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⑰ **Chain cutter excavator.**

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㉓ Proprietor: **CASAGRANDE SpA**
Viale Venezia, 97
I-33074 Fontanafredda (PN) (IT)

㉔ Inventor: **Casagrande, Bruno**
Via Malignani 3
I-33074 Fontanafredda (PN) (IT)

㉕ Representative: **Petraz, Gilberto Luigi**
G.L.P. S.a.s. di Gilberto Petraz P.le Cavedalis 6/2
I-33100 Udine (IT)

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Description

This invention concerns a chain cutter excavator. To be more exact, the invention concerns a chain cutter excavator able to dig ditches, trenches, wells, excavations for partition walls or other kinds of excavations according to the pre-characterizing part of claim 1; moreover, the excavator of the invention can work on and in any kind of ground, thereby augmenting its versatility.

Chain cutter excavators are known which have tools rotatable with a vertical axis. These types of excavators entail many drawbacks such as:

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

Chain cutter excavators are also known which have tools rotatable with a horizontal axis.

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

The final branch of each chain means has means to attack the earth, such as teeth or other means, which cooperate with like means provided on the periphery of the rotatable tools. Pneumatic means to remove debris are also included.

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

Another and greater shortcoming of this US patent 3,710,878 lies in the fact that the excavation face is not continuous. In fact, in the space between the two rotatable tools there is a dead zone in which the ground is attacked by a wedge means or blade means without any action in that zone by the means for attacking the ground.

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

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

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

A further drawback of this invention lies in the

difficulty encountered in adjusting and setting the chain means, which are embodied in two successive sections.

Patent US—A—3,894,587 is also known and discloses a chain cutter excavator with tools rotatable with a horizontal axis. This invention envisages a direct drive of the rotatable tools, which cooperate as far as their periphery.

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

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

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

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

This involves the need to make use of different machines when the ground changes, and also the need to remove separately the hard material crushed by the cutter tools.

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

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

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

A further purpose of the invention is to provide a chain cutter excavator equipped with means for continuous withdrawal of debris as the digging goes forward.

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

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

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

horizontal axis.

Said tools are driven indirectly by hydraulic motors located above the tools.

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

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

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

This enables material to be removed regularly and particularly efficiently.

The attacking means may consist of a plurality of suitably arranged and oriented teeth or projections. The teeth will be predisposed advantageously so that they can be replaced when broken or worn.

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

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

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

Indeed, when diverse tools are attacking zones of material of differing compactness, the tool which attacks the most compact material meets with a greater resistance to its forward movement and loads the elastic means positioned between itself and the head.

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

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

Furthermore, the elastic means, with the help of the damping means, absorb at least partially the stresses coming from the rotatable tools and loading the remainder of the structure.

The invention also envisages pneumatic means which withdraw continuously the debris being produced.

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

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

— two excavation means having their axes parallel to each other and substantially parallel to the excavation face, such means being equipped peripherally with means to attack the earth,

— hydraulic motor means arranged above such excavation means,

— chain means driven by the hydraulic motor means and driving the excavation means, such chain means being provided with independent means to attack the earth, and

— pneumatic means to withdraw debris, the chain cutter excavator being characterized in that:

— each said excavation means consists of a pair of rotatable tools provided centrally with an inner gear wheel,

— said hydraulic motor means comprise on their outer periphery ring gear means to drive said chain means, and to give motion to the inner gear wheel of each pair of rotatable tools,

— said means to attack the earth of one pair of tools pass tangentially in the vicinity of the means to attack the earth of the other pair of tools, and that the means to attack the earth, supported by the chain means and by the rotatable tools, form a substantially continuous excavation face having a section which coincides at least with the greatest section, normal to the axis, of the excavator head.

We shall describe hereinafter, as a non-restrictive example, a preferred embodiment of the invention with the help of the attached tables, wherein:

Figs. 1 give two partly cutaway views of the excavator of the invention;

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

Figs. 3 show a detail of said system.

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

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

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

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

tools 13 themselves.

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

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

A hydraulic motor 20 is located above each toothed wheel 15. Said hydraulic motors 20 are advantageously disposed with their motive axle 21 immovable and with their casing 22 rotating. A toothed crown 23 is located on the periphery of the casing 22.

