June 24, 1969 P. M. TOMARO, JR Re. 26,616

TORQUE ACTUATED REVERSIBLE GEAR REDUCTION ASSEMBLY

Original Filed June 22, 1962 Sheet 1 of 3

FIG-1-

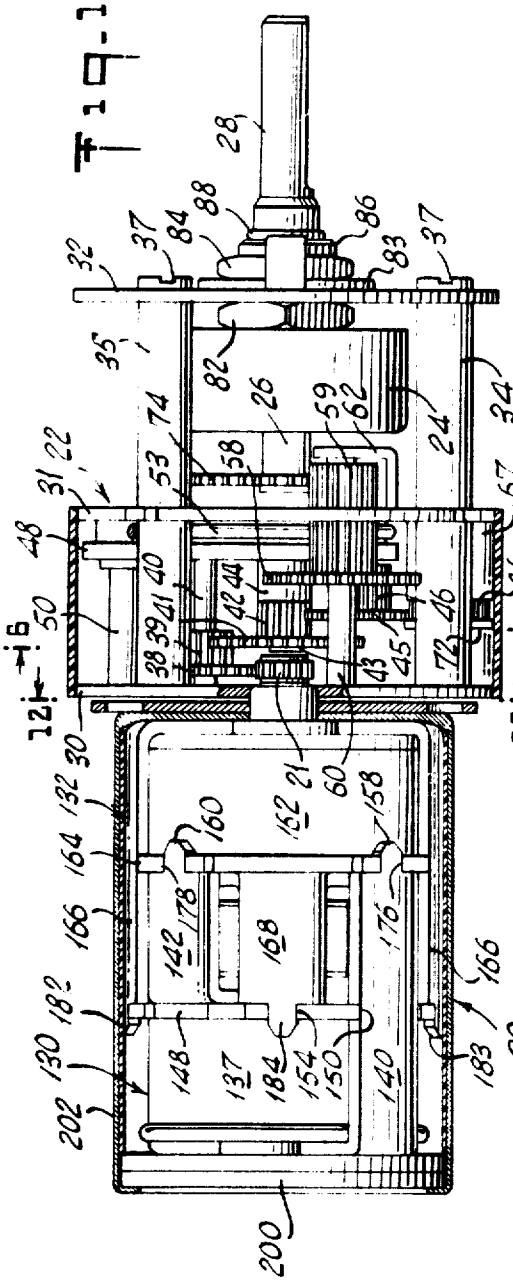
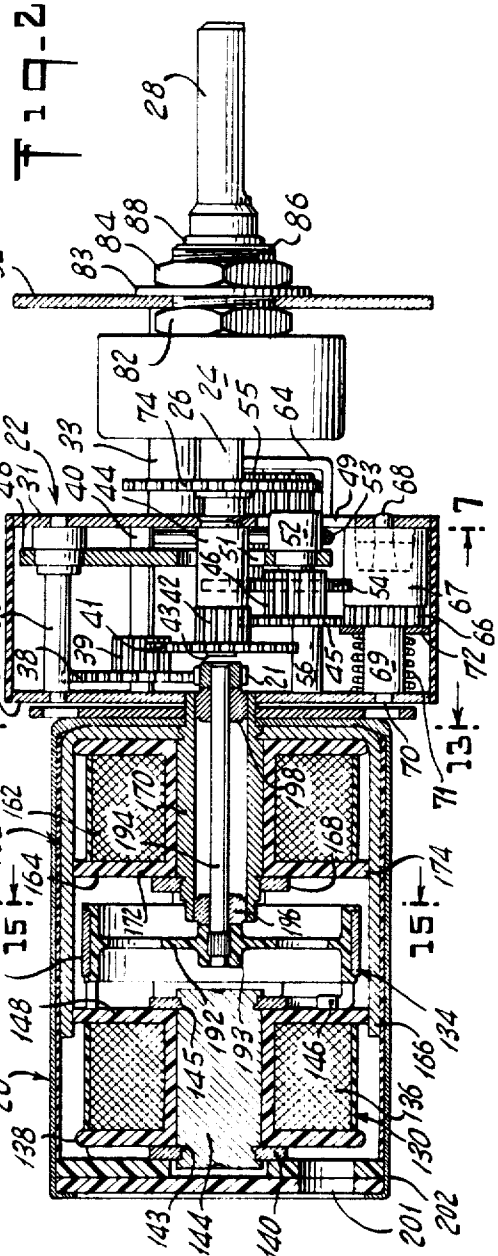


