



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 0 907 189 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.04.1999 Bulletin 1999/14

(51) Int. Cl.⁶: **H01F 7/16**

(21) Application number: **97307775.3**

(22) Date of filing: **02.10.1997**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE**

(71) Applicant: **Tu, Ming-Te**
Pali City, Taipei Hsien Taiwan (TW)

(72) Inventor: **Tu, Ming-Te**
Pali City, Taipei Hsien Taiwan (TW)

(74) Representative:
**Stonehouse, Sidney William
Barker Brettell
138 Hagley Road
Edgbaston
Birmingham B16 9PW (GB)**

(54) **Solenoid**

(57) A solenoid including a winding (10), a yoke shell (20), a tubular sliding track (30), a fixed iron core (40), and a movable iron core (50) with the winding (10) comprising a reel (12) and an enamelled wire (11) wound round the reel, the yoke shell (20) defining a holding space which holds the winding on the inside, the tubular sliding track (30) being fixedly mounted in a longitudinal central through hole of the reel (12) of the winding, the tubular sliding track (30) having a first end (31), a second end (33) and a longitudinal sliding hole (30) extending between the first and second ends, the fixed iron core (40) being fixedly mounted in the first end (31) of the tubular sliding track, and the movable iron core (50) being movable in the longitudinal sliding hole

(32) and partially projecting out of the second end (33) of the tubular sliding track, is characterised in that the movable iron core (50) is integrally made by forging and has an exhaust groove (54). Preferably the movable iron core (50) is integrally made and comprises a body portion (52), a head portion (51) and a raised peripheral collar (53) between the head and body portions, the exhaust groove (54) being in the body portion (52). The yoke shell (20) may comprise a yoke tube (21) having one integral threaded head cap (22) at one end and a bottom cap (23) at the opposite end which may be integral with the fixed iron core (40).

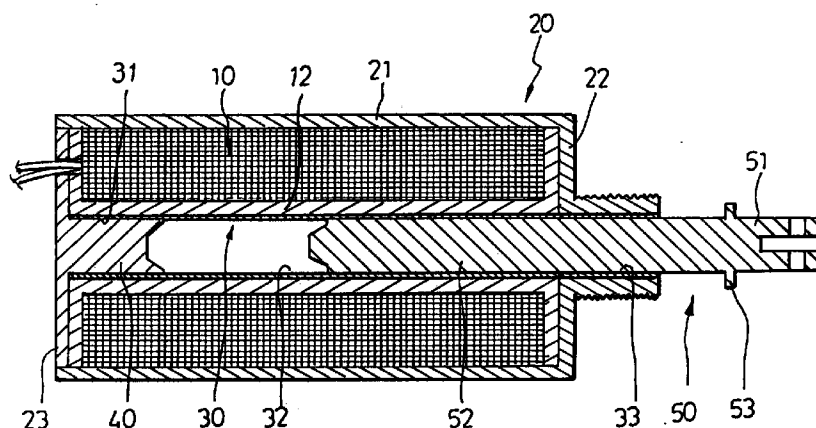


FIG. 4

Description

[0001] The present invention relates to solenoids, and more particularly to an improved structure of solenoid which has an exhaust groove at its movable iron core for exhaust of air.

[0002] Solenoids are intensively used in industrial products. Exemplars are seen in US Pat. Nos. 5 593 132; 5 427 319; 5 424 704; 5 192 936; 4 896 128; 4 217 567. A regular solenoid is generally comprised of a winding, a yoke shell, a tubular sliding track, a fixed iron core, and a movable iron core, the winding comprising a reel and an enamelled wire wound round the reel, the yoke shell defining a holding space which holds the winding on the inside, the tubular sliding track being fixedly mounted in a longitudinal central through hole of the reel of the winding, the tubular sliding track having a first end, a second end and a longitudinal sliding hole extending between the first end and the second end, the fixed iron core being fixedly mounted in the first end of the tubular sliding track, and the movable iron core being movable in the longitudinal sliding hole of the tubular sliding track and partially projecting out of the second end of the tubular sliding track. Figure 1 shows a solenoid of this kind, in which the yoke tube 100 and the threaded head cap 200 are separately made and then fitted together; the fixed iron core 300 and the movable iron core 400 are respectively made from free-cutting steel by milling; the movable iron core 400 is mounted with a clamping ring 500 outside the threaded head cap 200, and the fixed iron core 300 has a rear coupling flange 301 inserted through a hole of the bottom cap 600 and then hammered down to form a head. This structure of solenoid is complicated to install, and the threaded head cap 200 tends to be forced away from the yoke tube 100 by a twisting force or drag force. Furthermore, the complicated milling of the fixed iron core and movable iron core limits the selection of material for the iron cores.

