March 7, 1967 N. C. SPRING, JR., ETAL 3,308,314

RESILIENT NO-BACK DEVICE FOR SMALL SYNCHRONOUS MOTORS

Filed Feb. 10, 1964

FIG. 1

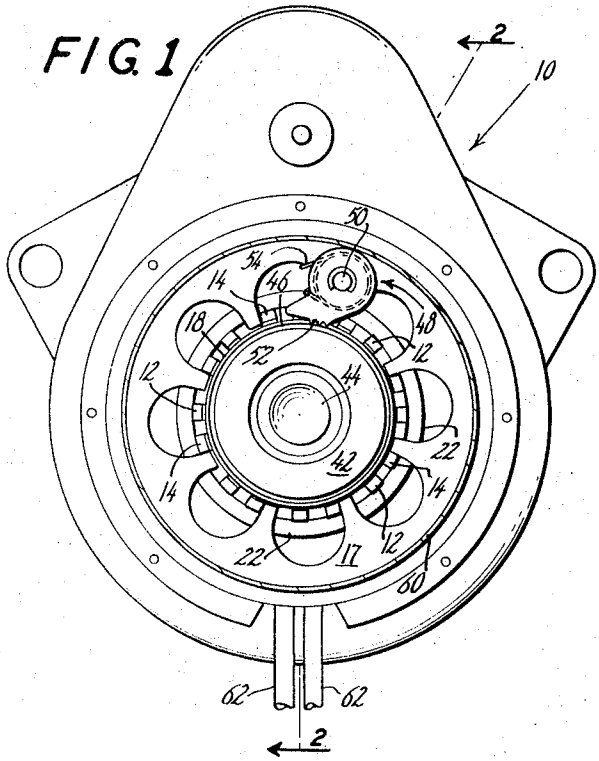


FIG. 2

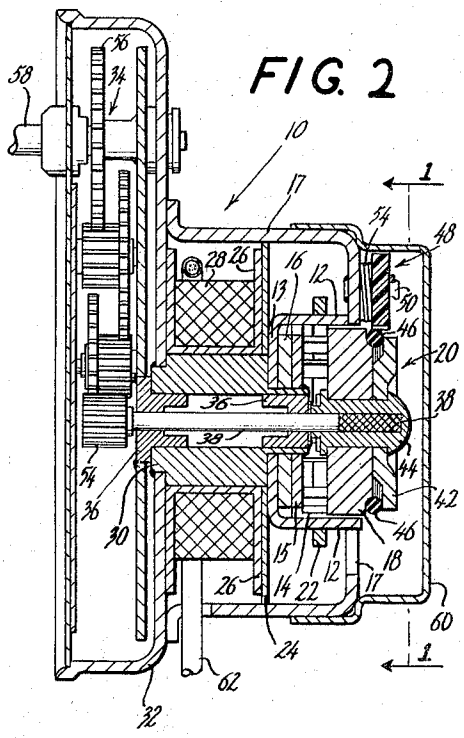


FIG. 5

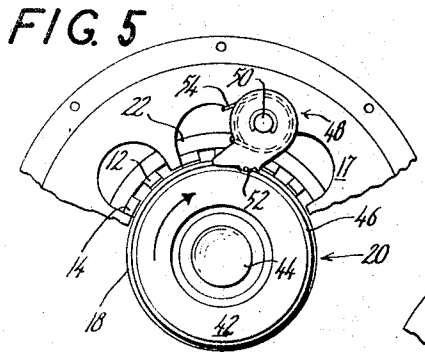


FIG. 3

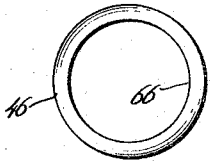


FIG. 7

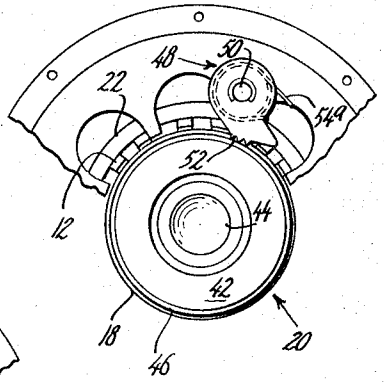


FIG. 4

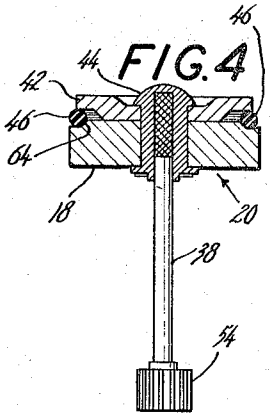
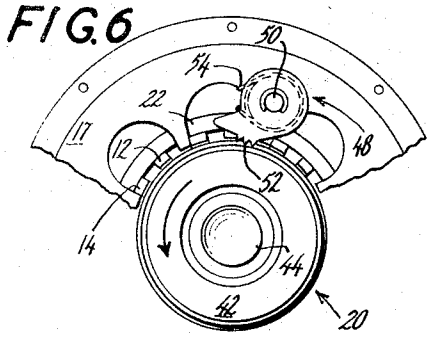


