United States Patent

[11] 3,592,316

[72] Inventor Heinz Daab, Darmstadt; Karl-Heinz Meier, Zerlhard uber Darmstadt, Im Fluer chen, both of Germany

[21] Appl. No. **838,931**
[22] Filed **July 3, 1969**
[45] Patented **July 13, 1971**
[73] Assignee Quick-Rotan Becker & Notz, Darmstadt, Germany
[32] Priority **July 9, 1968**
[33] **Germany**
[31] **P 17 63 645.2**

[54] **CLUTCH AND BRAKE WITH ADJUSTABLE TRANSFORMER CONTROL**
3 Claims, 5 Drawing Figs.

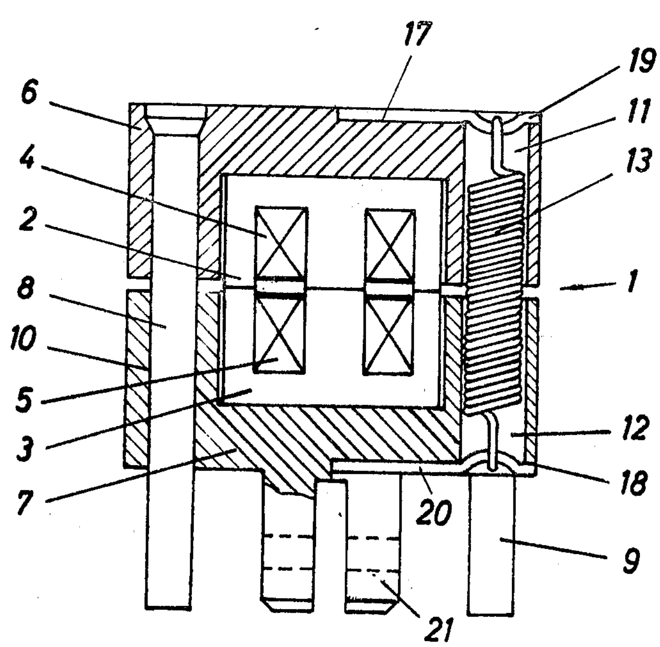
[52] **U.S. Cl.** .... **192/12 D,** 192/84 R, 317/156 R, 336/119, 336/129
[51] **Int. Cl.** **F16d 67/06**
[50] **Field of Search** 192/84, 90, 12.2, 18.2

[56] **References Cited**
UNITED STATES PATENTS

2,724,087	11/1955	Hand	192/84 X
2,850,654	9/1958	Jaeschke	192/104 X
3,253,563	5/1966	Myers	112/220
2,333,863	11/1943	Hull	192/12.2 X

Primary Examiner—Benjamin W. Wyche
Attorney—Otto John Munz

ABSTRACT: A speed-regulating unit for an electric motor drive connected in a system with electromagnetically actuated clutch and electromagnetically actuated brake members, wherein at least the clutch is rendered operative in response to a control voltage generated by means of the regulating unit. The unit is characterized by a variable transformer with a primary coil energized by an AC voltage, and a secondary coil supplying the control voltage. The coupling factor of the unit is adjustable to effect variable transformer action.