FIG-2-



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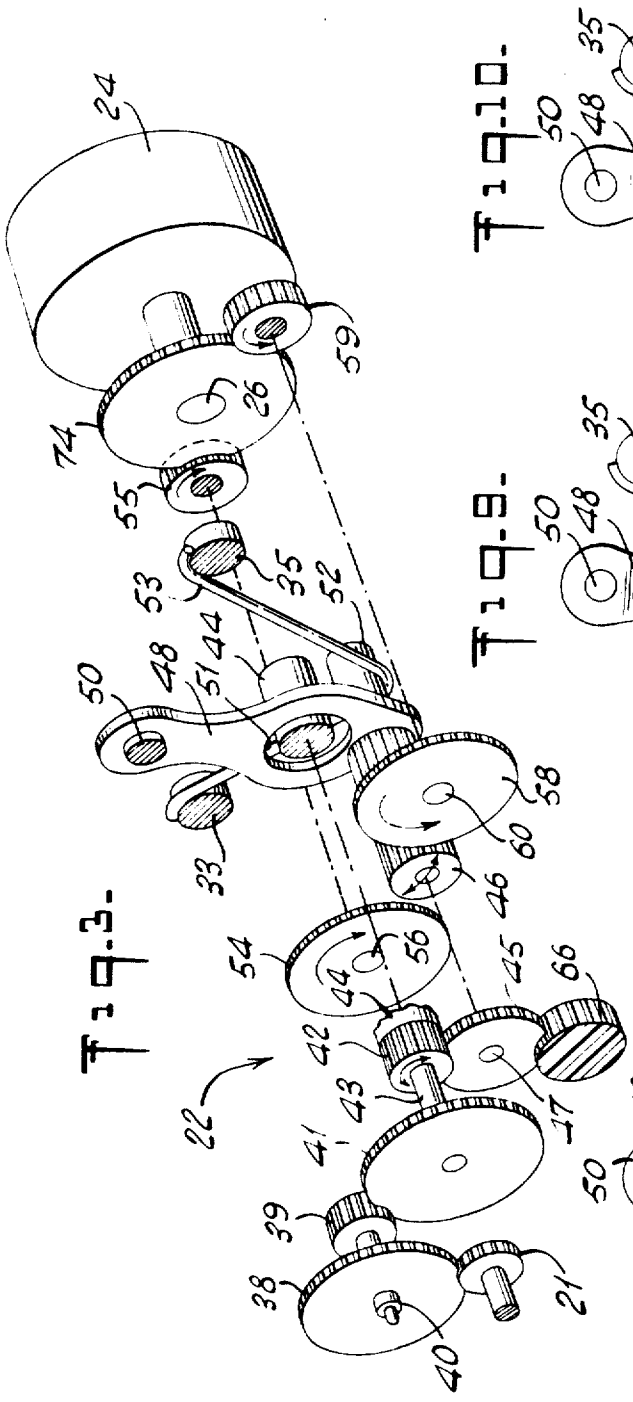


FIG. 3.

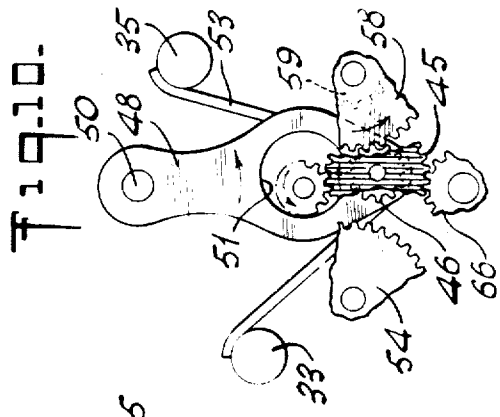


FIG. 10.

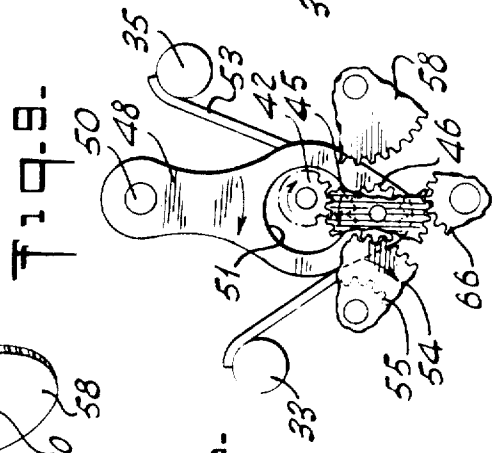


FIG. 9.

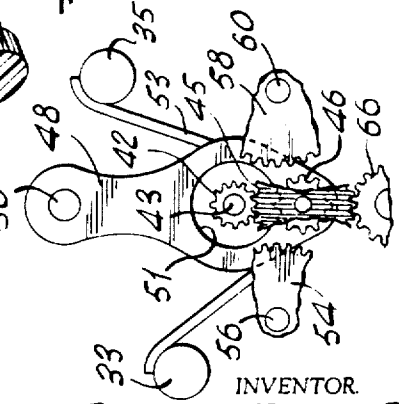


FIG. 8.

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Fig. 6.

