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(54) Automatic variator of comburent air flow in a burner.

(57) The invention discloses an automatic variator of the quantity of air supplied into a burner wherein said variator comprises an air lock (2; 102; 202; 302) hinged next to the opening (12) for the inlet of the combustion air from the helix (9) of the fan to the combustion chamber, which can be adjusted into position through an adjustment rod (6; 106; 206; 306), which co-operates with said air lock through a compensation unit (7; 107; 207; 307). Said compensation unit is attached to the adjustment rod and is in contact with the air lock through a contrasting element (74; 174; 274; 374) which is made to move by a temperature sensitive actuator (72; 172; 272; 372) belonging to the compensation unit.

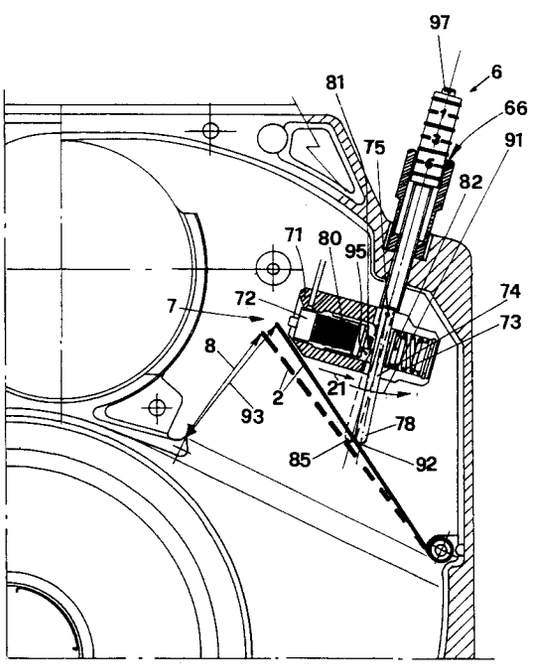

FIG.3

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The invention concerns an automatic variator of the combustion air supplied into a burner.

It is a known fact that the optimum performance of a burner is obtained when the quantity of oxygen sent in with the air is constant.

In order for this to occur, it is necessary for the air supply entering into the burner to vary according to its temperature. In fact, since the impeller of the fan turns at a constant number of r.p.m., it supplies into the combustion chamber a constant volume of air. Therefore, as it is easy to understand from simple thermodynamic considerations and considering that the pressure remains practically constant, that the number of molecules sent in varies with the variation of the air temperature. More specifically, with reference to a pre-determined condition of the outside temperature, the number of the molecules sent into the burner increases if the outside temperature decreases and it decreases whenever the outside temperature increases. It follows that, when the outside temperature of the air increases or decreases, the quantity of oxygen sent into the combustion chamber will be lower or higher respectively in relation to the conditions which permit to obtain an optimum combustion.

For this reason in the burners belonging to the known technique in correspondence with the opening for the inlet of the combustion air from the helix of the fan to the supply duct of the combustion chamber a mobile air lock is arranged. Said air lock is connected with an adjustment rod which, by moving the air lock itself, makes it possible to vary the air supply and therefore the quantity of oxygen entering the burner.

On the basis of what has been said it is obvious that the position of the air lock should be adjusted whenever the outside temperature of the air undergoes a variation, thus forcing the operator to intervene continuously.

It is for this reason that at the moment of starting up the burner the air lock is positioned through the adjustment rod so as to determine a supply permitting a combustion with an excess of oxygen corresponding to approximately 3% as compared to the stoichiometric parameters. The adjustment of this excess of air insures that the combustion occurs, regardless of the variation in the outside temperature, always with a slight excess of oxygen which rules out the possibility of discharging incombustibles into the environment and prevents the formation of deposits within the boiler.

Whenever the burner works with such an excess of oxygen, its performance decreases since a part of the burned fuel is wasted because of the heat in the excess air. In other words there is a higher consumption while the power yielded remains the same.

It is with the purpose of limiting such inconvenience that the variator according to the present invention is disclosed. Its purpose is that of obtaining the automatic variation of the combustion air supplied into the combustion chamber when the temperature conditions at the air inlet vary.

Another purpose of the variator according to the present invention is for the burner to perform with a lower excess of oxygen than the burners belonging to the known technique and offering the same performance.

The described purposes are reached by the invention of an automatic variator of the combustion air supplied into a burner, wherein said variator in accordance with the main claim comprises:

- an air lock, hinged in correspondence with the opening for the inlet of the combustion air from the helix of the fan to the combustion chamber, and adjustable into position through an adjustment rod and is characterized in that said adjustment rod cooperates with the mentioned air lock by means of a compensation unit which is secured to the adjustment rod itself and connected with said air lock by a contrasting element which is made to move by an actuator, sensitive to the variations of the temperature, wherein said contrasting element and said actuator belong to said compensation unit.

Advantageously through the automatic variator of the present invention the excess of air sent into the combustion chamber is decreased and, as a consequence, that is true also of the fuel combustion, while the power yielded remains the same.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description and from the drawings wherein:

- Fig. 1 shows in a longitudinal cross-section the variator according to the invention;
- Fig. 2 shows the automatic variator of Fig. 1 with the air lock arranged in the position which it acquires when the compensation unit registers a decrease in the outside temperature;
- Fig. 3 represents the automatic variator of Fig. 1 with the air lock in the position it acquires when the compensation unit registers an increase in the outside temperature;

- Fig. 4 represents a view of the compensation unit of the automatic variator according to the invention;
- Fig. 5 represents another view of the compensation unit of the automatic variator according to the invention;
- Fig. 6 represents a different embodiment of the automatic variator according to the invention;
- Fig. 7 represents yet another different embodiment of the automatic variator according to the invention;
- Fig. 8 represents another view of the different embodiment of the automatic variation represented in Fig. 7;
- Fig. 9 represents yet another view of the different embodiment of the variator represented in Fig. 7.

