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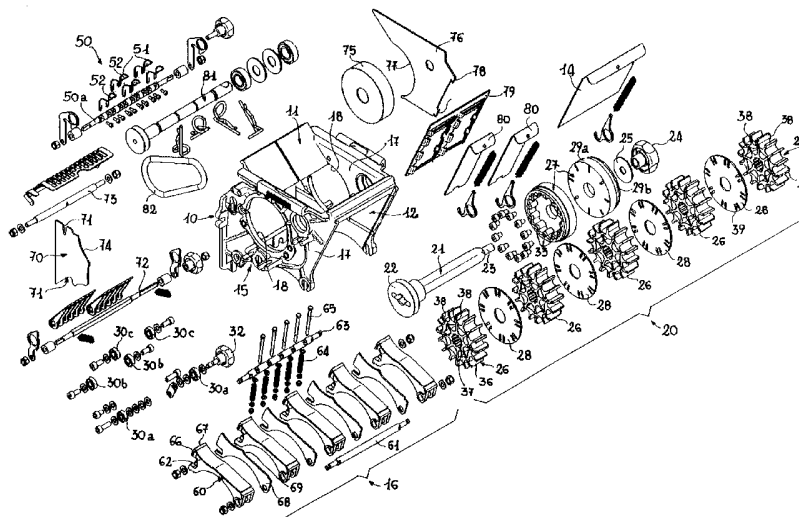
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(54) Title: A VOLUMETRIC METERING DEVICE FOR THE METERED DELIVERY OF GRANULAR AND POWDERY MA-
TERIALS, PARTICULARLY FOR MACHINES FOR DISTRIBUTING THE SAID MATERIALS



(57) Abstract: A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials, comprises a housing (10) formed in one piece of plastics material, a metering member (20) which is supported rotatably in the housing, can be handled individually, and includes a plurality of metering wheels (26) mounted on a shaft (21) and clamped in a group between two flanges (27), selective drive-transmission means (41) interposed between the wheels and the shaft, scraper means (50) for cleaning the wheels in motion and anchoring the idle wheels, and a feeler device (16) which is held at a distance from the metering member with resilient preloading.

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A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials.

Technical field

The subject of the present invention is a metering device for the metered
5 delivery of granular and powdery materials, particularly for machines for distributing the said materials.

Technological background

Volumetric metering devices are used widely in many different technical fields in which there is a need to deliver a substantially continuous and measured
10 flow of material over time. For example, the technical field of agricultural sowing machines with pneumatic seed-transportation is typical; in these machines it is known to provide a seed-loading hopper at the base of which a metering device, generally of the volumetric type with blades, is fitted and supplies metered quantities of seeds into a Venturi duct by which the seeds are admitted to an air-
15 flow and transported to the sowing drills.

The particular and preferred application of the invention is in all cases in which it is necessary to vary the flow-rate delivered, possibly within a fairly large range of values.

Typical metering devices formed in accordance with the prior art are
20 described, for example, in EP 0702890, EP 0606541, EP 0471155, and US-A-6138591.

Conventional metering devices normally comprise a box-like structure in which a bladed metering member is supported rotatably and cooperates with a flow-restricting device for regulating the flow-rate delivered. In one example, the
25 restricting device comprises a jacket movable axially in adjustable manner relative to the rotor of the distributor so as to cover a portion of the set of blades in order to reduce the overall capacity of the cells available. Alternatively, the rate of rotation of the metering member may be varied, or the capacity of the cells may be varied.

30 A first problem resulting from the known structure of conventional distributors is that they do not permit large adjustments of flow-rate whilst maintaining constant regulation of the metering for each adjustment. In fact there are critical speeds of the metering member beyond which its reliability is reduced.

A second problem typical of known structures is that they comprise a plurality of parts which have to be assembled by means of connections, screws, flanges etc. This philosophy is rather unsuitable for agricultural machines for which many adjustments have to be performed in the field and the consequent
5 need to remove various parts may lead to their loss, making reassembly impossible.

A further problem characteristic of metering devices is that they are subject to irremediable damage, or at least to blockage of the metering member, when foreign bodies of considerable size reach its rotor. In the absence of a timely
10 indication of this situation, particularly during sowing, it is possible, completely unwittingly, to sow whole fields unevenly or not at all.

Description of the invention

These problems and yet others which will become clearer from the following description are addressed and solved by the invention by means of a
15 metering device formed in accordance with the appended claims.

Brief description of the drawings

The characteristics and the advantages of the invention will become clearer from the detailed description of a preferred but not exclusive embodiment described by way of non-limiting example, with reference to the appended
20 drawings, in which:

- Figure 1 is a schematic view showing, in section, the basic components of a machine for distributing granular materials,
- Figure 2 is an exploded, perspective view of a delivery device formed in accordance with the present invention,
- 25 - Figure 3 and Figure 4 are exploded views of respective variants of a detail of the device of Figure 2,
- Figures 5, 6 and 7 are perspective views of the device of Figure 2 in the assembled condition, taken from different angles,
- Figures 8 and 9 are perspective views of the device of Figure 2 in an only
30 partially assembled condition, taken from different angles,
- Figure 10 is a perspective view of a detail of the device of Figure 2, on an enlarged scale, and
- Figure 11 is a side view of a further detail of the device of Figure 2.

Preferred embodiment of the invention

With reference to Figure 1, a machine for distributing granular materials, usable both for sowing seeds and for spreading manure, disinfectants etc., is generally indicated 1. The machine 1 comprises, basically, one or more hoppers
5 2 for holding the material to be spread, a blower 3 which delivers an air-flow under pressure to an air injector 4, a metering device 5 which supplies metered quantities of the material present in the hopper into the air-flow generated by the blower 3, and a distributor 6 which distributes the mixed flow of air and material transported thereby towards distribution ducts 7.

10 The metering device 5 can advantageously be constructed in accordance with one or more of the teachings of the present invention and is shown in detail in Figure 2 and the subsequent figures.

The device comprises a housing 10 which, by virtue of the provisions of the invention, can advantageously be constructed in a single piece by moulding of
15 plastics material. The housing 10 comprises a first, upper opening 11 which is open towards the hopper 2, a second, rear opening 12, closed in an openable manner by a removable door 14, and an opposed, third opening 15 which admits the granular material to the region of the air injector. The housing is closed at the bottom by a feeler member 16 which will be described further below.

20 The housing 10 further comprises opposed side walls 17 having two circular and coaxial through-holes 18. The holes serve for housing a metering member, generally indicated 20, in the housing 10.

