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(54) **Apparatus for cleaning the open draft boiler surfaces in a combustion or incineration plant**

Vorrichtung zum Reinigen von Kesselflächen einer Verbrennungsanlage

Appareil de nettoyage des surfaces de chaudières d'une usine de combustion ou d'incinération

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Description

Technical Field

[0001] The present invention relates to an apparatus for cleaning the open draft boiler surfaces in a combustion or incineration plant of the kind set forth in the introductory portion of claim 1.

Background Art

[0002] In apparatuses for cleaning boiler surfaces in a combustion or incineration plant of this kind, it is known to use a nozzle head with several nozzles for supplying a cleaning fluid to the boiler surfaces to be cleaned, said nozzle head being rotated and moved linearly in a direction in and out of the combustion chamber. An apparatus of this kind is known from US 5,579,726, which describes such a device for cleaning a boiler in service, said device comprising a lance and a rotating cleaning head mounted on the end of the lance and means for providing a linear movement in and out of the combustion chamber and means for rotating the cleaning head. The lance in this device is a stiff construction and the rotational and linear movements are provided by means of motors mounted externally of the combustion chamber to be cleaned. In all constructions shown and described in said document, the linear movement is in a horizontal direction, thus requiring that the lance is of a stiff construction. Another cleaning apparatus which comprises all the technical features of the preamble of claim 1 is known from DE-1 262 496.

Disclosure of the Invention

[0003] It is the object of the present invention to provide an apparatus for cleaning the open draft boiler surfaces in a combustion or incineration plant of the kind referred to above, which is of a simplified but yet effective construction compared to the prior art apparatuses, and this object is achieved with an apparatus of said kind which, according to the present invention, also comprises the features set forth in the characterizing clause of claim 1. With this arrangement the nozzle head on the end of the flexible hose can simply be lowered through the opening provided in the top of the open draft to be cleaned and moved downward while supplying cleaning fluid to the nozzles for delivery to the surfaces to be cleaned in an efficient way. Since the apparatus is positioned inside the open draft only during cleaning operations, the construction can be relatively simple as the cleaning fluid will keep the construction cool during the cleaning operation and the construction, thus, will not have to suffer the high temperatures inside the open draft of the combustion or incineration plant in service. Furthermore, the flexible hose construction reduces the amount of space required for introducing the cleaning apparatus into the open draft, thereby enabling the use of the apparatus in connection with existing plants substantially without any modifications thereof.

[0004] Preferred embodiments of the cleaning apparatus in accordance with the present invention, the advantages of which will be disclosed in the following detailed part of the present description, are revealed in the subordinate claims.

Brief Description of the Drawings

[0005] In the following detailed part of the present description, the invention will be explained more in detail with reference to the exemplary embodiment of an apparatus for cleaning the open draft boiler surfaces in a combustion or incineration plant according to the invention shown in the drawings, in which:

Fig. 1 schematically shows a combustion plant, in which the present invention is implemented,

fig. 2 schematically shows a cleaning head in cross-section, and

fig. 3 schematically shows a hose reel with a drive unit for controlled lowering and raising of the cleaning head and a pump unit for delivering the cleaning fluid to the flexible hose.

Description of the Preferred Embodiment

[0006] The combustion or incineration plant shown in fig. 1 comprises three successive open drafts 17, 18, 19 in which heat is transferred from the flue gasses to boiler tubes covering the walls of the open drafts 17, 18, 19. After the open drafts 17, 18, 19 a superheater 20 or several such superheaters and other boiler constructions are positioned.

[0007] In such a plant it is desired to keep clean the heat exchange surfaces in the open drafts 17, 18, 19 in order to reduce the heat transfer resistance from the flue gasses to the boiler tubes.

[0008] The cleaning apparatus implemented in the combustion or incineration plant shown in fig. 1 comprises a cleaning head 1 mounted on the end of a flexible hose 7 for insertion and lowing inside the open draft 17 through an opening 16 centrally positioned in the top of the open draft 17. The linear movement of the cleaning head 1 inside the open draft 17 is provided by rotating the hose reel 6 upon which the hose 7 is mounted.

[0009] The rotation of the nozzle head 4, as shown in fig. 2, is provided by means of a turbine 2 driven by the cleaning fluid entering the cleaning head 1 from the flexible hose 7. In order to reduce the speed of the rotation of the nozzle head 4, a gear train 3 is provided between the turbine 2 and the nozzle head 4. Several nozzles 5 are mounted on the nozzle head 4 in order to distribute the cleaning fluid in different directions during rotation of the nozzle head 4.