FIG. 6



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RESILIENT NO-BACK DEVICE FOR SMALL SYNCHRONOUS MOTORS

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7 Claims. (Cl. 310—41)

This invention relates to an improved unidirectional drive for use with an inductor motor and particularly to a self-starting synchronous motor capable of starting in either direction. Devices of this type are commonly known as no-back mechanisms.

As is well known, motors of this type incorporate a multi-polar field wherein alternate poles possess opposite polarity at a particular instant and change polarity in accord with alternating current applied to an associated field coil. The poles of a magnetized rotor cooperate with the alternate poles for purposes of driving the rotor which in turn drives a shaft or spindle with a pinion fixed thereto. The pinion then drives a gear train that ultimately turns an output shaft which drives a load.

In known motors of this type, the rotor is invariably integral with the pinion drive spindle and a no-back mechanism is usually associated therewith. Such mechanism generally incorporates one or more stop members which collide when the rotor starts in the undesired direction and a ratcheting effect ensues when the rotor starts and continues rotation in the desired direction. In the event of collision, the resulting kick-back to the rotor results in reversal thereof and it maintains rotation in the desired direction.

Generally, such mechanisms incorporate an appreciable time lag prior to effectiveness, produce objectionable noise during operation, and are subject to wear which not only detracts from operational efficiency but frequently results in breakage of the parts. Motors of the collision no-back type are exemplified in patents issued to E. L. Schellens, 2,436,231; E. H. Gates, Jr., 2,722,297; P. H. Morganson, 2,722,615; R. G. Tetro, 2,789,673.

Another type of no-back mechanism may be found in Patent 2,788,455 issued to W. Kohlhgen. This patent discloses a spring-loaded cam that cooperates with a disc, both of undisclosed substance. The disc is fixed on the output shaft which is fast on the last gear in the output train. This arrangement is supplemented by an intricately formed spring that acts as a stored energy medium. The spring cooperates with a pair of slots formed in an intermediate gear of the drive train. The combination is interdependent for effecting the no-back function. The principle of a spring-loaded cam cooperating with a disc without a supplemental means such as above outlined has proved to be unsatisfactory for many reasons. The most serious reason being motor stall due to locking of the cam and disc when the rotor starts in the undesired direction. Another reason being due to flat spots that are developed either on the disc or cam after the motor has been repeatedly subject to no-back operations. The latter condition not only contributes to motor stall but in noisy operation of the motor during performance.

The present invention contemplates a no-back mechanism of extreme simplicity wherein a simple ring of resilient material, commonly known as an O ring, is mounted integral with the motor rotor assembly. A spring-loaded, toothed pawl cooperates with the periphery of the O ring for insuring unidirectional rotation of the rotor, as will be more fully explained hereinafter. This arrangement not only overcomes the deficiencies of previous no-back devices, some of which are mentioned above, but can be adapted at a fraction of their expense.

Accordingly, it is the prime object of this invention to provide a self-starting synchronous motor with a directional drive control that is simple, reliable and efficient.

A further object is to provide a no-back mechanism that is "silent" during arresting action and during operation.

A still further object is to provide a self-starting synchronous motor wherein the rotor is arrested immediately if it starts rotation in the undesired direction.

In keeping with the above object, a further object is in the provision of a toothed pawl and resilient ring whereby engagement of toothed pawl with ring is not restricted to a specific area of the ring.

It is a related object to provide a no-back mechanism that can be readily adapted to existing motors with a minimum of modification to such motors.

A still further object is to provide a motor that can be run in either direction with a minimum of modification.

Finally, it is an object of substantial importance to provide a no-back mechanism employing the absolute minimum of parts that are free of close tolerance necessity.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

FIG. 1 is an enlarged plan view of a motor embodying the present invention as taken along the lines 1—1 of FIG. 2 and illustrating the elements thereof in quiescent condition;

FIG. 2 is a sectional view thereof as taken substantially along the lines 2—2 of FIG. 1;

FIG. 3 is a plan view of an O ring used in carrying out the invention;

FIG. 4 is a detail front sectional elevation illustrating the O ring of FIG. 3 as assembled on the rotor assembly;

FIG. 5 illustrates the rotor assembly at the point of momentary arrest subsequent to its start of rotation in the undesired direction;

FIG. 6 illustrates the rotor assembly rotating in the desired direction immediately following the arresting action of FIG. 5;

FIG. 7 is a detail view showing the toothed pawl reversed from the FIG. 1 position so that the desired rotation of the rotor is opposite to that of FIG. 1.