[0003] The present invention is aimed at providing a solenoid which eliminates the aforesaid drawbacks. It is an object of the present invention also to provide a solenoid which is efficient in performance. It is another object of the present invention to provide a solenoid which is durable in use. It is still another object of the present invention to provide a solenoid which is inexpensive to manufacture and easy to install.

[0004] According to one aspect of the present invention, the movable iron core is integrally made, having an exhaust groove longitudinally disposed at the periphery. The movable iron core can be used in a cylindrical solenoid, open square type solenoid, push type solenoid, pull type solenoid, etc.

[0005] According to another aspect of the present invention, the yoke shell is comprised of a yoke tube, a threaded head cap integral with one end of the yoke tube, and a bottom cap fastened to one end of the yoke tube remote from the threaded head cap.

[0006] According to still another aspect of the present invention, the bottom cap of the yoke shell is integral with the fixed iron core.

[0007] According to still another aspect of the present invention, the movable iron core has a collar made integrally with the periphery of its body and disposed outside the head cap of the yoke shell.

[0008] Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal view in section of a solenoid according to the prior art;

Figure 2 is an elevational view of a movable iron core for a solenoid according to the present invention;

Figure 3 is an elevational view of a yoke shell for a solenoid according to the present invention;

Figure 4 is a longitudinal view in section of a pull type cylindrical solenoid according to the present invention;

Figure 5 shows a movable iron core installed in an open type square solenoid according to the present invention; and

Figure 6 is a longitudinal view in section of a push type cylindrical solenoid according to the present invention.

[0009] Referring to Figures 2 to 4, a solenoid in accordance with the present invention is generally comprised of a winding 10, a yoke shell 20, a tubular sliding track 30, a fixed iron core 40, and a movable iron core 50.

[0010] Referring to Figures 3 and 4, the yoke shell 20 defines a space adapted to receive the winding 10. The winding 10 is comprised of a reel 12, and an enamelled wire 11 wound round the reel 12. The tubular sliding track 30 is mounted in the longitudinal central through hole of the reel 12 of the winding 10, having a first end 31, a second end 33, and a longitudinal sliding hole 32 extending between the first end 31 and the second end 33. The fixed iron core 40 is fixedly mounted in the first end 31 of the tubular sliding track 30. The movable iron core 50 moves in the longitudinal sliding hole 32 of the tubular sliding track 30 and partially projects out of the second end 33.

[0011] Referring to Figure 2 again, the movable iron core 50 comprises a body portion 52, a head portion 51 at one end of the body portion 52, a collar 53 raised around the periphery between the head portion 51 and the body portion 52, an exhaust groove 54 longitudinally disposed at the body portion 52, a longitudinal slot 56 at the head portion 51, and two transverse pin holes 57

bilaterally aligned at the head portion 51 in communication with the longitudinal slot 56 and adapted for coupling to a driven device. The whole unit of the movable iron core 50 is preferably integrally made from highly pure iron by forging.

[0012] Referring to Figures 3 and 4 again, the yoke shell 20 comprises a yoke tube 21, a threaded head cap 22 connected to one end of the yoke tube 21, and a bottom cap 23 fastened to one end of the yoke tube 21 remote from the threaded head cap 22. The yoke tube 21 and the threaded head cap 22 are integrally made from metal by forging. The bottom cap 23 and the fixed iron core 40 are also integrally made from highly pure iron by forging.

[0013] Figure 5 shows an open type square solenoid according to the present invention, in which the head portion 51, body portion 52 and collar 53 of the movable iron core 50 are integrally made from highly pure iron by forging.

[0014] Figure 6 shows a push type solenoid according to the present invention, in which the movable iron core 50 is integrally made by forging, having a push rod 60 integral with one end of the body portion 52; the yoke shell 20 is comprised of a yoke tube 21, a threaded head cap 22 integral with one end of the yoke tube 21, and a bottom cap 23.

[0015] As indicated above, the yoke tube and threaded head cap of the yoke shell are integrally made by forging. Therefore the yoke shell can bear high drag forces, shearing forces and twisting forces. Iron cores made from highly pure iron exhibit a magnetic property better than that of free-cutting steel.

[0016] It is to be understood that the drawings are designed for purposes of illustration only, and are not intended as a definition of the limits and scope of the invention disclosed.