As can be observed in Fig. 1, the automatic variator according to the invention, indicated as a whole with 1, comprises an air lock 2, hinged to body 4 of the burner at the spot marked with 3, and it can rotate around said spot 3 following both directions of arrow 5 when the adjustment rod 6 is operated.

In detail it will be observed that the air lock 2, by rotating around hinge 3, causes the variation of the dimensions of opening 8 through which the combustion air, coming from the helix 9 of fan 10, flows following direction 11 through the inlet opening 12, obtained within body 4 of the burner and from there it is conveyed following direction 13 into the supply duct 14 of the burner's head, which leads into the combustion chamber.

It will be observed further in Fig. 1, that the adjustment rod 6 presents an index 61, innerly matching a lock nut 62, screwed through thread 63 on the threaded stem 64 of rod 6.

Stem 64 is in turn coupled through yet another through-going thread 65 within body 4 of the burner.

The bottom end 96 of stem 64, as can be observed in Fig. 4, is matched with body 71 belonging to a compensation unit, indicated as a whole with 7, and which also comprises an actuator 72, which is sensitive to temperature, a contrasting spring 73, opposing the actuator and an oscillating pin 74, fulcred through a pivot 75 on body 71 and comprised between the actuator 72 and spring 73, as can be observed in Fig. 1.

The contact between stem 64 of the adjustment rod 6 and the air lock 2 occurs through the interposition of the compensation unit 7 and, more specifically, of its oscillating pin 74, against the air lock 2 itself.

When the burner is started, the position of the air lock 2 is calibrated by acting on the adjustment rod 6. More precisely, nut 62 is loosened, so as to make it possible for stem 64 to freely rotate through the rotation of screw 97. Index 61 is complete with a plurality of notches 67, each of which indicates, with reference, for instance, to the upper surface 66 of nut 62, the position of stem 64 corresponding to the correct position of the air lock 2, which will guarantee the optimum conditions under which the burner will work at its best.

While index 61 is rotating, stem 64 moves downwards or upwards along axis 15, according to the direction of thread 65, thereby dragging along in its rotation the entire compensation unit 7, its body 71 being kept in the correct position by the sliding surface 77, belonging to body 4 of the burner.

While the adjustment rod 6 moves, the air lock 2 remains in contact with the end 78 of the oscillating pin 74, since the former is pushed against said end 78 by the elastic effect of a spring 16, arranged within its hinge 3 and by the pressure of the air 11, generated by fan 10.

While the burner is working, the variations in the temperature are registered by an outside sensor (not represented in the drawings) which, through a capillary tube 79, containing a liquid which is sensitive to temperature, is connected with the sensitive actuator 72, belonging to the compensation unit 7.

Should the outside temperature vary, this causes the volume of the liquid contained in the sensor, in the capillary tube 79 and in the actuator 72 to vary, thereby causing variations in the length of the actuator 72, which, as can be observed in Fig. 1, consists of a plurality of elastic chambers 80, all of which are in communication with each other.

For instance, should the outside temperature decrease, the sensitive liquid undergoes a contraction which causes the length of actuator 72 to become shorter. In this case, as can be observed in Fig. 2, the head 81 of the actuator positioned in contact with the oscillating pin 74 through a bushing 95, draws backwards following direction 20 and spring 73, no longer being contrasted, and causes the rotation of the oscillating pin 74 by means of plate 82 around pivot 75 following the direction represented by arrow 83. The latter causes the displacement of end 78 of the oscillating pin 74 from position 85 to position 86 which, as can be observed, entails a movement of air lock 2 from its preceding position (represented with a marked dotted line in Fig. 2) representing opening 8 to a new position corresponding to a new opening 90 which is smaller than the preceding one. Thus a decrease in the amount of air supplied into the combustion chamber is achieved as a consequence of the decreased passage space for the air coming from the helix 9 of the fan. As a consequence the

quantity of oxygen introduced into the combustion chamber is maintained constant, if one considers that, as has already been said, if the temperature in the same volume of air decreases, the number of molecules and, as a consequence, the amount of oxygen contained therein increase. It can be observed in detail that the oscillating motion of the pin 74 is made possible, as can be observed in Fig. 5, by the fact that in body 71 of the compensation unit 7 there is a slot 50 within which the oscillating pin 74 can acquire any position during its oscillating movement.

If, on the other hand, the outside temperature increases, the sensitive liquid increases in volume and, as a consequence, it causes the lengthening of the actuator 72, the head 81 of which, through bushing 95 moves following direction 21, opposite to the previously described one, as can be observed in Fig. 3. Said head 81 pushes the oscillating pin 74, thereby causing both its rotation in the direction indicated by arrow 91 and the compression of spring 73.

This entails the displacement of end 78 of the oscillating pin 74 from its initial position 85 to position 92 which, as can be observed, entails the displacement of the air lock 2 from its initial position (represented with a marked dot line in Fig. 2) corresponding to opening 8, to a new position corresponding to a new opening 93, which is larger than 8. This permits the inlet into the combustion chamber of a larger amount of air. The quantity of oxygen entering into the combustion chamber remains, therefore, practically constant, since there occurs an increase in the air volume at a higher temperature, containing a smaller number of molecules and, therefore, of oxygen, as compared with the previously described situation.

It can, therefore, be understood, how the compensation unit 7 makes it possible to obtain a series of positions centering on the initial position of the air lock 2 and becoming larger or smaller following the variations of the outside temperature of the air, said varying positions being suited to increase or decrease the quantity of air supplied into the combustion chamber, so as to maintain practically constant the quantity of oxygen supplied.

Should different types of nozzles be assembled in the burner, it becomes necessary to replace pin 74 with another one having different dimensions.