The metering member 20 comprises a shaft 21 of polygonal, preferably square, cross-section, having, at one end, a joint 22 by means of which it can be
25 coupled for rotation with a drive shaft (not shown) and, at the other, opposite end, a threaded shank 23 onto which a hand wheel 24 is screwed with the interposition of a washer 25. The assembly serves to clamp to the shaft 21 a plurality of metering wheels 26, included in a group between two flanges 27 and intercalated with discs 28.

30 The flanges 27 are identical to one another and each has two external tracks 29a, 29b which serve to support the metering member in the housing 10 rotatably but with axial restraint. Support is achieved by means of three or more bearings 30a, 30b, 30c, the outer portions of which are in rolling contact with one

or other of the tracks 29a, 29b. The axial restraint is not actually necessary for the operation of the device since the shaft 21 is itself fixed axially relative to the housing as a result of its connection to the drive shaft by means of the joint 22. However, to prevent the metering member 20 from accidentally coming out of the housing 10 when the device is released from the drive shaft, the tracks 29a, 29b have different diameters (the track 29a, closer to the side wall of the housing, has a larger diameter) and one bearing 30a is fixed to the housing 10 removably by means of the hand wheel 32 and is engaged on the track 29b so that the shoulder existing between the two tracks performs the desired axial restraint. In order to remove the metering member from the housing, the hand wheel 32 is slackened, removing the bearing 30a and with it the axial restraint preventing the metering member from slipping out.

Both of the flanges, or at least one of them, may have a ring of axial seats 33 for cores (for examples, screws) cooperating with a proximity detector (not shown) in order to measure the rate of rotation of the metering member 20.

Each metering wheel 26 is moulded of plastics material and comprises a plurality of blades 36 which extend radially from a hub 37 having an axial hole 37a with a channelled profile in which the channels have a profile which can be coupled with the shaft 21 and the number of channels is a multiple of the number of sides of the shaft so as to permit different angular positionings of the wheels 26 on the shaft 21. The wheels can thus be mounted in a manner such that they are offset angularly relative to one another, improving the uniformity of the output.

Both to take account of this angular offset and to strengthen the blades at their free ends, axial appendages 38 are provided thereon and are housed in corresponding holes 39 in the discs 28. The discs 28 have circular holes and are not otherwise driven by the shaft 21.

The wheels 26 are interchangeable with second wheels 26a of different volumetric capacity or even with third wheels 40 of low volumetric capacity, which can also be mounted on the shaft 21 with the interposition of a release mechanism 41 (see Figures 3 and 4). One or more of the third wheels 40 can thus be disconnected from the drive of the shaft simply by being turned through 180°. In one direction, the mechanism 41 in fact brings about driving of the wheel 40 together with the shaft 21, whereas in the opposite direction, the mechanism

41 is disengaged from the shaft 21, rendering the wheel 40 idle. Moreover, for intermediate capacities, the first and second wheels 26, 26a, may be combined in the metering member 20, by being arranged alternately in the group of wheels.

A particular problem which is solved by the invention lies in the fact that some minute seeds with a high oil content (typically rape seeds) tend to release greasy substances into the cells of the metering wheels (and into the metering device in general), changing its capacity (to the extent of reducing it to zero). This specific problem has been solved by the invention by means of a special scraper device 50 which is mounted downstream of the region in which the seeds fall.

10 The scraper 50 comprises a shaft 50a on which bow-shaped metal scraper members 51, for example, of harmonic steel, are mounted; the number of scraper members 51 corresponds to the number of wheels 40. Each scraper member has a crosspiece 52 which can follow the profiles of the cells, deforming the corresponding bow resiliently whilst the wheel 40 rotates. The shaft 50a is in turn

15 rotatable on the housing between two positions in which the scraper members are disengaged from the wheels or, conversely, are engaged in contact therewith, respectively. Oily residues which tend to stick to the seeds and to the ever-present dust, are thus removed and fall into the pneumatic seed-conveyor duct in order to be removed from the device 5.

20 Again, with oily seeds, in spite of the provision of release mechanisms, one or more of the wheels which are intended to be rendered idle by being turned around on the shaft 21 may nevertheless be rotated as a result of the internal friction which is increased by the presence of residues of dirt. To prevent this occurring, the wheels 40 according to the present invention have, in one or more

25 of the cells formed in their surfaces between adjacent blades, respective tooth-like formations 54 which, in one direction of rotation, offer the crosspieces 52 of the scraper members an inclined rear face 55 on which the crosspiece 52 does not grip whereas, in the other direction of rotation, they offer the crosspiece 42 a substantially radial leading face with which the crosspiece 52 engages, preventing

30 further driving of the wheel 40. An example of this function relates to the central wheel of Figure 10.

The ability to release the scrapers from the wheels 40 when they are not required considerably reduces wear of the scrapers, maintaining their effective life.

A further advantageous aspect of the invention lies in the structure and functional capacity of the feeler member 16. In known solutions, this member is generally constituted by a pivoting scraper blade provided with a resilient rubber lip. The main disadvantages resulting from this structure are connected with the fact that, with variations in the rate of rotation of the metering member, the rubber lip deforms, varying the flow-rate of the device in a non-predetermined manner. Moreover, the passage of any foreign body (a stone or the like) can block its pivoting in the open position, with a consequent unexpected change in the metering.

The feeler member 16 according to the invention comprises a plurality of individual feeler elements 60, each having a first end engaged on a shaft 61 and each carrying, at its opposite end, a fork 62 which houses a further shaft 63 with predetermined clearance. The fork prong 66 facing the metering member 20 carries a resilient lip 67. Both of the shafts 61, 63 are supported between the side walls 17 of the housing 10.

The feeler elements 60 are spaced apart by fixed plate-shaped separators 68, which are also articulated on the shaft 61 at one end and engage the shaft 63 with their opposite ends, but without the ability to pivot about the shafts.

In the region of the fork 62, there are resilient preloading means, each including a helical spring 64 and a respective stay 65, which urge the respective feeler element 60 towards the corresponding metering wheel. However, the feeler element is kept spaced therefrom by the interaction of the corresponding prong of the fork 62 with the shaft 63. Alternatively, similar resilient preloading means are arranged to be active at the opposite end of each feeler element. It is thus possible to apply to the elements 60 a predetermined resilient preloading, preferably of the order of about 1.5 kg, without this leading to compression of the lip 67 against the metering member which, in conventional systems, is a potential cause of rupture of the seeds distributed. On the other hand, the feeler elements can perform oscillations about the shaft 61 which are limited by the other prong of the fork 62 so as to prevent the feeler member from opening completely, significantly altering the distribution parameters. This precaution is augmented by the provision of individual and independent feeler elements for each wheel.

