



(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.04.2002 Bulletin 2002/14

(51) Int Cl.7: H01H 19/02

(21) Application number: 00308597.4

(22) Date of filing: 29.09.2000

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

• German, Carl
Nantwich CW5 5PE (GB)

(71) Applicant: SIEMENS AKTIENGESELLSCHAFT
80333 München (DE)

(74) Representative: Allen, Derek et al
Siemens Shared Services Limited,
Intellectual Property Department,
Siemens House,
Oldbury
Bracknell, Berkshire RG12 8FZ (GB)

(72) Inventors:
• Taylor, Russell
Manchester, M14 5DN (GB)

(54) Hybrid actuator

(57) There is provided a combined LED lens and potentiometer actuator (100). In order to render a frequency inverter (130) proof against the ingress of dust and water, it is desirable to reduce the number of possible weaknesses in the environmental seal. The inverter (130) according to the present invention includes an ac-

tuator (100) which serves as a knob for a potentiometer (120) and which also acts as lens through which light from an internal optical status indicator (110), for example a light emitting diode, can pass. O-rings (104,106) are provided to complete the seal between the inside (132) and the outside (134) of the inverter (130).

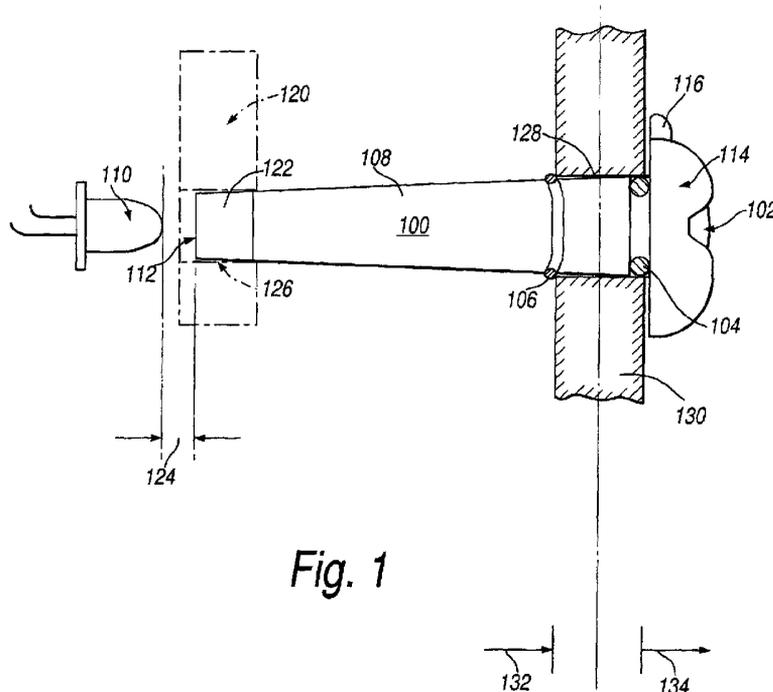


Fig. 1

Description

[0001] The present invention relates to a combined indicator lens and potentiometer actuator. In particular, the invention relates to a potentiometer actuator disposed in a frequency inverter supplying a variable speed motor, for example a COMBIMASTER[RTM] 411 combination motor and inverter.

[0002] Variable speed motors are used in many settings, for example for driving mechanical handling equipment, for driving electric fans or for powering conveyor belts. Rather than simply varying the voltage applied to a motor, it has been found more efficient to use frequency inverters to convert mains electricity into a variable, three phase power supply. Using a technique known as pulse width modulation (PWM), frequency inverters can vary both the voltage and frequency of the power supply to the motor, giving a wide range of control over speed, without loss of torque in the motor.

[0003] Variation of the speed of operation of variable speed motor can be achieved through the rotation of an external knob which engages an internal potentiometer. It is often advantageous that adjustment of the speed of operation be as simple as possible and as a result the knob can be arranged to be operable by hand or by means of a coin. The rotational adjustment may also be imparted by means of a dedicated tool.

[0004] The inverter can be in a number of different operational states, for example normal operation, malfunction and test mode. To indicate the current state, the inverter may be provided with an indicator arrangement. This indicator arrangement may comprise internal indicator lamps, for example light emitting diodes (LEDs), and corresponding indicator ports in a wall of the inverter housing. The provision of an indicator arrangement reduces the need for internal access for inspection and is thus a practical safety feature.