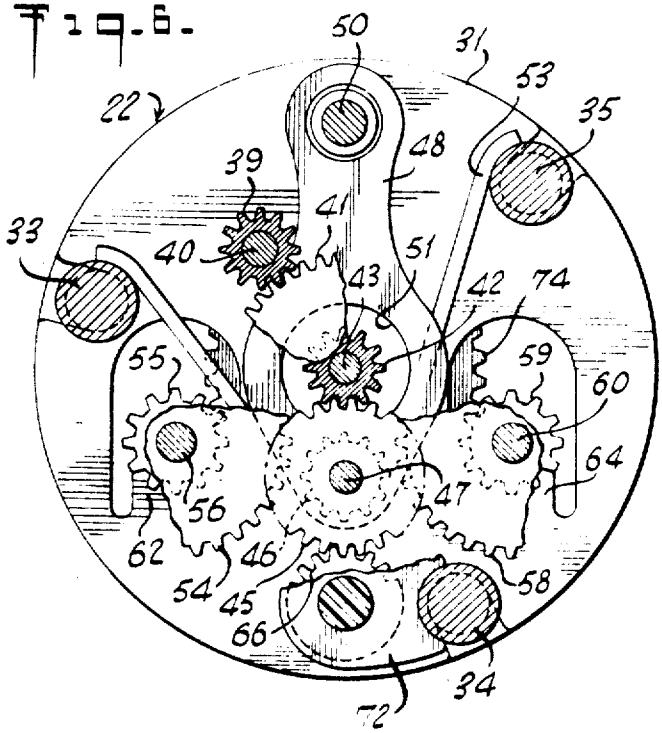


Fig. 4.

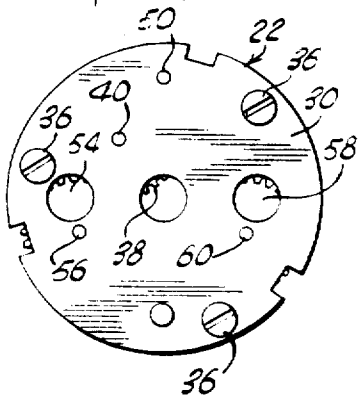


Fig. 7.

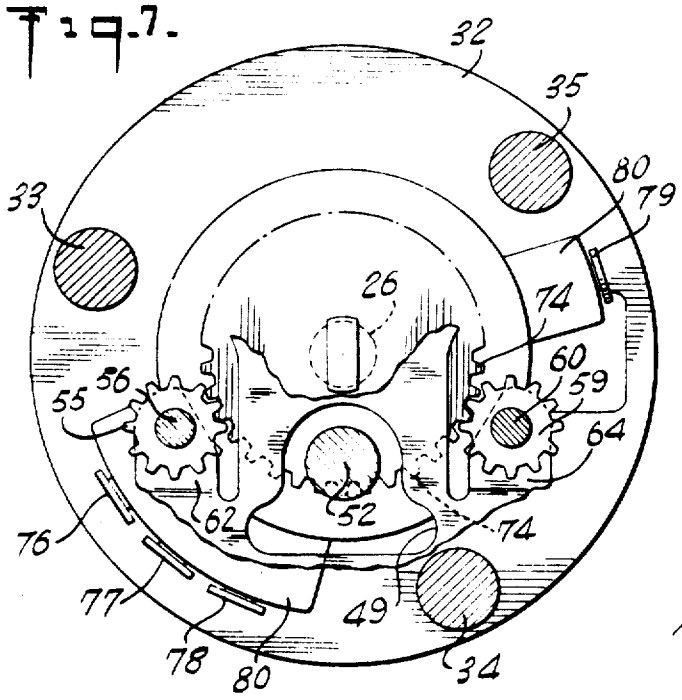
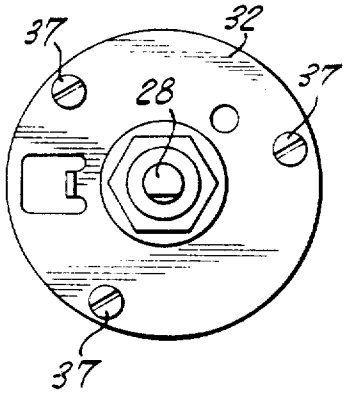


Fig. 5.



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TORQUE ACTUATED REVERSIBLE GEAR REDUCTION ASSEMBLY

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Original No. 3,241,385, dated Mar. 22, 1966, Ser. No. 204,460, June 22, 1962. Application for reissue Dec. 28, 1967, Ser. No. 706,997

Int. Cl. F16h *3/34, 5/52*

U.S. Cl. 74—354 9 Claims

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

ABSTRACT OF THE DISCLOSURE

A simplified, miniaturized, motorized potentiometer in which the motor can be selectively disconnected from the assembly when manual rotation is desired. The motor is reversible and the gear train includes movable gears that are responsive to energization of the motor and are adapted to mesh with one of the two intermediate output gears depending upon the desired direction of rotation of the motor. Each of the intermediate gears are coupled to the output shaft and will cause the shaft to rotate in a different direction.

This invention relates to motor and gear train assemblies. More particularly, this invention relates to a miniaturized motor and speed reduction gear assembly having particular utility as a means for rotatably positioning the shaft of a potentiometer or the like.

