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2,848,905

ANTENNA FEEDER DRIVE

Filed April 26, 1956

3 Sheets-Sheet 1

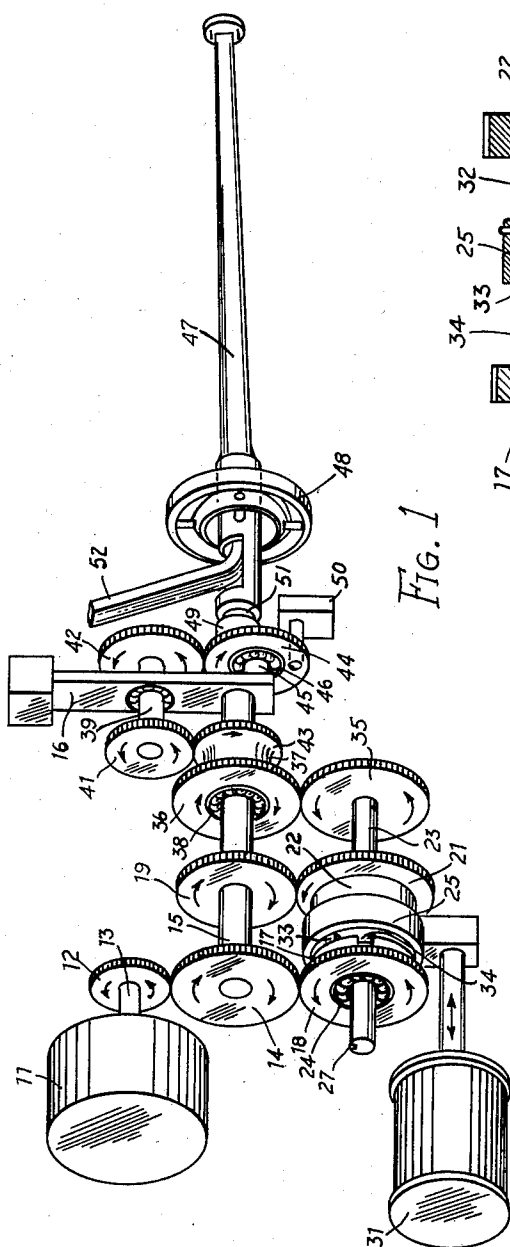


FIG. 1

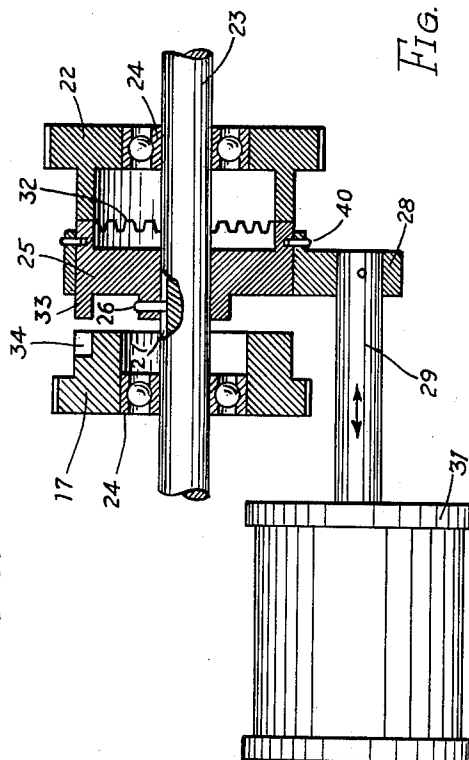


FIG. 2

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3 Sheets-Sheet 2

