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#### A DISPLACEMENT DEVICE

- 5 The present invention relates to a device for displacing sediment, for example sand, from the bottom of a container filled with liquid to a receptacle device according to preamble to the independent claim.

In many technical applications, liquid is allowed to rest in basins,  
10 pools (containers) for varying lengths of time in order that particles located (suspended) in the liquid be allowed to sink to the bottom and there form a sediment. In such contexts, it is often desirable that this sediment be removed from the bottom of the container at the same time as the container is filled with liquid. For example, such needs  
15 exist in treatment plants for waste water.

It is previously known to employ for this purpose scraper devices which displace the sediment to an edge region of the bottom of the pool, normally the short side of the pool or container, which is often between  
20 15 and 20 metres long. In order to remove the sediment which has been scraped together in this edge region, use is generally made of an arrangement comprising a pump which depends from a gantry above the pool. The pump includes a pump pipe whose intake opening is located close to the sediment strand. The pump, with its suction pipe is intended to be  
25 displaced along the strand of accumulated sediment.

The pump equipment, with its suspension construction, is expensive and wear on the pump is extreme, since sediment of the type under contemplation here contains considerable quantities of sand. For this reason,  
30 use is often made of a simple design in which considerable quantities of air are introduced in the lower region of a "pump pipe", this air



then rising upwardly in the water column inside the pump pipe. There thereby occurs a suction effect in the inlet of the pump pipe. The material in the sediment strand accompanies the water which is sucked into the pump pipe and is conveyed by the water to the outlet of the pump pipe above the surface of the water in the pool or container. This type of pump requires considerable electric power. Its lifting height above the surface of the water in the container is low. The ratio of water to sediment is very unfavourable. Normally, the sediment which is pumped up contains approximately 97 % water and approximately 3 % solid matter, for which reason the degree of efficiency of such an arrangement is poor in the extreme.

As disclosed above, use is also made of other more conventional pumps, but the mixture of sediment and water entails severe wear on the pumps. For all types of pumps, it applies that the mixture which is pumped up is of low total solids content and that, as a result, the mixture must be dewatered in equipment suited for this purpose, normally designated sand dewaterers.

Consequently, the art is in serious need of realizing a technique in which the degree of efficiency is considerably improved, at the same time as the operational reliability of the device itself is high and its service life long.

The above needs are satisfied by a device according to the characterizing clause in the appended main claim.

The technique disclosed according to the present invention entails that, in the mixture which is displaced up to the surface above the water, the sediment generally constitutes more than 60 weight percent. In addition, the displacement requires only low power output in the



drive means employed. As a result, the degree of efficiency of the device is considerably higher than in prior art technology.

Expedient embodiments of the present invention are disclosed in the appended subclaims.

The present invention will now be described in greater detail hereinbelow, with particular reference to the accompanying drawings, in which:

Fig. 1 is a cut-away schematic view of the device according to the present invention placed in one edge region of a pool or container;

Fig. 2a is a section through a vertical conveyor and a displacement device constituting feeding device to the vertical conveyor corresponding to the section A-A in Fig. 2b;

Fig. 2b is the section B-B in Fig. 2a;

Fig. 3a shows a section corresponding to the section of Fig. 2a for an alternative embodiment corresponding to the section A-A in Fig. 3b;

Fig. 3b is the section B-B in Fig. 3a;

Fig. 4a is a section corresponding to the section of Fig. 2a for yet a further embodiment corresponding to the section A-A in Fig. 4b;

Fig. 4b is the section B-B in Fig. 4a;



- j. 5a is a section corresponding to the section of Fig. 2a for still a further embodiment corresponding to the section A in Fig. 5b (the first conveyor operates as a ram conveyor and has its discharge end directly connected to the vertical conveyor, i.e. no separate infeed devices are employed);
- j. 5b is the section B-B in Fig. 5a;
- js. 6a-b are sections corresponding to those previously disclosed, in which two other conveyors are employed and the displacement device comprises two feeder screws;
- gs. 7a-c are sections through three embodiments of the conveyor vane of a screw thread; and
- g. 8a-b is a section corresponding to Fig. 5a and 5b of yet a further embodiment.
- g. 1 shows an arrangement including a pool (container) 20 with an edge region 21, the container being intended to be supplied with liquid containing particles (material) of a density which entails that the particles show a tendency to sink towards the bottom 28 of the container and there form a sediment. The normal filling level of the container 20 is shown at reference numeral 62. A first conveyor 22 is disposed, at the bottom 28 of the container, in an upwardly open path 23 through the edge region 21. The conveyor includes a screw thread 24 which, in certain embodiments, is provided with a mechanical shaft, while in other embodiments, no mechanical shaft is provided. Drive means 25 for the rotation of the screw thread are, in the embodiment of the device shown