There are numerous applications wherein it is desirable to position a rotatable shaft by remote control. For example, in stereophonic systems it is necessary to properly balance the two audio channels with respect to the listener's position to achieve a proper stereophonic effect. The controls for the system are generally located away from this position and it is difficult to adjust the system at one location so that the sound is properly balanced at another location. Thus, it is desirable to have a simple remote control system wherein the controls may be located at any point with respect to the speakers, so that a listener, regardless of his location, can readily adjust a potentiometer to balance the two channels.

The prior art has suggested a number of different methods for achieving this objective. For instance, one method employs a small, synchronous motor in combination with the potentiometer and a gear reduction assembly to reduce the angular velocity of the rotor shaft to a level suitable for balancing the potentiometer. However, because of the huge inertia of the gear reduction system, which may reduce the speed by a factor of one hundred or more, in these systems it is practically impossible to manually adjust the potentiometer, which for various reasons might be desirable.

Accordingly, it is an object of this invention to provide a simplified motor and gear train assembly for positioning a rotatable shaft while permitting manual adjustment thereof.

Another object is to provide a miniaturized gear train assembly for use with a reversible motor wherein the outlet shaft is driven in accordance with the direction of the rotation of the motor.

Still another object is to provide a simplified gear train assembly wherein the output shaft is disconnected from the assembly when the input shaft is not rotated.

Yet another object is to provide a simplified means for remotely controlling a potentiometer or the like.

The objects of the invention are accomplished by coupling a reversible, synchronous motor and gear train assembly to the rotatable object to be positioned. The electrical controls for the motor are situated at the operator's location so that he can determine the direction and extent of rotation. The gear train assembly includes a movable gear which, in response to energization of the motor, is adapted to mesh with one of two intermediate output gears depending upon the direction of rotation of the motor. The movable gear is spring-biased to a center position where it meshes with neither intermediate gear when the motor is stationary. Both of the intermediate gears are coupled to an output shaft and each will cause the shaft to rotate in a different direction. When the motor is not operated and the movable gear is returned to its center position, the output shaft is effectively disconnected from the main body of the gear train assembly.

A more complete description of the manner in which the above objectives are accomplished will be given with reference to the following specification and drawings wherein:

FIG. 1 represents a side view of the motor and gear train assembly in conjunction with a potentiometer;

FIG. 2 is a cross-sectional view of the apparatus of FIG. 1;

FIG. 3 is an exploded perspective view of the gear train assembly;

FIG. 4 is a top view of the gear train assembly;

FIG. 5 illustrates the bottom plate of the gear train assembly;

FIG. 6 is a view through the plane **6—6** of FIG. 1;

FIG. 7 is a cross-sectional view through the plane **7—7** of FIG. 2;

FIGS. 8, 9 and 10 are cross-sectional views through the plane **6—6** of FIG. 1 illustrating the operation of the movable gear;

[FIG. 11 is an exploded view of the motor;

FIG. 11a illustrates the rotor structure of the motor;

FIG. 12 is a view through the plane **12—12** of FIG. 1;

FIG. 13 is a top view of one of the stator sections of the motor through the plane **13—13** of FIG. 2;

FIG. 14 is a bottom view of the other stator section of the motor;

FIG. 15 is a view along the line **15—15** of FIG. 2 showing the pole piece construction and rotor; and

FIG. 16 is a schematic showing of the electrical circuit, motor, gear train and potentiometer.]

Referring now to FIGS. 1 and 2, the assembled unit is shown in combination with a potentiometer **24**. The motor is indicated at **20** and includes an output gear **21** which is secured to the rotor. The motor is attached to a gear train assembly **22**, which reduces the angular velocity of output **21** in order to adjust potentiometer **24**. Gear assembly **22** includes an output shaft **26** which is adapted to rotate the movable contact of the potentiometer, and, in addition, the potentiometer may be controlled manually in a conventional manner by means of a shaft **28**.

The operation and construction of motor **20** will be described in greater detail below. For purposes of explanation, it is sufficient to note at this point that the motor may be a reversible, synchronous motor. Depending upon the manner in which the coils of the motor are energized, the rotor, and thus the output gear **21**, will rotate in a clockwise or counterclockwise direction. If the invention is to be used, for example, to adjust the balance of a stereophonic system, potentiometer **24** will be the balancing means and will be located in the preamplifier. The shaft **28** will extend from the preamplifier casing where it may be manually rotated to balance the system. The motor **20** and gear train assembly **22** will

extend into the exterior of the casing. The leads controlling the motor may be connected to a small exterior unit including switch means for reversing the direction of rotation of the motor. The listener may then cause the movable contact of the potentiometer to rotate in either direction until the system is properly balanced. At that point, the coils of the motor are de-energized which, in accordance with the invention, automatically disengages the output shaft **26** of the potentiometer **24** from the gear train assembly **22**, permitting manual adjustment of shaft **28**. If the output shaft **26** were not disconnected from the gear assembly **22**, it would be extremely difficult to manually adjust the potentiometer because of the inertia of the gear reduction necessary to reduce the relatively high speed of output gear **21** to the angular velocity necessary for adjustment purposes.

