Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2147100 C 2004/05/18

(11)(21) 2 147 100

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 1995/04/13

(41) Mise à la disp. pub./Open to Public Insp.: 1995/10/19

(45) Date de délivrance/Issue Date: 2004/05/18

(30) Priorités/Priorities: 1994/04/18 (A 806/94) AT;
1994/07/01 (A 1307/94) AT

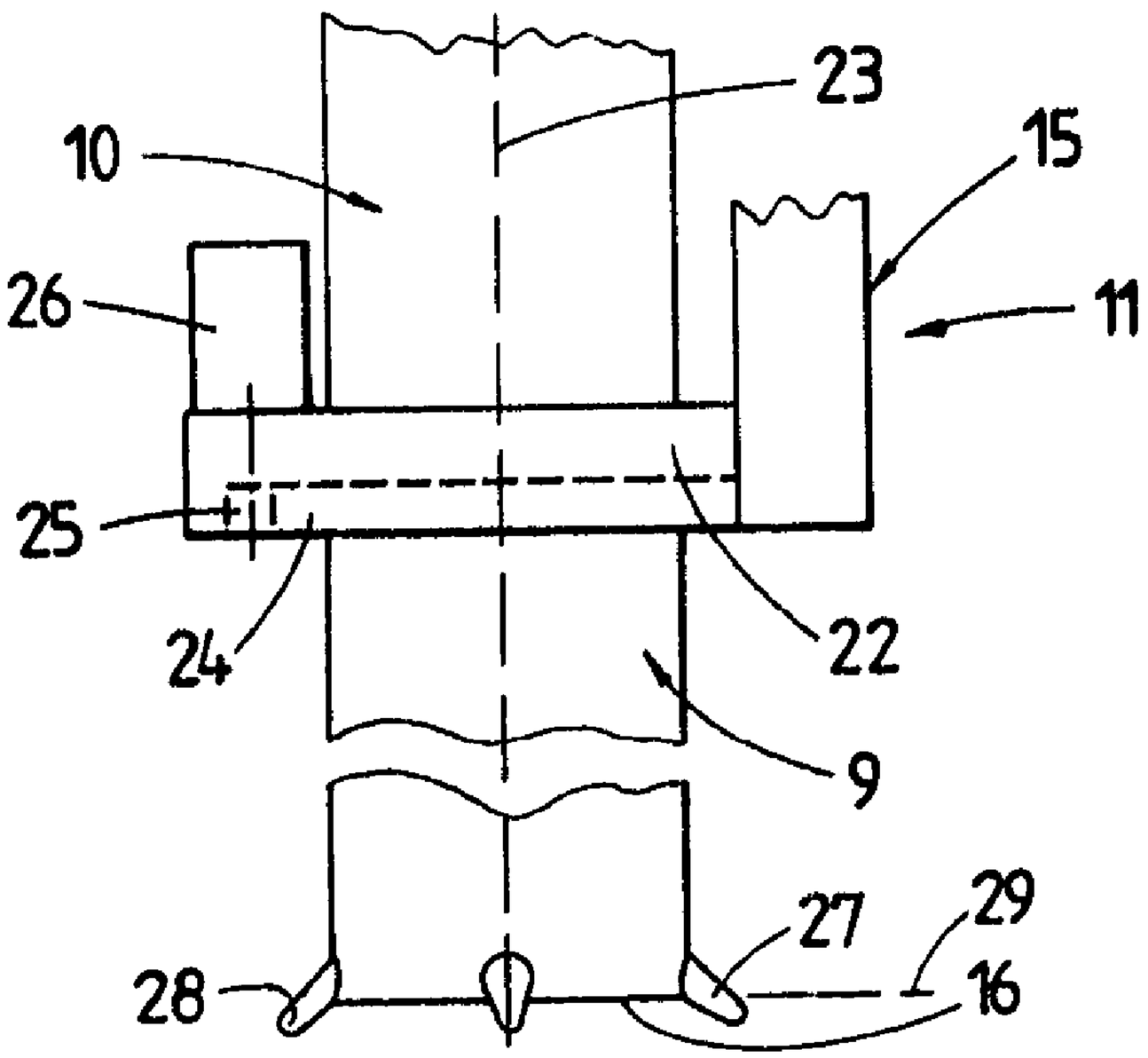
(51) Cl.Int.^{6}/Int.Cl.^{6} E01B 27/04, E01B 27/06

(72) Inventeurs/Inventors:
THEURER, JOSEF, AT;
OELLERER, FRIEDRICH, AT;
WORGOTTER, HERBERT, AT

(73) Propriétaire/Owner:
FRANZ PLASSER BAHNBAUMASCHINEN-INDUSTRIEGESELLSCHAFT M.B.H., AT

(74) Agent: RICHES, MCKENZIE & HERBERT LLP

(54) Titre : SUCEUSE AVEC EXTREMITE DE TUYAU A SUCTION ROTATIF
(54) Title: SUCTION MACHINE WITH ROTATABLE SUCTION PIPE END



(57) Abrégé/Abstract:
A suction machine for taking up bedding ballast of a track by suction is provided with a transversely and vertically adjustable suction pipe (10) with a suction opening (16) located in a suction pipe end portion (9). A rotary drive (26) is associated with the suction pipe end portion (9) which is mounted so as to be rotatable about its longitudinal axis (23).

ABSTRACT

A suction machine for taking up bedding ballast of a track by suction is provided with a transversely and vertically adjustable suction pipe (10) with a suction opening (16) located in a suction pipe end portion (9). A rotary drive (26) is associated with the suction pipe end portion (9) which is mounted so as to be rotatable about its longitudinal axis (23).

SUCTION MACHINE WITH ROTATABLE SUCTION PIPE END

The invention relates to a suction machine for taking up ballast by suction, comprising a machine frame designed for mobility on undercarriages and having a vacuum generator and a ballast store, and a suction pipe which is transversely and vertically adjustable by means of a displacement device with drives, wherein a suction pipe end portion movable by means of the displacement device and having a longitudinal axis has a suction opening for taking up ballast.