the drawing, provided in connection with the discharge portion 27 of first conveyor and are illustrated in the Figure in one version in which the drive means are located outside the wall 30 of the pool or container. It will be obvious to a person skilled in the art that, in other embodiments, the drive means may be located within the container. The geometric longitudinal axis of the screw thread carries reference numeral 26.

A second conveyor 40 is provided in connection with the discharge portion 27 of the first conveyor and comprises a casing 41, a rotary screw thread 44 (Fig. 2a), an infeed portion 70 with an infeed opening (Fig. 2a) located in the region of the bottom of the container, and a discharge portion 42 located above the normal filling level of the container. The casing 41 of the second conveyor is shown in the Figure in one embodiment in which the casing has at least one corner. However, it will be obvious that, in other embodiments, the casing is of circular or oval cross-sections. In certain embodiments, the casing is provided with inner rib-like devices, in particular in those embodiments in which the casing is of circular or oval cross-section. Drive means 45 for rotation of the screw thread are, in the illustrated embodiment, disposed above the filling level of the container. In the upper region of the casing and above the maximum filling level, the casing is, in a preferred embodiment, provided with drainage openings 47. In certain embodiments, the ejector of the discharge portion 42 is disposed above a screen grid which, in turn, is located above the highest filling level of the container.

In the embodiment shown in the Figure, a receptacle device 29 for sediment is provided in connection with the discharge portion 42 of the second conveyor. In certain embodiments, the receptacle device is fed with sediment direct from the discharge portion 42 of the conveyor,



le, in other embodiments, a special conveyor unit 60 (in one preferred embodiment provided with drainage openings) connects the charge portion with the receptacle device 29, or the receptacle device 29 is fed with material which is discharged by the ejector via above disclosed screen grid.

transferring sediment from the first conveyor 22 to the second conveyor 40, there is disposed, in the region of the bottom 28 of the container, a mechanical device 50. In Figs. 2a and 2b, the mechanical device 50 is shown in one version in which it comprises a screw conveyor generally provided with a screw thread 51 which has no mechanical lift. With its discharge portion 52, the screw conveyor connects to a second conveyor. The sediment is fed to the screw thread 51 from the first conveyor 22 and, on its rotation, feeds in sediment into the lower portion of the second conveyor 40.

In its very simplest version, the mechanical device consists of the discharge portion 27 of the first conveyor 22 which, in its discharge portion 27, is connected to the second conveyor 40. In its very simplest version the transition is formed between the first and second conveyors 22 and 40, and thereby the mechanical device 50, by the end portion of the path 23 of the first conveyor 22. This embodiment is shown in Figs. 8a and 8b. In certain practical applications, depending for example on the composition of the sediment and the rigidity of the material, a support 12 is provided so as to keep the screw thread 24 in place and prevent it from "lifting".

In a second embodiment, the conveyors are interconnected with one another by means of flanges 31. In certain embodiments, the first conveyor has, in its discharge end, a short casing 63 (cf. Figs. 5a,b) which surrounds the screw thread 24 of the conveyor and forms a



stantially tight connection with the casing 41 of the second conveyor 40. In this embodiment, the mechanical device 50 consists of a connection. The drive means of the first conveyor are, in one preferred embodiment, then connected to the first conveyor at that end which is located furthest away from the connection of the conveyor to the second conveyor. The discharge portion 27 of the first conveyor thereby forms an infeed device 34 to the second conveyor 40. The casing of the second conveyor is provided with an opening whose dimensions are adapted to the dimensions of the screw thread 24 of the first conveyor. The dimensions of the spiral thread and the opening are, in this instance, selected such that the cross-sectional area of the opening generally exceeds the cross-sectional area which, on rotation of the spiral thread, is formed by the outer bounding definition of the spiral thread.