The operation of the gear train assembly will be described in detail with additional reference to FIGS. 3–7. FIG. 3 is an exploded view of the gear train assembly. FIGS. 4 and 5 are top and bottom views of the assembly, respectively, while FIGS. 6 and 7 are views through the planes **6—6** and **7—7**, respectively, of FIGS. 1 and 2. As shown most clearly in FIGS. 1–3, the output gear **21**, attached to the rotor of the motor **20**, extends into the gear train assembly **22**. The assembly is supported by means of a top plate **30**, a middle plate **31** and a bottom plate **32**. The plates are fixed and held together by horizontal supporting posts **33**, **34** and **35**, spaced about the periphery of the assembly. Upper screws **36** (FIG. 4) and lower screws **37** extend into the posts to secure the assembly together. Middle plate **31** may be secured by means of small cut-out portions which are received in suitable grooves of the supporting posts.

The output gear **21** extends through the top plate **30** and into engagement with a pair of offset coaxial gears **38** and **39**. Gear **21** engages the larger diameter gear **38** which along with gear **39** is secured to a pin **40** journaled in top plate **30** and middle plate **31**. Gear **39** engages a large diameter gear **41** which is coaxial with a smaller gear **42**. Gears **41** and **42** are secured to a pin **43** which is rotatably supported in a stationary post **44** extending from the center of middle plate **31** toward the inner plate **30**.

In accordance with the invention, a pair of movable coaxial gears **45** and **46** are secured to a pin **47** which is journaled in a pivotable yoke **48**. Yoke **48** is mounted between inner plate **30** and middle plate **31** by means of a post **50** which is pivotally supported in these two plates at a point toward the periphery of the gear train assembly between supporting posts **33** and **35**. Yoke **48** includes an aperture **51** which straddles the stationary post **44** on which the pair of central coaxial gears **41** and **42** are supported. As illustrated, yoke **48** is secured to post **50** at a slight distance above the upper surface of middle plate **31**. Mounted on yoke **48** beneath coaxial gears **45** and **46**, a small downwardly extending post **52** extends into an opening **49** (FIG. 7) provided in plate **31**. A V-shaped spring **53** is situated between the middle plate **31** and yoke **48** with its apex passing around the outside of post **52** and the extremities of its arms braced against supporting posts **33** and **35**, as shown in FIGS. 3 and 7. If desired, the spring may be wound around post **52** or any other spring configuration may be employed within the spirit of the invention.

Spring **53** is adjusted to position yoke **48** so that gear **46** is centered between and out of engagement with two pairs of intermediate coaxial output gears **54**, **55** and **58**, **59**, respectively. Gears **54** and **55** are secured to a pin **56**, and gears **58** and **59** are secured to a pin **60**. Middle plate **31** has a pair of integrally formed L-shaped arms **62** and **64** extending dowinwardly towards outer plate **32** as shown in FIGS. 1 and 2. Pin **56** is journaled in arm **62** and middle plate **31**, and pin **60** is journaled in arm **64** and plate **31** to permit rotation of whichever intermediate gear is engaged by the movable gear **46**, as will be described below. The small diameter gears **55** and **59** of the intermediate coaxial gears are in permanent engagement with an output gear **74** secured to output shaft **26**, and since each intermediate pair of gears is caused to rotate in a different direction, the direction of rotation of shaft **26** is determined by which pair of gears is engaged by movable gear **46**.

The movement of gear **46** into engagement with one of the pairs of intermediate coaxial gears is enabled by means of a clutch pinion **66** which is best illustrated in FIG. 2. Pinion **66** engages the large diameter movable gear **45**. The pinion may be made of a non-metallic material and includes a hollow cylindrical base portion **67** extending toward middle plate **31**. The clutch pinion **66** is rotatably supported in plates **31** and **30** by means of a downwardly extending pin **68** and an upwardly extending pin **70** concentric with base portion **67**.

A clutch pinion spring **71**, surrounding post **69**, is tensioned between top plate **30** and a clutch pinion washer **72** (FIG. 6) which rests above pinion **66** and helps maintain the pinion in engagement with gear **45**. Thus, although the clutch pinion **66** is capable of rotation, the force of spring **71** causes friction between middle plate **31** and the bottom of the cylindrical base **67** which tends to inhibit the rotation of pinion **66**.