[0010] As shown in fig. 3, the hose reel 6 is mounted for rotation on an axle driven by a drive unit 8 for the hose reel 6, said drive unit 8 comprising an electric motor 9 and a reduction gear mechanism 10. As likewise shown in fig. 3, the electric motor 9 is controlled from a control unit 15 controlling the motor speed and rotational direction of the motor 9.

[0011] As also shown in fig. 3, the cleaning fluid is supplied to the hose 7 by means of a pump unit 11 comprising an electric motor 12 driving a pump 13. The electric motor 12 is controlled by the control unit 15 in order to be able to control the pressure of the cleaning fluid delivered to the flexible hose 7. The connection between the pump 13 and the hose reel 6 comprises a rotational coupling 14 in order to allow the hose reel 6 to rotate relative to the fixedly positioned pump 13.

[0012] As can be seen in fig. 1, each of the open drafts 17, 18, 19 have a centrally positioned opening 16 for insertion of the cleaning head 1 and the flexible hose 7 and for lowering and raising the cleaning head 1 downward and upward through the open drafts 17, 18, 19. During lowering and raising of the cleaning head 1, cleaning fluid is supplied through the flexible hose 7 whereby the nozzle head 4 is rotated and cleaning fluid is supplied to the internal surfaces of the open drafts 17, 18, 19 through the nozzles 5. These nozzles 5 are dimensioned to supply a concentrated jet of cleaning fluid to the internal surfaces of the open drafts 17, 18, 19, substantially without any dissolving into droplets of the concentrated jets. Preferably, the cleaning fluid is water which, when hitting the inner surfaces in the open drafts 17, 18, 19, evaporates whereby the water expands to a volume of approximately 1,500 times its original volume, said expansion providing the forces necessary for removing dirt from the surfaces hit. As already mentioned the cleaning is performed in service, i.e. the combustion or incineration plant is burning off fuel and producing heat and the surfaces to be cleaned are at a high temperature, necessary for providing the evaporation of the cleaning fluid.

[0013] Due to the fact that cleaning is performed during function of the plant, the cleaning can be performed whenever this is considered necessary, e.g. as detected by rising temperature of the flue gasses entering the superheater 20, because of dirt on the boiler surfaces reducing the heat transfer from the flue gasses in the open drafts 17, 18, 19. Thus, it is possible, in a controlled manner, to keep the temperature of the flue gasses entering the superheater 20 below a desired maximum temperature of e.g. 600 - 650 °C.

[0014] In this way corrosion on the superheater tubes is reduced and, furthermore, a reduction in temperature of the flue gasses in the superheater 20 results in less sticky deposits on the superheater surfaces. In a typical incineration plant the cleaning of each open draft 17, 18, 19 is performed approximately every week, e.g. one of each of the open drafts 17, 18, 19 is cleaned every second day. In this way it has proven possible to reduce the temperature of the flue gasses entering the superheater 20 by approximately 100 °C.

[0015] In a test setup, the cleaning fluid used was water and supplied to the flexible hose 7 at a pressure of approximately 4 - 5 bar on the top of the open drafts 17, 18, 19 and the nozzle head was provided with 6 nozzles. The time involved in cleaning a single open draft 17 was approximately 5 - 10 minutes and approximately 1,000 l of water were used for the cleaning.

[0016] Due to the fact that the cleaning system is only to be used approximately once a week, a single cleaning system may service several open drafts 17, 18, 19 by providing suitable means for introducing the cleaning head 1 and the flexible hose 7 through the corresponding openings 16.

[0017] Although the invention has been described above in connection with a preferred embodiment of the invention, as shown in the figures, it will be evident for a person skilled in the art that several deviations may be envisaged within the scope of the following claims, such deviations comprising among others the provision of several openings 16 for each of the open drafts 17, 18, 19 to be cleaned, in order to have the cleaning head 1 moved up and down closer to the surfaces, said openings 16 being positioned at a distance from the central part of each open draft 17, 18, 19, the provision of automatic means for opening and closing the openings 16, the provision of several cleaning systems, e.g. one cleaning system for each open draft 17, 18, 19, each such cleaning system comprising its respective cleaning head 1, flexible hose 7 and hose reel 6, etc.