Equipping a total of three end portions of suction pipes, arranged in the vertical direction, in the region of the suction openings with rotating tools for loosening encrusted ballast is already known through GB 2 172 326 A.The end portions are each designed for vertical and transverse displacement by separate drives of a displacement device. To enable the suction machine to advance continuously, the end portions of the suction pipes are arranged so as to be displaceable longitudinally relative to the machine frame. After being centred over a sleeper crib, the end portions with the suction openings are lowered into the ballast, ballast located in the adjoining areas beneath the sleepers also being removable by suction through rotation of the tools.

Another suction machine known through DE 71 27 884 U has a vibration device fixed in the region of the suction opening to the end portion of the suction pipe, by which the suction opening which has teeth may be set vibrating. In a different embodiment, roller-shaped tools are provided to loosen the ballast, these also being associated with the suction opening.

Other suction machines are also known through DE 21 36 306 A, US 4 741 072, DE 41 08 673 A and DE 89 13 731 U.

The object of the present invention is now to provide a suction machine of the type previously defined with which the take-up of the ballast effected by the suction stream is improved, more particularly even when the ballast is in an encrusted state.

This object is achieved according to the invention with the suction machine specified in the introduction in that a rotary drive is associated with the suction pipe end portion which is mounted so as to be rotatable about its longitudinal axis.

By virtue of this rotatable construction, the take-up of ballast can be substantially improved while involving a minimum of design effort. It is particularly advantageous here that as a result of the rotation of the suction opening and the relative moment resulting therefrom in relation to the adjacent ballast stones, the latter are set in motion. This mechanically initiated initial movement is then continued, accelerated, with the aid of the suction power. As a result of the rotation according to the invention of the suction opening, the ballast can therefore be removed by suction quickly and with greater efficiency.

The efficiency of this suction-removal can be additionally increased if, according to another design variant of the invention, entraining elements are provided in the region of the suction opening, projecting therefrom.

Accordingly, in one aspect, the present invention resides in a machine for aspirating ballast from a bed supporting a track, which comprises: (a) a machine frame, (b) undercarriages supporting the machine frame on the track for mobility therealong, (c)

a vacuum generator on the machine frame, (d) a ballast storage receptacle on the machine frame, (e) a suction tube connected to the vacuum generator, (1) the suction tube terminating in a substantially vertical tubular end section having a substantially vertically extending longitudinal axis and defining a suction opening at one end thereof for aspirating the ballast, the tubular end section being rotatable about the longitudinal axis, and (2) a section of the suction tube adjoining an end opposite to the one end of the tubular end section being flexible, (f) a bearing at the opposite end of the tubular end section for rotatably connecting the tubular end section to the adjoining flexible suction tube section for rotation of the tubular end section about the longitudinal axis, (g) a displacement mechanism attaching the suction tube to the machine frame for vertically and transversely displacing the tubular suction tube end section, the displacement mechanism comprising (1) drive means for vertically and transversely displacing the tubular suction tube end section, and (h) a drive on the bearing for rotating the tubular suction tube end section about the longitudinal axis while the ballast is being aspirated.

In another aspect, the present invention resides in A machine for aspirating ballast from a bed supporting a track, which comprises: (a) a machine frame, (b) undercarriages supporting the machine frame on the track for mobility therealong, (c) a vacuum generator on the machine frame, (d) a ballast storage receptacle on the machine frame, (e) a suction tube connected to the vacuum generator, (1) the suction tube terminating in a substantially vertical tubular end section having a longitudinal axis and defining a suction opening at one end thereof for aspirating the ballast, an upper portion of the suction opening defining a suction plane extending obliquely with respect to the longitudinal axis while a lower portion of the suction opening defines a plane extending perpendicularly to the longitudinal axis, and (2) a section of the suction tube adjoining an end opposite to the one end of the tubular end section being flexible, (f) a bearing at the opposite end of the tubular end section for rotatably connecting the tubular end section to the adjoining flexible suction tube section for rotation of the tubular end section about the longitudinal

axis, (g) a displacement mechanism attaching the suction tube to the machine frame for vertically and transversely displacing the tubular suction tube end section, the displacement mechanism comprising (1) drive means for vertically and transversely displacing the tubular suction tube end section, and (h) a drive on the bearing for rotating the tubular suction tube end section about the longitudinal axis.

In a further aspect, the present invention resides in a machine for aspirating ballast from a bed supporting a track, which comprises: (a) a machine frame, (b) undercarriages supporting the machine frame on the track for mobility therealong, (c) a vacuum generator on the machine frame, (d) a ballast storage receptacle on the machine frame, (e) a suction tube connected to the vacuum generator, (1) the suction tube terminating in a substantially vertical tubular end section having a longitudinal axis and defining a suction opening at one end thereof for aspirating the ballast, an upper portion of the suction opening defining a suction plane extending obliquely with respect to the longitudinal axis, and (2) a section of the suction tube adjoining an end opposite to the one end of the tubular end section being flexible, (f) a slidable tube vertically adjustably mounted on the tubular end section and extending coaxially about the longitudinal axis thereof, the slidable tube having a lower end defining another suction opening whose suction plane extends perpendicularly to the longitudinal axis, (g) a bearing at the opposite end of the tubular end section for rotatably connecting the tubular end section to the adjoining flexible suction tube section for rotation of the tubular end section about the longitudinal axis, (h) a displacement mechanism attaching the suction tube to the machine frame for vertically and transversely displacing the tubular suction tube end section, the displacement mechanism comprising (1) drive means for vertically and transversely displacing the tubular suction tube end section, and (i) a drive on the bearing for rotating the tubular suction tube end section about the longitudinal axis.

The invention is described in more detail in the following with the aid of exemplary embodiments shown in the drawing, in which

Fig. 1 shows a side view of a suction machine with a suction pipe fixed at the end thereof on a machine frame by means of a displacement device and projecting over the machine end,

Fig. 2 shows a greatly enlarged partial view of a suction pipe end portion of the suction pipe which has a suction opening, and

Fig. 3 to 10 show other exemplary embodiments of a specially designed suction opening and suction pipe end portion.

The suction machine 1 evident in Fig. 1 has a machine frame 4, designed for mobility on on-track undercarriages 2, with a vacuum generator 3 and a driver's cab 5 positioned at the end and comprising a central control unit 6. Further, the suction machine 1 is equipped with an engine for the supply of energy and with a motive drive 7. Provided for guiding and supporting a suction pipe end portion 9 of a suction pipe 10 projecting over one machine end 8 is a displacement device 11 or supporting construction fixed to the machine frame 4. This is composed of two parts 14,15 arranged one following the other in the logitudinal direction of the machine and pivotally connected to one another, forming an articulation point with a vertical pivot axis 12 and a pivot drive 13. The suction pipe end portion 9 is adjustable by means of various drives 13,21 along the XYZ space coordinates.