A different embodiment of the described compensation unit is based on the same performance principle and is represented in Fig. 6, wherein the compensation unit, indicated as a whole with 207, comprises, in this case, too, a body 271 within which there is an actuator 272, sensitive to temperature. Opposite it there is a contrasting spring 273 which is co-axial with it.

In this modified embodiment the contrasting element consists of stem 274 belonging to piston 276 which co-operates with actuator 272, sensitive to temperature and can slide within body 271 of the compensation unit 207.

Stem 274 is arranged co-axially inside the contrasting spring 273 and its end is shaped as a ball 278 which contrasts against the air lock 202 through the interposition of a cam 215.

Body 271 of the compensation unit 207 is attached to body 204 of the burner through a pivot 268 around which it can yieldingly rotate thanks to a spring 269, presenting an end 218 attached to the body 204 of the burner and the opposite end 219 attached to the body 271 of the compensation unit 207.

In this case, too, the adjustment of the opening of the air lock 202 occurs through the changing positions of the adjustment rod 206, the threaded stem 264 of which maintains under stress spring 269 by contrasting against body 271 of the compensation unit 207.

Therefore, the displacement of the adjustment rod 206 causes the compensation unit 207 to rotate around pivot 268 which in turn allows the adjustment of the opening of the airlock 202, following the temperature registered by index 261 of the adjustment rod 206. In fact, when the temperature becomes higher or lower than the pre-determined value, the degree of aperture of the air lock 202 changes automatically because of the changing position of end 278 of stem 274 caused by the actuator 272, sensitive to temperature and acting on piston 276.

In both the described embodiments the automatic variator of the air supply according to the invention permits the automatic adjustment of the supplied quantity of air following the variation in the air temperature, said quantity varying from a predetermined air quantity through the changing positions of the adjustment rod which is chosen in accordance with the type of nozzle assembled in the burner.

Whenever nozzles of different types are assembled in the burner, it becomes necessary to replace the cam with another one having a different profile and to position the adjustment rod so as to vary the opening of the air lock, in order to permit the inlet of a different amount of air supply. Thereafter, the automatic variator will increase or decrease said pre-determined opening following the variations of the air temperature.

Yet another differing embodiment of the invention, represented in the Figs. 7, 8 and 9, foresees the compensation unit 107 to comprise the body 171, fulcred on the body 104 of the burner through a pivot 168, around which it can rotate, since it is made elastic through a spring 169, when it is

pushed by an adjustment rod 106.

The contrasting element 174 consists of a pin which moves by rotating around a pivot 175 through which it is fulcred on the body 171. The rotation occurs because of the action of the actuator 172 which is sensitive to temperature variations, is contained within body 171 and contrasts against a contrasting spring 173, which is co-axial with it and is also contained within body 171.

The tapered end 178 of the contrasting element 174 is in contact with a cam 115 applied on the air lock 102, wherein said cam, as can be observed in the Figs. 8 and 9, presents in the longitudinal direction 315 the longitudinal profile 316, visible in Fig. 7, while in the transversal direction 317 it presents the transversal profile 318, visible in Fig. 9.

The shape of cam 115 develops, therefore, over a surface, indicated as a whole with 319, against which the tapered end 178 of the contrasting element 174 contrasts.

By correctly positioning the adjustment rod 106,because of rotation of the body 171 around the pivot 168, the end 178 of the contrasting element 174 positions itself along the longitudinal profile 316 of cam 115, thereby allowing several variations in the degree of aperture of the air lock 102, which can be smaller or larger than the pre-determined opening, each degree of aperture being suited to allow the inlet of the amount of air necessary to guarantee an optimum performance of the burner according to any type of nozzle.

More specifically, in order to point out a situation of wider opening, Fig. 7 shows with a dotted line the position acquired by the air lock 102 when the contrasting element 174 is in contact with part 400 having a larger curvature than cam 115.

Following the variations of the air temperature, the widening or narrowing of the opening of the air lock as compared with the initially pre-determined degree of opening occur because of the displacement of the end 178 of the contrasting element 174 along the transversal profile 318 of cam 115, because of the action of the actuator 172 which is sensitive to temperature changes.

Another different embodiment, represented in Fig. 10, foresees the compensation unit 307 to comprise a body 371 fulcred on the body 304 of the burner thorough a pivot 368, around which it can rotate, since it is made elastic through a spring 369, when it is pushed by the adjustment rod 306.

The actuator 372 which is sensitive to temperature changes, is contained within the body 371 within which it is comprised between the bottom 472 of the body 371 and a bushing 373 axially sliding within the body 371, wherein said actuator is made elastic through a contrasting spring 473.

Outside said body 371 and co-axial with the same, is placed the contrasting element 374, which, as it can be observed, comprises a tubular element which is placed outside the body 371 of the compensation unit and co-axial with it and is complete with an end 378 having an essentially ball-shaped surface positioned in contact with the round profile 416 of a cam 415 attached to the air lock 302.

The contrasting element 374 can telescopically and co-axialy slide in relation to body 371 of the compensation unit 307, since it is connected with it through a pivot 385 passing through transversally both within bushing 373 and in the slots 387 obtained in the body 371.

It can be observed that, when the temperature increases the actuator 372, which is sensitive to temperature changes, becomes longer and, as a consequence, it displaces the contrasting element 374 in the direction indicated by arrow 386, since pivot 385 is free to move in direction 386 within the slots 387. This offers the advantage of a decrease in the overall dimensions when the temperature increases.

In this embodiment, too, through the correct positioning of the adjustment rod 306, the end 378 of the contrasting element 374 displaces itself along profile 416 of cam 415, thereby allowing variations of a larger or smaller opening of the air lock 302 as compared to the pre-determined opening, each being suited to allow the inlet of the quantity of air necessary to the optimum performance of the burner for any type of nozzle.

When the air temperature varies, the larger or smaller degree of opening, as compared with the pre-determined opening occurs because of the displacement of the air lock 302 operated by the end 378 of the contrasting element 374, because of the action of the temperature sensitive actuator 372.