Claims

1. Apparatus for cleaning open draft boiler surfaces in a combustion or incineration plant in service, said apparatus comprising

- a nozzle head (4) with several nozzles (5),
- means for rotating the nozzle head (4),
- means for providing a mainly linear movement of the nozzle head (4) inside the open draft (17, 18, 19), and
- means for supplying a cleaning fluid to the rotating and linearly moving nozzle head (4), whereby the cleaning fluid exiting the nozzles (5) hits the surfaces to be cleaned,

wherein

the nozzle head (4) is mounted on the end of a flexible hose (7), delivering the cleaning fluid to the nozzles (5), and capable of being inserted, lowered and raised (4) inside open draft boilers, **characterized by** the means for rotating the nozzle head (4) being provided as a drive unit (2, 3) mounted on the end of the flexible hose (7), said drive unit (2, 3) being driven by the cleaning fluid delivered to the nozzles (5) through the flexible hose (7) and comprising a

turbine (2) driven by the cleaning fluid entering the cleaning head (1) from the fexible hose (7) and a gear train (3) to reduce the speed of the rotation of the nozzle bead (1).

2. Apparatus in accordance with claim 1, **characterized by** the cleaning fluid being water.

3. Apparatus in accordance with claim any of the preceding claims, **characterized by** the means for providing a mainly linear movement of the nozzle head (4) inside the open draft (17, 18, 19) comprising a hose reel (6) with a drive unit (8) for lowering and raising the nozzle head (4) on the end of the flexible hose (7) downward and upward inside the open draft (17, 18, 19).

4. Apparatus in accordance with claim 3, **characterized by** the drive unit (8) for the hose reel (6) being a speed controlled (15) gear motor (9, 10).

5. Apparatus in accordance with any of the preceding daims, **characterized by** the means for supplying the cleaning fluid to the nozzle head (4) comprising a feed water pump (11) delivering the cleaning fluid at a pre-determined pressure level through the flexible hose (7).

6. Apparatus in accordance with claim 5, **characterized by** the feed water pump (11) being pressure controlled (15).

7. Apparatus in accordance with any of the preceding claims, **characterized by** the pressure level of the cleaning fluid delivered to the nozzles (5) being less than 10 bar.

8. Apparatus in accordance with any of the preceding claims, **characterized by** the nozzles (5) of the nozzle head (4) being of a type which keeps the outflowing jet from the nozzles concentrated with only minor dissolving into droplets.

9. Apparatus in accordance with any of the preceding claims, **characterized by** the rotational speed of the rotating nozzle head (4) being between 1 and 50, preferably between 5 and 10, revolutions per minute.

10. Apparatus in accordance with any of the preceding claims, **characterized by** the flexible hose (7) being a flexible bellows-type metal hose (7), preferably of stainless steel material.

Patentansprüche

1. Vorrichtung zum Reinigen der Oberflächen eines Kessels mit offenem Zug in einer in Betrieb befindlichen Verbrennungs- oder Veraschungsanlage, wobei die Vorrichtung umfasst:

- einen Düsenkopf (4) mit mehreren Düsen (5),
- Mittel zum Drehen des Düsenkopfs (4),
- Mittel für die Erzeugung einer hauptsächlich geradlinigen Bewegung des Düsenkopfs (4) innerhalb des offenen Zugs (17, 18, 19) und
- Mittel zum Zuführen eines Reinigungsfluids zu dem sich drehenden und geradlinig sich bewegenden Düsenkopf (4), wobei das die Düsen (5) verlassende Reinigungsfluid auf die zu reinigenden Oberflächen austritt,

wobei der Düsenkopf (4) am Ende eines flexiblen Schlauchs (7) angebracht ist, der den Düsen (5) das Reinigungsfluid zuführt, und in die Kessel mit offenem Zug eingeführt und darin abgesenkt und angehoben werden kann,
dadurch gekennzeichnet, dass die Mittel zum Drehen des Düsenkopfs (4) als Antriebseinheit (2, 3) vorgesehen sind, die am Ende des flexiblen Schlauchs (7) angebracht sind, wobei die Antriebseinheit (2, 3) durch das Reinigungsfluid angetrieben wird, die durch den flexiblen Schlauch (7) den Düsen zugeführt wird, und eine Turbine (2), die durch das von dem flexiblen Schlauch (7) in den Reinigungskopf (1) eintretende Reinigungsfluid angetrieben wird, und einen Getriebezug (2) zum Verringern der Drehzahl des Düsenkopfs (1) aufweist.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** das Reinigungsfluid Wasser ist.

3. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Mittel für die Schaffung einer hauptsächlich geradlinigen Bewegung des Düsenkopfs (4) in dem offenen Zug (17, 18, 19) eine Schlauchhaspel (6) mit einer Antriebseinheit (8) zum Absenken und Anheben des Düsenkopfs (4) am Ende des flexiblen Schlauchs (7) abwärts bzw. aufwärts in dem offenen Zug (17, 18, 19) umfassen.

4. Vorrichtung nach Anspruch 3, **dadurch gekennzeichnet, dass** die Antriebseinheit (8) für die Schlauchhaspel (6) ein geschwindigkeitsgesteuerter (15) Getriebemotor (9, 10) ist.

5. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Mittel zum Zuführen des Reinigungsfluids an den Düsenkopf (4) eine Beschickungswasserpumpe (11) umfassen, die das Reinigungsfluid mit einem vorgegebenen Druckpegel durch den flexiblen Schlauch (7) fördert.

6. Vorrichtung nach Anspruch 5, **dadurch gekenn-**

zeichnet, dass die Beschickungswasserpumpe (11) druckgesteuert (15) ist.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Druckpegel des zu den Düsen (5) geförderten Reinigungsfluids niedriger als 10 Bar ist.

8. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Düsen (5) des Düsenkopfs (4) von einem Typ sind, der den ausströmenden Strahl von den Düsen konzentriert hält, so dass nur eine geringe Auflösung in Tröpfchen erfolgt.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Drehzahl des rotierenden Düsenkopfs (4) im Bereich von 1 bis 50, vorzugsweise im Bereich von 5 bis 10 Umdrehungen pro Minute liegt.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der flexible Schlauch (7) ein flexibler, balgartiger Metallschlauch (7), vorzugsweise aus rostfreiem Stahl, ist.

Revendications

1. Appareil de nettoyage de surfaces d'évaporateur à tirage ouvert dans une installation de combustion ou d'incinération en service, ledit appareil comprenant :

- une tête de buses (4) munie de plusieurs buses (5) ;
- des moyens pour faire tourner la tête de buses (4) ;
- des moyens pour assurer un déplacement principalement linéaire de la tête de buses (4) à l'intérieur du tirage ouvert (17, 18, 19) ; et
- des moyens pour fournir un fluide de nettoyage à la tête de buses (4) se déplaçant en rotation et de façon linéaire, le fluide de nettoyage sortant des buses (5) frappant ainsi les surfaces à nettoyer ;

dans lequel la tête de buses (4) est montée sur l'extrémité d'un tuyau flexible (7) délivrant le fluide de nettoyage aux buses (5) et pouvant être insérée, abaissée ou élevée, à l'intérieur de l'évaporateur à tirage ouvert ;
caractérisé en ce que les moyens de rotation de la tête de buses (4) sont prévus sous la forme d'une unité d'entraînement (2, 3) montée sur l'extrémité du tuyau flexible (7), ladite unité d'entraînement (2, 3) étant entraînée par le fluide de nettoyage délivré aux buses (5) par l'intermédiaire du tuyau flexible (7) et comprennent une turbine (2) entraînée par le fluide de nettoyage pénétrant dans la tête de nettoyage (1) à partir du tuyau flexible (7) et un train d'engrenage (3) afin de réduire la vitesse de rotation de la tête de buses (4).

2. Appareil selon la revendication 1, **caractérisé en ce que** le fluide de nettoyage est de l'eau.

3. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les moyens pour assurer un déplacement principalement linéaire de la tête de buses (4) à l'intérieur du tirage ouvert (17, 18, 19) comprennent une bobine de tuyau (6) munie d'une unité d'entraînement (8) pour abaisser et soulever la tête de buses (4) à l'extrémité du tuyau flexible (7) vers le bas et vers le haut à l'intérieur du tirage ouvert (17, 18, 19).

4. Appareil selon la revendication 3, **caractérisé en ce que** l'unité d'entraînement (8) pour la bobine de tuyau (6) est un moteur à engrenages (9, 10) commandé en vitesse (15).

5. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les moyens pour fournir le fluide de nettoyage à la tête de buses (4) comprennent une pompe à eau d'alimentation (11) délivrant le fluide de nettoyage à un niveau de pression prédéterminé par l'intermédiaire du tuyau flexible (7).

6. Appareil selon la revendication 5, **caractérisé en ce que** la pompe d'eau d'alimentation (11) est commandée en pression (15).

7. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le niveau de pression du fluide de nettoyage délivré aux buses (5) est inférieur à 10 bars.

8. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les buses (5) de la tête de buses (4) sont d'un type maintenant le jet de sortie des buses concentré avec seulement une dissolution mineure en gouttelettes.

9. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la vitesse de rotation de la tête rotative de buses (4) est comprise entre 1 et 50, de préférence entre 5 et 10 tours par minute.

10. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le tuyau flexible (7) est un tuyau flexible en métal du type à soufflet (7), de préférence en acier inoxydable.

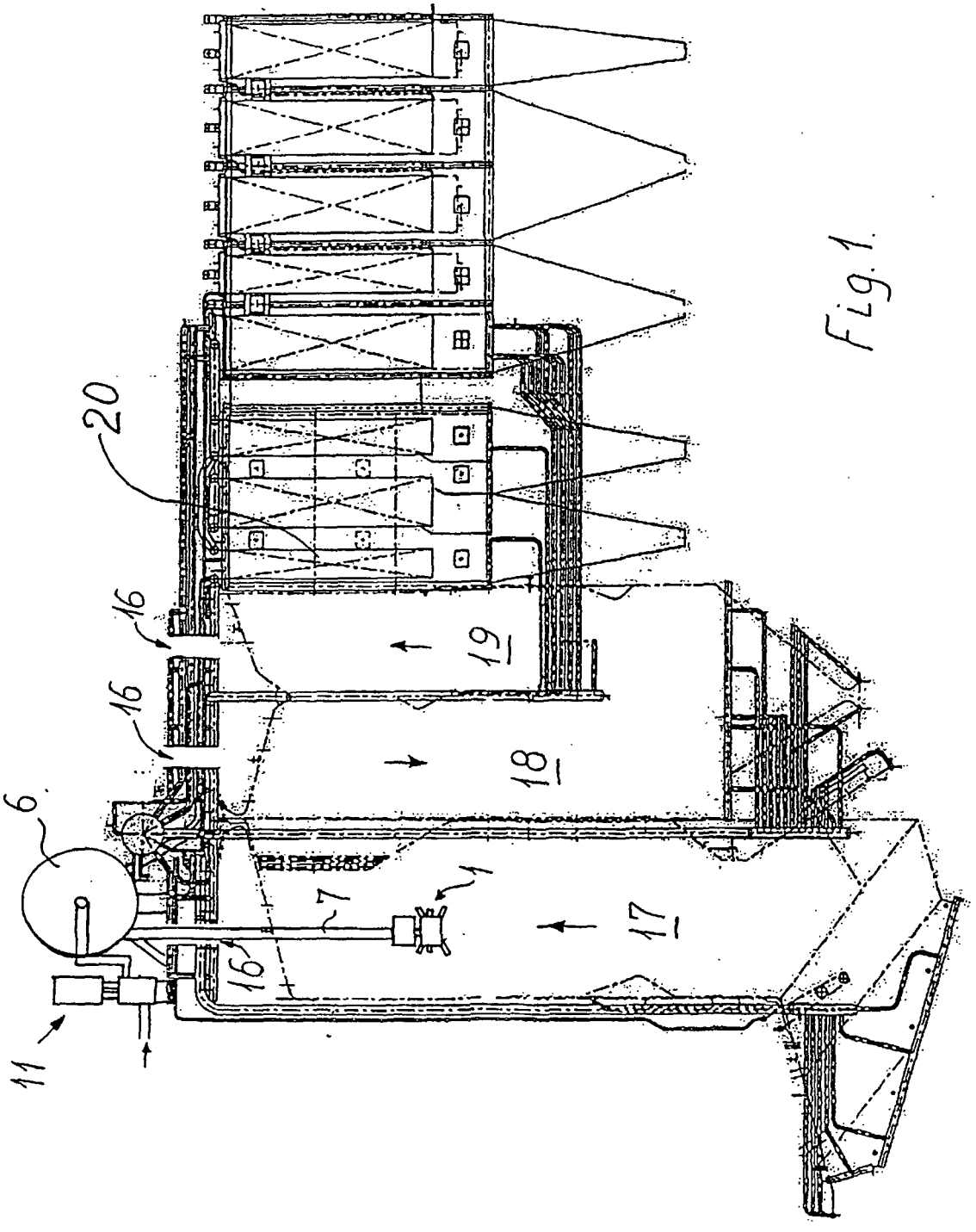


Fig.1.