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

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

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

It remains within the spirit of the invention if toothings differentiated to suit the specific usages are envisaged and if the toothing on the chain 25 is envisaged as being different from that on the wheels 16.

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

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

Blade means 27 are interposed between the two contrarotatable tools 13 and contribute to a further crushing of the debris in our example.

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

Said pipe 29 (see Figs. 2) has a squashed end portion 129 which terminates in an aspiration intake 30.

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

Each pipe 32 widens at its lower part 132, which is superimposed at the side of the end portion 129 of the withdrawal pipe 29.

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

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

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

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

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

Index

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

Claims

1. Chain cutter excavator (10) able to work in any kind of ground and make ditches, trenches, wells, excavations for partition walls, etc., which comprises:

— two excavation means (12) having their axes parallel to each other and substantially parallel to the excavation face (24), such means (12) being equipped peripherally with means (26) to attack the earth,

— hydraulic motor means (20) arranged above such excavation means (12),

— chain means (25) driven by the hydraulic motor means (20) and driving the excavation means (12), such chain means (25) being provided with independent means (26) to attack the earth, and

— pneumatic means (28) to withdraw debris, the chain cutter excavator (10) being characterized in that:

— each said excavation means (12) consists of a pair of rotatable tools (13) provided centrally with an inner gear wheel (15),

— said hydraulic motor means (20) comprise on their outer periphery ring gear means (23) to drive said chain means (25), and to give motion to the inner gear wheel (15) of each pair of rotatable tools (13),

— said means (26) to attack the earth of one pair of tools (13) pass tangentially in the vicinity of the means (26) to attack the earth of the other pair of tools (13), and that the means (26) to attack the earth, supported by the chain means (25) and by the rotatable tools (13), form a substantially continuous excavation face (24) having a section which coincides at least with the greatest section, normal to the axis, of the excavator head (11).

2. Chain cutter excavator (10) as claimed in Claim 1, in which the support means which support the rotatable tools (13) are fork-type support means.

3. Chain cutter excavator (10) as claimed in Claim 1 or 2, in which the fork support means (17) are connected to the head (11) by guide means (39) and spring means (18) cooperating with damper means (19).

4. Chain cutter excavator (10) as claimed in any claim hereinbefore, in which the hydraulic motor means (20) are provided with an immovable drive axle (21) and a rotatable casing (22), a toothed ring (23) which drives a chain means (25) being comprised on the periphery of the casing (22).

Patentansprüche

1. Fräsgreifer (10), der dazu geeignet ist, in jedem Bodentyp zu arbeiten, und Gräben, Einschnitte, Gruben, Blenden, usw. ausführen kann, wobei der genannte Fräsgreifer (10) aufweist:

— zwei Ausgrabungsmittel (12) mit zueinander parallelen und zur Ausgrabungsstelle (24) wesentlich parallelen Achsen, wobei die genannten Mittel (12) peripher mit Bodenabbaumitteln (26) versehen sind,

— Hydromotormittel (20), die oberhalb der genannten Ausgrabungsmittel (12) angeordnet sind,

— Kettenmittel (25), die von den genannten Hydromotormitteln (20) angetrieben werden, und die genannten Ausgrabungsmittel (12) antreiben, wobei die genannten Kettenmittel mit unabhängigen Bodenabbaumitteln (26) versehen sind, und

— pneumatische Mittel (28) zur Evakuierung der Trümmerstücke,

wobei der genannte Fräsgreifer (10) dadurch gekennzeichnet ist, daß:

— jedes genannte Ausgrabungsmittel (12) aus einem Paar rotierender Werkzeuge (13) besteht, die zentral mit einem inneren Zahnrad (15) versehen sind,

— daß die genannten Hydromotormittel (20) an ihrer äußeren Peripherie Zahnkranzmittel (23) zur Mitnahme der genannten Kettenmittel (25) und zur Bewegungszuführung an das innere Zahnrad (15) jedes Paares rotierender Werkzeuge (13) aufweisen, und

— daß die genannten Bodenabbaumittel (26) eines Paares Werkzeuge (13) in der Nähe der Bodenabbaumittel (26) des anderen Paares Werkzeuge (13) tangential fahren, und daß die von den genannten Kettenmitteln (25) und von den genannten rotierenden Werkzeugen (13) abgestützten Bodenabbaumittel (26) eine wesentlich durchlaufende Ausgrabungsstelle mit einem Durchschnitt bilden, der mindestens mit dem größten, zur Achse senkrechten Durchschnitt des Kopfes (11) des Greifers (10) übereinstimmt.

