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54 Chain cutter excavator.

57 This invention concerns a cutter bucket (10) able to work in any kind of ground and to make ditches, trenches, wells, excavations for partition walls, etc. which comprises:

- excavation means (12) consisting of two pairs of rotatable tools (13) having their axes parallel to each other and substantially parallel to the excavation face (24), such tools (13) being provided peripherally with means (26) to attack the earth, the means (26) to attack the earth of one pair of tools passing near the means (26) to attack the earth of the other pair,

- hydraulic motor means (20) arranged above the excavation means (12),

- chain means (25) driven by the hydraulic motor means (20) and driving the excavation means (12) by an inner gear wheel (15), the chain means (25) being provided with independent means (26) to attack the ground, and

- pneumatic means (28) to withdraw debris,

in which cutter bucket (10) the hydraulic motor means (20) comprise on their outer periphery ring gear means (23) to drive the chain means (25), and the means (26) to attack the ground, being supported by the chain means (25) and by the rotatable tools (13), form a substantially continuous excavation face (24) stretching at least to the periphery of the cutter bucket (10).

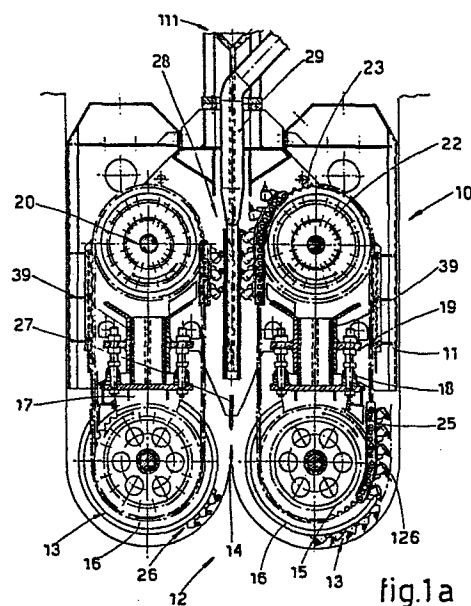


fig.1a

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"CUTTER BUCKET"

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2 This invention concerns a cutter bucket. To be more exact, the
3 invention concerns a cutter bucket able to dig ditches,
4 trenches, wells, excavations for partition walls or other
5 kinds of excavations; moreover, the bucket of the invention
6 can work on and in any kind of ground, thereby augmenting its
7 versatility.

8 Cutter buckets are known which have tools rotatable with a
9 vertical axis. These types of buckets entail many drawbacks
10 such as:

- 11 - considerable sideways bulk,
12 - limited capacity and speed of penetration,
13 - considerable wear of their parts and
14 - complex maintenance.

15 Cutter buckets are also known which have tools rotatable
16 with a horizontal axis.

17 US 3,710,878, for instance, is known and describes a cutter
18 bucket equipped with tools rotatable with a horizontal axis,
19 the tools being lodged at the end of a box-shaped head. These
20 rotatable tools are powered with chain means having two
21 consecutive branches. These chain means take their motion from
22 as many synchronized motor means through a transmission of
23 gear wheels.

24 The final branch of each chain means has means to attack

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1 the earth, such as teeth or other means, which cooperate with
2 like means provided on the periphery of the rotatable tools.
3 Pneumatic means to remove debris are also included.

4 The aforesaid mechanical synchronization does not permit
5 adaptation of the speeds of the individual tools and therefore
6 does not enable the vertical nature of the excavation to be
7 corrected.

8 Another and greater shortcoming of this US patent 3,718,878
9 lies in the fact that the excavation face is not continuous.
10 In fact, in the space between the two rotatable tools there is
11 a dead zone in which the ground is attacked by a wedge means
12 or blade means without any action in that zone by the means
13 for attacking the ground.

14 The invention lends itself, therefore, to excavation in
15 friable earth or not very consistent ground but is not
16 suitable for employment in rocky and compact ground.