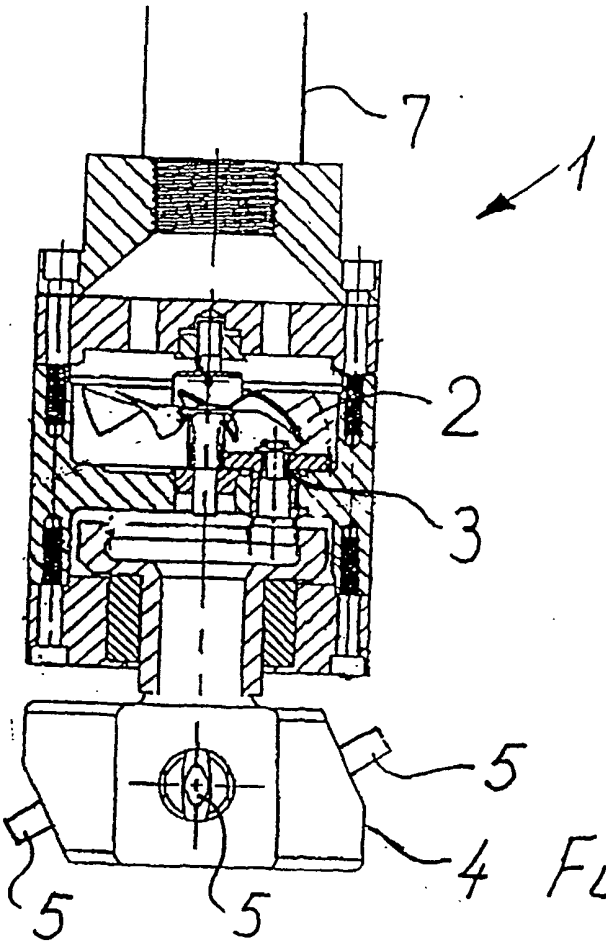


Fig. 2.

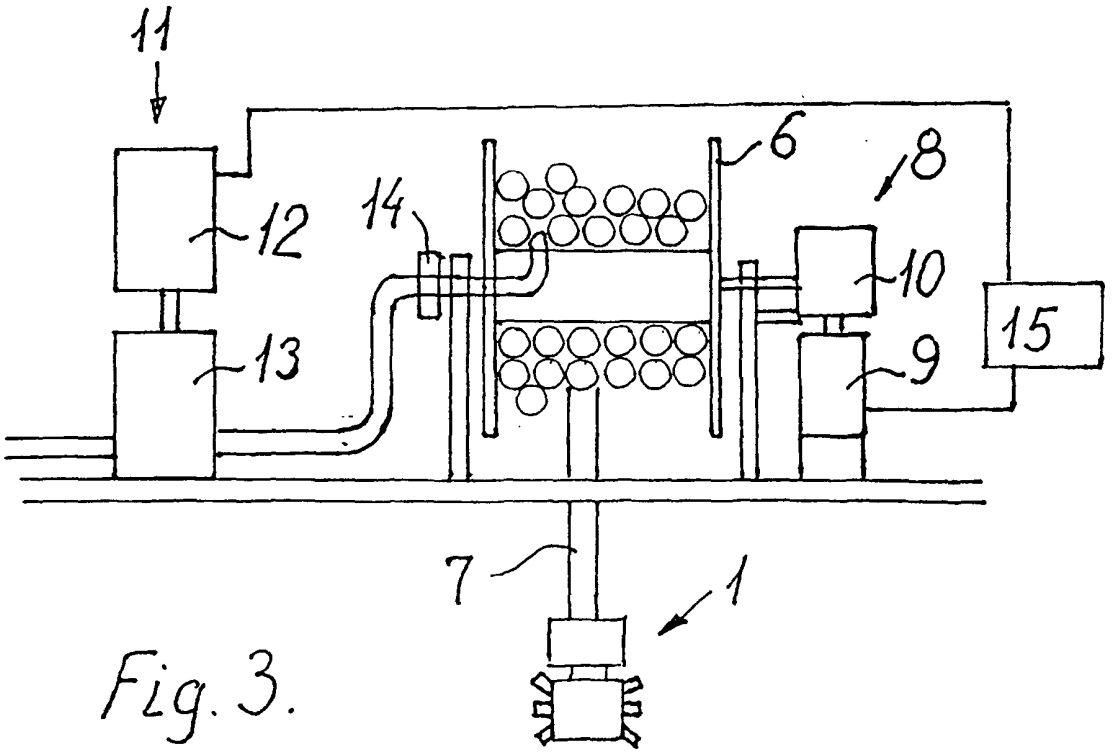


Fig. 3.