2. Fräsgreifer (10) nach Anspruch 1, dadurch gekennzeichnet, daß die Lagermittel der rotierenden Werkzeuge (13) Gabellager (17) sind.

3. Fräsgreifer (10) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Gabellagermittel (17) durch Führungsmittel (39) und elastische Mittel (18), die mit Dämpfungsmitteln (19) mitwirken, an den Kopf (11) verbunden sind.

4. Fräsgreifer (10) nach irgendeinem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Hydromotormittel (20) mit fester Treibachse (21) und drehendem Gehäuse (22) angeordnet sind, wobei an der Peripherie des genannten Gehäuse (22) ein Zahnkranz (23) vorhanden ist, der die Kettenmittel betätigt.

Revendications

1. Excavateur à chaîne (10) capable de travailler dans n'importe quelle sorte de terrain et de creuser des fossés, tranchées, puits, fouilles pour murs de refend, etc., qui comprend:

— deux moyens d'excavation (12) ayant leurs axes parallèles entre eux et sensiblement parallèles à la face (24) de l'excavation, ces moyens (12) étant équipés sur leur périphérie de moyens (26) d'attaque de la terre,

— des moyens moteurs hydrauliques (20) agencés au-dessus de ces moyens d'excavation (12),

— des moyens du type chaîne (25) entraînés par les moyens moteurs hydrauliques (20) et qui

entraînent les moyens d'excavation (12), lesdits moyens du type chaîne (25) étant équipés de moyens indépendants (26) d'attaque de la terre, et

— des moyens pneumatiques (28) pour évacuer les déblais, l'excavateur à chaîne (10) étant caractérisé en ce que:

— chacun desdits moyens d'excavation (12) est composé d'une paire d'outils rotatifs (13) équipés en position centrale d'une roue dentée intérieure (15),

— lesdits moyens moteurs hydrauliques (20) comprennent, sur leur périphérie extérieure, des moyens (23) formant une roue dentée pour entraîner lesdits moyens du type chaîne (25) et pour imprimer le mouvement à la roue dentée intérieure (15) de chaque paire d'outils rotatifs (13),

— lesdits moyens (26) d'attaque de la terre appartenant à une paire d'outils (13) passent tangentiellement dans le voisinage des moyens (26) d'attaque de la terre appartenant à l'autre paire d'outils (13), et en ce que les moyens (26) d'attaque de la terre, qui sont supportés par les

moyens du type chaîne (25) et par les outils rotatifs (13) forment une face d'excavation (24) sensiblement continue, ayant une section qui coïncide au moins avec la section maximum normale à l'axe, de la tête d'excavateur (11).

2. Excavateur à chaîne (10) selon la revendication 1, dans lequel les moyens supports qui supportent les outils rotatifs (13) sont des moyens supports du type fourche.

3. Excavateur à chaîne (10) selon la revendication 1 ou la revendication 2, dans lequel les moyens support (17) du type fourche sont reliés à la tête (11) par des moyens de guidage (39) et des moyens à ressort (18) qui coopèrent avec des moyens amortisseurs (19).

4. Excavateur à chaîne (10) selon l'une quelconque des revendications précédentes, dans lequel les moyens moteurs hydrauliques (20) sont munis d'un arbre d'entraînement fixe (21) et d'un corps rotatif (22), une couronne dentée (23) qui entraîne des moyens (25) du type chaîne étant prévue sur la périphérie du corps (22).