17 Moreover, the rotatable tools do not work laterally to the
18 head, and blade means to improve the excavation which are able
19 to be lowered with jacks are provided so as to trim the walls
20 of the excavation itself. In rocky or compact ground these
21 blade means provide just a fancy demonstration without any
22 practical benefit, so that, as soon as compact or rocky ground
23 is reached, the excavation cannot progress because these
24 blades form a hindrance.

25 Moreover, means are not provided for resilient suspension
26 of the rotatable tools, such suspension means being able to
27 compensate for variations of load on the individual tools
28 owing to variability in local consistency of the ground.

29 A further drawback of this invention lies in the difficulty
30 encountered in adjusting and setting the chain means, which
31 are embodied in two successive sections.

32 Patent US-A-3,894,587 is also known and discloses a cutter
33 bucket with tools rotatable with a horizontal axis. This

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1 invention envisages a direct drive of the rotatable tools,
2 which cooperate as far as their periphery.

3 The motors therefore have to be located on the same axis as
4 the said rotatable tools.

5 Such a lay-out arranges for the cutter tools to be
6 supported at one end on the drive axles, and this entails a
7 considerable overall size in the direction axial to the motors
8 and a dangerous mechanical stress on the supports (referenced
9 with 6 in this patent) and on the motors themselves.

10 Moreover, owing to the presence of these supports there is
11 the difficulty, or impossibility, of obtaining a continuous
12 excavation face since there is a dead space corresponding with
13 the support of each motor, and this dead space cannot be
14 reduced beyond a given limit depending on the mechanical
15 strength of such supports.

16 Also known are the methods of attacking ground comprising
17 rocky strata, the use of scoop or shovel buckets being
18 alternated for the soft strata and cutter tools being used for
19 the rocky strata.

20 This involves the need to make use of different machines
21 when the ground changes, and also the need to remove separat-
22 ely the hard material crushed by the cutter tools.

23 Working, therefore, takes a long time and is not economical
24 and in any event is costly.

25 Our invention has the purpose of providing a cutter bucket
26 able to eliminate the foregoing drawbacks and shortcomings,
27 which are all inherent in the known art.

28 One purpose of the invention is to provide a cutter bucket
29 of a modest overall size and suitable for attacking the ground
30 and for working along the whole width of the excavation face,
31 thereby making possible very great forward movements in depth
32 in ground of any nature and consistency.

33 A further purpose of the invention is to provide a bucket

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1 equipped with means for continuous withdrawal of debris as the
2 digging goes forward.

3 Yet another purpose of the invention is to provide motor
4 means having a high motive torque and high power but to keep
5 the overall size of the bucket very small.

6 It is also wished to obtain by means of the invention an
7 optimum distribution of load among the various cutter tools
8 when more than one in number if any lack of uniformity in the
9 consistency of the areas of ground attacked by the various
10 tools is found.

11 These purposes and others which will become clear from the
12 description and examples given are achieved according to the
13 invention by envisaging a head equipped with excavation means
14 consisting of one or more tools rotatable around a horizontal
15 axis.

16 Said tools are driven indirectly by hydraulic motors lo-
17 cated above the tools.

18 The invention envisages advantageously a chain transmission
19 between each motor and the relative tool. Said chain bears on
20 its outer side suitable means for attacking the ground.

21 Like attacking means are solidly fixed on the periphery of
22 said rotatable tools driven by the chain.

23 The kind of lay-out adopted for the rotatable means and, in
24 particular, the drive of the rotatable tools by a chain which
25 itself is equipped with means to attack the ground, enables
26 said means attacking the ground to be arranged advantageously
27 in such a way as to form a continuous excavation face free of
28 dead spaces and having a size the same as or slightly greater
29 than the overall thickness of the bucket.

30 This enables material to be removed regularly and parti-
31 cularly efficiently.

32 The attacking means may consist of a plurality of suitably
33 arranged and oriented teeth or projections. The teeth will be

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1 predisposed advantageously so that they can be replaced when
2 broken or worn.

3 According to the invention the hydraulic motors have an
4 immovable axle and a rotatable casing. A toothed ring which
5 actuates the relative chain together with the attacking means
6 is fixed solidly to the casing of each motor.