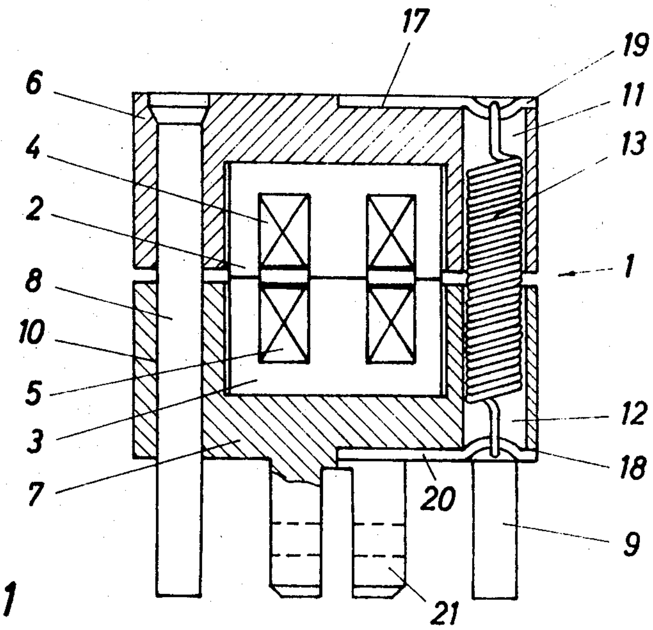


FIG.1

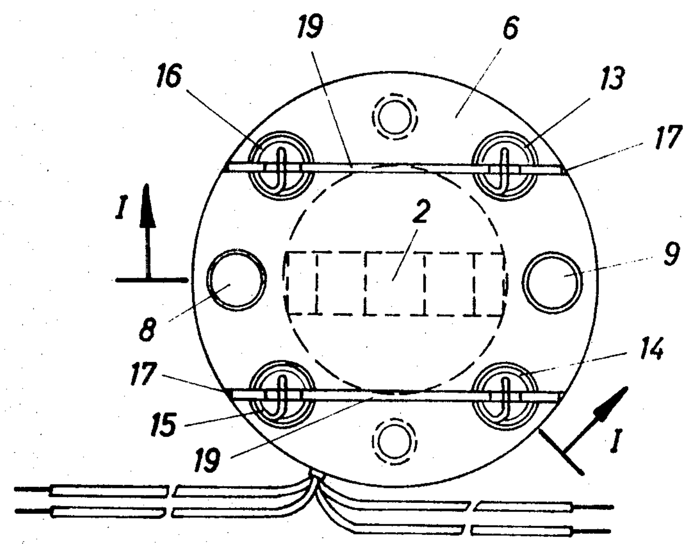


FIG.2

INVENTORS
HEINZ DAAB,
KARL-HEINZ MEIER

BY [signature]
ATTORNEY

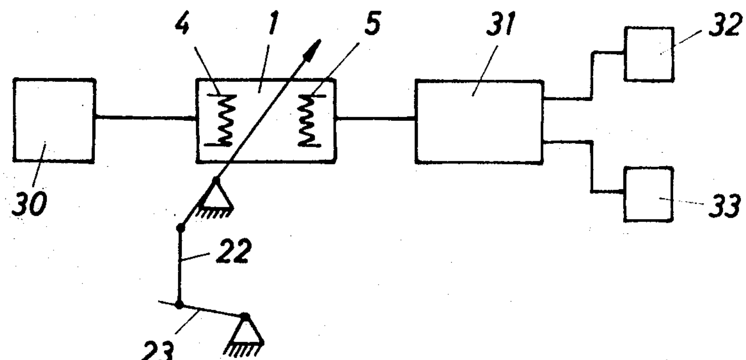


FIG.3

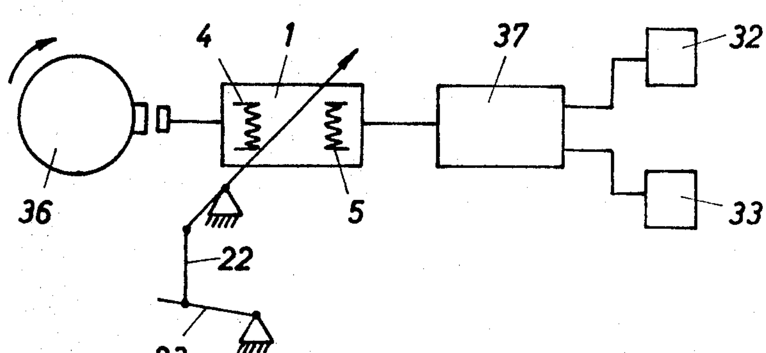


FIG.4

INVENTORS
HEINZ DAAB,
KARL-HEINZ MEIER

BY [signature]
ATTORNEY

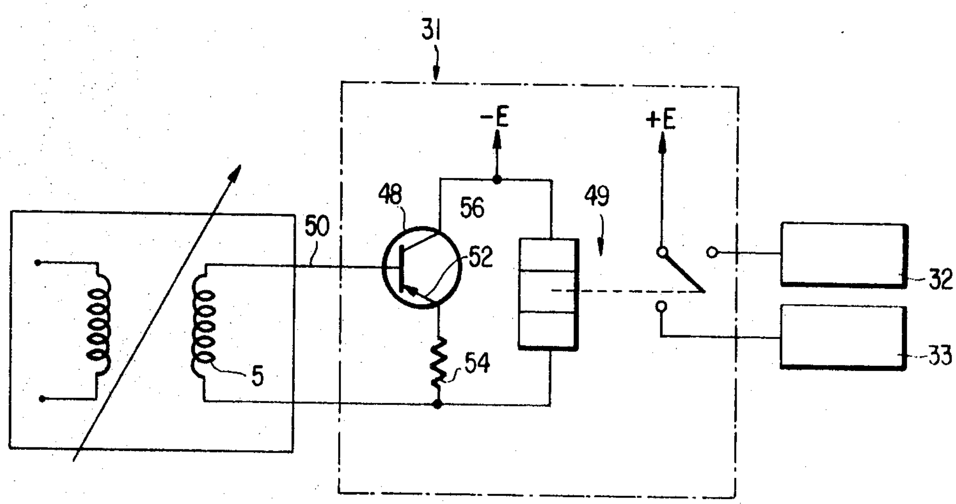


FIG. 5

INVENTORS
HEINZ DAAB
KARL-HEINZ MEIER

BY Otto John Munz.
ATTORNEY

CLUTCH AND BRAKE WITH ADJUSTABLE TRANSFORMER CONTROL

FIELD OF THE INVENTION

The present invention relates to control means for an electric motor drive having an electromagnetically actuated clutch and an electromagnetically actuated brake rendered responsive to the output of a variable transformer.

