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(54) Electromagnetically operated pump

(57) An electromagnetically operated pump, to feed two-stroke internal-combustion engines with precise and controlled amounts of oil, comprises in a casing (1): a cylinder (2); a piston element (3) with a through pipe (4), axially movable in said cylinder (2); an electromagnetic coil (10) external to the cylinder (2), to control the movements of the piston element (3) against the action of spring means (11); a pumping and metering chamber (7) for the oil to be fed, at one end (9) of the cylinder (2); and valve means (12, 13) housed in said casing (1) close to said end (9), one of said means (12) cooperating with said piston element (3). According to the invention, two opposite abutments (14, 15) are formed on the piston element (3), said abutments (14, 15) cooperating with corresponding abutments (16, 17) of an element apt to stop the cylinder (2) into the casing (1). In said pump, the stroke (C) of the piston element (3) into the cylinder (2) is limited exclusively by the cooperation between said abutments (14, 15 and 16, 17) which thereby determine the metering of the oil to be fed.

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Description

[0001] The present invention concerns an electromagnetically operated pump for the precise and controlled feeding of oil to two-stroke internal-combustion engines.

[0002] There are known to be in technique many types of pumps allowing to feed two-stroke internal-combustion engines with precise and controlled amounts of oil, in strict correlation with the running of the actual engine. Amongst others, use is already being made since quite some time of electrically operated pumps, in which an electromagnetic coil controls the piston of a cylinder in axis therewith, against the action of a spring, so as to empty at each working cycle a pumping chamber thereof in which the oil to be fed is metered.

[0003] The present invention concerns a pump of this type, with the object to improve its characteristics as far as structural simplicity, and metering precision and easiness, all being very important in view of the special use for which said pump is intended.

[0004] To reach this object, the pump according to the invention - comprising in a casing: a cylinder; a piston element with a through pipe, axially movable in said cylinder; an electromagnetic coil external to the cylinder, to control the movements of the piston element against the action of spring means; a pumping and metering chamber for the oil to be fed, at one end of the cylinder; and valve means housed in said casing, close to said end, one of said means cooperating with said piston element - is characterized in that, two opposite abutments are formed onto the piston element, said abutments cooperating with corresponding abutments of an element apt to stop the cylinder into the casing.

[0005] Suitably, said stop element consists of a fastener bearing onto the end of said cylinder opposite to that of the chamber, stout spring means being interposed between said element and the casing to stop the cylinder therein, and the stroke of the piston element into said cylinder is limited exclusively by the cooperation between said abutments.

[0006] The invention will now be described in further detail, with reference to the accompanying drawing, in which:

[0007] Fig. 1 is an axial section view of the improved pump according to the invention;

[0008] Fig. 2 is a partial cross-section view of the pump, along the line II-II of fig. 1;

[0009] Fig. 3 is a perspective view of the means (fastener, washer, spring) to stop the pump cylinder into the casing; and

[0010] Fig. 4 is an enlarged detail of fig. 1, showing how the abutments of the piston element cooperate with the stop element.

[0011] As clearly shown on the drawings, the pump according to the invention comprises a casing 1, containing a cylinder 2 and a piston element 3, axially movable into the cylinder 2 and crossed by a pipe 4 connected with branches 5 and 6 - for oil inlet and outlet respectively - of the casing 1. At one end of the cylinder 2 there is a chamber 7 for pumping the oil to be fed, delimited by the plane surface 8 of the casing 1, onto which bears the cylinder 2, and by the bottom end 9 of the piston element 3. Externally to the cylinder 2 there is an electromagnetic coil 10 fed with pulse current in strict correlation with the running of the two-stroke engine to be equipped with the pump. When energized, said coil 10 controls the movements of the piston element 3 towards the chamber 7, against the action of a spring 11 which acts in an opposite sense when the coil 10 is de-energized. Two ball valves 12, 13, are provided in the casing 1 close to the oil pumping chamber 7, the first of said valves cooperating with the bottom end 9 of the piston element 3, in correspondence of the outlet of the pipe 4. As better explained hereinafter, when the piston element 3 is moved by the electromagnetic coil 10, the valve 12 is closed while the valve 13 opens; viceversa, the valve 13 closes when the piston element 3 is moved by the spring 11 and while the valve 12 opens.

[0012] According to the invention, two opposite abutments 14, 15, are formed on the piston element 3, close to the end opposite to the bottom end 9, said abutments 14, 15, cooperating with corresponding abutments, 16 and 17 respectively, of an element apt to stop the cylinder 2 into the casing 1. In the illustrated embodiment of the pump according to the invention, said stop element consists of a fastener 18 bearing onto the end of the cylinder 2 opposite to that contacting the plane surface 8 of the casing 1, said fastener 18 being pressed, through a bearing washer 18A, by a stout Belleville spring 19 engaging the plane surface 20 of the casing 1. Always, according to the invention, the axial dimensions of the piston element 3 and of its parts, and the axial position therein of the abutments 14, 15, are chosen so that the stroke C of said piston element 3 into the cylinder 2 is limited exclusively by the cooperation between said abutments and the abutments 16 and 17 respectively, and so that the bottom end 9 of the piston element 3 never gets in contact with the plane surface 8 of the casing 1.