Experimental tests performed on prototypes have made possible automatic adjustments of an increased or decreased volume of air supplied, as compared with a pre-determined quantity, and chosen according to the supply necessary for the type of nozzle mounted in the burner. These tests had the purpose of limiting the excess of the air in the combustion chamber, thereby achieving considerable reductions in the fuel consumption.

During the manufacturing process the adjustment rod, the compensation unit, the air lock, as well as the elastic means controlling the movements of the air lock and of the compensation unit may acquire shapes differing from the described ones. Said possible changes will, however, still fall within the spirit and scope of the present invention, such as they are claimed hereinafter.

Claims

1. An automatic variator of the combustion air supplied into a burner comprising an air lock (2; 102; 202; 302) hinged in correspondence with the opening (12) for the inlet of the combustion air from the helix (9) of the fan to the combustion chamber, and adjustable into position through an adjustment rod (6; 106; 206; 306) provided with a stem (64; 264) coupled within the body (4; 104; 204; 304) of the fan, characterized in that the end of said stem (64; 264) of said adjustment rod (6; 106; 206; 306) cooperates with a compensation unit (7; 107; 207; 307) complete with a contrasting element (74; 174; 274; 374) the end of which (78; 178; 278; 378) is in contact with said air lock, said contrasting element (74; 174; 274; 374) belonging to the body (71; 171; 271; 371) of the compensation unit (7; 107; 297; 307) and being operated through a temperature sensitive actuator (72; 172; 272; 372), also belonging to the body of the compensation unit.

2. An automatic variator according to claim 1, characterized in that the temperature sensitive actuator (72; 172; 272; 372) is contained within the body (71; 171; 271;371) of the compensation unit (7; 107; 207; 307) and is positioned in axial contrast against a contrasting spring (73; 173; 273; 473), the latter being also contained within the actuator body, the contrasting element (74; 174; 274; 374) being comprised between said actuator and said spring.

3. An automatic variator according to claim 1, characterized in that the stem (64; 264) of the adjustment rod (6; 106; 206; 306) is complete with a thread (65) and it presents at one of its ends an index (61; 261), said stem and said index being inserted into and going through a nut (62) screwed around the stem itself and contrasting against the body (4; 104; 204; 304) of the burner.

4. An automatic variator according to claim 3, characterized in that the index (61; 261) is complete with reference notches (67) relating to an upper surface (66) of the nut (62) acting as a reference point, said index (61; 261) matching said nut.

5. An automatic variator according to claim 1, characterized in that the body (71; 171; 271; 371) of the compensation unit (7; 107; 207; 307) co-operates with the end of the stem (64; 264) of the adjustment rod (6; 106; 206; 306) which protrudes toward the interior of the body (4; 104; 204; 304) of the burner.

6. An automatic variator according to claim 1, characterized in that the body (171; 271; 371) of the compensation unit (107; 207; 307) is attached to the body (104; 204; 304) of the burner by means of a pivot (168; 268; 368) around which said compensation unit can yieldingly rotate by means of elastic means.

7. An automatic variator according to claim 6, characterized in that the elastic means which cause the rotation of said body (171; 271; 371) of said compensation unit (107; 207; 307) to be yielding around said pivot (168; 268; 368) are at least one spring (169; 269; 369) the ends of which are attached, the one (218) to the body (104;204; 304) of the burner and the other one (219) to the body (171; 271; 371) of the compensation unit (107; 207; 307).

8. An automatic variator according to claim 7, characterized in that said at least one spring (169; 369) is co-axial with the pivot (168; 368).

9. An automatic variator according to claim 1, characterized in that the contrasting element is a pin (74; 174) oscillating around a pivot (75; 175) attached to the body (71; 171) of the compensation unit (7; 107) and is free to oscillate within a slot (50) made in the body (71; 171) of the compensation unit (7; 107).

10. An automatic variator according to claim 1, characterized in that the contrasting element consists of a stem (274) complete at one of its ends with a piston (276) sliding within the body (271) of the compensation unit (207) to which it belongs and axially co-operating with the temperature sensitive actuator (272).

11. An automatic variator according to claim 1, characterized in that the contrasting element (374) consists of a tubular element, co-axially arranged outside the body (371) of the compensation unit (307) to which it belongs, said contrasting element (374) co-operating with said body (371) through the interposition of a bushing (373) co-axially sliding within the body (371) said contrasting element (374) being connected through junction means to said bushing (373).

12. An automatic variator according to claim 11, characterized in that the junction means of said contrasting element (374) with said bushing (373) consist of at least one pivot (385) connecting them together and going through slots

(387) made laterally in the body (371) itself.

13. An automatic variator according to claim 1, characterized in that the end (78) of the contrasting element (74) is directly in contact with the air lock (2).

14. An automatic variator according to claim 1, characterized in that the end (178; 278; 378) of the contrasting element (174; 274; 374) is in contact with the air lock (102; 202; 302) through the interposition of a cam (115; 215;415).

15. An automatic variator according to claim 1, characterized in that the end of the contrasting element (74; 174) is a tapered end (78; 178) made in the contrasting element itself.

16. An automatic variator according to claim 1, characterized in that the end of the contrasting element (274; 374) is an essentially ball-shaped surface (278; 378).

17. An automatic variator according to claim 1, characterized in that the air lock (2; 102; 202; 302) is made yielding at the spot where it is hinged (3) through at least one elastic element (16) which connects it with the body (4; 104; 204; 304) of the burner.