In a third embodiment, the mechanical device 50 includes special mechanical displacement means 57 (Fig. 2-4 and 6) which take care of the sediment discharged from the discharge portion 27 of the first conveyor and feed this sediment to the second conveyor 40. In connection with Figs. 2-4 and 6, embodiments for such mechanical means 57 will be described hereinbelow.

Figs. 2a and 2b show one embodiment in which the mechanical device 50 for displacing sediment from the first conveyor 22 to the second conveyor 40 includes a plate 58 disposed at an oblique angle and whose lower portion merges into a U-path 59 for a spiral thread 51 forming a displacement means 57 coupled to the second conveyor 40. Analogous with that disclosed above for the interconnection of the first conveyor 22 with the second conveyor 40, the displacement means 57 include a discharge portion 52 which is connected to the second conveyor 40. As a result, the discharge portion is connected to the casing 41 of the second



veyor by means of a mechanical interconnection device 53. The displacement means 57 cooperate with the opening 64 of the second conveyor through which the second conveyor receives material from the displacement means 57. Drive means 35 for rotation of the spiral thread 51 of the displacement means 57 are connected to the displacement means. It will be apparent from the embodiment illustrated in Figs. 2a and 2b that, in the embodiment shown in the two Figures the first conveyor 22 drives the second conveyor 40, and that the displacement means 57 are provided for conveying material in a direction which is opposed to that of the first conveyor. The displacement means 57 are located on a lower level than the discharge end of the first conveyor 20, in order to make it possible that material can be displaced from the first conveyor to the displacement means 57 in that the material sinks towards the displacement means.

Figs. 3a and 3b show an embodiment corresponding to that illustrated in Figs. 2a and 2b but in which the discharge portion 27 of the first conveyor 22 is located ahead of the second conveyor 40. The mechanical device 50 for displacing sediment from the first conveyor to the second conveyor is of a construction which substantially corresponds to that described with reference to Figs. 2a and 2b, with the difference being that the displacement means 57 are disposed to feed material in the same direction as the first conveyor.

Figs. 4a and 4b show one embodiment in which the mechanical feeder device 50 is adapted so as to permit the first conveyor 20 and the displacement means 57 to make an angle with one another, in which event the first conveyor passes over the displacement means. The discharge portion 27 of the first conveyor 22 then includes a downwardly open portion in the U-path 65 of the conveyor for discharging material from the first conveyor to the spiral thread 51 of the displacement means



57. The discharge portion of the displacement means is of a construction corresponding to that described above.

In the embodiment illustrated in Figs. 6a and 6b, the device includes  
5 two second conveyors 40a, 40b. In such instance, the mechanical device  
50 comprises two separate displacement means 57a, 57b which displace  
the material each into its second conveyor. Beneath the first conveyor,  
the mechanical device is provided with a guide surface 60 which is of  
V-shaped cross-section, with the apex or tip of the V facing upwards.  
10 The guide surface is formed, for example, from one or more metal  
sheets, is cast in concrete, etc. The "V-tip" of the cross-section is  
located beneath the first conveyor 22 and, as a rule, substantially in  
the vertical plane or somewhat offset in relation to the vertical plane  
through the geometric centre axis of the first conveyor.

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Figs. 7a-c show three embodiments of the conveyor vane 46 of the screw  
thread 44. In Fig. 7a, the upstanding vane 46a consists of a single  
vane 72, in Fig. 7b the vane 46b consists of two part-vanes 73, 74,  
while in Fig. 7c the vane 46c consists of three part-vanes 73, 74, 75.

20 In the Figures, the casing 41 is also shown, as well as the geometric  
axis 71 of the second conveyor. The arrow F marks the direction of dis-  
placement of the material, upwards in the second conveyor 40.

Fig. 7 b shows one embodiment in which the extent of the first half-  
25 blade 73 located most proximal the geometric centre axis is, in both  
the axial and the radial directions, shorter than the second half-blade  
74 located most distal from the centre axis 71. The drive surfaces 76,  
77 of both half-blades are disposed substantially flush with one  
another. The edge surface of the first half-blade 73 facing away from  
30 the centre axis 71 abuts against the edge surface of the second half-  
blade 74 facing towards the centre axis.