[0013] Fig. 1 shows the piston element 3 with its bottom end 9 spaced apart from the plane surface 8 of the casing 1, and the pumping chamber 7 full of oil. In this condition, the abutment 14 of the piston element 3 is in contact with the abutment 16 of the fastener 18, pressed by the spring 11. When, in operation, the coil 10 is energized, the piston element 3 moves towards the plane surface 8 compressing the oil into the chamber 7, while the valve 12 keeps closed the pipe 4 into which flows the oil, let in through the branch 5. The oil pressure in the chamber 7 opens the valve 13 and the oil is fed through the branch 6 into the engine, in the exact and controlled amount corresponding to the volume of the chamber 7 which, at the end of the stroke, is occupied by the piston element 3. It appears evident, from what has been said, that the metering of said amount of oil

depends exclusively on the length of the stroke C of the piston element 3, as well as - of course - on the inside diameter of the cylinder 2. In fact, the piston element 3 stops, with the chamber 7 never completely empty, when its abutment 15 cooperates with the abutment 17 of the fastener 18 (fig. 4). It is also evident that the pumping of the oil is carried out by energizing the electromagnetic coil 10. When the coil 10 is de-energized and its action ceases, the spring 11 causes the piston element 3 to return into its initial rest position; the valve 13, no longer subject to pressure, closes while the valve 12 opens, due to the difference between the pressure of the oil let in upstream of the branch 5 and the oil pressure downstream thereof. The oil thus fills again the pumping chamber 7.

[0014] The pump described heretofore has a very simple structure and its working is very reliable; but, above all, it can be very easily adapted, at extremely reduced costs, to the most different requirements of capacity: the volume of the oil pumping and metering chamber 7 occupied by the piston element 3 (namely, the amount of oil being fed at each piston stroke C) can in fact be easily adjusted, not only by acting on the distance between the abutments 14 and 15 of the piston element 3, but also by simply replacing the existing fastener 18 with a similar fastener of different thickness, or even by varying with a simple mechanical operation the thickness of the fastener 18 being used. It can be easily seen that, by keeping unchanged all the other components of the pump and by merely replacing the fastener 18, a single pump - with specific characteristics according to the invention - can feed even considerably different oil capacities per piston stroke, and be thus immediately adapted to many different requirements and applications. The same can be done, with a simple mechanical operation, by reducing to different extents the thickness of a starting fastener 18 having a single thickness. Moreover, the simple mechanical working of the fastener allows to obtain - in case of special requirements, but, if wishing, also in mass production - extremely precise meterings of the oil volumes being pumped at each piston stroke. Finally, as already said, the structure of the pump according to the invention allows to obtain all this at extremely reduced costs and without having to carry out particularly elaborate mechanical operations.

[0015] It is anyhow understood that further embodiments of the pump can be provided, other than that described heretofore, without thereby departing from the protection scope of the present invention.

Claims

1. Electromagnetically operated pump to feed two-stroke internal-combustion engines with precise and controlled amounts of oil - of the type comprising, in a casing (1): a cylinder (2); a piston element (3) with a through pipe (4), axially movable in said cylinder (2); an electromagnetic coil (10) external to the cylinder (2), to control the movements of the piston element (3) against the action of spring means (11); a pumping and metering chamber (7) for the oil to be fed, at one end (9) of the cylinder (2); and valve means (12, 13) housed in said casing (1) close to said end (9), one of said means (12) cooperating with said piston element (3) - **characterized in that**, two opposite abutments (14, 15) are formed on the piston element (3), said abutments (14, 15) cooperating with corresponding abutments (16, 17) of an element apt to stop the cylinder (2) into the casing (1).

2. Pump as in claim 1), wherein the stroke (C) of the piston element (3) into the cylinder (2) is limited exclusively by the cooperation between said abutments (14, 15 and 16, 17), which thereby determine the metering of the oil to be fed.

3. Pump as in claims 1) and 2), wherein said stop element consists of a fastener (18) bearing onto the end of the cylinder (2) opposite to that of the chamber (7), stout spring means being interposed between said element (18) and the casing (1) to stop the cylinder (2) therein.

4. Pump as in claim 3), wherein said spring means consist of a Belleville spring (19) acting on said fastener (18) through a bearing washer (18A).