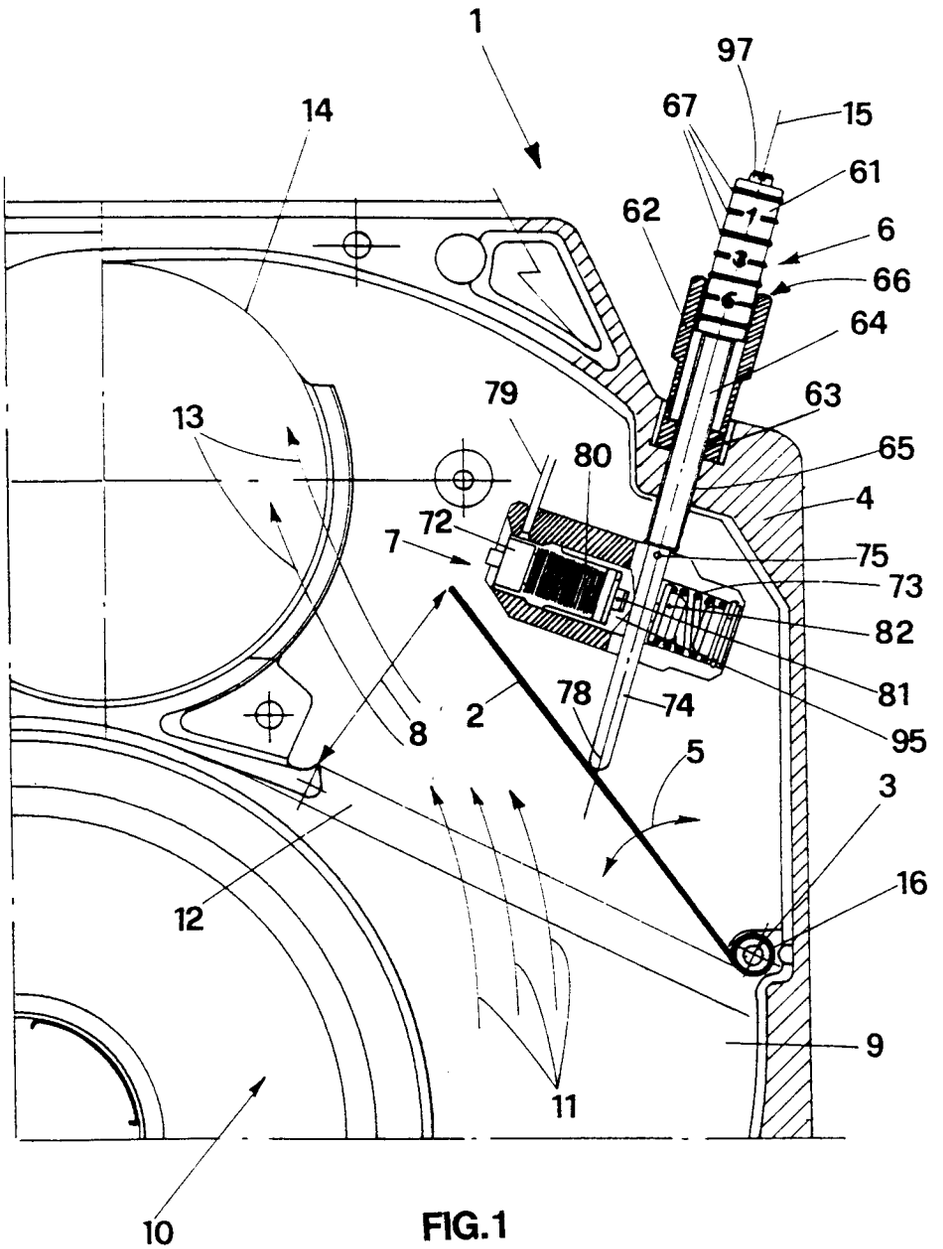
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FIG.1