7 This particular construction enables a very small thickness
8 of the head of the cutter bucket to be obtained; it also makes
9 it possible to lessen advantageously the number of movable
10 parts and also to obtain a particularly strong assemblage.

11 The invention envisages advantageously that the toothed
12 wheels at the end are fitted in an elastic, damped manner. In
13 this way an excellent distribution of the load can be achieved
14 when the bucket comprises more than one rotatable tool.

15 Indeed, when diverse tools are attacking zones of material
16 of differing compactness, the tool which attacks the most
17 compact material meets with a greater resistance to its for-
18 ward movement and loads the elastic means positioned between
19 itself and the head.

20 As a result, by means of said elastic means the greater
21 part of the vertical load weighs on the tool which needs it
22 most, namely the tool which is working on the most compact
23 material.

24 The tool which is biting into the least compact material
25 continues to advance without rotating in an empty space,
26 whereas the other tool makes up the difference in forward
27 movement owing to the effect of the greater load applied to
28 it.

29 Furthermore, the elastic means, with the help of the damp-
30 ing means, absorb at least partially the stresses coming from
31 the rotatable tools and loading the remainder of the
32 structure.

33 The invention also envisages pneumatic means which withdraw

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1 continuously the debris being produced.

2 The whole assemblage is installed in a working head of a
3 much reduced thickness.

4 The invention is therefore embodied with a cutter bucket
5 able to work in any kind of ground and to make ditches,
6 trenches, wells, excavations for partition walls, etc., which
7 comprises:

- 8 - excavation means consisting of two pairs of rotatable tools
9 having their axes parallel to each other and substantially
10 parallel to the excavation face, such tools being provided
11 peripherally with means to attack the earth, the means to
12 attack the earth of one pair of tools passing near the means
13 to attack the earth of the other pair,
 - 14 - hydraulic motor means arranged above the excavation means,
 - 15 - chain means driven by the hydraulic motor means and driving
16 the excavation means by an inner gear wheel, the chain means
17 being provided with independent means to attack the ground,
18 and
 - 19 - pneumatic means to withdraw debris,
- 20 the cutter bucket being such that the hydraulic motor means
21 comprise on their outer periphery ring gear means to drive the
22 chain means, and that the means to attack the ground, being
23 supported by the chain means and by the rotatable tools, form
24 a substantially continuous excavation face stretching at least
25 to the periphery of the cutter bucket.

26 We shall describe hereinafter, as a non-restrictive examp-
27 le, a preferred embodiment of the invention with the help of
28 the attached tables, wherein:-

29 Figs.1 give two partly cutaway views of the bucket of the
30 invention;

31 Figs.2 show two views of the pneumatic system to withdraw
32 debris;

33 Figs.3 show a detail of said system.

1 In the figures the cutter bucket of the invention bears the
2 reference number 10. Said bucket 10 comprises a head 11 with
3 an outer shape substantially like a box without a bottom from
4 the lower side of which the excavation means 12 jut out.

5 The head 11 has the task of bearing and protecting the in-
6 side parts and is connected at its upper end to a shaft 111,
7 which can be, for instance, telescopic and be borne by a self-
8 propelled means, which is not shown here.

9 The methods of suspending and thrusting the bucket 10 form
10 part of the prior art.

11 The excavation means 12 in our example consist of a pair of
12 rotating tools 13, but said tools 13 according to the invent-
13 ion can be included in another number albeit advantageously in
14 contrarotatable pairs. In the example shown the rotatable
15 tools 13 are contrarotatable, the purpose being to obtain not
16 only a symmetry of the forces but also the drawing of the
17 crushed material to a middle aspiration zone 14 located
18 between the tools 13 themselves.

19 In our example each of the rotatable tools 13 consists of
20 an inner toothed wheel 15 coaxial with and solidly fixed to
21 two outer wheels 16, one on each side. The inner toothed wheel
22 15 is supported by a fork 17.