The operation of the gear train assembly will now be described in greater detail with specific reference to FIGURES 8, 9 and 10, which are cross-sectional views through the plane **6—6** of FIG. 1. These figures illustrate the manner in which the rotation of the yoke enables gear **46** to drive one of the two intermediate coaxial gears. It will be recalled that under normal conditions, the movable gear **46** is biased by spring **53** to a position between intermediate gears **54** and **58** where it is in engagement with neither gear. Under these conditions, the output gear **74**, and thus the potentiometer **24**, is effectively disconnected from the gear train assembly. Depending upon the direction of rotation of the output gear **21** of motor **20**, it is necessary to engage one of the two pairs of intermediate coaxial gears. Thus, assume gear **21** is rotating in a clockwise direction. Coaxial gears **38** and **39** which are connected therewith, rotate in a counterclockwise direction, while coaxial gears **41** and **42** which are in engagement with gear **39** rotate in a clockwise direction. Movable gears **45** and **46** which are in engagement with gear **42** also rotate in a counterclockwise direction. Since intermediate gears **54** and **58** are in engagement with none of the above-mentioned gears, neither gear immediately responds to the rotation of the output gear **21**. However, since clutch pinion **66** is friction biased against middle plate **31** by the action of spring **71**, the pinion tends to resist rotation causing the entire movable gear **45** to tend to move in a counterclockwise direction around the friction pinion **66**. Gear **47** and gear **46** are mounted on a yoke **48** which is capable of a pivotable movement about pivot post **50**, and therefore coaxial gears **45** and **46** move to the position shown in FIG. 9 where the small diameter gear **46** engages the large diameter gear **54**. Since gear **46** is secured to gear **45**, which in turn engages small central gear **42**, intermediate gear **54** will rotate in a clockwise direction causing gear **55**, which meshes with output gear **74**, to rotate output shaft **26** in a counterclockwise direction at a greatly reduced speed. The movement of the yoke is limited by engagement of gear **46** with intermediate gear **54**, and when the frictional forces between the clutch pinion **66** and the middle plate **31** are overcome, the pinion will be forced to rotate also. As the yoke **48** pivots from its center position illustrated in FIG. 8, it acts against the biasing force of spring **53**, so that even when gear **46** engages intermediate gear **54** it is being urged to its center position.

When the movable contact of potentiometer **24** has been rotated to a desired position, the operator may

throw a switch to halt operation of the motor. As soon as gear **21** stops rotating, the force that is holding gear **46** in engagement with intermediate gear **54** is removed, and the centering spring **53** returns the yoke **48** to its initial position indicated in FIG. 8. During the return movement, pinion **66** remains fixed, and movable gears **46** and **45** drive the front end of the gear train and motor in reverse as yoke **48** pivots back to its neutral position under the influence of springs **53**. As above-discussed, at this point the movable gear **46** is centered between the two pairs of intermediate coaxial gears effectively disconnecting the output shaft **26** from the main body of the gear train assembly. In this state, it is relatively easy to manually adjust the potentiometer by means of shaft **28**, since it is only necessary to push against the intermediate output gears which are in engagement with output gear **74**.

If the operator thereafter causes the motor to rotate in the reverse direction so that gear **21** is turning in a counterclockwise direction, the action is similar to that described above. In this case, however, as shown in FIG. 10, the movable gears **45** and **46** rotate with yoke **48** in a countreclockwise direction about pivot post **50**, causing gear **46** to move into engagement with intermediate output gear **58**. When the energization is removed from the coils of the motor and gear **21** stops rotating, centering spring **53** returns the yoke to its center position illustrated in FIG. 8, disengaging gear **47** form either intermediate output gear **58** or **54**.

Potentiometer **24** includes terminals **76**, **77**, **78** and **79** supported on an insulation board **80** in a conventional manner as illustrated in FIG. 7. The potentiometer is mounted on the inner surface of bottom plate **32** and includes a threaded sleeve **86** which extends through plate **32** and is secured thereto by means of an inner nut **82**, an external washer **83**, and an external nut **84**. A C-clip **88** retains the shaft **28** in its proper position within sleeve **86**.

Motor **20** is a synchronous motor of the hysteresis type. Such motors are economical to manufacture, so that despite their relatively low efficiency they are particularly suitable for the present purposes in view of the light load which might be driven. Because of improved techniques, these motors have found increasing favor wherein a small synchronous motor must be used to drive relatively light loads, such as a clock, potentiometer or the like.

Although a specific embodiment of the invention has been disclosed, many modifications thereof will be obvious to one skilled in the art, and the invention should not be limited except as defined in the following claims.

I claim:

1. A gear reduction assembly for coupling the driving shaft of a reversible motor to a single output shaft whereby said output shaft may be driven by said motor, said assembly comprising an input gear operatively coupled to the drive shaft and rotatable in response to the rotation of said driving shaft, an output gear coupled to said output shaft, a pair of intermediate gears in engagement with said output gear and means for decoupling said driving and output shafts at times when said motor is not running whereby to facilitate manual control of said output shaft at such times, said means comprising a pair of coaxial movable gears having different diameters, a subframe for mounting said coaxial gears, said frame being pivotably mounted on an axis remote from the axis of the input gear for providing transverse movement thereof, the first of said coaxial movable gears being in engagement with said input gear whereby said coaxial movable gears can traverse a portion of the circumference of said input gear, a pinion supported within said assembly and frictionally biased against rotation, said pinion being coupled to the first of said coaxial movable gears to permit said coaxial movable gears to traverse said input gear responsive to the rotation of said driving shaft whereby the second of said coaxial movable gears is moved into engagement with one of said intermediate gears depending upon the direction in which said driving shaft is rotating, and spring means biased by the movement of said coaxial movable gears for moving said second coaxial gear out of engagement with either of said intermediate gears when said motor is not running.