With these means for limiting the pivoting of the feeler member, breakages of the feeler elements could occur should foreign bodies of dimensions larger than the maximum opening between the feeler elements and the respective wheels pass through the metering member. To prevent this, according to a further characteristic of the invention, each separator 68 is arranged to have a nib 69 of a shape and size such as to alter the angle of introduction between the feelers and the metering member 20 so that foreign bodies arriving in the introduction opening between the feelers and the metering body are "rejected" by virtue of the increased amplitude of the angle of introduction as defined above and are prevented from entering the introduction opening. By way of indication, the angle of introduction as varied by the provision of the nibs 68 is about 80°.

According to a further characteristic of the invention, flow separator means 70 may be arranged in the region of the opening 15 for admitting the granular material into the air-flow which is responsible for its transportation. These separator means 70 are of the type comprising a fixed plate supported, by means of notches 71, on shafts 72, 73 extending between the side walls 17 of the housing 10. The shaft 72 also serves to support respective surfaces for collecting the seed and sending it to the air-injection duct 4.

On the side facing the metering member, the separator plate 70 has an arcuate profile 74 complementary with the outer surface of a toothless wheel 75 which is fitted centrally between the metering wheels. It is thus possible, with a single metering device, to supply two distributors and respective blowers separately, in fact doubling the capacity of the distributing machine.

According to an additional characteristic of the invention, second separator means 76 may be disposed in the housing, upstream of the metering member 20, so as to separate, not only at the output but also at the input, products which may optionally be different and which can be metered by a single metering device. The second separator means 76 comprise a fixed plate, also provided with an arcuate profile 77 complementary with the surface of the toothless wheel 75, and having teeth 78 for engagement on a plate 79 which is equipped with two doors 80 and can replace the door 14 when this arrangement is selected. Amongst the advantages conferred by this technical solution is the fact that it is possible to distribute different products through the right-hand and left-hand sides of the

same metering device. For example, it is possible to construct sowing machines with double seed-loading hoppers and a single metering device suitable, for example, for sowing alternating bands of male and female plants for the production of selected hybrids. That is, it is possible to distribute different products simultaneously, optionally with different metering, adjustable in dependence on the type of metering wheels used for the right-hand and left-hand sides.

Finally, a stirrer 81 is provided, supported rotatably between the side walls 17 of the housing 10 and rotated by the joint 22, by means of a belt transmission 82.

The metering device of the present invention thus achieves the objects indicated, at the same time offering many advantages over the prior art, amongst which is greater ease of handling during operations to assemble and dismantle the individual components.

CLAIMS

1. A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials, comprising a housing (10) and a metering member (20) supported rotatably in the housing, characterized in that the housing is formed in a single piece.
2. A device according to Claim 1 in which the housing (10) is moulded of plastics material.
3. A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials, comprising a housing (10) and a metering member (20) supported rotatably in the housing, characterized in that the metering member (20) comprises at least one metering wheel (26) clamped between a pair of flanges (27), the housing comprising juxtaposed openings (18) at least one of which has dimensions such as to allow the metering member, complete with the at least one wheel (26) and the flanges, to pass from and towards the housing, at least one of the flanges being arranged to close the respective opening when the metering member is fitted in the operative position in the housing, and constituting means for the rotatable support of the metering member in the housing.
4. A device according to Claim 3 in which both of the openings (18) have dimensions such as to allow the metering member (20), complete with the at least one wheel (26) and the flanges (27), to pass from and towards the housing, both of the flanges being arranged to close the respective openings when the metering member is fitted in the operative position in the housing, and constituting means for the rotatable support of the metering member in the housing.
5. A device according to Claim 3 or Claim 4 in which the flanges (27) carry peripherally at least two rolling tracks (29a, 29b) for at least one bearing or wheel (30a, 30b, 30c), a shoulder being defined between the tracks, and the at least one bearing or wheel being restrained on the housing (10) for the rotatable support of the metering member (20) and for the axial restraint thereof, by means of the shoulder.
6. A device according to Claim 5 in which at least one of the bearings or wheels (30a) is removable from the housing to allow the metering member to be moved away from and towards the housing.

7. A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials, comprising a metering member (20), characterized in that the metering member includes a plurality of metering wheels (26) which are structurally independent of one another and are interposed in a group between a pair of flanges (27), and a shaft (21) acting as a tie between the flanges in order to clamp in a group the flanges and the metering wheels interposed between them, to constitute a unit which can be handled individually.

8. A device according to Claim 7 in which the shaft (21) comprises, at one of its ends, a joint (22) for connection to a drive shaft.

9. A device according to Claim 7 or Claim 8 in which the shaft (21) has means for clamping the group of flanges and wheels at the end remote from the joint (22), the joint (22) acting as an abutment shoulder for the clamping.

10. A device according to any one of Claims 7, 8 and 9, in which the shaft (21) has a polygonal cross-section.

11. A device according to Claim 10 in which each of the metering wheels (26) has a hub (37) having a hole (37a) of polygonal cross-section which can be coupled with the polygonal cross-section of the shaft.

12. A device according to Claim 11 in which the holes (37a) in the hubs of the metering wheels have channelled profiles in which the channels have profiles which can be coupled with the profile of the shaft (21) and the number of channels is a multiple of the number of sides of the shaft so as to permit various angular positionings of the metering wheels on the shaft.

13. A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials, comprising a metering member (20) carrying a plurality of metering wheels (26) having blades (36) and clamped together in a group, characterized in that the blades have appendages (38) by means of which the blades of one wheel are restrained on the blades of the adjacent wheel.

14. A device according to Claim 13 in which a disc (28) having holes (39) for the appendages (38) is interposed between adjacent metering wheels (26), the disc (28) constituting an interconnection element between the blades (36) of adjacent wheels.

15. A device according to Claim 14 in which the disc (28) has seats (39) for the appendages (38), the seats being offset relative to one another to permit an angularly offset interconnection of the sets of blades of adjacent wheels.

16. A device according to one or more of Claims 3 to 15 in which the
5 wheels (26) can be interchanged and/or combined with wheels of different dimensions (26a, 40).

17. A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials, comprising a metering member (20) with metering wheels (40) clamped in a group
10 and keyed to a common drive-transmission shaft (21), characterized in that selective drive-transmission means (41) are interposed between the wheels and the shaft in order to exclude the wheels from driving by the shaft or, conversely, to connect the wheels for driving by the shaft.

18. A device according to Claim 17 in which the wheels (40) are mounted
15 reversibly on the shaft (21) and the selective drive-transmission means comprise a release mechanism (41) which brings about the driving connection between wheels and shaft in a first mounting condition and disconnection between wheels and shaft in a second mounting condition, in which the wheels are turned through 180° relative to the first condition.