23 The fork 17 is positioned centrally in relation to each
24 pair of rotatable tools 13 and contains in its centre the
25 inner gear wheel 15. Moreover, the fork 17 is fitted
26 resiliently in relation to the head 11, for spring means 18,
27 damper means 19 and means 39 to guide the lengthwise sliding
28 of the fork 17 are interposed.

29 A hydraulic motor 20 is located above each toothed wheel
30 15. Said hydraulic motors 20 are advantageously disposed with
31 their motive axle 21 immovable and with their casing 22 rot-
32 ating. A toothed crown 23 is located on the periphery of the
33 casing 22.

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1 This particular construction of the motor 20/toothed crown
2 23 group makes possible a very small overall axial size of
3 said group, as can be seen in Fig.1b.

4 The toothed crown 23 draws with a chain 25 the toothed
5 wheel 15 and therewith the outer wheels 16 solidly fixed to
6 the latter 15.

7 Both the wheels 16 and the chain 25 bear on their periphery
8 means 26 for attacking the ground, said means 26 consisting of
9 a plurality of suitably fixed and oriented teeth 126 in our
10 example.

11 It remains within the spirit of the invention if toothings
12 differentiated to suit the specific usages are envisaged and
13 if the tothing on the chain 25 is envisaged as being differ-
14 ent from that on the wheels 16.

15 Fig.1b shows clearly how the lay-out of the mechanical
16 organs according to the invention and, in particular, the
17 positioning of the motors 20 higher than the rotatable tools
18 13, and the chain transmission 25, which itself bears means
19 to attack the ground, enable an excavation face 24 free of
20 dead spaces to be obtained.

21 The diameter of the wheel 15 as compared to that of the
22 wheels 16 is selected advantageously in such a way as to form
23 an excavation face 24 suitably shaped like an inverted V (see
24 Fig.1b). This arrangement ensures that the crushed material is
25 drawn towards the centre line of the tool 13 and thereafter
26 towards the aspiration zone 14.

27 Blade means 27 are interposed between the two contrarotat-
28 able tools 13 and contribute to a further crushing of the
29 debris in our example.

30 Means 28 to withdraw debris, being pneumatic means in our
31 example, are comprised in the middle of the head 11. Said
32 means 28 include a withdrawal pipe 29 in this instance.

33 Said pipe 29 (see Figs.2) has a squashed end portion 129

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1 which terminates in an aspiration intake 30.

2 Means 31 to deliver compressed air consist, in our example,
3 of two pipes 32 positioned at the sides of the withdrawal pipe
4 29. Said pipes 32 are connected above to a supply of compres-
5 sed air 33 or of another fluid under pressure.

6 Each pipe 32 widens at its lower part 132, which is super-
7 imposed at the side of the end portion 129 of the withdrawal
8 pipe 29.

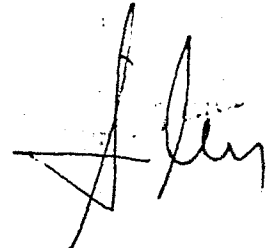
9 Nozzle means 34 positioned in the end zone of the lower
10 part 132 of each pipe 32 near the intake 30 produce a flow of
11 air directed upwards within the withdrawal pipe 29. This lay-
12 out has the effect of drawing and aspirating the debris within
13 said pipe 29, which opens out suitably outside the bucket 10.

14 Figs.3 show a detail of the nozzle means 34 according to
15 the invention. Fig.3a gives a view along the section A-A
16 (Fig.2b) of the end portion 129 with the parts 132 of the
17 pipes 32. Fig.3b is a cutaway side view of the nozzle means
18 34.

19 The air coming from 132 is sent through a plurality of
20 holes 35 to as many chambers 36, which comprise a non-return
21 valve 37 with a ball 137 and spring 237.

22 The air is sent at high speed through an oblique nozzle 38
23 from the chamber 36 to the pipe 29 and creates an upward flow.