Attached to the suction pipe end portion 9 connected to the part 15 is a flexible part of the suction pipe 10, whose opposite end 17 to a suction opening 16 is mounted for displacement perpendicularly to the longitudinal direction of the machine and horizontally. In order to store the ballast taken up by suction, two ballast stores 18 are provided, situated opposite one another in the transverse direction of the machine and each having a discharge opening. Located between these and the vacuum generator 3 are two filter chambers with closable discharge openings. Beneath these discharge openings is provided a conveyor belt 19, extending in the longitudinal direction of the machine, in order to transport the ballast taken up by suction onto a coupled loading wagon 20.

As is evident in Fig. 2, the suction pipe end portion 9 provided for penetration into the ballast is mounted in its upper end region opposite the suction opening 16 by means of a rotary bearing 22 on the adjoining flexible region of the suction pipe 10 so as to be rotatable about a longitudinal axis 23. The rotary bearing 22 connected to the part 15 of the displacement device 11 has a toothed ring 24 arranged coaxially to the suction pipe end portion 9 and connected thereto, the said toothed ring being in positive-locking connection with a driving pinion 25 of a hydraulic rotary drive 26.

Associated with the suction opening 16 serving to pick up ballast are entraining elements 27, fixed to the cylindrical suction pipe end portion 9 and extending in the radial direction, for loosening or moving the adjacent ballast stones to be taken up by suction. The entraining elements 27 are arranged with respect to their longitudinal direction at an angle to the longitudinal axis 23, the free

ends 28 being designed to project beyond a suction plane 29 formed by the annular suction opening 16 and extending perpendicularly to the longitudinal axis 23.

In operation, the suction pipe end portion 9 or the suction opening 16 is positioned over a sleeper crib, for example, from the driver's cab 5 with the aid of the central control unit 6, and by operation of the drives 13,21 is lowered onto the ballast. In parallel therewith, with operation of the rotary drive 26, the suction pipe end portion 9 rotates around its longitudinal axis 23, as a result of which the ballast stones coming into contact with the suction opening 16 and with the also rotating entraining element 27 are mechanically set in an initial movement. These ballast stones are then sucked up more quickly by the suction stream and supplied to one of the two ballast stores 18. The sleeper crib may be entirely cleared by suction as a result of a superimposed transverse movement of the suction pipe end portion 9.

In order to optimize various special operations, for instance the removal by suction of ballast beneath the sleepers or beneath track conductors, it may be advantageous to modify the entraining elements 27 by an elongated construction thereof. For this it is expedient to join the lower region of the suction pipe end portion 9 comprising the suction opening 16 and the entraining elements 27 releasably to the remaining part of the suction pipe end portion 9 by means of a quick-fitting coupling. This advantageously enables the respective optimally effective entraining elements 27 to be used in adaptation to different conditions of use with minimal conversion times.

As is evident in Fig. 3, entraining elements 30 may be formed by appropriate deformation of portions of the suction

opening 16. These entraining elements 30 are formed by blades 31 extending downwards beyond the suction plane, the front end regions 32 of which, in the direction of rotation (see arrow) of the suction pipe end portion 9, are situated further away from the longitudinal axis 23 than the rear regions 33 in the direction of rotation. By means of these entraining elements 30 forming a turbine blade-like plane of higher order, ballast is moved in the radial direction inwards to the suction opening 16 in order to improve the suction efficiency.

In the variant of embodiment shown in Fig. 4, the suction pipe end portion 9 is formed as a ring 43, mounted on the suction pipe 10 so as to be rotatable, to which the finger-shaped entraining elements 27 are fixed so as to be detachable. The rotation of the ring 43 about the longitudinal axis 23 is effected by a drive shaft 44, connected to the rotary drive 26, and a driving pinion 25.

Fig. 5 shows a side view of a suction pipe end portion 9, the region forming the suction opening 16 being situated in a suction opening plane 34 shown by dot and dash lines. This suction opening plane forms an angle α with the longitudinal axis 23 of the suction pipe end portion 9. This is preferably 45°, but it may vary depending on the desired size of the suction opening 16 expediently between about 30° and 50°. Distributed round the elliptical suction opening 16 are entraining elements 27 which project in the shape of teeth. Because of the oblique position of the suction opening 16, particularly in conjunction with the rotation of the suction pipe end portion 9 around the longitudinal axis 23, it is possible to achieve an improved action for also removing by suction the ballast located beneath the sleepers.

The other variant of a suction pipe end portion shown in Fig. 6 also has an obliquely positioned suction opening 16 which is produced by a bend in the lower end region of the suction pipe end portion 9.

The variant evident in Fig. 7 and 8 shows a suction pipe end portion 9 with a sliding tube 35 arranged coaxially to it and circular in cross-section, which is designed so as to be vertically adjustable by means of a schematically indicated drive 36 relative to the suction pipe end portion 9 with the aid of guides 37. While the suction pipe end portion 9 has an obliquely positioned first suction opening 16 shown in Fig. 5, the lower end of the sliding tube 35 is provided with a second suction opening 38. This lies in a suction opening plane 39 extending perpendicularly to the longitudinal axis 23. With this variant, it is possible, with the sliding tube 35 moved appropriately, to perform suction removal either with a suction opening 38 extending perpendicularly to the longitudinal axis 23 (Fig. 7) or with an oblique suction opening 16 (Fig. 8), as desired. In both positions the suction pipe end portion 9 is rotated continuously about the longitudinal axis 23 with the aid of a rotary drive which is not shown specifically.

Finally, Fig. 9 and 10 (Fig. 10 is a view of the suction pipe end portion 9 shown in Fig. 9 in the direction of arrow VI) show yet another variant of a suction pipe end portion 9. This has a suction opening 16 composed of two regions 40,41. The first region 40 of the suction opening 16 comprises the obliquely positioned part located in the suction opening plane 34, while the second region 41 forming the suction opening plane 39 extends perpendicularly to the longitudinal axis 23. In this second region 41 which includes about a quarter of the circumference of the suction pipe end portion 9, recesses 42 are provided on the suction pipe end portion 9 which form tooth-shaped entraining elements 27.