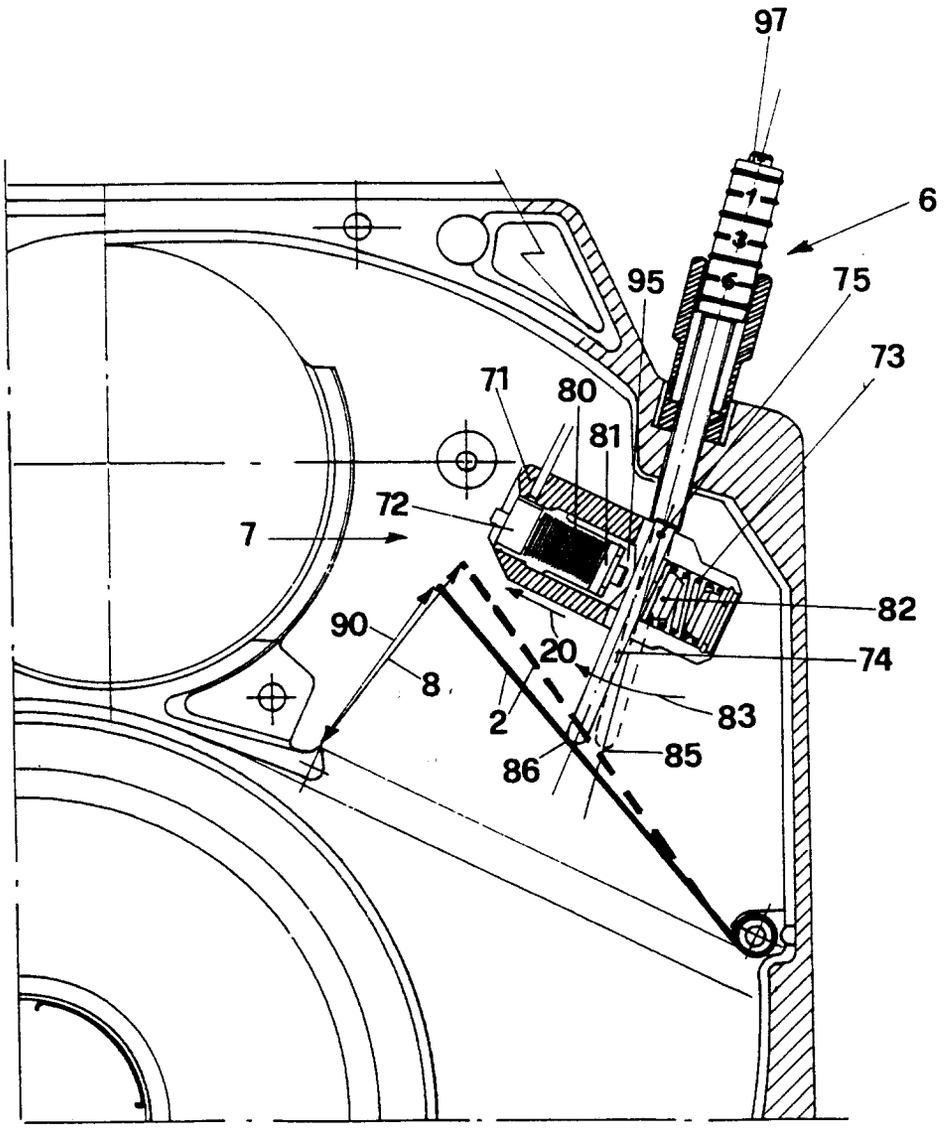

FIG.2

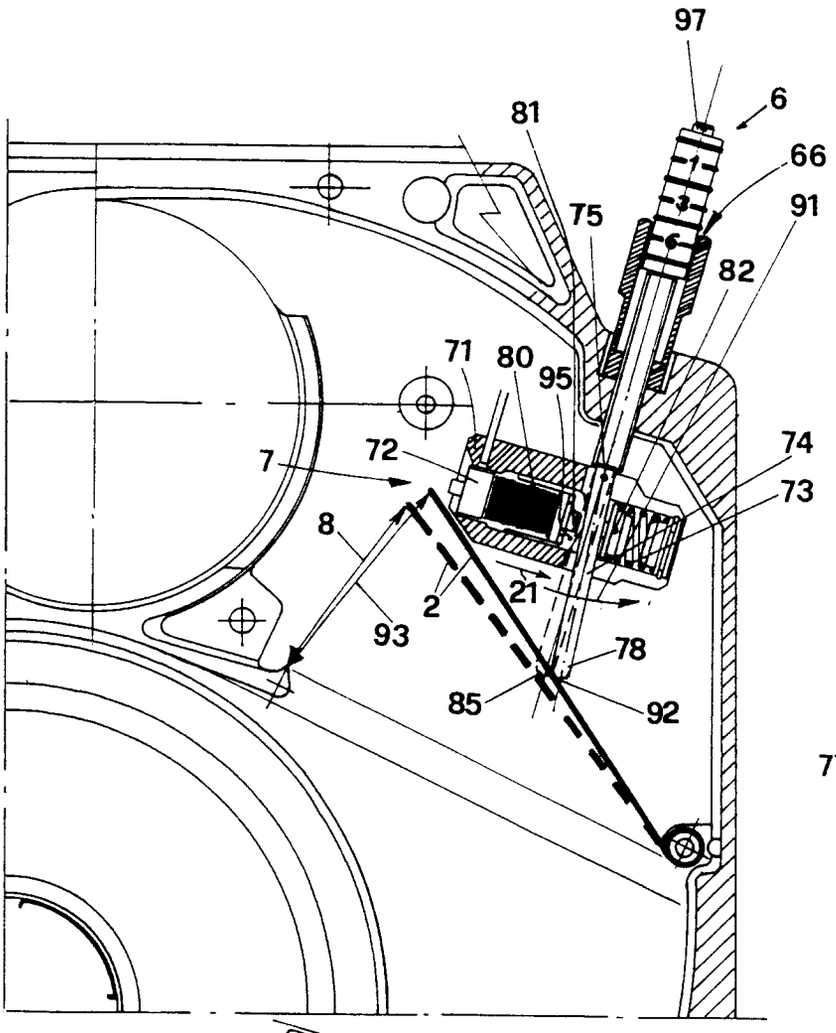

FIG.3

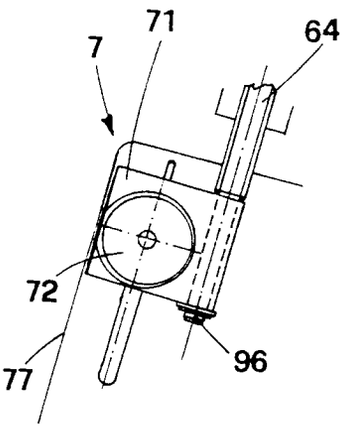

FIG.4