2. The combination of a motor and gear assembly, said motor including a bi-directional motor having a single output drive shaft, said gear assembly including an input gear operatively coupled to the drive shaft and rotatable in response to the rotation of said driving shaft, an output gear coupled to said output shaft, a pair of intermediate gears in engagement with said output gear, and means for decoupling said driving and output shafts at times when said motor is not running whereby to facilitate manual control of said output shaft at such times, said means comprising a pair of coaxial movable gears having different diameters, a subframe for mounting said coaxial gears, said frame being pivotably mounted on an axis remote from the axis of the input gear for providing transverse movement thereof, the first of said coaxial movable gears being in engagement with said input gear whereby said coaxial movable gears can traverse a portion of the circumference of said input gear, a pinion supported within said assembly and frictionally biased against rotation, said pinion being coupled to the first of said coaxial movable gears to thereby permit said coaxial movable gears to traverse said input gear responsive to the rotation of said driving shaft whereby the other of said coaxial movable gears is moved into engagement with one of said intermediate gears depending upon the direction in which said driving shaft is rotating, and spring means biased by the movement of said coaxial movable gears for moving said other coaxial gear out of engagement with either of said intermediate gears when said motor is not running.

3. A gear reduction assembly according to claim **1** wherein said intermediate gears each comprises a pair of coaxial gears, one of said intermediate coaxial gears being in engagement with said output gear and the other of said intermediate coaxial gears being adapted to engage said other movable coaxial gear.

4. An assembly for selectively controlling a potentiometer manually or by a motor, said assembly comprising a potentiometer having a rotatable output shaft for adjusting said potentiometer and a rotatable control shaft for manually adjusting said potentiometer; a motor having a drive shaft; and gear means coupling the drive shaft of said motor with the output shaft of said potentiometer for adjusting said potentiometer under control of said motor during energization of said motor in a manner whereby upon deenergization of said motor said gear means decouples said output shaft from the drive shaft of said motor thereby permitting adjustment of said potentiometer under manual control via said control shaft, said gear means including a pair of coaxial movable gears of different diameters, a movable subframe upon which said coaxial movable gears are mounted, at least one of said coaxial gears being selectively operatively connected to one of the other gears of said gear means for coupling the drive shaft of said motor with the output shaft of said potentiometer when said motor is operative, but disconnected from said one other gear when said motor is inoperative.

5. An assembly for selectively controlling a potentiometer manually or by means of a motor, said assembly comprising a potentiometer having a rotatable output shaft for adjusting said potentiometer; said motor being provided with a drive shaft; and gear means coupling said drive shaft of said motor with the output shaft of said potentiometer for adjusting said potentiometer under control of said motor during energization of said motor in a manner whereby upon deenergization of said motor

said gear means decouples said output shaft from the drive shaft of said motor thereby permitting adjustment of said potentiometer under manual control through said control shaft, said gear means comprising an input gear operatively coupled to the drive shaft of said motor and rotatable in response to rotation of said drive shaft, an output gear coupled to the output shaft of said potentiometer, a pair of intermediate gears in engagement with said output gear, and means for decoupling said drive and output shafts at times when said motor is deenergized, said means comprising a pair of co-axial movable gears having different diameters, a subframe for mounting said coaxial gears, said subframe being pivotally mounted on an axis remote from the axis of the first of said coaxial movable gears being in engagement with said input gear whereby said coaxial movable gears can traverse a portion of the circumference of said input gear, a pinion supported within said gear means and frictionally biased against rotation, said pinion being coupled to the first of said coaxial movable gears to permit said coaxial movable gears to traverse said input gear responsive to the rotation of said drive shaft whereby the second of said coaxial movable gears is moved into engagement with one of said intermediate gears depending upon the direction in which said drive shaft is rotating, and spring means biased by the movement of said coaxial movable gears for moving said second coaxial gear out of engagement with either of said intermediate gears when said motor is deenergized.

6. An assembly as claimed in claim 5, wherein said intermediate gears each comprises a pair of coaxial gears, one of intermediate coaxial gears being in engagement with said output gear and the other of said intermediate coaxial gears being adapted to engage said other movable coaxial gear.