19. A device according to Claim 17 or Claim 18 in which scraper means
20 (50) are provided, and are active on the wheels (40) individually to remove deposits therefrom.

20. A device according to Claim 19 in which the scraper means comprise a plurality of resilient bows (51) each active on the respective wheel (40)
25 individually.

21. A device according to Claim 19 or Claim 20 in which the scraper means (50) are movable relative to the metering member (20) between an operative position in which they are active on the wheels (40) and an inoperative position in which they are spaced therefrom.

22. A device according to one or more of Claims 17 to 21 in which the
30 scraper means (50) and the wheels (40) comprise mutual engagement means (52, 54) for restraining the wheels in a stationary position when they are excluded from driving by the shaft.

23. A device according to Claim 22 in which the mutual engagement means comprise a crosspiece (52) on each scraper (51) and at least one tooth-like element (54) on each wheel, the tooth-like element defining a leading face which can engage the crosspiece when the wheel is oriented in the second mounting condition and defining an inclined rear face (55) which can slide relative to the crosspiece when the wheel is oriented in the first mounting condition.

24. A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials, comprising a housing (10), a metering member (20) supported rotatably in the housing, and a feeler device (16) mounted in the housing and active in the manner of a scraper blade with a lip (67) thereof operative on the metering member, characterized in that restraining means (63) active on the feeler device in order to keep it a predetermined distance from the metering member, and resilient preloading means (64) active on the feeler device in order to press its operative lip towards the metering member with predetermined preloading, are provided.

25. A device according to Claim 24 in which the feeler device comprises a plurality of feeler elements (60) active individually and independently on respective corresponding metering wheels (26) of the metering member (20).

26. A device according to Claim 25 in which the feeler elements (60) are articulated pivotably by their respective ends remote from the operative lip (67) on a shaft (61) fixed to the housing (10), and means are provided for limiting their pivoting relative to the shaft.

27. A device according to Claim 26 in which the means for limiting pivoting comprise, at the end corresponding to the operative lip, a fork-shaped element (62) between the prongs of which a second shaft (63) is housed with predetermined clearance.

28. A volumetric metering device for the metered delivery of granular and powdery materials, particularly for machines for distributing the said materials, comprising a housing (10), a metering member (20) supported rotatably in the housing, and a feeler device (16) mounted in the housing and active in the manner of a scraper blade with a lip (67) thereof operative on the metering member, characterized in that it comprises means for altering locally the angle of

introduction between the feeler device (16) and the metering member, the means being associated with the feeler device, immediately upstream of the operative lip.

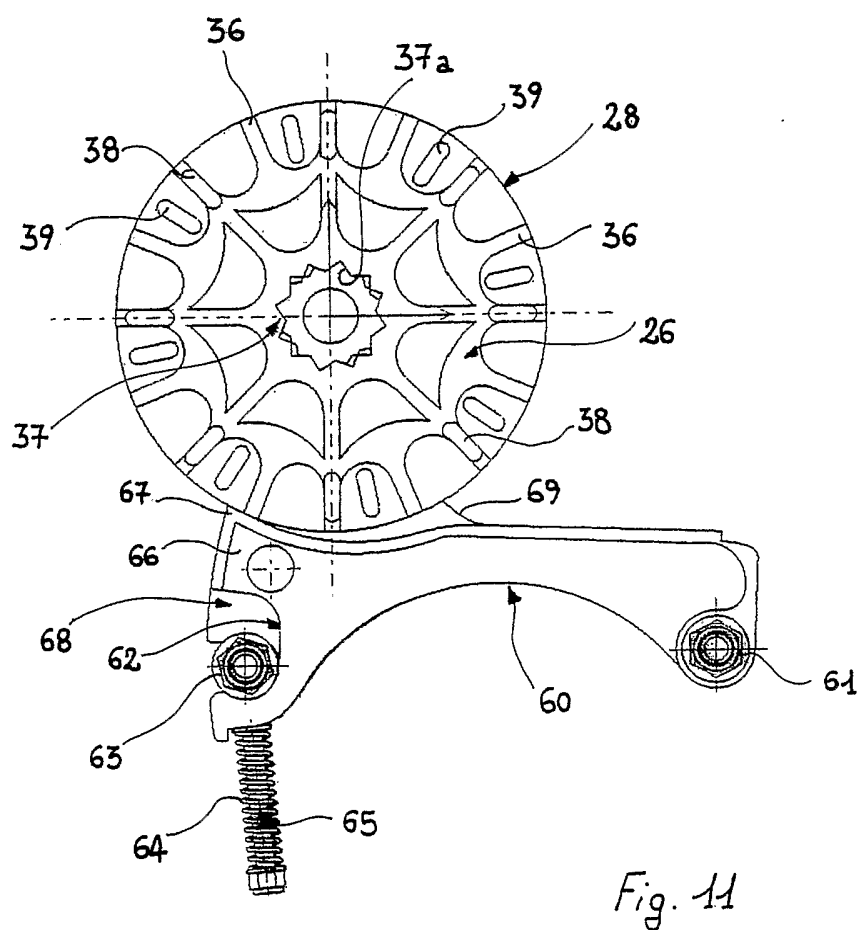
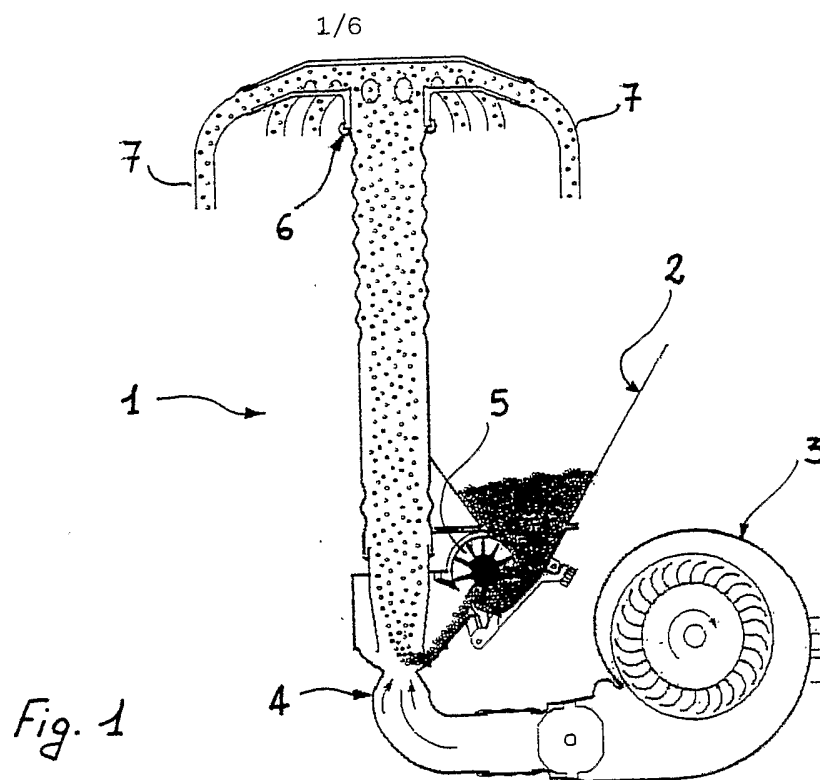
29. A device according to Claim 28 in which the feeler device comprises a plurality of feeler elements (60) active individually and independently on respective
5 corresponding metering wheels (26) and the means for altering the angle of introduction comprise a plurality of separators (68) interposed between the feeler elements and each having a nib (69) projecting towards the metering device.