What is claimed is:

1. A machine for aspirating ballast from a bed supporting a track, which comprises

(a) a machine frame,

(b) undercarriages supporting the machine frame on the track for mobility therealong,

(c) a vacuum generator on the machine frame,

(d) a ballast storage receptacle on the machine frame,

(e) a suction tube connected to the vacuum generator,

(1) the suction tube terminating in a substantially vertical tubular end section having a substantially vertically extending longitudinal axis and defining a suction opening at one end thereof for aspirating the ballast, the tubular end section being rotatable about the longitudinal axis, and

(2) a section of the suction tube adjoining an end opposite to the one end of the tubular end section being flexible,

(f) a bearing at the opposite end of the tubular end section for rotatably connecting the tubular end section to the adjoining flexible suction tube section for rotation of the tubular end section about the longitudinal axis,

(g) a displacement mechanism attaching the suction tube to the machine frame for vertically and transversely displacing the tubular suction tube end section, the displacement mechanism comprising

(1) drive means for vertically and transversely displacing the tubular suction tube end section, and

(h) a drive on the bearing for rotating the tubular suction tube end section about the longitudinal axis while the ballast is being aspirated.

2. The ballast aspirating machine of claim 1, wherein the bearing comprises a gear ring coaxially arranged about the longitudinal axis on the tubular end section, and the rotating drive comprises a drive gear meshing with the gear ring.

3. The ballast aspirating machine of claim 1, further comprising entrainment elements affixed to the tubular end section at the suction opening for loosening the ballast aspirated through the opening.

4. The ballast aspirating machine of claim 3, wherein the entrainment elements are finger-shaped and project radially outwardly from the tubular end section.

5. The ballast aspirating machine of claim 3, wherein the suction opening defines a suction plane extending perpendicularly to the longitudinal axis of the tubular end section, and the entrainment elements have a longitudinal axis enclosing an angle with the longitudinal axis of the tubular end section and free ends projecting downwardly beyond the suction plane.

6. The ballast aspirating machine of claim 3, wherein the suction opening defines a suction plane, and the entrainment elements are shovels projecting downwardly beyond the suction plane, the shovels having leading and trailing end portions in the direction of rotation of the tubular end section, the leading end portion being farther removed from the longitudinal axis of the tubular end section than the trailing end portion.

7. The ballast aspirating machine of claim 3, wherein the entrainment elements are detachably affixed to the tubular end section.

8. The ballast aspirating machine of claim 3, wherein the rotatable tubular end section is a ring to which the entrainment elements are affixed.

9. The ballast aspirating machine of claim 1, wherein the suction opening defines an obliquely extending suction plane enclosing an angle α with the longitudinal axis of the tubular end section.

10. The ballast aspirating machine of claim 9, wherein the angle α is about 30° to 50°.

11. The ballast aspirating machine of claim 10, wherein the angle α is 45°.

12. A machine for aspirating ballast from a bed supporting a track, which comprises

(a) a machine frame,

(b) undercarriages supporting the machine frame on the track for mobility therealong,

(c) a vacuum generator on the machine frame,

(d) a ballast storage receptacle on the machine frame,

(e) a suction tube connected to the vacuum generator,

(1) the suction tube terminating in a substantially vertical tubular end section having a longitudinal axis and defining a suction opening at one end thereof for aspirating the ballast, an upper portion of the suction opening defining a suction plane extending obliquely with respect to the longitudinal axis while a lower portion of the suction opening defines a plane extending perpendicularly to the longitudinal axis, and

(2) a section of the suction tube adjoining an end opposite to the one end of the tubular end section being flexible,

(f) a bearing at the opposite end of the tubular end section for rotatably connecting the tubular end section to the adjoining flexible suction tube section for rotation of the tubular end section about the longitudinal axis,

(g) a displacement mechanism attaching the suction tube to the machine frame for vertically and transversely displacing the tubular suction tube end section, the displacement mechanism comprising

(1) drive means for vertically and transversely displacing the tubular suction tube end section, and

(h) a drive on the bearing for rotating the tubular suction tube end section about the longitudinal axis.

13. The ballast aspirating machine of claim 12, wherein the tubular end section has a circular circumference and the lower suction opening portion extends over at least a fourth of the circumference.

14. The ballast aspirating machine of claim 12, wherein the lower suction opening portion has an edge defining recesses forming teeth-shaped entrainment elements.

15. A machine for aspirating ballast from a bed supporting a track, which comprises

(a) a machine frame,

(b) undercarriages supporting the machine frame on the track for mobility therealong,

(c) a vacuum generator on the machine frame,

(d) a ballast storage receptacle on the machine frame,

(e) a suction tube connected to the vacuum generator,

(1) the suction tube terminating in a substantially vertical tubular end section having a longitudinal axis and defining a suction opening at one end thereof for aspirating the ballast, an upper portion of the suction opening defining a suction plane extending obliquely with respect to the longitudinal axis, and

(2) a section of the suction tube adjoining an end opposite to the one end of the tubular end section being flexible,

(f) a slidable tube vertically adjustably mounted on the tubular end section and extending coaxially about the longitudinal axis thereof, the slidable tube having a lower end defining another suction opening whose suction plane extends perpendicularly to the longitudinal axis,