[0005] The indicator lamps can be arranged to blink with different patterns corresponding to different operational states. Alternatively indicators may be provided which can generate signals of a variety of colours, for example red for malfunction, green for normal operation. It is possible that a single indicator can produce signals of more than one colour, for example certain light emitting diodes allow the production of light at a number of different wavelengths. Naturally other signals can be used to indicate operational states for example audible signals from a loudspeaker.

[0006] Of great importance in the reliable operation of electrical devices, inverters included, is isolation from undesirable material. Dust and water can cause particular problems and standards have evolved which detail the degree to which a device is proof against the ingress of water and dust. The environmental protection achieved by frequency inverters is graded along an index of protection (IP) wherein the protection against dust is graded along one scale and against water on another scale, for example an IP rating IP56 corresponds

to 5 on the dust scale (ranging from no protection - 0 to total protection - 6) and 6 on the water scale (ranging from no protection - 0 to protection against continuous submersion - 8).

5 **[0007]** For each indicator port and potentiometer adjustment knob port in an inverter's housing the index of protection for the whole inverter is marginally more compromised.

10 **[0008]** It is therefore an object of the invention to obviate or at least mitigate the aforementioned problems. If the number of possible ingress points can be reduced a higher IP rating can be attained.

15 **[0009]** In accordance with one aspect of the present invention, there is provided an electrical device including: a housing; a rotatable control means; an actuator for applying rotational moment to the rotatable control means; and an indicator arrangement; characterised in that the actuator is substantially transparent and permits light emitted by the indicator arrangement to be observed from outside the electrical device, the actuator having: a tip portion at an end neighbouring the indicator arrangement; a shaft portion for guiding the light from the indicator arrangement; and a head portion at an end opposite to the tip portion and external to the electrical device.

25 **[0010]** Advantageously, the shaft portion of the actuator is reflective and the head portion of the actuator is roughened.

30 **[0011]** The tip portion is preferably provided with an engaging surface which engages with the rotatable control means thereby enabling the application of rotational moment thereto.

35 **[0012]** The actuator may be maintained in position in a port hole in the housing of the electrical device by means of a sealing O-ring and a retaining O-ring, the sealing O-ring ensures that material cannot pass through the port hole from the outside of the housing to the inside of the housing and the retaining O-ring retains the actuator in axial position.

40 **[0013]** Furthermore, the head portion of the actuator may be provided with a wiper. The wiper preferably engages a raised area provided upon an external surface of the housing and thus prevents rotation of the actuator in a predetermined excluded region. The predetermined excluded region may correspond to undesirable settings of the rotatable control means.

45 **[0014]** The rotatable control means is preferably a potentiometer. It should however be noted that the hybrid actuator of the invention can be used to rotate alternative control means, for example circuits including variable resistors or tuneable resonant components, and is not limited to rotating potentiometers.

50 **[0015]** An inverter having a hybrid actuator according to the present invention can be protected against both the ingress of dust particles and water in powerful jets. In terms of the IP rating, the present invention thus has an improved rating of IP66.

[0016] Due to the combination of sealing and retaining

O-rings, the present invention exceeds the protection standard by maintaining IP66 environmental protection under rotation of the hybrid actuator and under extended exposure to high pressure hosing.

[0017] For a better understanding of the present invention, reference will now be made, by way of example only, to the accompanying drawings in which:-

Figure 1 shows a hybrid actuator according to the present invention in position in an inverter;

Figure 2 shows a hybrid actuator according to the present invention from a different perspective; and

Figure 3 illustrates the operation of a wiper on the head of the hybrid actuator according to the present invention.

[0018] Prior art inverters have independent potentiometer knobs and indicator ports. However independent potentiometer knobs and indicator ports inevitably require a corresponding number of independent access ports. The more access ports the more difficult it is to maintain a high IP rating.

[0019] Figure 1 illustrates a portion of an inverter in accordance with the present invention. The inverter has a housing 130 within which are arranged a light emitting diode 110, a potentiometer 120 and a hybrid actuator 100, which combines the functions of a potentiometer knob and indicator lens. The hybrid actuator 100 has a head portion 114 outside the inverter housing 130 and a shaft portion 108 within the housing 130.