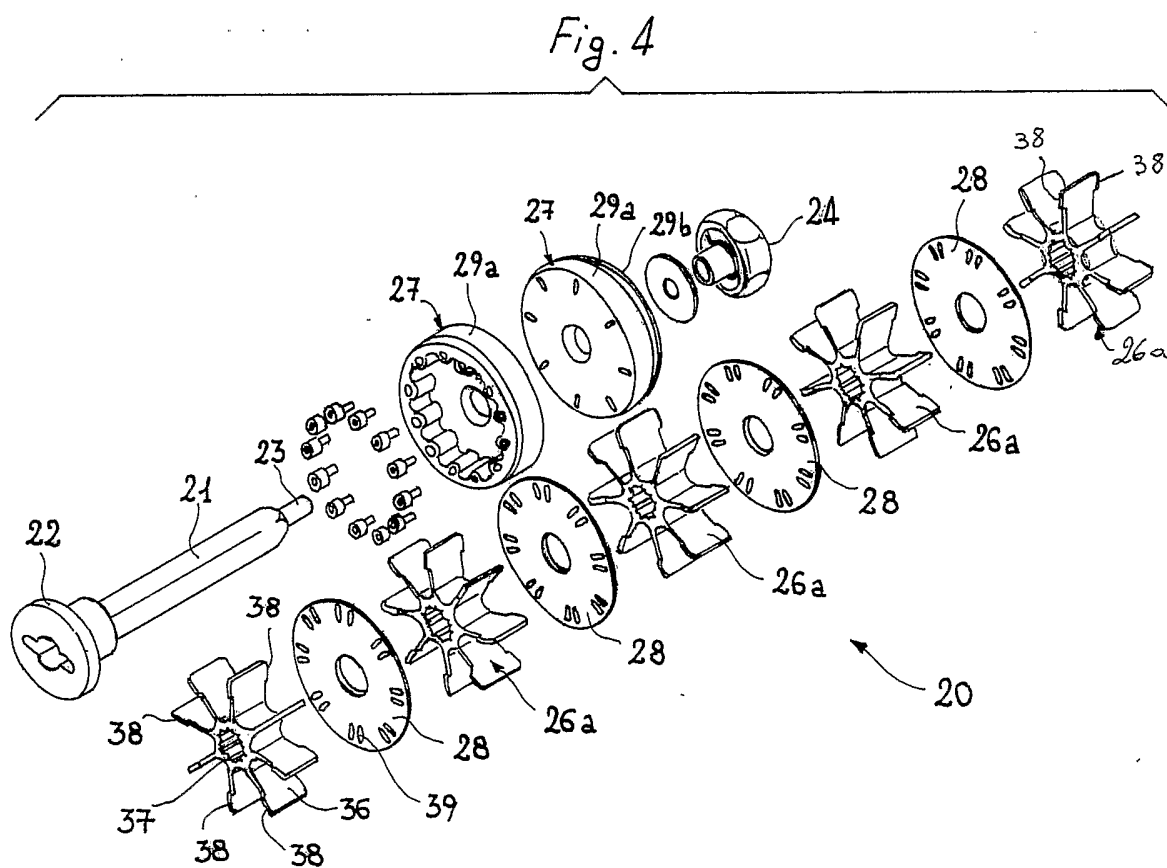
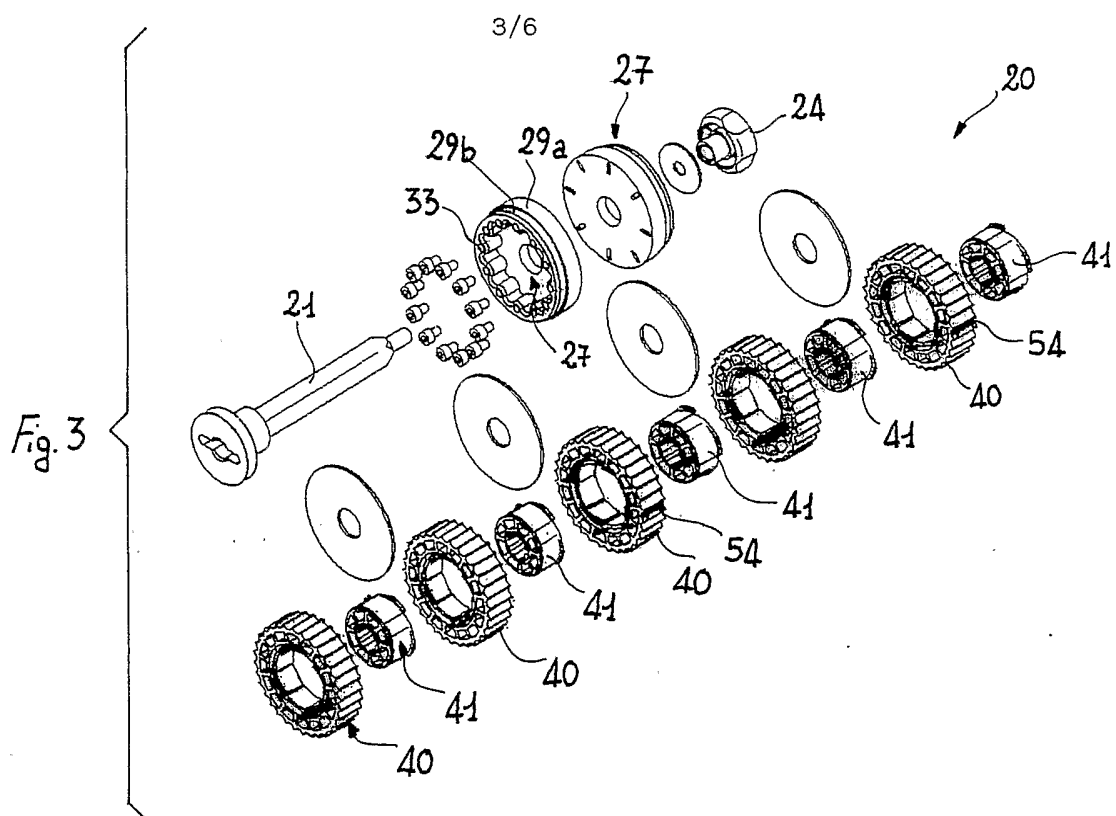
30. A device according to one or more of the preceding claims in which first flow-separator means (70) are provided, disposed in the region of an output
10 opening (15) from the housing (10).