Claims

1. A solenoid comprised of a winding (10), a yoke shell (20), a tubular sliding track (30), a fixed iron core (40), and a movable iron core (50), said winding (10) comprising a reel (12) and an enamelled wire (11) wound round said reel, said yoke shell (20) defining a holding space which holds said winding (10) on the inside, said tubular sliding track (30) having first end (31), a second end (33) and a longitudinal sliding hole (32) extending between said first end (31) and said second end (33), said fixed iron core (40) being fixedly mounted in the first end (31) of said tubular sliding track (30), and said movable iron core (50) being movable in the longitudinal sliding hole (32) of said tubular sliding track (30) and partially projecting out the second end (33) of said tubular sliding track (30), characterised in that said movable iron core (50) is integrally made by forging and has a exhaust groove (54).
2. A solenoid according to claim 1, characterised in that said moveable iron core (50) comprises a body portion (52), a head portion (51) at one end of said body portion and a collar (53) raised around the periphery between said head portion (51) and said body portion (52), and said exhaust groove (54) is disposed at said body portion (52) of said movable iron core (50).
3. A solenoid according to claim 2, characterised in that said movable iron core (50) is integrally made from highly pure iron by forging.
4. A solenoid according to claim 1 or claim 2, characterised in that said yoke shell (20) comprises a yoke tube (21), a threaded head cap (22) integral with one end of said yoke tube (21) and a bottom cap (23) fastened to one end of said yoke tube (21) remote from said threaded head cap (22).
5. A solenoid according to claim 4, characterised in that said bottom cap (23) of said yoke tube (20) is integral with said fixed iron core (40).
6. A solenoid comprised of a winding (10), a yoke shell (20), a tubular sliding track (30), a fixed iron core (40), and a movable iron core (50), said winding (10) comprising a reel (12) and an enamelled wire (11) wound round said reel, said yoke shell (20) defining a holding space which holds said winding (10) on the inside, said tubular sliding track (30) being fixedly mounted in a longitudinal central through hole of said reel (12) of said winding (10), said tubular sliding track (30) having a first end (31), a second end (33) and a longitudinal sliding hole (32) extending between said first end (31) and said second end (33), said fixed iron core (40) being fixedly mounted in the first end (31) of said sliding track (30), and said movable iron core (50) being movable in the longitudinal sliding hole (32) of said tubular sliding track (30) and partially projecting out of the second end (33) of said tubular sliding track (30), characterised in that said yoke shell (20) comprises a yoke tube (21), a threaded head cap (22) integral with one end of said yoke tube (21), and a bottom cap (23) fastened to one end of said yoke tube (21) remote from said threaded head cap (22).
7. A solenoid according to claim 6, characterised in that said bottom cap (23) of said yoke shell (20) is integral with said fixed iron core (40).
8. A solenoid according to claim 6 or 7, characterised in that said movable iron core (50) is integrally made from highly pure iron by forging, having a forwardly extended push rod (60) integral with one end of a body (52) thereof.