DESCRIPTION OF THE PRIOR ART

Generally employed as speed-regulating units for electric drives of the type referred to hereinabove are potentiometers to which a reference voltage is applied. A portion of this voltage is adjustable by means of a potentiometer slider and can be tapped as a control voltage (see, for example, U.S. Pat. No. 3,160,128). In actual practice, such potentiometers are frequently subjected to a great deal of wear and tear. When the drive is used, for example, in industrial sewing machines, it may occur that the potentiometer slider is moved several thousand times daily over the entire adjusting path thereof because 2,000 seams and more are made on the machine each day. As a result, the potentiometer has frequent breakdowns and must be replaced, which leads to undesirable delays and losses in production. Corresponding drawbacks arise when the drive is used for coil-winding machines and the like in which the drive must be accelerated and slowed down in frequent alternation.

SUMMARY OF THE INVENTION

It is the object of the present invention to propose speed-regulating unit for motor drives which has a considerably longer service life than present devices.

In accordance with the present invention, this object is obtained with the use of a variable transformer having an adjustable coupling factor which comprises a primary coil energized by AC voltage and a secondary coil supplying a system control voltage. The regulating unit according to the present invention does not have any moving contacts corresponding to the known potentiometer slider. Its service life is therefore virtually unlimited.

The transformer coils are suitably wound on two cores being aligned with each other and having an adjustable airgap therebetween. Each of the cores is preferably housed in an insulative casing. The casing parts are held together by biasing springs, and may be forced apart by means of an actuating member, in adjustable amounts against, the force of the biasing springs. With increasing distance between the cores, the coupling factor is reduced and the voltage induced in the secondary coil decreases accordingly due to the widened airgap.

The adjustment of the cores may be controlled by a foot pedal via a linkage or rod system.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features, advantages and possibilities of application of the present invention will become apparent from the following description of one embodiment thereof, taken in connection with the accompanying drawings, wherein

FIG. 1 is a cross-sectional view through a speed-regulating unit according to the present invention taken along line I–I in FIG. 2;

FIG. 2 is a top plan view of the nominal speed-regulating unit according to FIG. 1;

FIG. 3 is a schematic block diagram of a control equipped with the nominal speed-regulating unit according to the present invention;

FIG. 4 is a schematic block diagram of a regulation system equipped with the nominal speed-regulating unit according to the present invention; and

FIG. 5 is an electrical schematic diagram of a control circuit.

The speed-regulating unit according to the present invention as shown in FIGS. 1 and 2, generally identified with reference numeral 1, comprises two ferromagnetic cores 2, 3, both of which are made with an E-shaped cross section of laminated sheets. The central branch or leg of the core 2 concentrically mounts a primary coil 4, and the central leg of the core 3 concentrically mounts a secondary coil 5. The cores 2, 3 are in longitudinal alignment with each other and are diametrically positioned in insulated cylindrical casing members 6 and 7, respectively. The mutually confronting end faces of the legs of the cores 2, 3 are surface ground to form a uniform airgap therebetween. The coils 4, 5 have the same number of turns.

Rigidly disposed in the casing member 6 are two guide bolts 8, 9. The projecting ends of the guide bolts slidably engage corresponding bores in the casing members 6 and 7, only one of which has been illustrated at 10 in FIG. 1. The casing members 6, 7 further have four peripherally spaced bores, each bore including axially spaced bore sections 11 and 12, aligned with each other in pairs. Each of the pairs of bores 11, 12 receives one of the coil springs 13—16. Two chordal grooves 17 and 18, respectively, are provided in the oppositely disposed end faces of the casing members 6, 7. Inserted into the grooves are the supporting rods 19 and 20, respectively. The oppositely positioned ends of the tension springs 13—16 are crimped around the supporting rods 19, 20.

The casing member 7 is provided, at one end face thereof, with a bifurcated element 21 which may be connected by way of a suitable linkage or rod system 22 with an actuating member, for example a foot pedal 23 (FIGS. 3 and 4), supported by stationary pivot points 46 and 47, respectively.

In the operating position illustrated in FIG. 1, during which the confronting facing ends of the legs of the cores 2, 3 rest against, or make contact with each other without an airgap, the coupling factor between the coils 4, 5 is practically equal to 1. When the primary coil 4 is energized with a predetermined voltage, and if the coils 4, 5 have the same number of turns, practically the same voltage is induced in the secondary coil 5. If, on the other hand, the casing member 7 is displaced from the casing 6, against the force of the tension springs 13 to 16, an airgap 24 having an adjustable dimension is produced between the cores 2, 3 and the coupling factor decreases. The voltage induced in the secondary coil 5 decreases, and by virtue of the mutual distance of the cores 2, 3, it is reduced steadily and exponentially.