31. A device according to Claim 30 in which the first separator means are of the type comprising a fixed plate (70) supported, by means of notches (71), on shafts (72, 73) extending between side walls (17) defined in the housing, the plate having, on the side facing the metering member (20), an arcuate profile (74)
15 complementary with the outer surface of a toothless wheel (75) which is fitted centrally between the metering wheels (26).

32. A device according to Claim 30 or Claim 31 in which second separator means (76) are disposed in the housing (10) upstream of the metering member so as to separate products, which may optionally be different, at the input.

20 33. A device according to Claim 32 in which the second separator means comprise a fixed plate (76) provided with an arcuate profile (77) complementary with the surface of the toothless wheel (75).





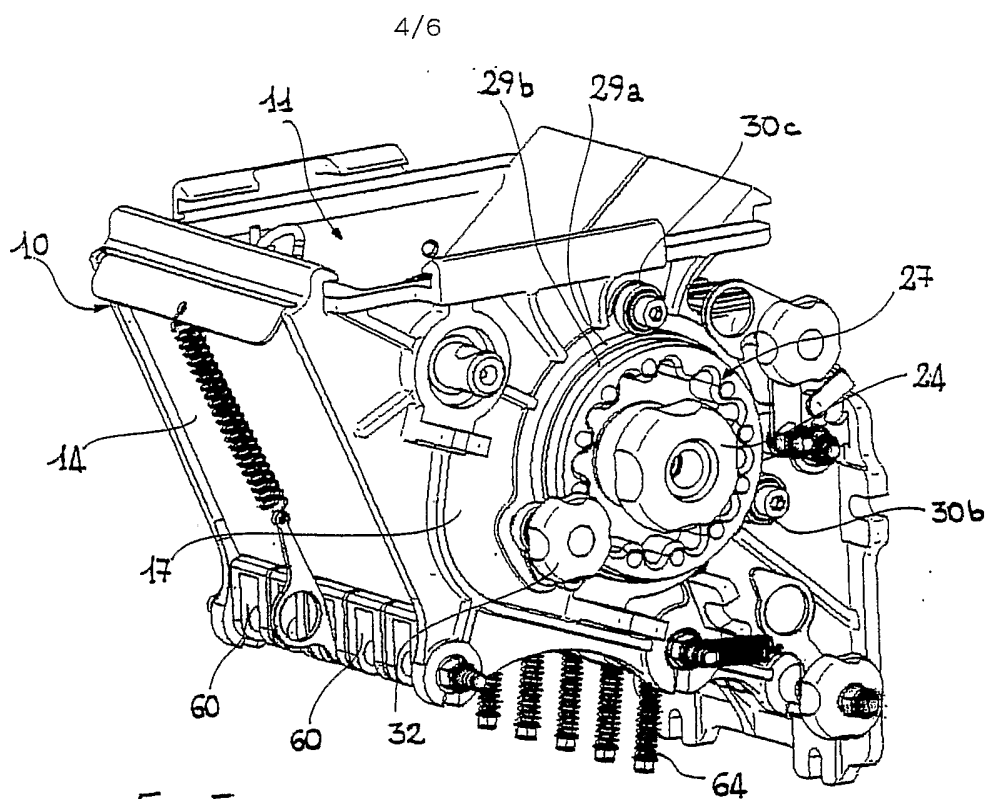


Fig. 5

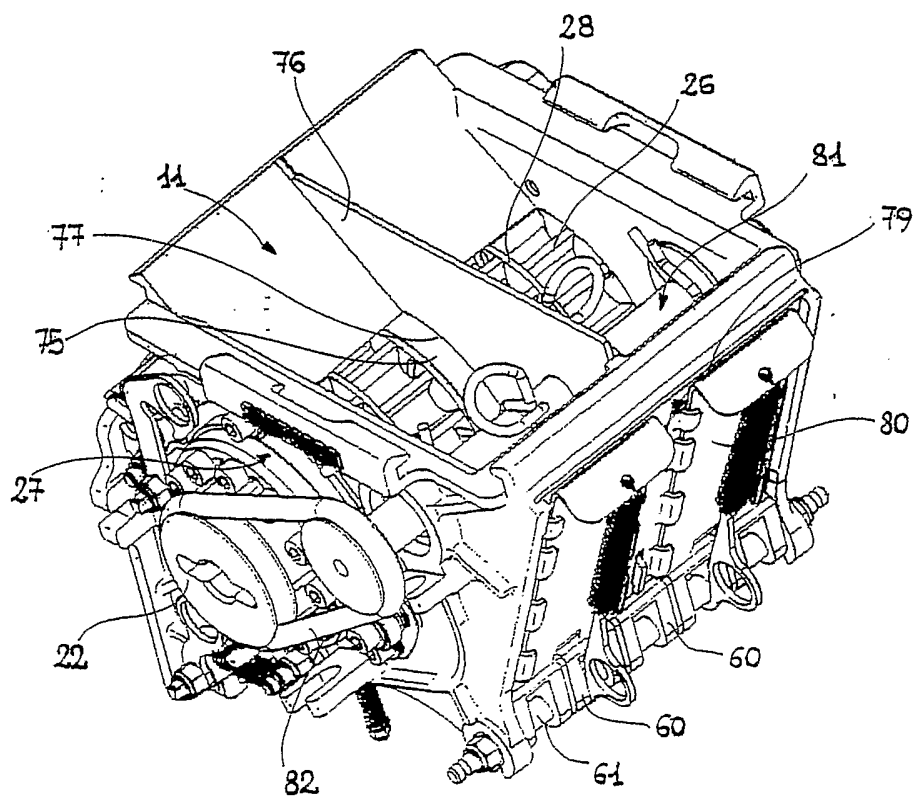


Fig. 6

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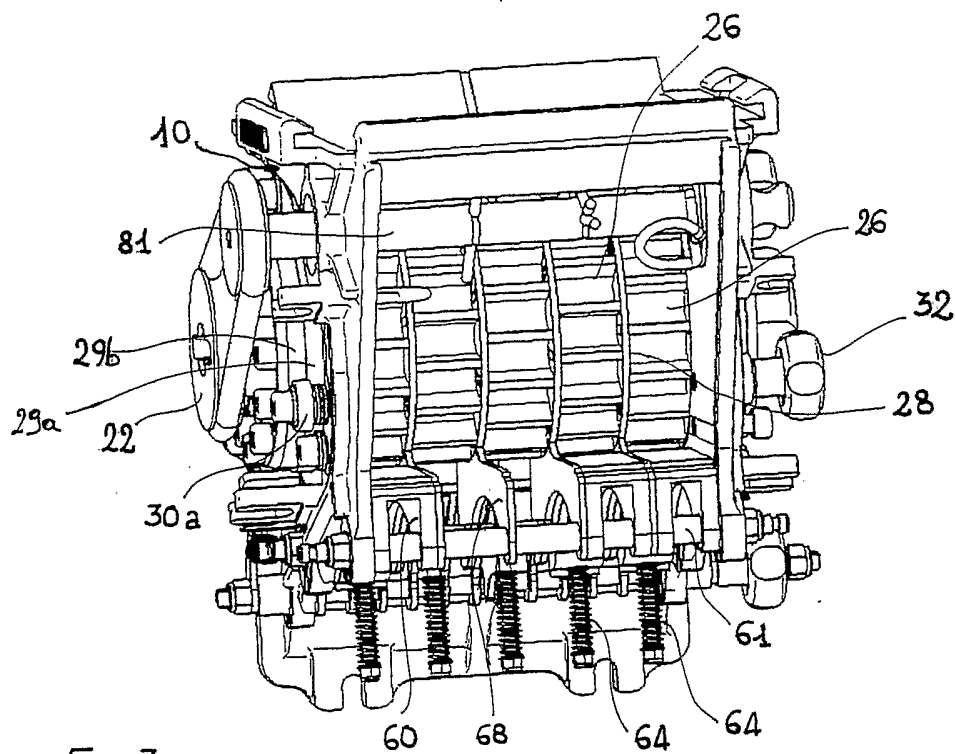