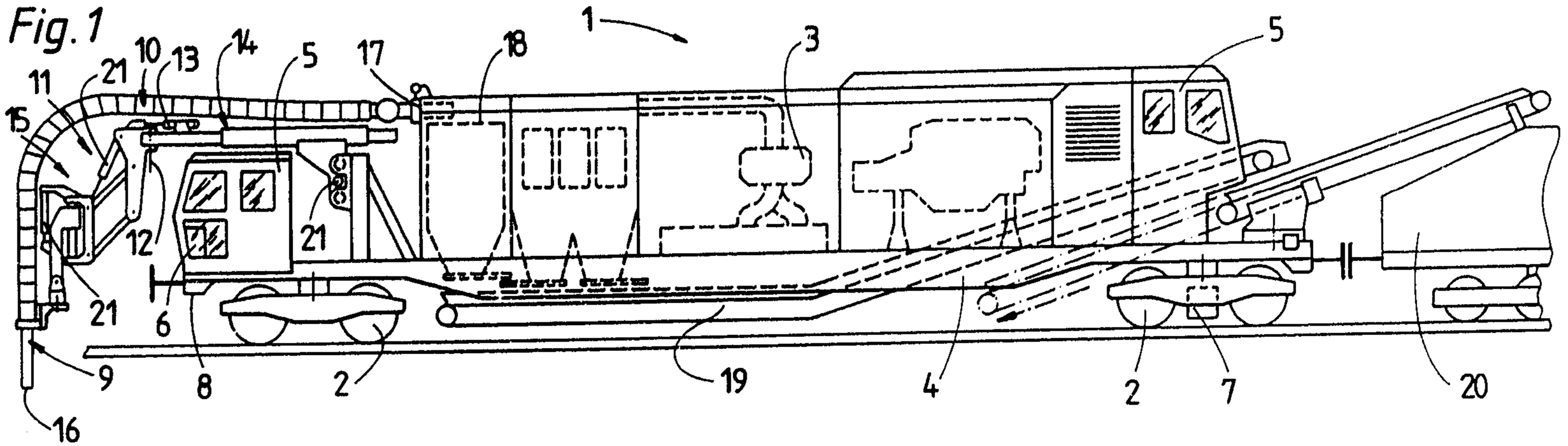
(g) a bearing at the opposite end of the tubular end section for rotatably connecting the tubular end section to the adjoining flexible suction tube section for rotation of the tubular end section about the longitudinal axis,

(h) a displacement mechanism attaching the suction tube to the machine frame for vertically and transversely displacing the tubular suction tube end section, the displacement mechanism comprising

(1) drive means for vertically and transversely displacing the tubular suction tube end section, and

(i) a drive on the bearing for rotating the tubular suction tube end section about the longitudinal axis