24 The aspiration intake 30 can have a hard metal lining so as
25 to lessen wear caused by the passage of debris.

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INDEX

1	
2	10 - cutter bucket
3	11 - head
4	111 - carrying shaft
5	12 - excavation means
6	13 - rotatable tools
7	14 - middle aspiration zone
8	15 - inner toothed wheel
9	16 - outer wheels
10	17 - fork
11	18 - spring means
12	19 - damping means
13	20 - hydraulic motors
14	21 - drive axle
15	22 - casing
16	23 - toothed ring
17	24 - excavation face
18	25 - chain
19	26 - means to attack ground
20	126 - teeth
21	27 - blade means
22	28 - means to withdraw debris
23	29 - withdrawal pipe
24	129 - squashed end portion
25	30 - aspiration intake
26	31 - means to deliver compressed air
27	32 - pipes
28	132 - lower part of pipes
29	33 - compressed air supply
30	34 - nozzle means
31	35 - holes
32	36 - chambers
33	37 - non-return valve

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CLAIMS

2 1 - Cutter bucket (10) able to work in any kind of ground and
3 to make ditches, trenches, wells, excavations for partition
4 walls, etc., which comprises:

5 - excavation means (12) consisting of two pairs of rotatable
6 tools (13) having their axes parallel to each other and
7 substantially parallel to the excavation face (24), such
8 tools (13) being provided peripherally with means (26) to
9 attack the earth, the means (26) to attack the earth of one
10 pair of tools passing near the means (26) to attack the
11 earth of the other pair,

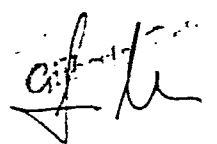
12 - hydraulic motor means (20) arranged above the excavation
13 means (12),

14 - chain means (25) driven by the hydraulic motor means (20)
15 and driving the excavation means (12) by an inner gear wheel
16 (15), the chain means (25) being provided with independent
17 means (26) to attack the ground, and

18 - pneumatic means (28) to withdraw debris,
19 the cutter bucket (10) being such that the hydraulic motor
20 means (20) comprise on their outer periphery ring gear means
21 (23) to drive the chain means (25), and that the means (26) to
22 attack the ground, being supported by the chain means (25) and
23 by the rotatable tools (13), form a substantially continuous
24 excavation face (24) stretching at least to the periphery of
25 the cutter bucket (10).

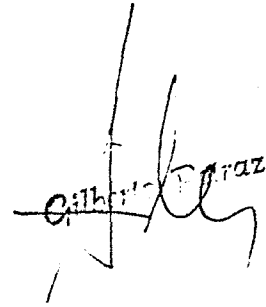
26 2 - Cutter bucket (10) as claimed in Claim 1, in which the
27 rotatable tools (13) are sustained by fork support means (17)
28 positioned centrally within the pairs of rotatable tools (13)
29 and containing centrally the inner gear wheel means (15).