7. An assembly for selectively controlling a potentiometer manually or by means of a motor, said assembly comprising a potentiometer having a rotatable output shaft for adjusting said potentiometer; said motor being provided with a drive shaft; and gear means coupling said drive shaft of said motor with the output shaft of said potentiometer for adjusting said potentiometer under control of said motor during energization of said motor said gear means decouples said output shaft from the drive shaft of said motor thereby permitting adjustment of said potentiometer under manual control through said control shaft, said gear means comprising an input gear operatively coupled to the drive shaft of said motor and rotatable in response to rotation of said drive shaft, and output gear coupled to the output shaft of said potentiometer, a pair of intermediate gears in engagement with said output gear, and means for decoupling said drive and output shafts at times when said motor is deenergizing, said means comprising a pair of co-axial movable gears having different diameters, a subframe for mounting said co-axial gears, said subframe being pivotally mounted on an axis remote from the axis of the first of said co-axial movable gears being in engagement with said input gear whereby said co-axial movable gears can traverse a portion of the circumference of said input gear, a pinion supported within said gear means and frictionally biased against rotation, said pinion being coupled to the first of said co-axial movable gears to permit said co-axial movable gears to traverse said input gear responsive to the rotation of said drive shaft whereby the second of said co-axial movable gears is moved into engagement with one of said intermediate gears depending upon the direction in which said drive shaft is rotating, and spring means biased by the movement of said co-axial movable gears for moving said second co-axial gear out of engagement with either of said intermediate gears when said motor is deenergized; an input gear operatively coupled to the drive shaft of said motor and rotatable in response to rotation of said drive shaft, an output gear coupled to the output shaft of said potentiometer, a pair of intermediate gears in engagement with said output gear, and means for decoupling said drive and output shafts at times when said motor is deenergized, said means comprising a pair of co-axial movable gears having different diameters, a subframe for mounting said co-axial gears, said subframe being pivotally mounted on an axis remote from the axis of the input gear for providing transverse movement thereof, the first of said co-axial movable gears being in engagement with said input gear whereby said co-axial movable gears can traverse a portion of the circumference of said input gear, a pinion supported within said gear means and frictionally biased against rotation, said pinion being coupled to the first of said co-axial movable gears to thereby permit said co-axial movable gears to traverse said input gear responsive to the rotation of said drive shaft whereby the other of said co-axial movable gears is moved into engagement with one of said intermediate gears depending upon the direction in which said drive shaft is rotating, and spring means biased by the movement of said co-axial movable gears for moving said other co-axial gear out of engagement with either of said intermediate gears when said motor is deenergized.

8. An assembly for selectively controlling a potentiometer manually or by motor, said assembly comprising a potentiometer having a rotatable output shaft for adjusting said potentiometer and a rotatable control shaft for manually adjusting said potentiometer, a motor having a drive shaft, gear means coupling said drive shaft of said motor with the said output shaft of the potentiometer for adjusting said potentiometer under control of said motor during energization of said motor in a manner whereby upon deenergization of said motor said gear means decouples said output shaft from the drive shaft of said motor thereby permitting adjustment of said potentiometer under manual control through said control shaft, said gear means comprising an input gear operatively coupled to the drive shaft of said motor and rotatable in response to rotation of said drive shaft, an output gear coupled to the output shaft of said potentiometer, a pair of intermediate gears operatively connected with said output gear, and means for coupling and decoupling said drive and output shafts, said means comprising a pair of co-axial movable gears having different diameters, a subframe for mounting said co-axial gears, said subframe being pivotally mounted on an axis remote from the axis of said co-axial gears, one of said co-axial gears being operatively coupled to said input gear whereby said input gear responsive to the rotation of said drive shaft and the action of at least one of the other gear means causes said subframe to pivot and the other co-axial gear to drivingly engage a selected intermediate gear depending upon the direction in which said drive shaft is rotating and thereby couple said drive and output shafts, and spring means previously biased by the pivotal movement of said subframe for moving said other co-axial gear out of engagement with said selected intermediate gear at times when said motor is deenergized.

9. The combination as claimed in claim 8 wherein said subframe is provided with said co-axial gears at an end thereof remote from the pivotal mounting of said subframe, and said intermediate gears being located adjacent to and on opposite sides of said co-axial gears whereby pivotal movement of said subframe in one direction causes said other co-axial gear to engage one of said intermediate gears and the pivotal movement of said subframe in an opposite direction causes said other co-axial gear to engage the other of said intermediate gears.

References Cited

The following references, cited by the Examiner, are of record in the patented file of this patent or the original patent.

UNITED STATES PATENTS

1,380,874 6/1921 Valent ..... 74—354

(Other references on following page)

9

UNITED STATES PATENTS

1,841,950	1/1932	Hinman	74—405 X
2,046,412	7/1936	Reynolds	74—354
2,094,669	10/1937	Pratt	74—353 X
2,506,562	5/1950	Wait	74—812 X
2,587,038	2/1952	Goodell	74—354 X
2,828,648	4/1958	Hazard	74—354 X
2,896,873	7/1959	Mageoch	74—354 X
2,972,900	2/1961	Bailey et al.	74—354
2,978,923	4/1961	Carlson	74—354 X
3,028,767	4/1962	Moore	74—354 X

10

3,040,599	6/1962	Carlson	74—354
3,168,840	2/1965	Williams	74—354
3,212,355	10/1965	Visin	74—625

FOREIGN PATENTS

789,165	1/1958	Great Britain.

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