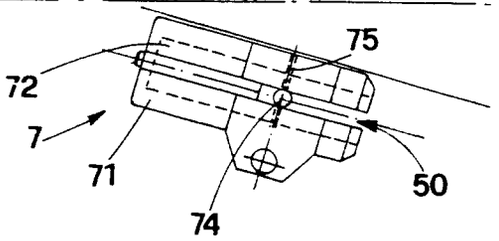

FIG.5

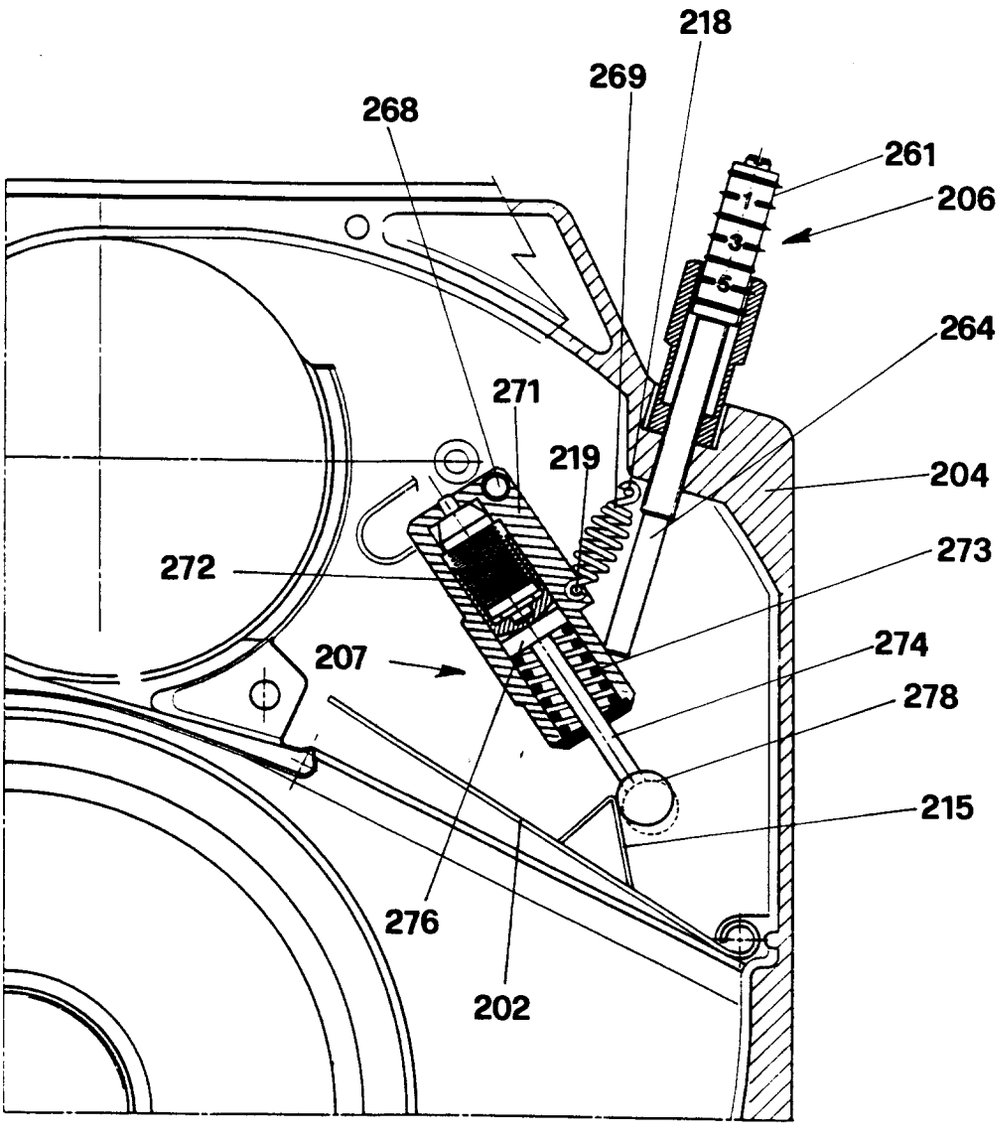
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FIG.6