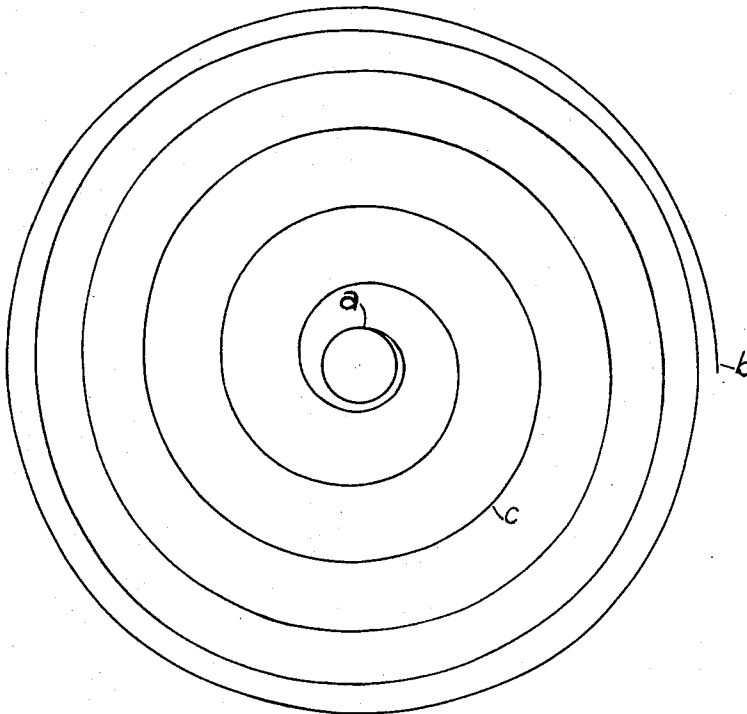


FIG. 3

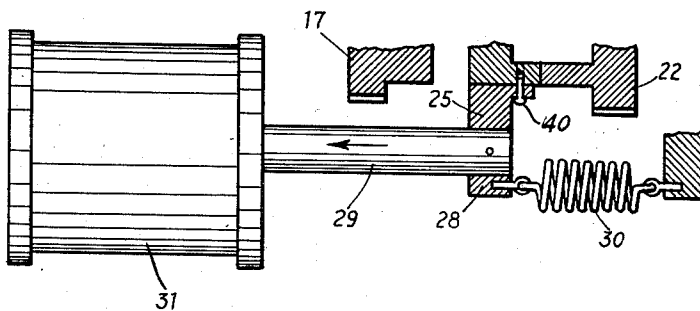


FIG. 4

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FIG. 5

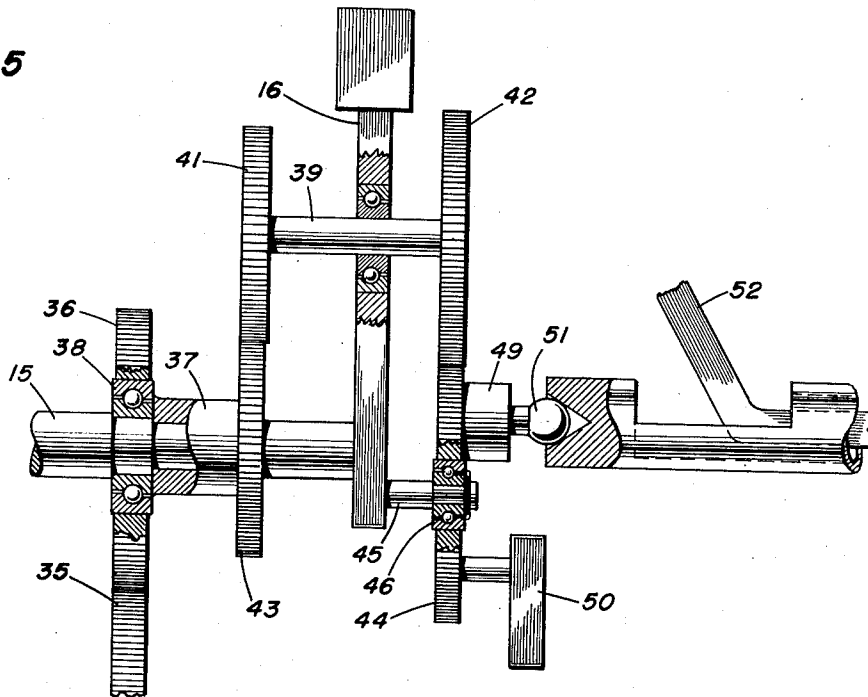
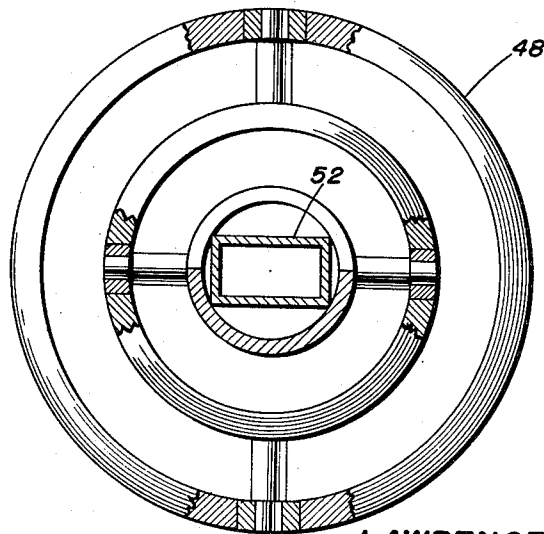