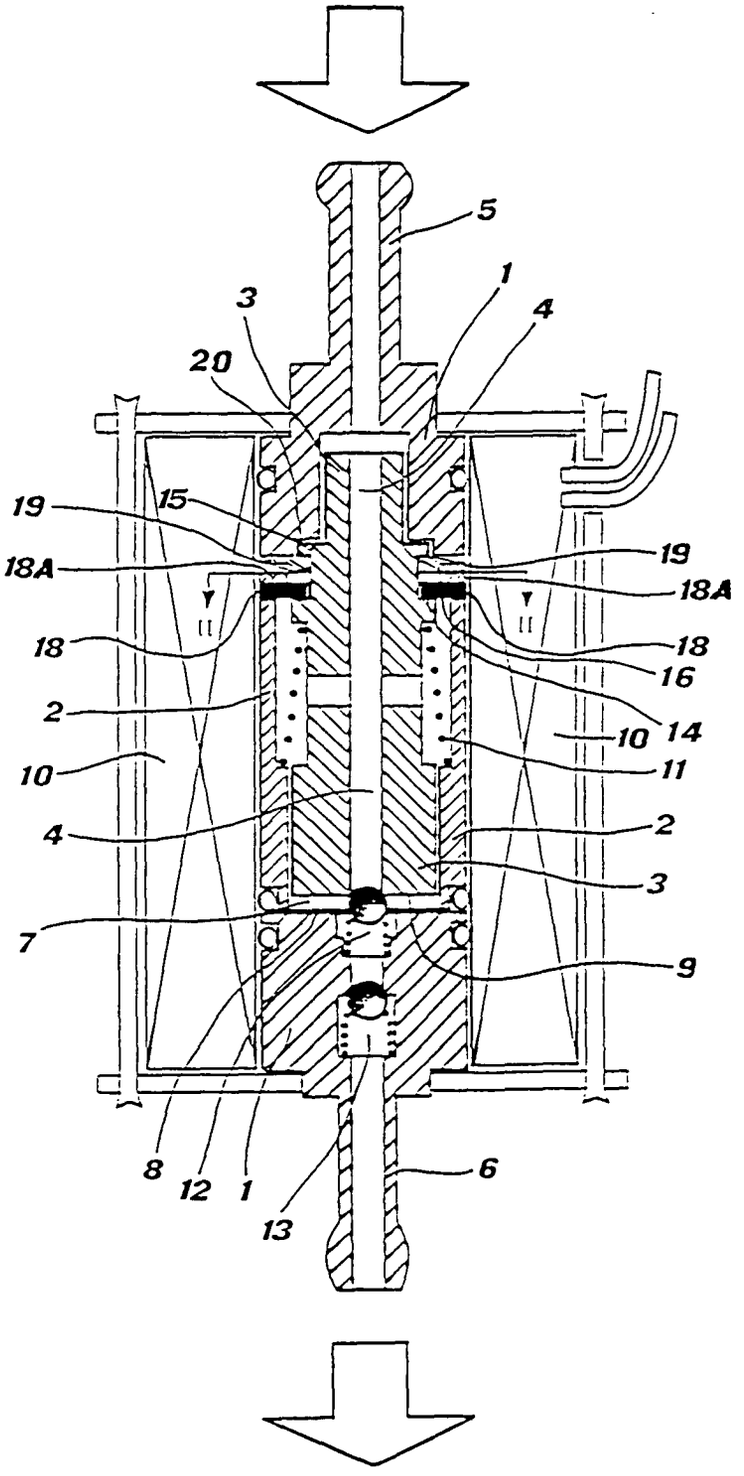

FIG.1

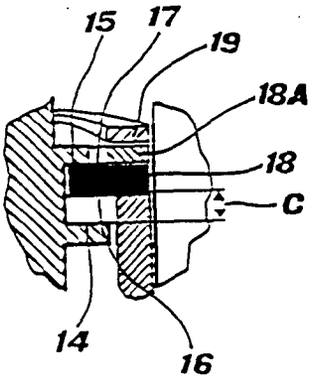

FIG.4

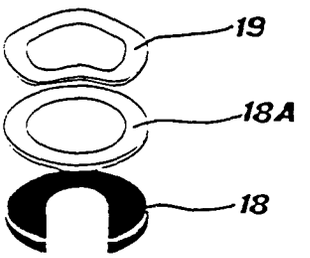

FIG.3

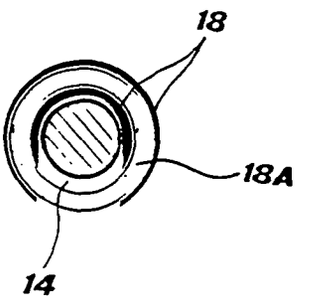

FIG.2

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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 4696

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)
A	EP 0 953 764 A (MAGNETI MARELLI SPA) 3 November 1999 (1999-11-03) * abstract; figures *	1	F04B17/04 F01M3/02
A	EP 1 001 167 A (MIKUNIADEC CORP) 17 May 2000 (2000-05-17) * abstract; figure 1 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F04B
F01M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 May 2002	Mouton, J

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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
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29-05-2002

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