Fig. 1



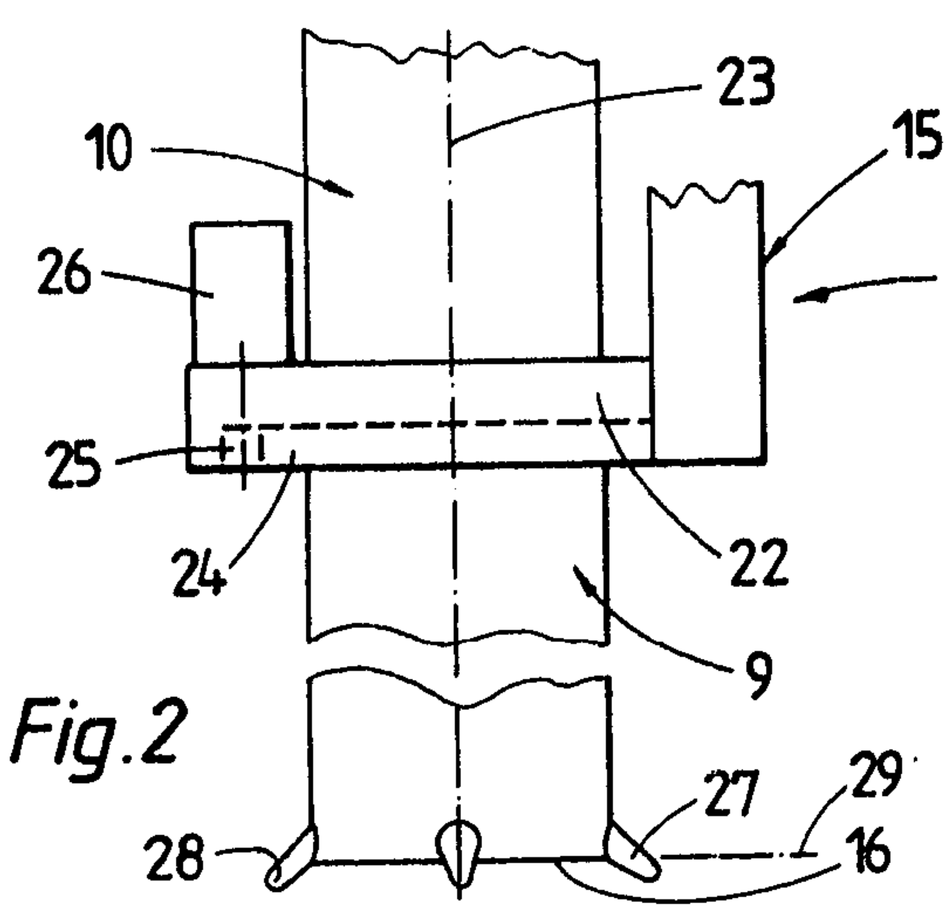


Fig.2

Fig.3

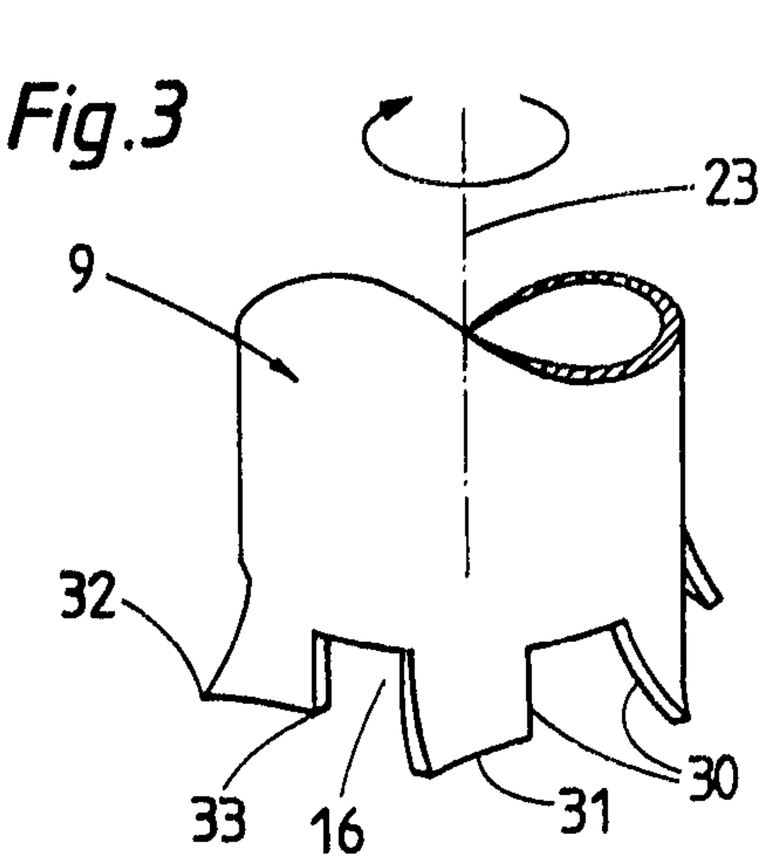
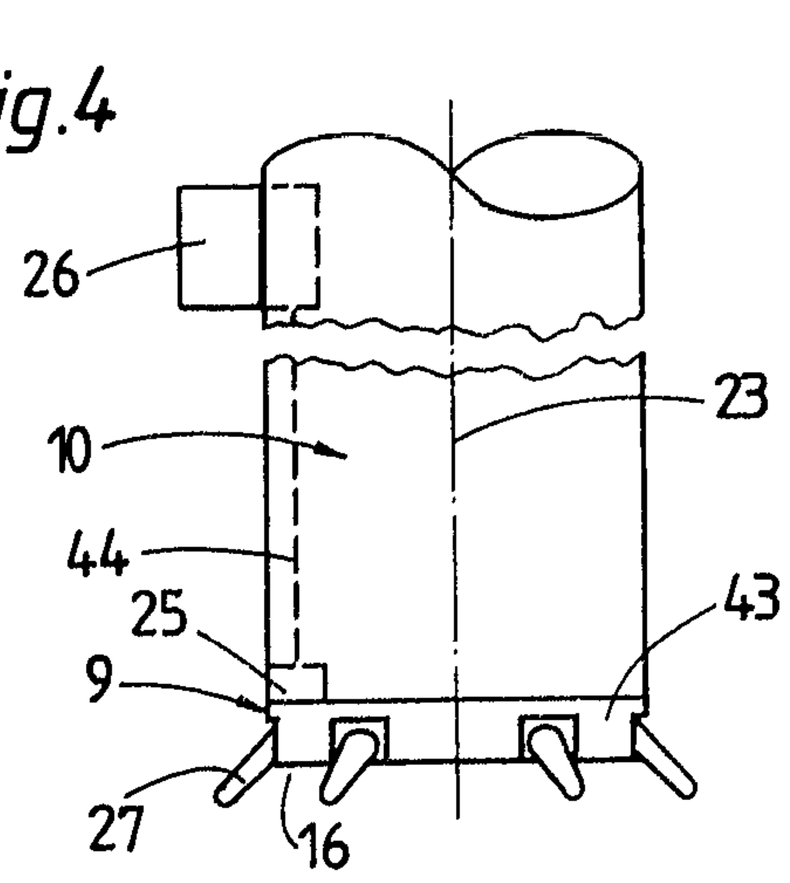