FIG. 6



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ANTENNA FEEDER DRIVE

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to an antenna feeder drive and more particularly to an antenna feeder or horn drive that permits a change from spiral scanning to conical scanning in a short period of time.

Heretofore the shifting or changing of antenna feeder drives from one form of scanning to another form has been accomplished by highly complex devices that were necessitated by high speed shifting and these complex devices were difficult, if not impossible, to balance dynamically. Consequently often mechanically unsound mechanisms were employed to do the shifting and it was not uncommon to have a model disintegrate due to faulty balancing.

The present invention provides a novel way of driving a feed antenna or antenna horn in which a first gear train arrangement drives a sun gear at a fixed speed and a second gear train arrangement is equipped to drive a planet gear at two different speeds, one of which is the same as the speed of the sun gear. When the sun gear and the planet gear are traveling at the same speed, there is no relative motion between them and the antenna feed horn, which is connected to the sun gear, is rotated in a conical pattern. When the sun gear and the planet gear are rotating at different speeds, there is relative motion between one another and the planet gear will rotate around the sun gear with a characteristic planetary motion. This planetary motion will cause the antenna feed horn to be rotated in a spiral pattern, which is desirable for search purposes.

It is therefore a general object of the present invention to provide a novel means of driving an antenna feed horn whereby the feed horn can be made to mutate either in a conical or spiral pattern.

Another object is to provide for shifting from conical rotation to spiral rotation in a short period of time.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 is a gear schematic showing the complete invention;

Figure 2 is a partial sectional view showing a clutching arrangement;

Figure 3 is a diagrammatic view showing a spiral pattern that the antenna feed horn can traverse;

Figure 4 is a partial sectional view showing a variation in a clutching arrangement;

Fig. 5 is a fragmentary diagrammatic view with parts thereof broken away and in section and showing with greater particularity the details of the pivotal connection between certain parts of the structure illustrated diagrammatically in Fig. 1; and

Fig. 6 is a diagrammatic view of the gimbal type

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mounting arrangement of Fig. 1 with parts thereof broken away and in section.

Referring now to the drawings, there is shown in Figure 1 a drive motor 11 having a gear 12 attached to shaft 13. Gear 14 is attached to shaft 15, which is connected to carrier plate 16 and carrier plate 16 is rotated at the same speed as shaft 15. A shifting mechanism has a first clutch plate 17 that has a gear portion 18 that meshes with gear 14. Gear 19 which is also attached to shaft 15 meshes with gear portion 21 which is integral with a second clutch plate 22.

Referring now to Figure 2 of the drawings, it can be seen that the two clutch plates 17 and 22 are rotatably mounted on clutch shaft 23 by means of bearings 24. A slidable clutch plate 25 is keyed to clutch 23 by means of a key 26 which engages keyway 27. The slidable clutch plate 25 has a collar 28 that extends outwardly and a shaft 29 of a solenoid 31 is attached thereto. Clutch plate 25 is free to rotate within collar 28, but any lateral movement of collar 28 is transferred to clutch plate 25 through pins 40.

As shown in Figure 2, solenoid 31 could be of the push-pull type, and the slidable clutch plate can be moved forward or backward to engage the desired clutch plate. As illustrated in Figure 4 of the drawings, solenoid 31 might be a single action type and when not energized, spring 30 will keep the slidable clutch plate 25 engaged with clutch plate 22.