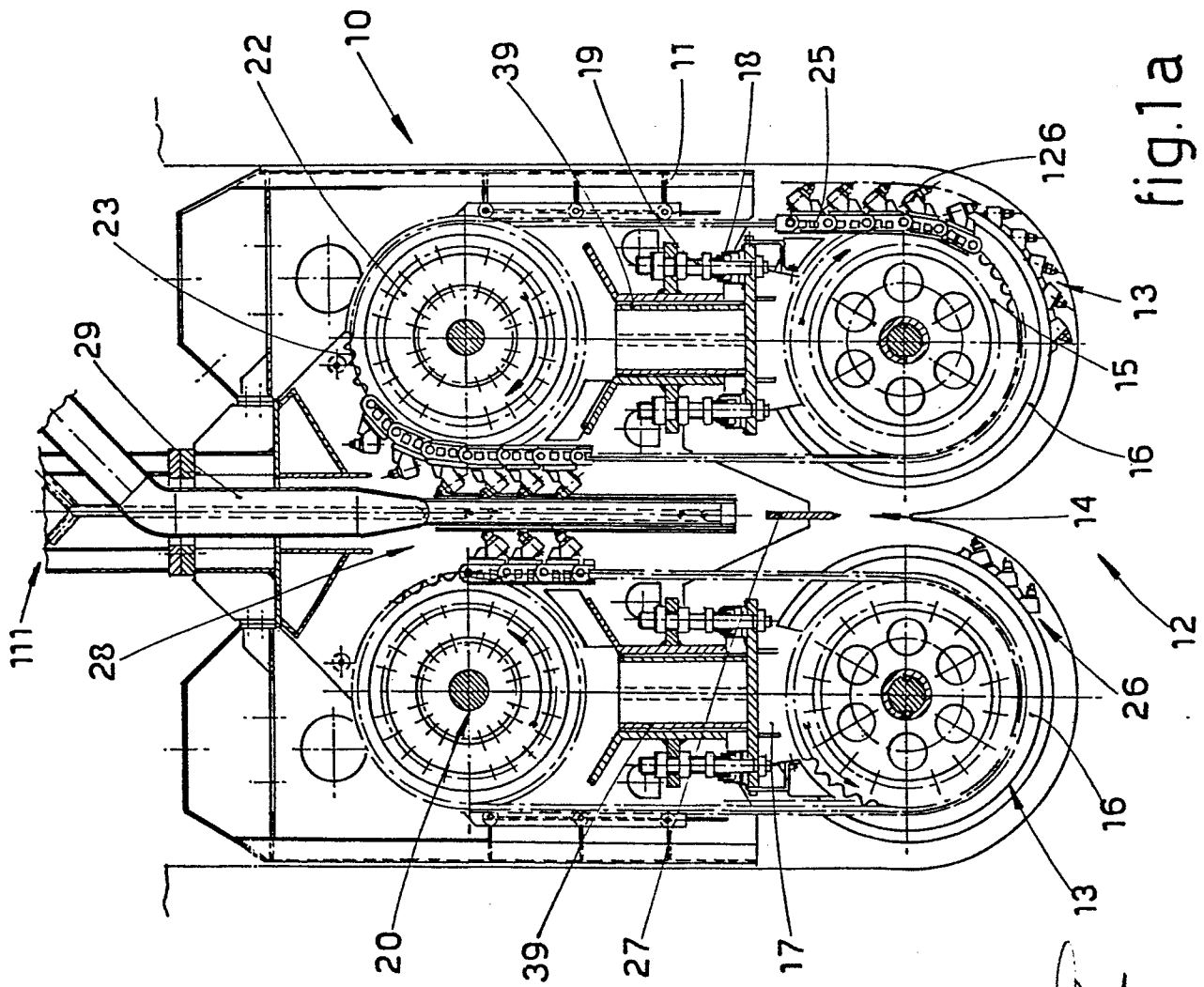
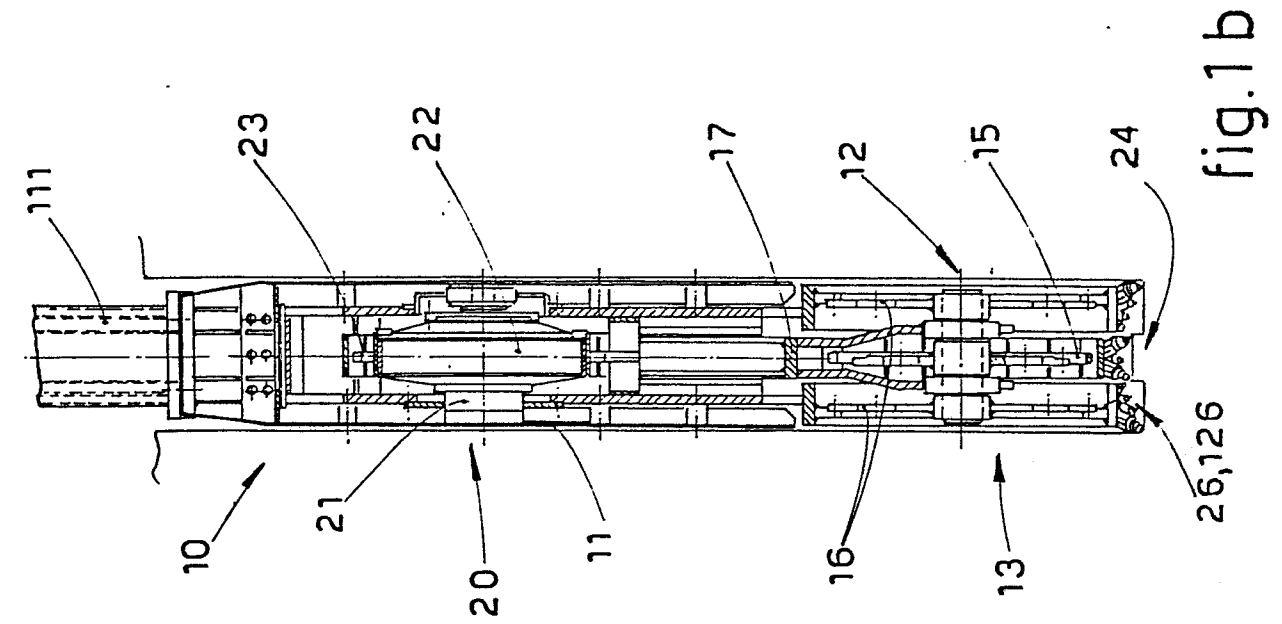
30 3 - Cutter bucket (10) as claimed in Claim 1 or 2, in which
31 the fork support means (17) are connected to the head (11) by
32 guide means (39) and spring means (18) cooperating with damper