Fig.4



2147100

Fig.5

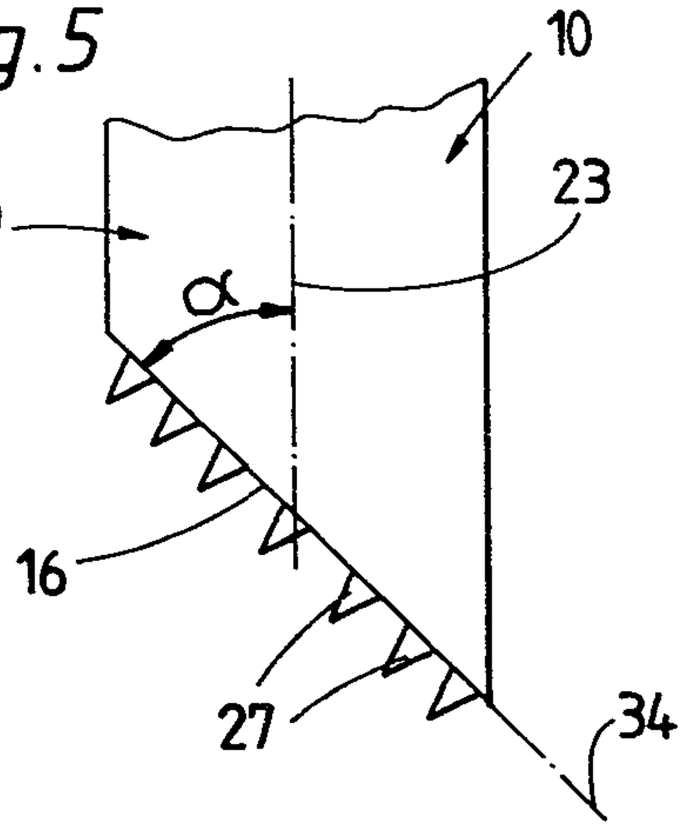


Fig.6

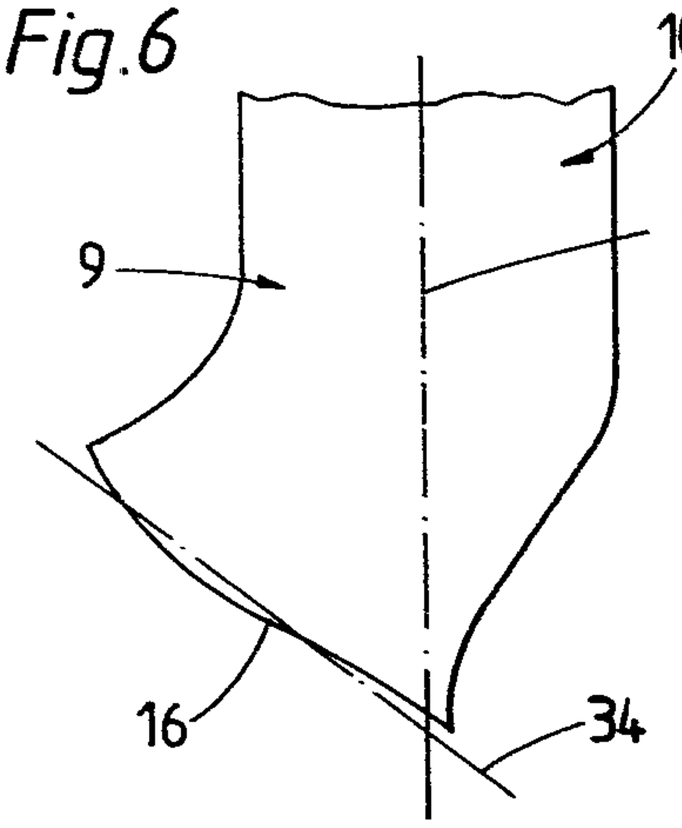


Fig.7

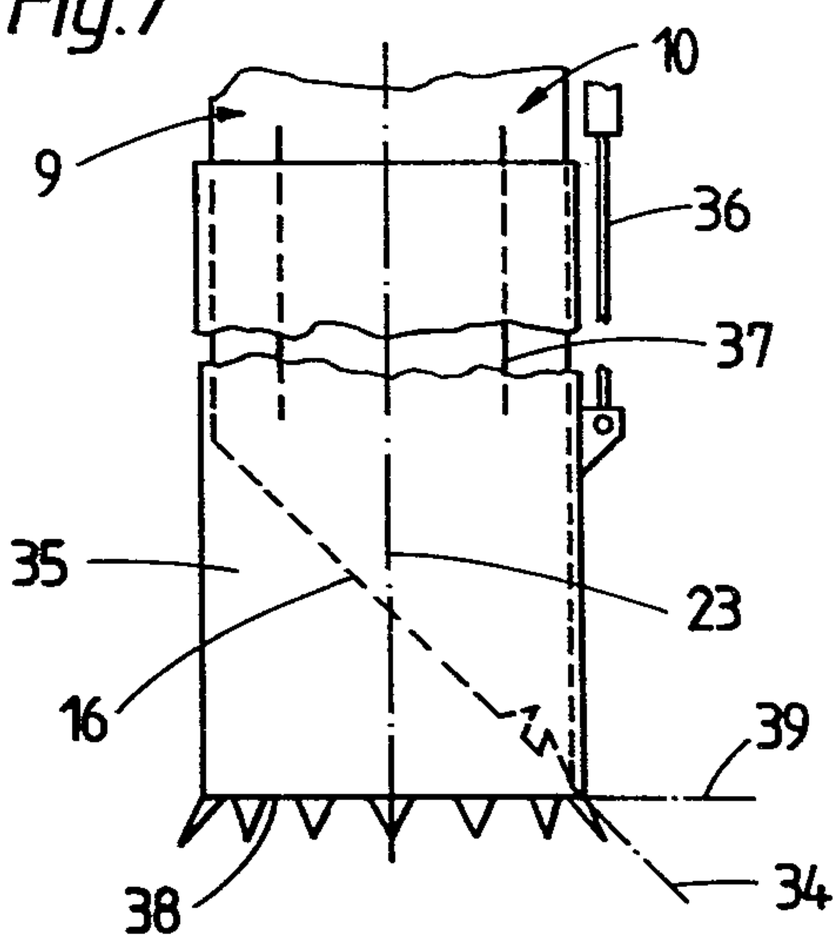


Fig.8

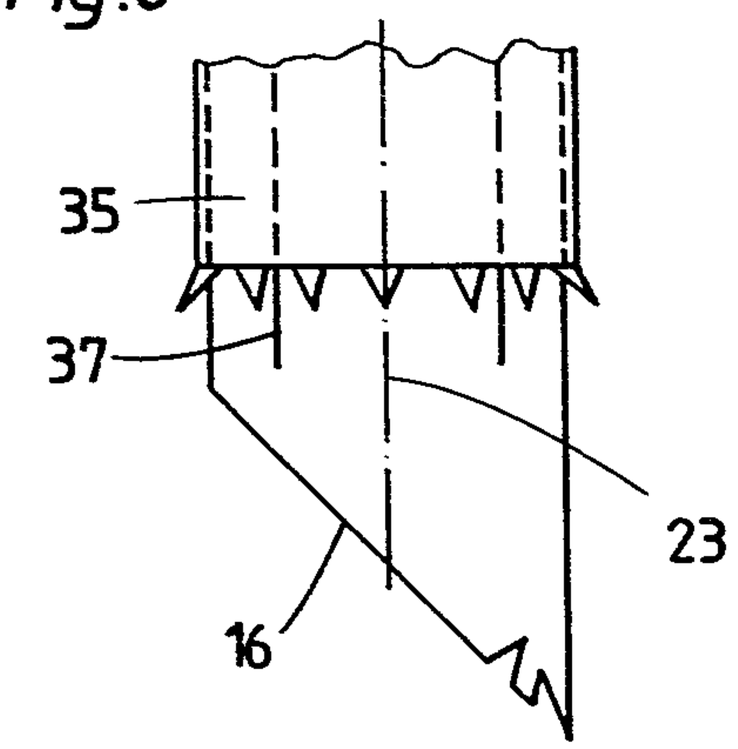