Referring again to Figure 2 of the drawings, it can be seen that slidable clutch plate 25 has a plurality of teeth 32 that mesh with teeth on the face of clutch plate 22. The slidable clutch plate 25 has a single tooth 33 on the other end, and this single tooth 33 can be engaged with a notch 34 which is provided on the face of first clutch plate 17. It can thus be seen that since the slidable clutch plate 25 can only be engaged in a single position, which is when tooth 33 is in notch 34, then whenever slidable clutch plate 25 is engaged with first clutch plate 17, there will always be the same angular relationship between clutch shaft 23 and shaft 15. The need for this same angular relationship will be understood when the operation of the device is described.

Referring again to Figure 1 of the drawings, it is shown that gear 35 is attached to clutch shaft 23 and meshes with gear 36 which is part of sleeve 37. Sleeve 37 is rotatably mounted on shaft 15 by means of bearings 38. Shaft 39, which is rotatably mounted through carrier plate 16, has gears 41 and 42 attached thereto, gear 41 being driven by gear 43 which is part of sleeve 37. Primary gear 42 is on the same shaft as gear 41 and is in mesh with secondary gear 44. Gear 41 serves as an orbital gear with respect to gear 43, and primary gear 42, being carried by 39, partakes of the same orbital motion as 41, however, only with respect to shaft 15. Shaft 39 is capable either of turning or not turning. When shaft 39 is turning, primary gear 42 drives secondary gear 44 about its shaft 45 which is connected to carrier 16, carrying the eccentric 49 and the counterweight 50 for eccentric 49 with it.

Referring still to Figure 1 of the drawings, it can be seen that secondary gear 44 is rotatably mounted on shaft 45 by means of a bearing 46. Antenna feed horn 47 is connected to wave guide 52 and pivotally coupled mechanically at 49 as by a ball and socket coupling at 51. Fig. 5 to the second gear 44 and mounted in gimbal assembly 48 Figs. 1 and 6.

In operation, shaft 15 is driven at a fixed speed by drive motor 11. By way of example, the speed of shaft 15 might be 1750 R. P. M. Gears 14, 18, 35, and 36 have the same number of teeth and it can be seen then that whenever slidable clutch plate 25 is engaged with first clutch plate 17, clutch shaft 23 will be turning at

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the same speed as shaft 15, and likewise sleeve 37 will be rotating at the same speed as shaft 15. When shaft 15 and sleeve 37 are turning at the same speed, there will be no relative motion between gears 41 and 43 since carrier plate 16 is in rotation with shaft 15. Also, there will not be any relative motion between primary gear 42 and secondary gear 44.

Referring to Figures 1 and 3 of the drawings, it can be seen that the nutation of the antenna feed horn 47 in a conical pattern is caused by the offset of the coupling 49 from the centerline of shaft 15 and that whenever shaft 15 is rotating, the centerline of coupling 49 is rotating in a circle *a*, as shown in Figure 3. Since the antenna feed horn 47 is supported in gimbal assembly 48, the movement of the coupled end of the antenna feed horn 47 will cause it to nutate in a conical pattern.

When it is desired to change from a conical scanning pattern to a spiral scanning pattern, the clutch assembly is shifted so that the slidable clutch plate 25 is engaged with the second clutch plate 22. Clutch shaft 23 will then be turning at a speed different from the speed of shaft 15 due to the gear ratio of gears 19 and 21 and consequently sleeve 37 will be turning at a speed different from the speed of shaft 15. The speed difference, by way of example, may be on the order of 120 R. P. M. and the speed of the sleeve 37 might be either faster or slower than the speed of shaft 15. It can be seen that when secondary gear 44 is rotating there will be relative motion between secondary gear 44 and carrier plate 16 and consequently the antenna feed horn will nutate in a spiral pattern *c*, as shown in Figure 3 of the drawings.