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1 means (19).
2 4 - Cutter bucket (10) as claimed in any claim hereinbefore,
3 in which the hydraulic motor means (20) are provided with an
4 immovable drive axle (21) and a rotatable casing (22), a
5 toothed ring (23) which drives a chain means (25) being
6 comprised on the periphery of the casing (22).

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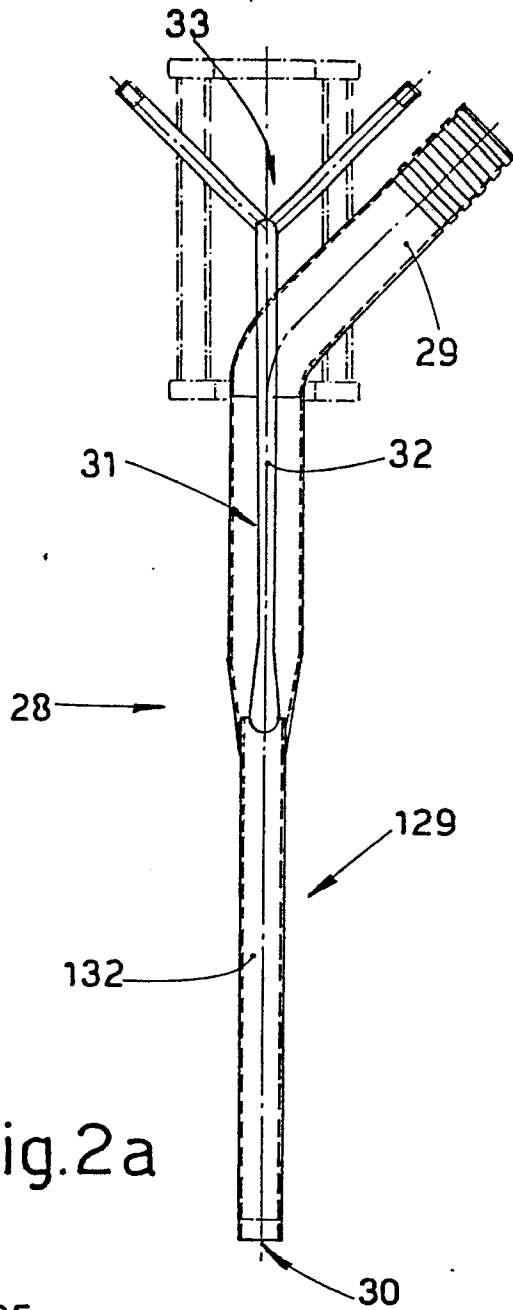