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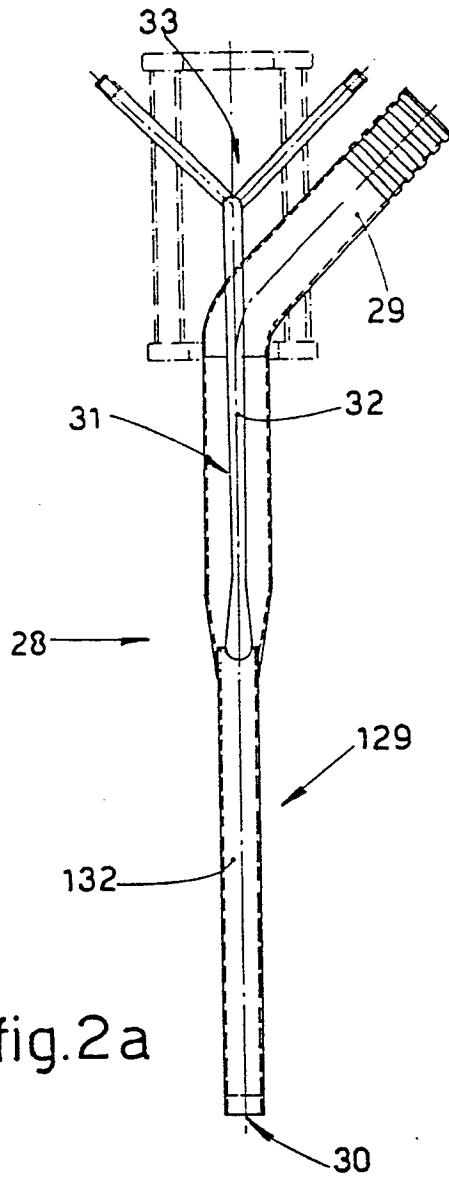


fig.2a

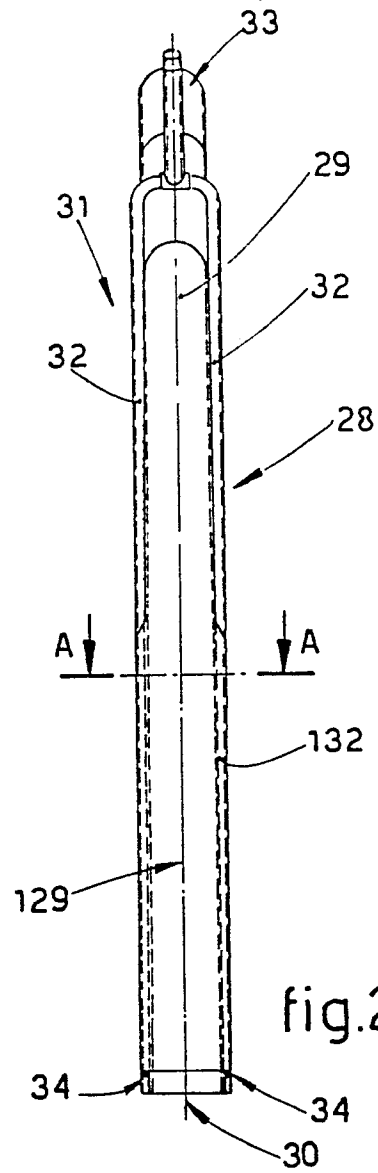


fig.2b

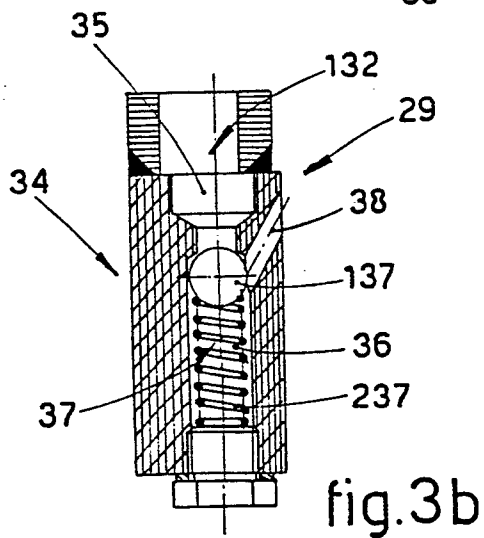


fig.3b

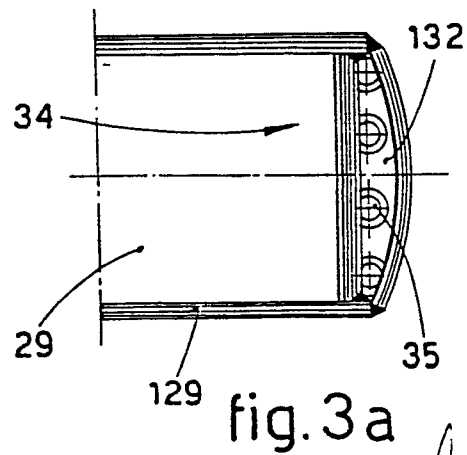


fig.3a

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