Fig. 7

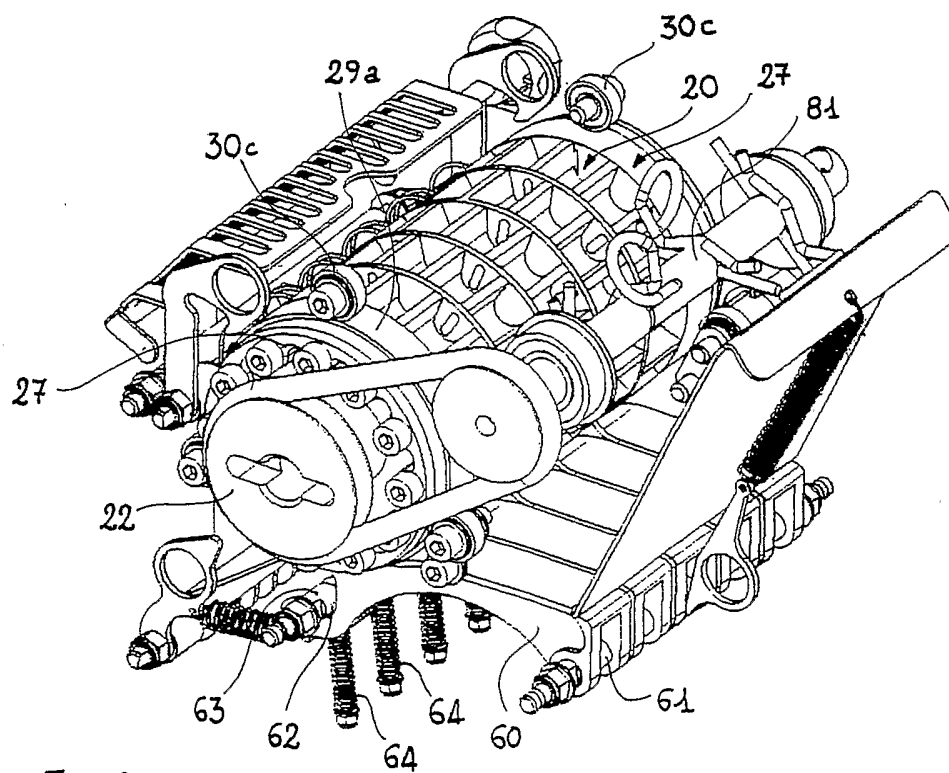


Fig. 8

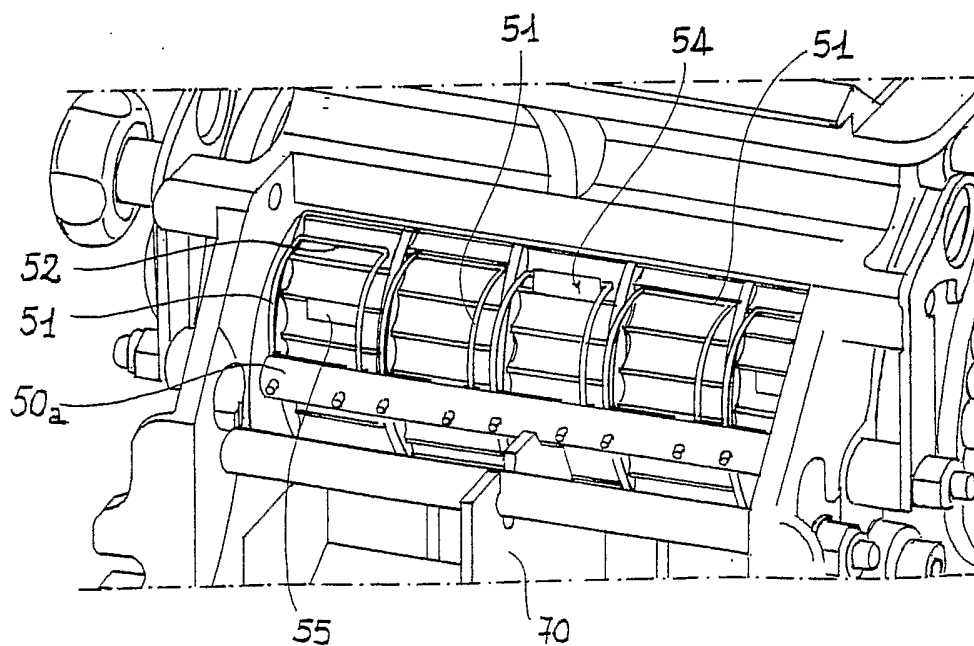
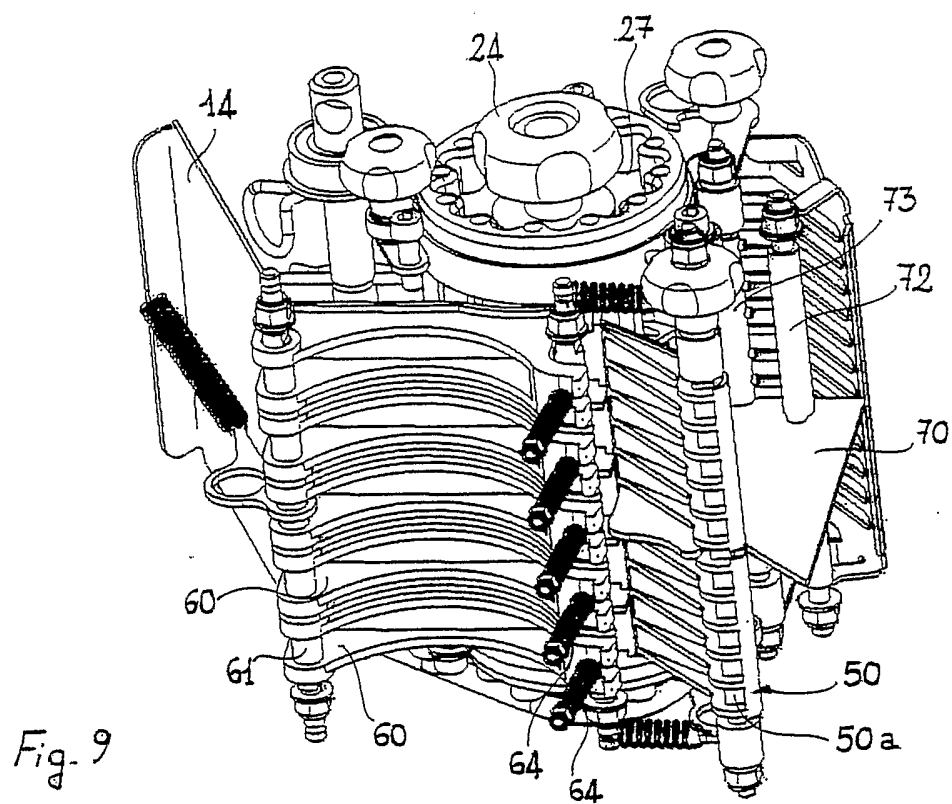


Fig. 10

INTERNATIONAL SEARCH REPORT

 International Application No
 PCT/IT 02/00443

 A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 G01F11/24 A01C7/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

 Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 G01F A01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

 Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
 EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 602 727 A (JACKSON CARROLL V) 29 July 1986 (1986-07-29) column 2, line 31 -column 4, line 68; figures 1-3 ---	1-4
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

30 May 2003

Date of mailing of the international search report

02.07.03

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/IT 02/00443

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 826 523 A (GREGOR DAVID WALTER) 27 October 1998 (1998-10-27) column 3, line 61 -column 5, line 43; figures 5-8 column 11, line 34 - line 57	1-4, 7-11,16
A		5,6
X	column 7, line 25 -column 11, line 57; figures 1,2,6,7,14,15,20	30,32
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X	column 7, line 56 -column 8, line 5; claim 9; figures 3-5	13,14
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A	DE 198 15 198 A (AMAZONEN WERKE DREYER H) 7 October 1999 (1999-10-07) column 1, line 60 -column 2, line 6; claim 1; figures 1-3	13
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A		18,30-33
Y		19-23
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Y		19-23
A		27
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IT 02/00443

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-11, 16 (as dependent on any of claims 3-11),
30-33 (as dependent on any of claims 1-11, 16)

See remark below.

- 1.1. Claims: 1 and 2,
30-33 (as dependent on any of claims 1 or 2)

Claims 1, 2 and 30-33 (as dependent on any of claims 1 or 2) concern a volumetric metering device with a single-part housing.

The common special technical feature of claims 1 and 2 (and 30-33) is the single-part housing.

- 1.2. Claims: 3-6, 16 (as dependent on any of claims 3-6),
30-33 (as dependent on any of claims 3-6,
16)

Claims 3-6, 16, 30-33 concern a volumetric metering device with easily replaceable metering member.

The common special technical feature of claims 3-6, 16, 30-33 is the housing with juxtaposed openings of which at least one has dimensions such as to allow the complete metering member with the flanges to pass from and towards the housing.