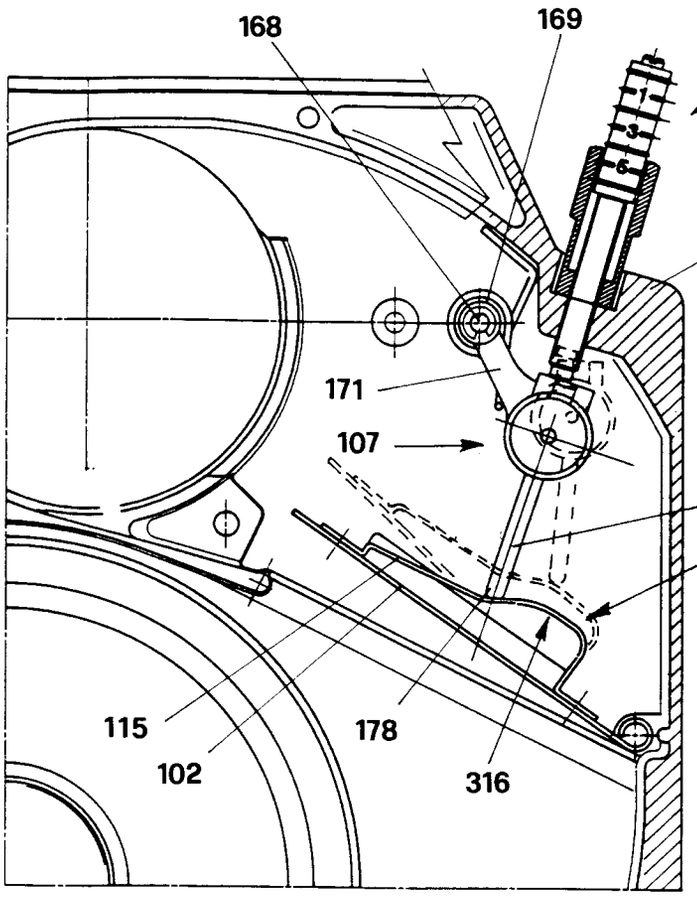


FIG.7

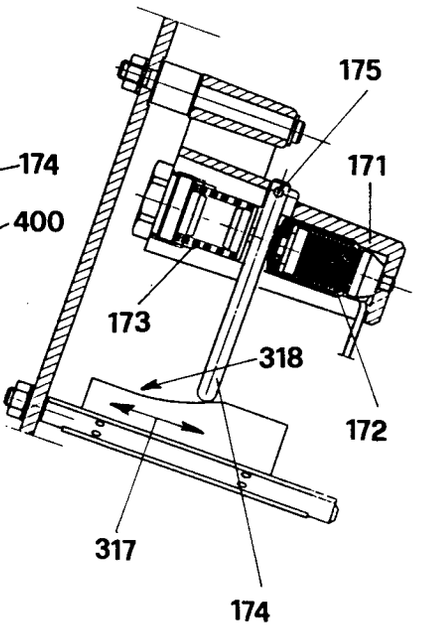


FIG.9

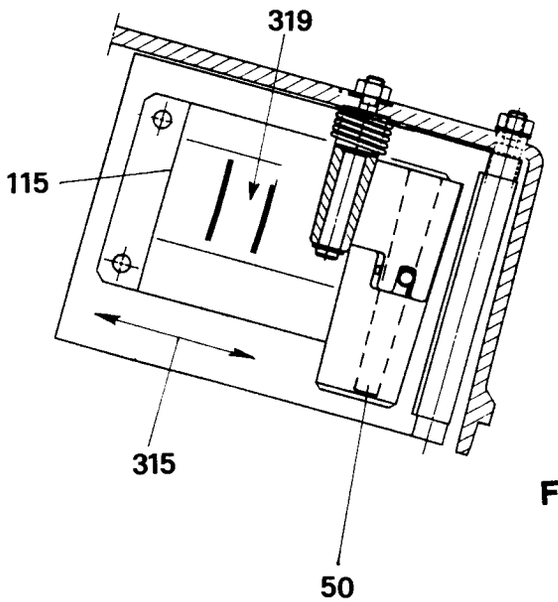
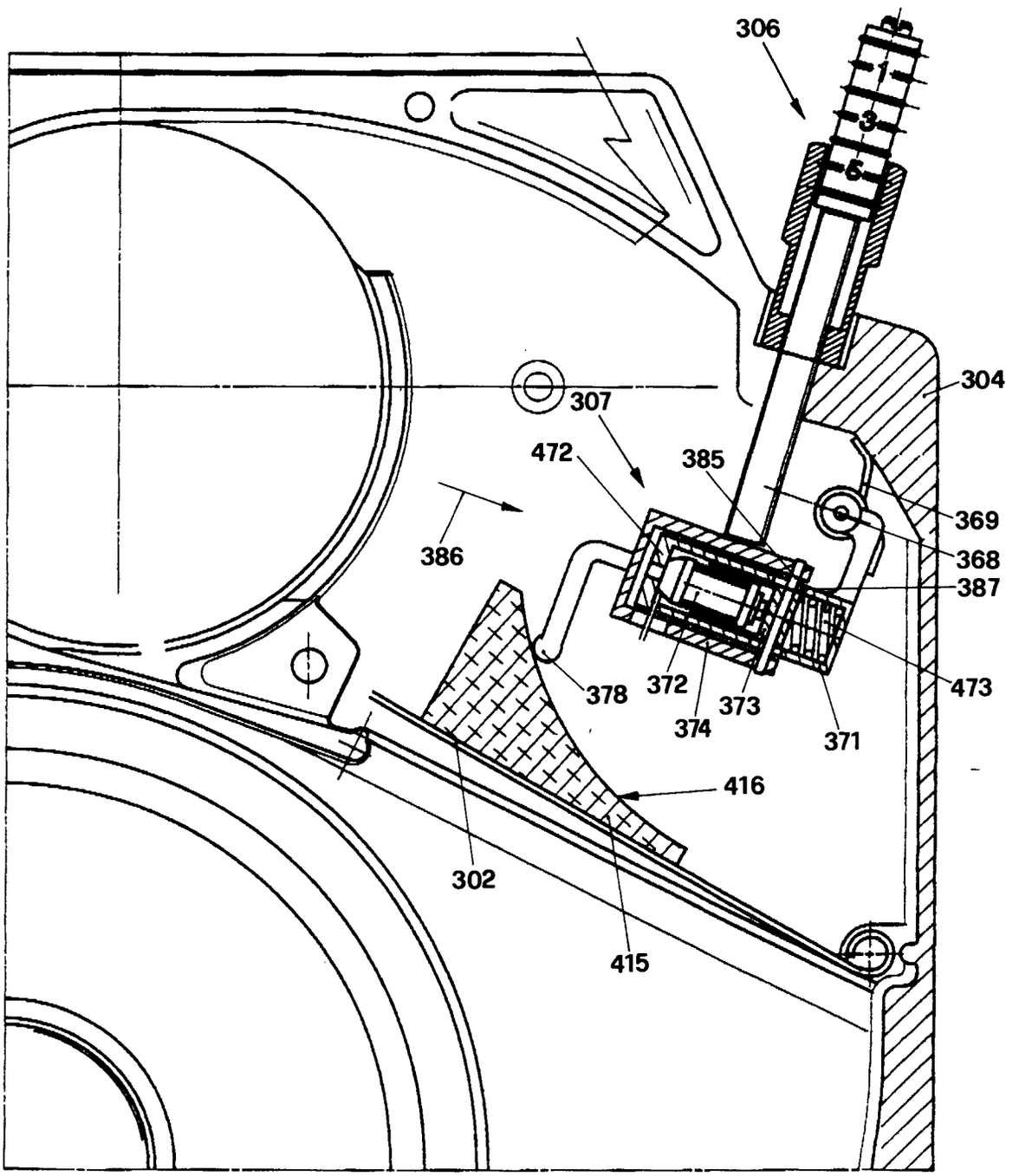


FIG.8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368
386
387
473
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416
302
415

FIG.10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 10 1909

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.5)
X	PATENT ABSTRACTS OF JAPAN vol. 10, no. 222 (M-504)2 August 1986 & JP-A-61 059 114 (YOSSHINARI YUJI) * abstract *	1	F23N3/04 F23C7/00
Y	* figure *	2	
Y	GB-A-465 597 (SATCHWELL)	2	
A	* the whole document *	1,3,4	
A	US-A-2 681 695 (BILLS) * figure 6 *	1	
A	DE-A-3 310 507 (BRÖTJE) * the whole document *	1	
A	GB-A-1 271 794 (DRAYTON HYDROFLEX)		
A	GB-A-1 307 987 (ALLIED IRONFOUNDERS)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F23N
F23C
F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 APRIL 1993	KOOIJMAN F.G.M.

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