Fig.9

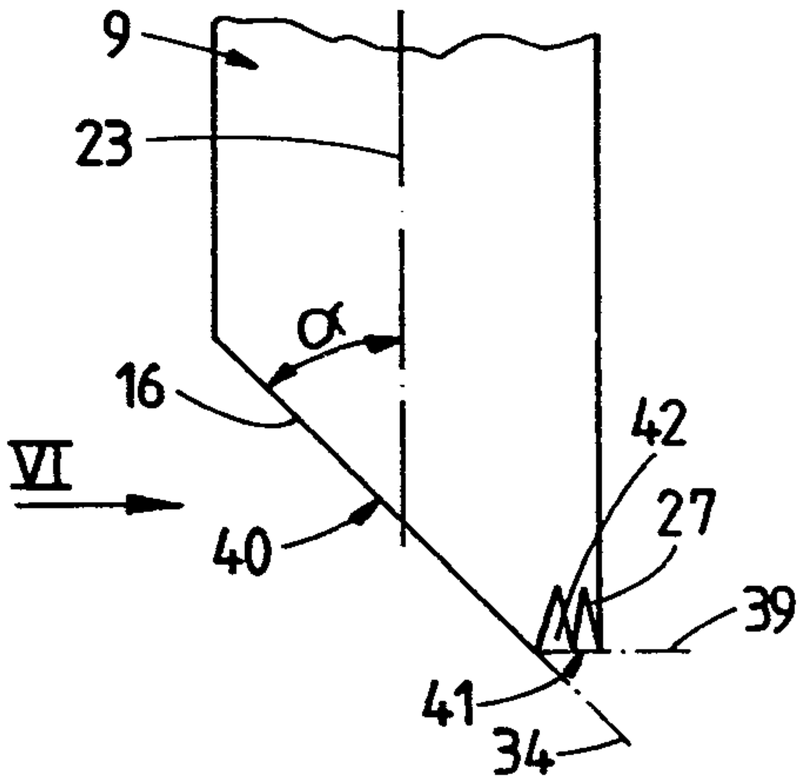
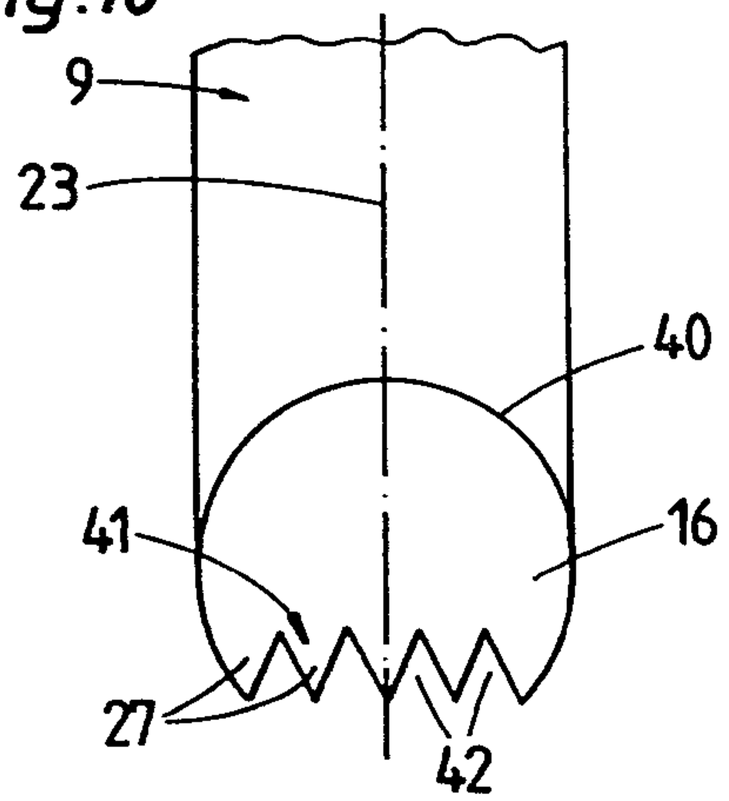
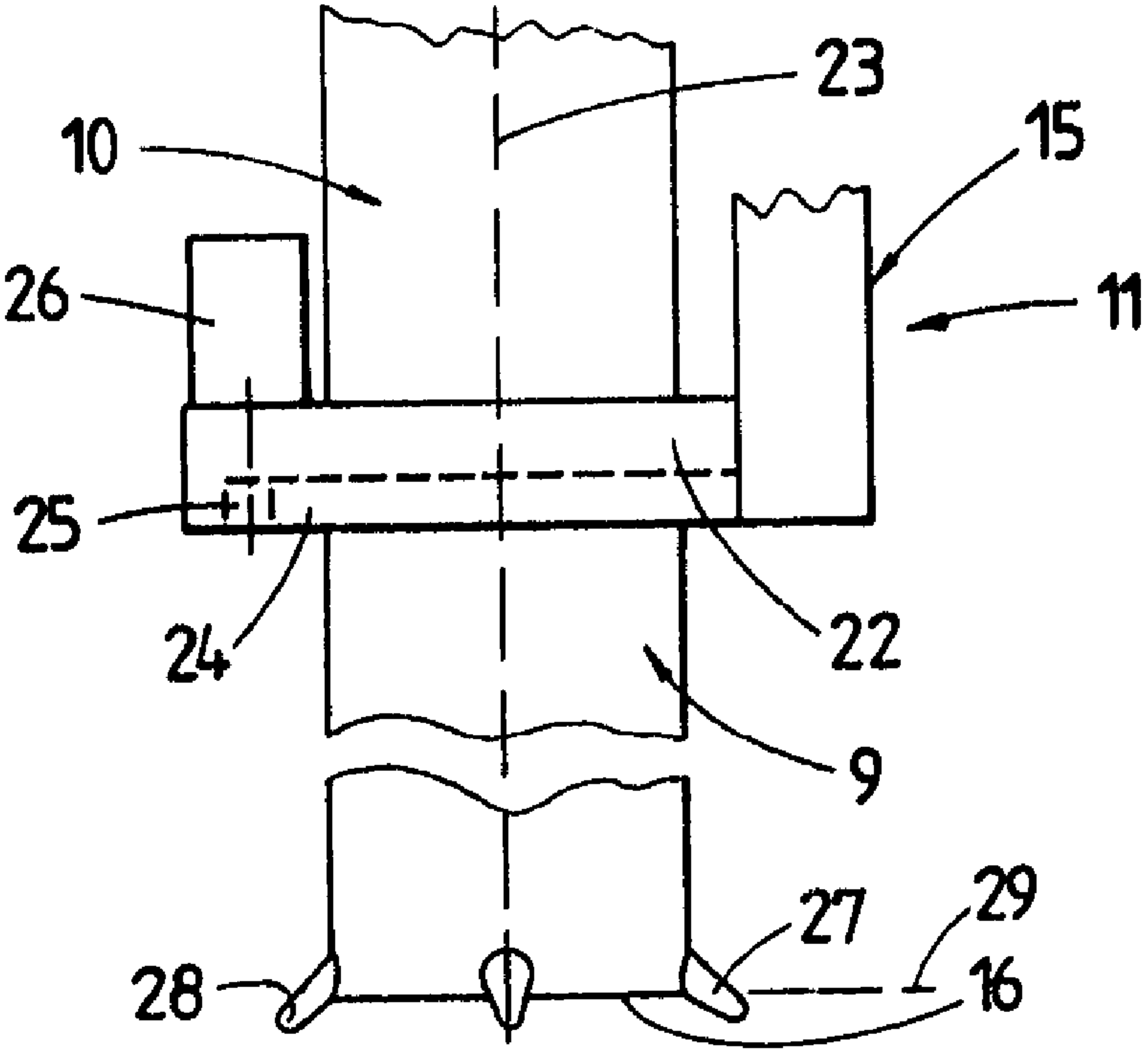


Fig.10




23
10
15
26
11
25
24
22
9
27
29
28
16