Referring to the drawings, numeral **10** indicates a conventional shaded pole, self-starting synchronous motor which includes primary pole pieces **12** and shaded pole pieces **14**. A shading ring **16** is provided between the base portions **13** and **15** of the primary and shaded pole pieces, respectively. Ring **16** serves to slightly delay the flux path to the shaded poles **14** via a housing cup member **17**. The shaded poles **14** maintain a magnetizing influence on a permanent magnet rotor **18** of an assembly **20** for sustaining unidirectional rotation thereof once the rotor assembly gets underway, as is well known. A sizing ring **22** is fitted about pole pieces **12** and **14** for alignment and to insure the proper air gap between pole pieces and rotor. A non-metallic bracing washer **24** seats between the base **13** of the primary pole pieces and bobbin **26** that houses an energizing coil **28**. A core **30** is inserted through a central aperture of bobbin **26**. Core **30** is staked at its upper end to the base portion **15** of the shaded pole pieces and at its lower end core **30** is staked to a gear train housing **32** which encloses the usual gear train, indicated at **34**. Core **30**, pole pieces **12**, **14**, ring **16** and the coil accommodating bobbin **26** are thus rigidly retained. A pair of bearings **36** are likewise fixed within the central bore in core **30** to accommodate a driving spindle **38**.

At its upper end, spindle **38** supports permanent magnet

rotor **18**, a formed disc **42** and a binding member **44**. Disc **42** and rotor **18** are formed to accommodate and retain a resilient ring **46** which is mounted therebetween by stretching. Spindle **38**, rotor **40**, disc **42**, member **44** and resilient ring **46** make up the rotor assembly **20**. Resilient ring **46**, commonly known as an O ring, may be of Buna N 70 rubber, a substance commercially known as neoprene, or any like material.

A pawl, preferably of molded Delrin, is pivotally mounted as at **50** on cup member **17** and is provided with teeth **52**. Pawl **48** is gently urged counterclockwise (FIG. 1) by a torsion spring **54** so that teeth **52** lightly contact the periphery of resilient ring **46** for purpose of insuring predetermined directional rotation of the rotor assembly, as will be more fully explained below.

A pinion **54** is pressed on the lower end of spindle **38** and serves as the initial drive for gear train **34**. Gear **56** serves to drive an output shaft **58** which may be coupled to a load. A motor cover **60** is frictionally pressed on member **17** to encase the upper region of the motor.

When coil **28** is energized from a power source via wires **62**, the rotor assembly **20** immediately commences to rotate. With this type of motor, the rotor assembly is inclined to start and continue rotation in a predetermined or desired direction. However, such action cannot be guaranteed and the rotor frequently starts in the undersired direction, particularly if the torque requirement of the motor is high. Therefore, the novel rotation direction controlling means of resilient ring **46** and toothed pawl are provided so that the rotor assembly is restricted to rotation in one direction only, referred to herein as the desired direction. When restricted from rotation in the undesired direction, the rotor assembly will immediately reverse and continue to run in the opposite or desired direction.

Referring particularly to FIGS. 3 and 4, the angled portion **64** of rotor **18** is of slightly greater diameter than the inner diameter **66** of resilient ring **46** when said ring is in the relaxed condition. Accordingly, ring **46** is stretched and mounted between disc **42** and rotor **18**, as best shown in FIG. 4, and thus frictionally retained against slippage or dislodgement.

In FIGS. 1, 2, 5 and 6, pawl **48** is mounted to insure counterclockwise rotation of rotor assembly **20**. FIG. 5 illustrates the co-action of pawl **48** and resilient ring **46** as the rotor assembly **20** starts in the undesired direction from the FIG. 1 position. Immediately pawl **48** pivots from the position shown in FIG. 1 to the position shown in FIG. 5 and slightly compresses the contact area of ring **46** through the action of teeth **52**. Such action prohibits rotation in the clockwise direction, and through the compressing action of resilient ring **46** at said contact area, impels or bounces the rotor assembly in the counterclockwise or desired direction, as indicated by the arrow in FIG. 6. It is important to note that the above action is "noiseless" and instantaneous; there is no appreciable time lag or lost motion effect in performing the no-back action. Furthermore, there is no restrictive area on the periphery of the resilient ring **46** that need be engaged by teeth **52** of pawl **48** and as the motor operates teeth **52** gently engage the periphery of ring **46** and also act to remove objectionable foreign matter such as lubricant deposits that tend to hinder performance. It can thus be appreciated that teeth **52** of pawl **48** not only serve to continually cleanse the periphery of ring **46** but are maintained in poised position to immediately interrupt rotor assembly **20** should it start in the undesired direction.