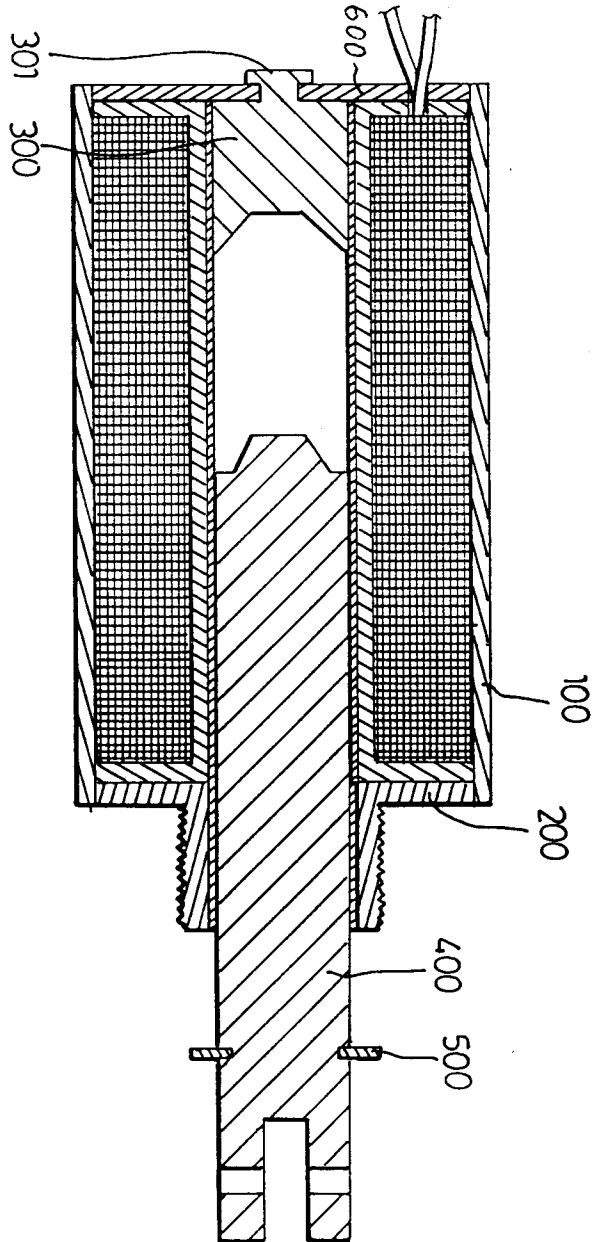


FIG. 1 PRIOR ART

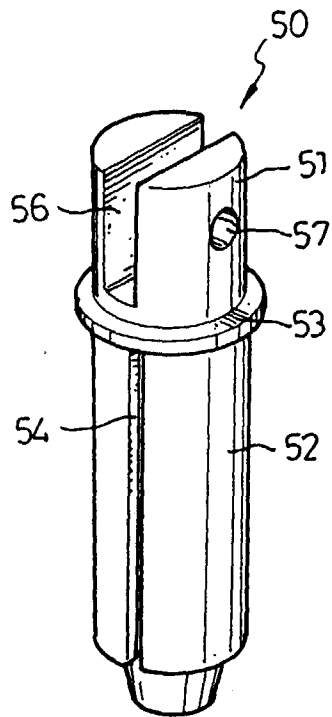


FIG. 2

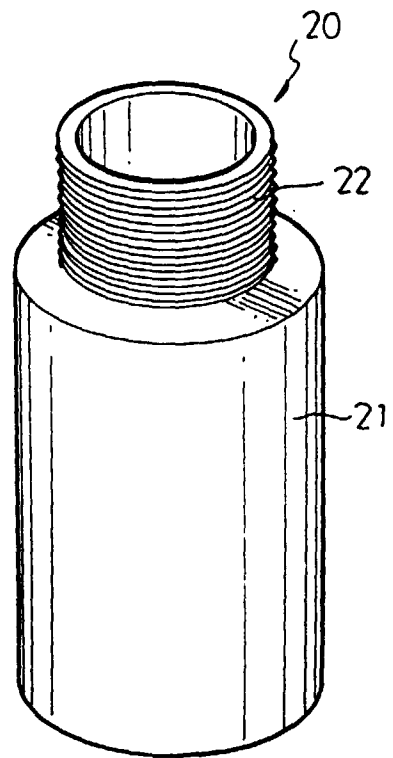


FIG. 3

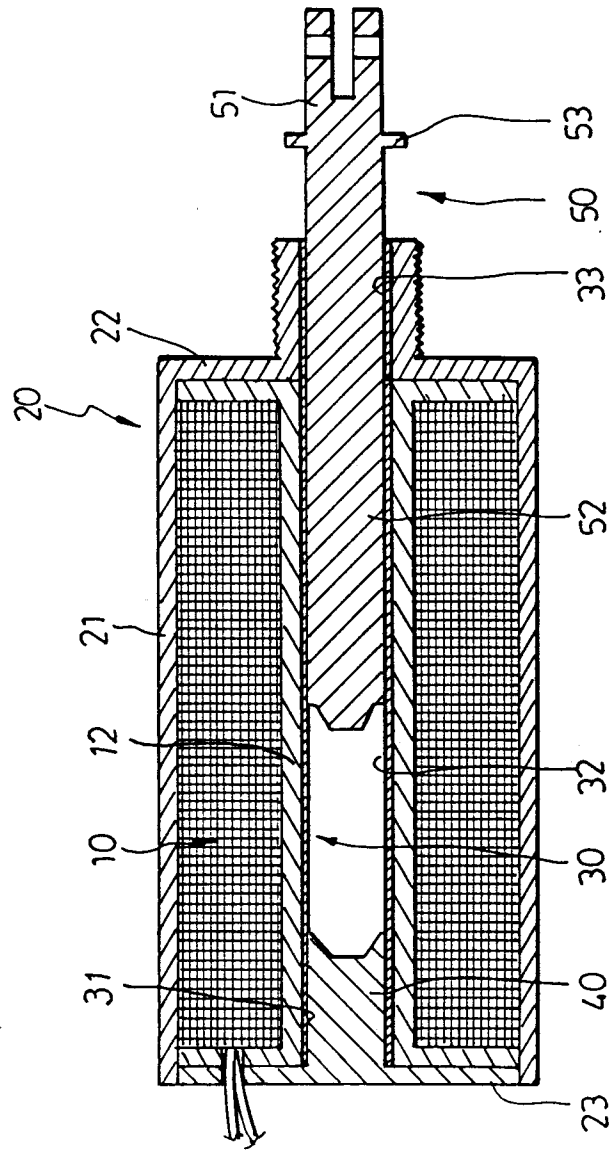


FIG.4

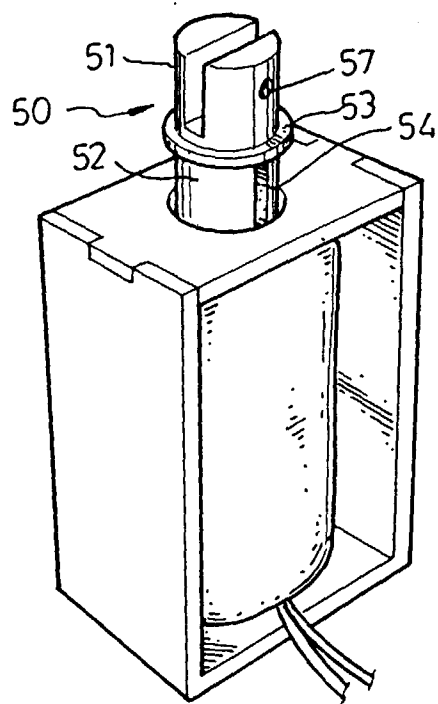


FIG. 5

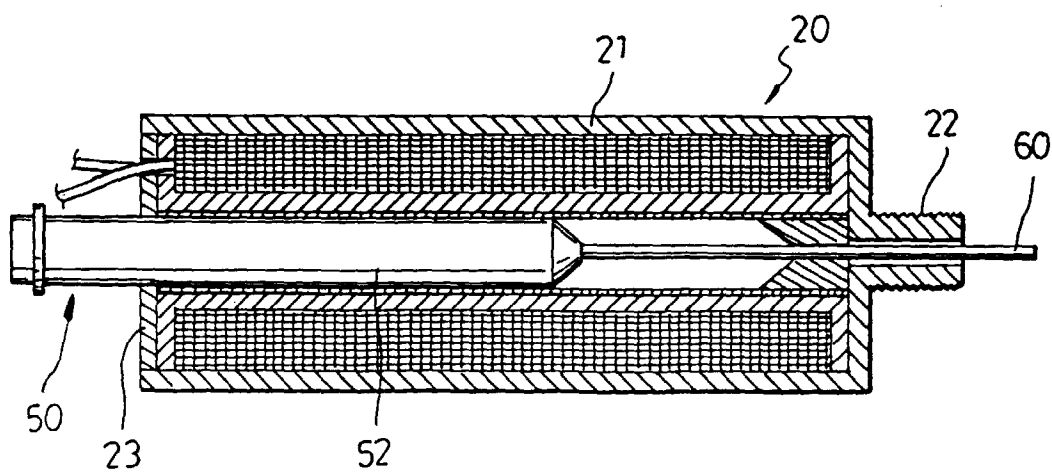


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 7775

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.6)
X	US 4 526 340 A (KOLCHINSKY ABEL E ET AL) * column 4, line 19 - line 38 *	1	H01F7/16
A	---	6	
Y	GB 981 510 A (DONALD ALEXANDER LARNER) * page 2, line 82 - line 94 *	1	
X	---	6,7	
A	---	4,5	
Y	PATENT ABSTRACTS OF JAPAN vol. 015, no. 043 (C-0801), 31 January 1991 & JP 02 277749 A (HITACHI LTD), 14 November 1990, * abstract *	1	
A	---	3	
A	EP 0 009 388 A (LEDEX INC) ---		
A	DE 34 18 654 A (REXROTH MANNESMANN GMBH) -----		
The present search report has been drawn up for all claims			
			H01F
Place of search		Date of completion of the search	Examiner
THE HAGUE		2 March 1998	Vanhulle, R
CATEGORY OF CITED DOCUMENTS 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 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 & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P04C01)