[0020] A tip 112 of the shaft portion 108 is arranged to be adjacent to the LED 110 with a small gap 124 therebetween. In further embodiments of the present invention, the small gap 124 may be absent. The hybrid actuator 100 is made of a substantially transparent material, for example plastic or toughened glass, and thus light emitted by the LED 110 is conveyed from the LED 110 to the outside of the inverter via a "light tube" defined by the shaft portion 108 and the head portion 114 of the hybrid actuator 100. Naturally, any other suitable substantially transparent material can be used. To facilitate efficient passage of light through the shaft portion 108, the surfaces of the shaft portion 108 are made reflective whilst the outer surface of the head portion 114 is roughened to disperse any light originating within the inverter housing 130.

[0021] The end of the shaft portion 108 is provided with an engaging surface 122, for engaging with a corresponding receiving portion 126 of the potentiometer 120. When the head portion 114 of the hybrid actuator 100 is rotated from outside the inverter housing 130, the rotational moment thus acts upon the potentiometer 120 and the speed of the motor is adjusted accordingly. It will be understood that the engaging surface 122 and the corresponding receiving portion 126 may take a variety of known forms from a simple key and key-hole arrangement to an arrangement where the engaging surface 122 and the receiving portion 126 are both provided

with interlocking fingers or hooks.

[0022] The head portion 114 of the hybrid actuator 100 is provided with an adjustment slot 102 and a wiper 116. The adjustment slot 102 is arranged to allow an adjustment tool, for instance a coin, a screwdriver or a dedicated adjustment tool, to be inserted therein and thereby cause the hybrid actuator to rotate.

[0023] To complete an environmental seal between the inside 132 and the outside 134 of the inverter housing 130, a sealing O-ring 104 is provided. The sealing O-ring 104 prevents the ingress of water and or dust particles even when the hybrid actuator 100 is rotated and is disposed within a port hole 128 in the inverter housing 130. A further retaining O-ring 106 is disposed at the inner rim of the port hole 128 and serves to retain the hybrid actuator 100 in axial position as well as supplementing the sealing function of the sealing O-ring 104.

[0024] Figures 2 and 3 show the hybrid actuator 100 from two further perspectives. The wiper 116 is a small protrusion disposed upon the head portion 114. When the hybrid actuator 100 is in place in the inverter and engages the potentiometer 120, the wiper 116 prevents the hybrid actuator from over- or under-rotating the receiving portion 126 of the potentiometer 120. As may be seen in Figure 3, the wiper 116 prevents undesirable rotation of the receiving portion 126 by engaging with a raised area 304 provided in the surface of the inverter housing 130 adjacent to port hole 128 in which the hybrid actuator 100 is placed. The raised area 304 is arranged to exclude rotation of the hybrid actuator 100 from a predetermined excluded region 302 corresponding to settings of the potentiometer 120 which could potentially cause damage or failure of the inverter and/or a motor supplied by the inverter.

[0025] It will be understood that the wiper 116 may alternatively be provided on the shaft portion 108 within the inverter housing 130. In the latter case the raised area 304 will also be provided on the inside of the inverter housing 130 adjacent to the port hole 128.

Claims

1. An electrical device including:

- a housing (130);
- a rotatable control means (120);
- an actuator (100) for applying rotational moment to the rotatable control means (120); and
- an indicator arrangement (110);

characterised in that the actuator (100) is substantially transparent and permits light emitted by the indicator arrangement (110) to be observed from outside the electrical device, and **in that** the actuator (100) has: a tip portion (112) at an end neighbouring the indicator arrangement (110); a shaft portion (108) for guiding the light from the in-

indicator arrangement (110); and a head portion (114) at an end opposite to the tip portion (112) and external to the electrical device.

2. An electrical device according to Claim 1, wherein the shaft portion (108) of the actuator (100) is reflective and the head portion (114) of the actuator (100) is roughened. 5

3. An electrical device according to Claims 1 or 2, wherein the tip portion (124) is provided with an engaging surface (122) which engages with the rotatable control means (120) thereby enabling the application of rotational moment thereto. 10

4. An electrical device according to Claims 1, 2 or 3, wherein the actuator (100) is maintained in position in a port hole (128) in the housing (130) of the electrical device by means of a sealing O-ring (104) and a retaining O-ring (106), the sealing O-ring (104) ensures that material cannot pass through the port hole (128) from the outside of the housing (134) to the inside of the housing (132) and the retaining O-ring (106) retains the actuator (100) in axial position. 15

5. An electrical device according the any of the preceding claims, wherein the head portion (114) of the actuator is further provided with a wiper (116). 20