In an actual installation of unit 1, the free ends of guide bolts 8 and 9 are attached to a stationary support 45. As an outward pull is exerted on bifurcated element 21, the airgap 24 between the cores widens. Release of the pulling force causes the springs 13, 14, 15 and 16 to contract thereby resulting in a confronting displacement of the cores 6 and 7 toward each other for diminishing the airgap width.

Possibilities of application of the nominal speed-regulating unit 1 are schematically illustrated in FIGS. 3 and 4 in the form of block diagrams.

In the arrangement according to FIG. 3, an AC reference voltage source 30 which generates an AC reference voltage having a constant amplitude is connected to the primary coil 4. A portion of the AC reference voltage, which is adjustable by means of the regulating unit 1, passes from the secondary coil 5 as an input voltage to a control circuit 31. To the outputs of the latter are connected an electromagnetically actuated clutch 32 and an electromagnetically actuated brake 33 to govern a conventional output shaft drive of a motor which is energized by a source. The control circuit 31 may expediently be so designed that it renders the clutch and the brake operative in periodic alternation, whereby the ratio between the integral of the clutch current and the integral of the brake current depends upon the amplitude of the control voltage being supplied to the control circuit 31, which is adjusted by means of the regulating unit 1. The control circuit may be characterized as a voltage detection or amplitude threshold device.

A typical control circuit 31 and 37 are shown in FIG. 5, in the form of a transistor switch 48 having the base 50 and emitter 52 thereof connected to the secondary winding 5 of the variable transformer 1 through bias resistor 54. The collector 56 of the transistor is connected to a s.p.d.t. single-pole double-throw relay 49 which selectively becomes connected to the clutch 32 or brake 33, in preselected response to the output of the winding 5. Instead of influencing the clutch 32 and the brake 33 in response to the control voltage of the speed-regulating unit 1, the clutch 32 could also be controlled individually or separately.

FIG. 4 illustrates the use of the regulating unit 1 in an automatic control system. Rather than being connected to a constant alternating reference voltage, the primary coil 4 of the regulating unit 1 is connected, in this case, to the output of a speed measuring member 36, such as a generator, which supplies an AC voltage dependent upon the speed of the output shaft 34 of the motor to which the member 36 is mounted. The secondary coil 5 of the regulating unit 1 in in operative engagement with the input of a control circuit 37 of the threshold detection type, which actuates the clutch 32 and the brake 33 alternately and in response to the output signal of the regulating unit 1, in a manner similar to the circuit arrangement shown in FIG. 3. The regulating unit 1 allows for setting a nominal speed which is compared with the actual speed determined by the measuring member 36. The feedback resulting from the measuring member completes a servo loop for the system.

It is understood that a rectifier is connected in parallel with the regulating unit 1 when the control circuits 31 and 37 require as input signals, a DC control voltage.

Various modifications are contemplated and may be obviously resorted to by those skilled in the art without departing from the spirit and scope of the invention as hereinafter defined by the appended claims.

We claim:

1. In a speed regulation system for a motor having an output shaft, the system comprising:

a reference source of AC voltage,

a mechanically variable transformer having an input and an output, the input being connected to the source,

a control circuit connected to the transformer output for sensing the voltage generated thereat,

and an electromagnetic clutch connected to the motor shaft, the clutch being actuated in response to the output of the control circuit, indicative of the position of the transformer,

said transformer including first and second cores mounted in slidably adjustable relation to each other,

and coils mounted on the cores to serve as primary and secondary windings,

and means for adjusting the distance between the cores, thereby varying the airgap and the inductive coupling factor between the windings and together with an electromagnetic brake connected to the motor shaft, the brake being actuated in response to a predetermined output of the control circuit indicative of a second preselected state of the transformer.

2. In a speed regulation system for a motor having an output shaft, the system comprising:

a reference source of AC voltage,

a mechanically variable transformer having an input and an output, the input being connected to the source,

a control circuit connected to the transformer output for sensing the voltage generated thereat,

and an electromagnetic clutch connected to the motor shaft, the clutch being actuated in response to the output of the control circuit, indicative of the position of the transformer,

said transformer including first and second cores mounted in slidably adjustable relation to each other,

and coils mounted on the cores to serve as primary and secondary windings,

and means for adjusting the distance between the cores, thereby varying the airgap and the inductive coupling factor between the windings.

3. The system set forth in claim 2, further comprising means normally biasing the cores in a closed position for minimizing the airgap therebetween.