FIG. 7 illustrates the mounting of pawl **48** as adapted to a motor wherein the desired rotation of rotor assembly **20** is clockwise. Pawl **48** is merely mounted opposite to the position shown in FIG. 1 and a new spring **54a** is added to provide the opposite torsional effect. The primary poles **12** and shaded poles **14** are alternately disposed in contrast to the FIG. 1 showing.

Thus with the novel arrangment of a simple O ring and a spring-urged toothed pawl, an efficient, quiet and extremely inexpensive no-back mechanism has been provided. Moreover, the random engagement feature insures long operational efficiency of the O ring and, should service need be administered to the no-back mechanism, all elements thereof are readily accessible and easily replaced at a bare minimum of cost and effort.

It should also be pointed out that pawl **48** may conceivably be of resilient material and mount pivotally as by a metal insert. Alternatively, the ring would be of a non-resilient material. With such arrangement operation is satisfactory but wear is concentrated at one area of the pawl and a shorter effective life of the arresting member of the no-back unit can be expected as contrasted by long operational efficiency afforded by random engagement of teeth **52** at the periphery of resilient ring **46**.

Having described the invention by making detailed reference to preferred forms of the elements thereof it is obvious that various modifications may be made without departing from the spirit of the invention. It is therefore understood that this invention is not limited to the exact arrangement disclosed except as limited by the state of the art to which this invention pertains.

What is claimed is:

1. In a synchronous motor the combination of:
alternate field poles,
a rotatable permanent magnet rotor capable of starting and running in a first or a second direction on effecting alternating opposite polarities in said alternate field poles,
a resilient member rotatable with said rotor,
an element pivotally arranged adjacent said resilient member, and means on said pivotal element for arrestingly engaging and compressing said resilient member when said rotor rotates in said first direction whereupon said rotor is impelled in said second direction.

2. The combination defined in claim **1** including a spring biasingly engaged with said pivotal element and said means includes teeth which are biased by said spring toward said resilient member.

3. In a synchronous motor the combination of:
alternate field poles,
a rotor assembly including a permanent magnet rotor, said rotor assembly capable of starting and running in a first or a second direction when said permanent magnet rotor is affected by alternating opposite polarities in said alternate field poles,
a resilient ring frictionally mounted on said rotor assembly,
a pawl pivotally biased in abutment with said ring, and means on said pawl for arrestingly engaging and compressing a portion of said ring when said rotor assembly starts in said first direction whereupon said rotor assembly is impelled and continues to run in said second direction.

4. The combination defined in claim **3** wherein said means includes projections at least one of which brushes said ring while said rotor assembly runs in said second direction.

5. The combination defined in claim **3** wherein said rotor assembly includes a permanent magnet rotor portion and a formed disc portion integral with said rotor portion, and said frictionally mounted resilient ring is located between said permanent magnet rotor portion and said formed disc portion and retained against dislodgement on said rotor assembly by said formed disc portion.

6. In a synchronous motor the combination of:
alternate field poles,
a rotor assembly including a permanent magnet rotor, said rotor assembly capable of starting and running in a first or a second rotary direction when said perma-

nent magnet rotor is affected by alternating opposite polarities in said alternate field poles,

a rotor element unified with said rotor assembly,

a pawl arranged adjacent to and for engaging said rotor element,

and means on said pawl to effect a compressing engagement between said rotor element and said pawl means when said assembly starts in said first direction whereupon said rotor assembly is impelled toward and continues to run in said second direction.

7. In a synchronous motor the combination of:

alternate field poles,

a unitary rotor assembly including a permanent magnet rotor portion, a formed disc portion and a spindle portion,

said rotor assembly capable of starting and running in a desired or an undesired direction when said permanent magnet rotor is affected by alternating opposite polarities in said alternate field poles,

a resilient ring mounted on at least one portion of said rotor assembly,

a cup member partially enclosing said rotor assembly,

a pawl pivotally mounted on said cup member adjacent said ring,

a spring arranged between said cup member and said pawl to bias said pawl toward said ring,

and means on said pawl for arrestingly engaging and compressing said ring at one portion thereof when said rotor assembly starts in said undesired direction whereupon said rotor assembly is impelled toward and continues to run in said desired direction.

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L. L. SMITH, *Assistant Examiner.*