fig.2a

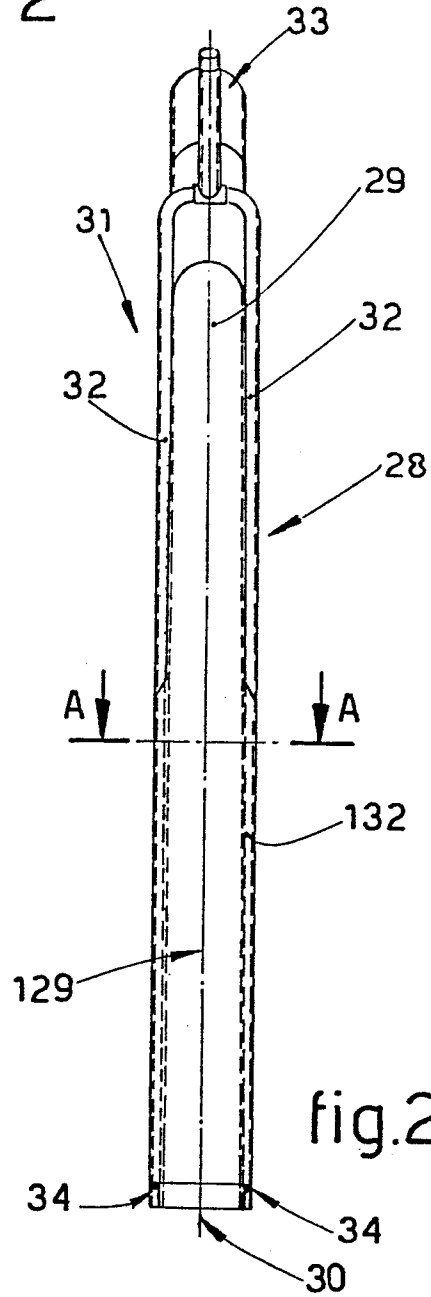


fig.2b

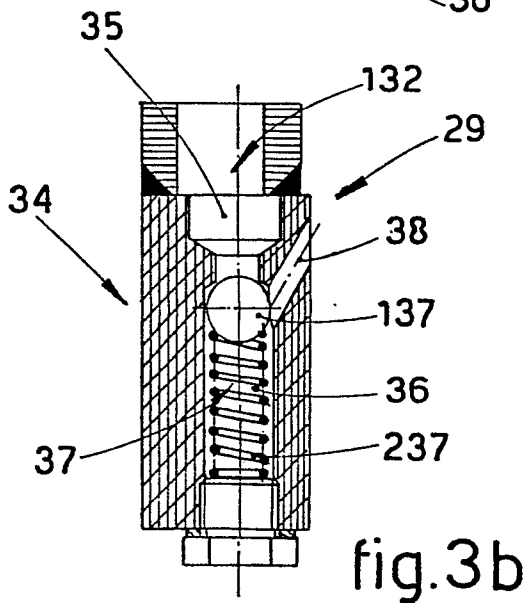


fig.3b

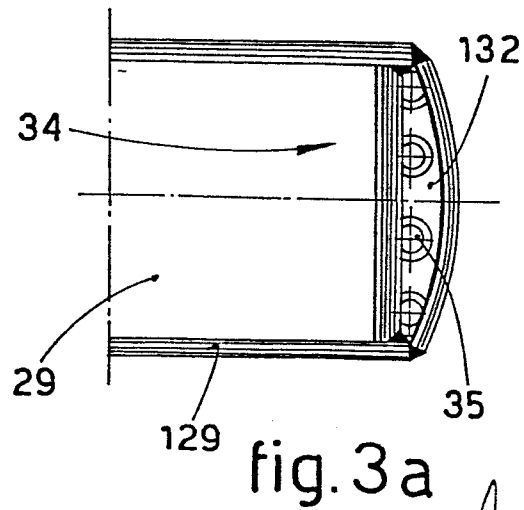


fig.3a

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