Referring again to Figure 3 of the drawings, it can be seen that if the speed difference between sleeve 37 and shaft 15 is, for example, 120 R. P. M., then the center of coupling 49 will travel from circle *a* to point *b* and back again to circle *a* in one half second, along the path shown by spiral *c*. Also the relative motion between first clutch plate 17 and slidable clutch plate 25 is 120 R. P. M. or 2 revolutions per second, and if it is desired to change from spiral scanning to conical scanning, solenoid 31 can be energized which will move slidable clutch plate 25 toward first clutch plate 17. Tooth 33 will then slide around the face of first clutch plate 17 by the driving force of teeth 32 still in partial engagement until notch 34 is in alignment with tooth 33, and tooth 33 will then engage notch 34 and lock the slidable clutch plate 25 and first clutch plate 17 together, thus causing clutch shaft 23 to rotate at the same speed as shaft 15. It should be understood that partial gear tooth engagement at 32 must exist while tooth 33 is sliding around the face of gear 17. But as soon as tooth 33 drops into the notch 34 the teeth 32 will have disengaged. The action, necessarily, is instantaneous, in other words, the shift from engagement at 32 to engagement at 33—34 must be instantaneous. This shifting will take place in a half second or less, as the relative motion between slidable clutch plate 25 and first clutch plate 17 is 2 revolutions per second, which means that tooth 33 passes notch 34 every half second.

Tooth 33 is located on slidable clutch plate 25 such that when it engages notch 34, the center of coupling 49 is at position *a*, as shown in Figure 3 of the drawings, and therefore whenever shaft 15 and clutch shaft 23 are rotating at the same speeds, the antenna feed horn 47 will nutate in a conical pattern.

It can thus be seen that the device heretofore described permits an antenna feed horn to be changed from spiral scanning to conical scanning and back again to spiral scanning, when desired, in a relative short period of time.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that the in-

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vention may be practiced otherwise than as specifically described.

What is claimed is:

1. An antenna drive comprising a shaft, a carrier plate attached to said shaft, an eccentric shaft attached to said carrier plate, a secondary gear rotatably journaled on said eccentric shaft, a primary gear in mesh with said secondary gear and rotatably mounted to said carrier plate, means for driving said carrier plate at a fixed speed, first and second gear trains for selectively driving said primary gear at different speeds, one of which is the same as the speed said carrier plate is drivable, clutch means for selectively connecting one of said gear trains in driving relation with said primary gear, and a gimbal mounted antenna feed horn pivotally connected in eccentric relation to the axis of said secondary gear for vertical movement with respect thereto whereby said antenna feed horn is selectively nutated in spiral and conical patterns.

2. An antenna drive as set forth in claim 1 wherein said clutching means for selectively connecting one of said gear trains in driving relation with said primary gear includes a clutch shaft, first and second clutch plates rotatably mounted on said shaft, a slidable clutch plate slidably attached to said clutch shaft, and means for selectively engaging said slidable clutch plate with said first and second clutch plates.

3. An antenna drive as set forth in claim 2 wherein said first clutch plate has a single notch on the face thereof and said slidable clutch plate has a single tooth on the face thereof adaptable for engaging said notch whereby the engagement of said single tooth in said notch adapts said antenna feed horn to be nutated in a conical pattern.

4. An antenna drive comprising a shaft, a carrier plate attached to said shaft, a secondary gear rotatably journaled to said carrier plate, a primary gear in mesh with said secondary gear and rotatably mounted to said carrier plate, a sleeve rotatably carried by said shaft and in driving relation with said primary gear, a drive motor adaptable for driving said shaft at a fixed speed, a plurality of gear trains geared to said drive motor for selectively driving said sleeve at different speeds, one of which is the same as the speed said shaft is drivable, clutching means for selectively engaging said plurality of gear trains, solenoid means for operating said clutching means, and a gimbal mounted antenna feed horn pivotally connected at one end thereof in eccentric relation to said secondary gear whereby said antenna feed horn is selectively nutated in spiral and conical patterns.

5. An antenna drive as set forth in claim 4 wherein said clutching means for selectively engaging said plurality of gear trains includes a clutch shaft, first and second clutch plates rotatably mounted on said clutch shaft, said first clutch plate having a notch on the face thereof, and a slidable clutch plate slidably attached to said clutch shaft and having a single tooth adaptable for engaging said notch, whereby the engagement of said single tooth in said notch adapts said antenna feed horn to be nutated in a conical pattern, and whereby engagement of said slidable clutch plate with said second clutch plate adapts said antenna feed horn to be nutated in a spiral pattern.

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