mounted in the bushings, a gear rack extending longitudinally on the shaft and into said gear case, a coaxially connected pinion and driving gear, a clevis journalling said pinion and gear on an axis normal to a plane common to the axis of said shaft and the center pitch line of the rack teeth and parallel with the plane of the tips of said rack, a stem slidably supporting said clevis on the gear case for adjusting movement normal to the plane of the tooth tips of said rack and to position the said pinion in mesh with said rack, clamp means for locking the clevis in adjusted position for pitch-line mating of the pinion and said rack, a selsyn unit having a pinion thereon, means for mounting the selsyn unit on the gear case in axially parallel relation with said driving gear and with the

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selsyn pinion in mesh with the driving gear, and means for shifting the selsyn unit to adjust the pitch-line mating of the selsyn pinion and the driving gear.

7. A selsyn drive assembly comprising, a gear case, a pair of axially-spaced and aligned linear ball-bushings fixed in the gear case, a shaft reciprocatingly mounted in the bushings, a gear rack extending longitudinally on the shaft and into said gear case, a coaxially connected pinion and driving gear, a clevis journalling said pinion and gear on an axis normal to a plane common to the axis of said shaft and the center pitch line of the rack teeth and parallel with the plane of said rack, a stem slidably supporting said clevis on the gear case for adjusting movement normal to the plane of the tooth tips of said rack and to position the said pinion in mesh with said rack, clamp means for locking the clevis in adjusted position for pitch-line mating of the pinion and said rack, a selsyn unit mounted on a sidewall of said gear case in axially parallel relation with said driving gear and having a pinion extended into said case in meshed engagement with said driving gear, and means for shifting said selsyn unit about an eccentric axis normal to the plane of the driving gear to adjust the mating relation of the selsyn pinion with said gear.

8. A selsyn drive assembly comprising, a gear case, a pair of axially-spaced and aligned linear ball bushings fixed on the gear case, a shaft of circular cross-section reciprocatingly mounted in the bushings and having a longitudinally extending peripheral recess, a gear rack rigidly anchored in said shaft recess with the crown of the rack teeth disposed inwardly of the shaft circumference, a coaxially connected pinion and driving gear, a clevis journalling said pinion and gear on an axis parallel with the plane of the tooth crowns of said rack and normal to a plane common to the shaft axis and the center pitch line of the rack teeth, a stem supporting said clevis in the gear case for adjustment in a direction normal to the plane of the tooth crowns of said rack and to position the said pinion in mesh with the rack, a clamp means for locking the clevis in adjusted position relative to the plane of said rack tooth crowns, a mounting plate secured on a sidewall of said gear case for rotation about an axis parallel with the axis of said driving gear, a selsyn unit eccentrically secured on said mounting plate in axially parallel relation with the driving gear and having a pinion extending into said gear case for driving engagement with said gear, and means for rotating said mounting plate to swing the axis of said selsyn unit toward and away from the axis of said driving gear.

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