- 1.3. Claims: 7-11,
16 (as dependent on any of claims 7-11),
30-33 (as dependent on any of claims 7-11,
16)

Claims 7-11, 16, 30-33 concern a volumetric metering device with a plurality of metering wheels.

The special technical feature of claims 7-11, 16, 30-33 is the provision of a plurality of metering wheels on a shaft between a pair of flanges.

2. Claims: 12, 16 (as dependent on claim 12),
30-33 (as dependent on any of claims 12 or 16)

Claims 7-23 concern a volumetric metering device with a plurality of metering wheels. However, the subject-matter of claim 7 (the plurality of metering wheels arranged as

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

defined in claim 7) is not new in the sense of Article 33(2) PCT, see document US-A-5 826 523. Claim 12 appears to be the first claim of the above-mentioned group of claims which is new against document US-A-5 826 523. Therefore, a posteriori lack of unity (i.e. lack of unity after taking the prior art into consideration) between claims 12, 13-16, and 17-23 arises.

Claims 12, 16, 30-33 concern a volumetric metering device with a plurality of metering wheels which can be mounted in various angular positions on the shaft.

The special technical feature of claims 12, 16, 30-33 is the provision of a multiplicity of grooves in hubs of the wheel so as to permit various angular positionings on the shaft.

3. Claims: 13-15, 16 (as dependent on any of claims 13-15),
30-33 (as dependent on any of claims 13-16)

Claims 13-16, 30-33 concern a volumetric metering device with a plurality of metering wheels with a means for mutual restraining of the metering wheels.

The special technical feature linking these claims together is the provision of appendages on the blades by which the blades are restrained on the blades of the adjacent wheel.

4. Claims: 17-23, 30-33 (as dependent on any of claims 17-23)

Claims 17-23, 30-33 concern a volumetric metering device with a plurality of metering wheels with means for selectively deactivating rotation of the metering wheels.

The special technical feature linking these claims together is the provision of selective drive-transmission means interposed between wheels and shaft.

5. Claims: 24-29, 30-33 (as dependent on any of claims 24-29)

These claims concern a volumetric metering device having a feeler device operative on the metering member.

The common special technical feature of claims 24-33 is the provision of a scraper blade metering member.

Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IT 02/00443

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