6. An electrical device according to Claim 5, wherein the wiper (116) engages a raised area (304) provided upon an external surface of the housing (130) and thus prevents rotation of the actuator (100) in a predetermined excluded region (302). 25

7. An electrical device according to Claim 6, wherein the predetermined excluded region (302) corresponds to undesirable settings of the rotatable control means (120). 30

8. An electrical device according to any one of the preceding claims, wherein the rotatable control means (120) is a potentiometer. 35

40

45

50

55

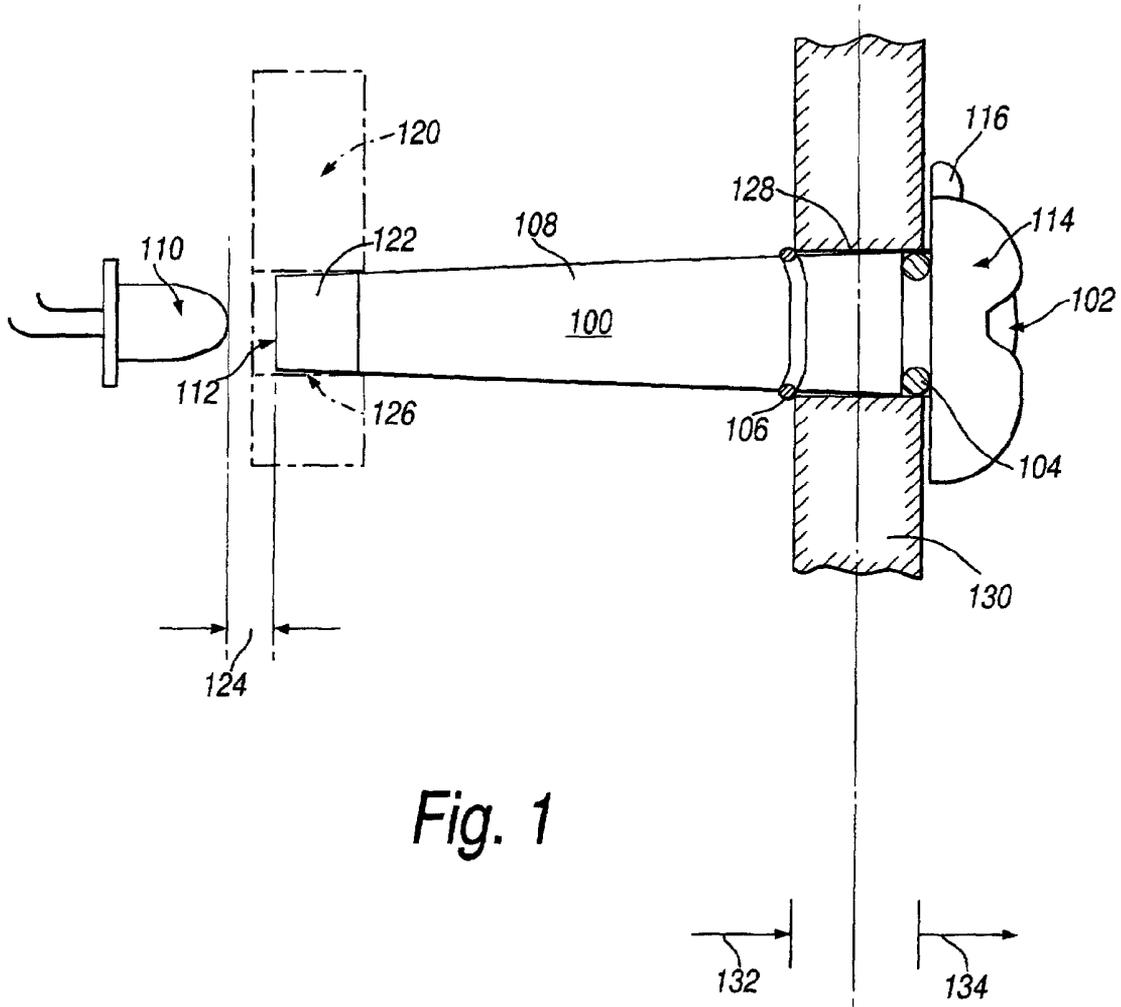


Fig. 1

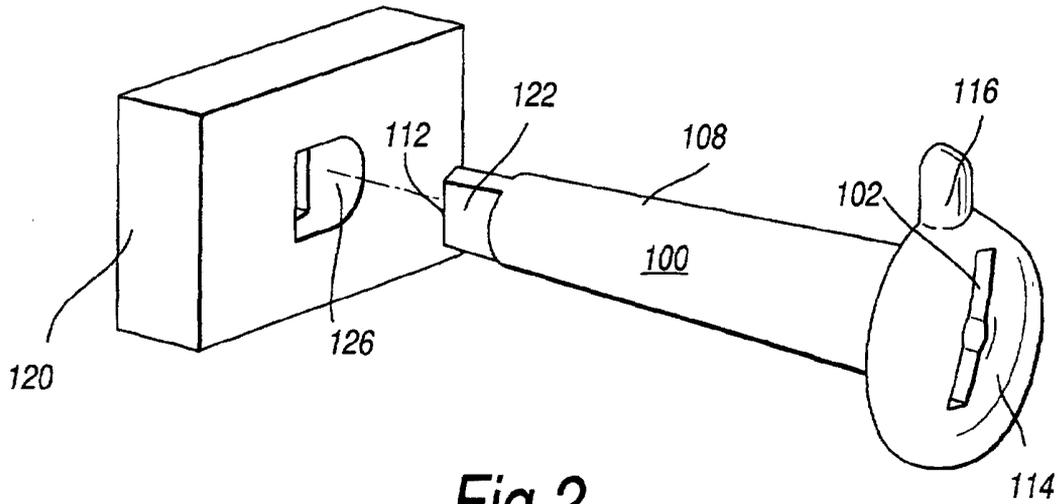


Fig. 2

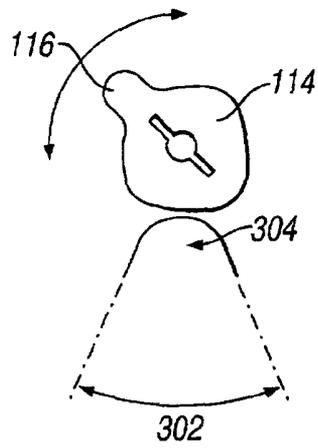


Fig. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 30 8597

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 88 05 154 U (SCHRÖDER-APARATE GMBH.) 27 October 1988 (1988-10-27) * the whole document *	1-3,8	H01H19/02
X	US 2 449 213 A (R.R. FREDRICK) 14 September 1948 (1948-09-14) * the whole document *	1,3,8	
X	US 5 204 502 A (FERRIS GLENN E ET AL) 20 April 1993 (1993-04-20) * column 2, line 15 - column 3, line 16; figure 2 *	1,3,8	
X	DE 88 14 607 U (SIEMENS) 19 January 1989 (1989-01-19) * claim 1 *	1,3,8	
A	FR 2 158 396 A (DREEFS E GMBH) 15 June 1973 (1973-06-15) * page 6, line 26-29 *		
A	DE 198 50 681 A (BSH BOSCH SIEMENS HAUSGERAETE) 4 May 2000 (2000-05-04) * column 4, line 8-15 *		TECHNICAL FIELDS SEARCHED (Int.Cl.7) H01H

~~The present search report has been drawn up for all claims~~

Place of search THE HAGUE	Date of completion of the search 16 February 2001	Examiner OVERDIJK J.
-------------------------------------	---	--------------------------------

<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p>	<p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>..... & : member of the same patent family, corresponding document</p>
---	--

EPO FORM 1503 (03.92) (P04001)

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

claims searched : 1-3 and 8



European Patent
Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 00 30 8597

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-3 8

Transparent rotating actuator for an electrical device, wherein the light from an indicator arrangement is guided through the transparent shaft portion towards the head portion.

2. Claim : 4

Use of O-rings for retaining the actuator's axial position and to ensure material can not pass through the port hole from outside of the housing to the inside of the housing.

3. Claims: 5-7

An actuator provided with a wiper cooperating with a raised area upon an external surface of the housing to prevent rotation of the actuator in a predetermined excluded region

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 30 8597

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-02-2001

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 8805154	U	27-10-1988	NONE	
US 2449213	A	14-09-1948	NONE	
US 5204502	A	20-04-1993	NONE	
DE 8814607	U	19-01-1989	NONE	
FR 2158396	A	15-06-1973	DE 2155139 A DK 168680 A DK 143170 B ES 408191 A	17-05-1973 21-04-1980 06-07-1981 16-11-1975
DE 19850681	A	04-05-2000	WO 0026930 A	11-05-2000

EPC FORM P/0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82