In Fig. 7c, a third part-blade 75 is fixed against the drive surface of the second part-blade 74. From the second part-blade 74, the third part-blade projects radially outwardly towards the casing 41. The third  
5 part-blade 75 is shorter in both radial and axial extent than the second part-blade 74. In the embodiments according to Figs. 7b and 7c, the part-blades are fixed to one another.

In one preferred embodiment, at least one of the spiral threads  
10 disposed in the two separate displacement means 57 (cf. for example Fig. 2) is designed as a spiral with no mechanical shaft. As a rule, the corresponding situation applies to the first conveyor 22 and the second conveyors 40. The drive means 25, 35 for the first conveyor 22 and for the displacement means 57, respectively, are provided along or  
15 inside the wall 30 of the pool or container.

The geometric axis 54 in the transport direction of the screw thread 51 of the displacement means 57 is, at least in the discharge portion 52, directed towards the centre of the screw thread 44 of the second conveyor. In certain embodiments, the axis 26 of the screw thread 44 of  
20 the second conveyor 40 and the screw thread of the displacement means 57 make an oblique angle with each other in the region of the discharge portion 42. In a plane through the geometric axis of the two screw threads, these make an angle  $\alpha$  of at least approx.  $\pm 45^\circ$  and preferably  
25 at least approx.  $\pm 60^\circ$ . As a rule, the second conveyor 40 and the displacement means are oriented such that these geometric axes make substantially a right angle with each other.

As a rule, the screw thread of the displacement means is substantially  
30 horizontal, but in certain embodiments where material needs to be displaced in the vertical direction, it makes an oblique angle with the



vertical plane, for example an angle of at most approx 45° and preferably at most approx. 30°.

In the embodiment in which the first conveyor 22 is directly connected  
5 to the second conveyor 40 for feeding material into this conveyor, the  
path 23 of the first conveyor is, in certain versions, also upwardly  
open in the transition to the second conveyor. On rotation of the screw  
thread 24 of the first conveyor 22, the first conveyor builds up an ac-  
cumulation of material in the transition to the second conveyor. This  
10 accumulation of material forms a "seal" which prevents liquid from  
flowing in and out through the infeed opening of the second conveyor.

In certain embodiments there is provided (cf. Fig. 4), in connection to  
the mechanical device 50 for displacing sediment, a first sensor 35 for  
15 sensing the level of sediment in the displacement means 57. The sensor  
is connected via a signal communication 36 to a master unit 37 which,  
via a signal communication 38, is coupled to the drive means 55 of the  
displacement means and, via a signal communication 68 to the drive  
means 45 of the second conveyor 40. In certain embodiments, the master  
20 unit 37 is also connected to the drive means 25 of the first conveyor  
22 via a signal communication 39. The master unit is operative on a  
time-lag basis first to start the drive means 45 of the second conveyor  
40, thereafter the drive means 55 for the displacement means 57 and  
thereafter, also in certain embodiments, the drive means 25 of the  
25 first conveyor 22 when the sediment has reached the predetermined level  
in the mechanical device.

In certain embodiments, a further second sensor 66 is also provided, at  
a lower level than the first sensor. The second sensor is coupled via  
30 signal connections 67 to the master unit 37. The signal from the second



sensor is utilized by the master unit for emitting signals to the drive means 45, 55 which entail that they stop.

In other embodiments, the power supplied to the drive means 55 of the displacement means is sensed, and when the power falls below a predetermined level, both the drive means 55 of the displacement means 57 and the drive means 45 of the second conveyor 40 are stopped. The time during which the drive means are to operate is, in certain embodiments, adjustable at a level which is based on the time consumed to transport a given quantity of material out of the mechanical device 50 and through the second conveyor 40. In reality, this implies that the requisite time is calculated based on the capacity of the displacement means 57, when the second conveyor is dimensioned to have a capacity which is at least as great as the capacity of the displacement means 57.

It is obvious that the above described technique relating to the master unit 37 and to sensors 35, 66 connected thereto is, in certain practical applications, employed for any of the embodiments whatever of the device according to the present invention.

Sediment which has accumulated in the first conveyor 22 is displaced thereby continuously or intermittently towards the discharge portion 27 of the conveyor. Via the mechanical device 50, the sediment is transferred to the second conveyor 40 in that the sediment is displaced (forced) via the discharge portion 52 of the mechanical device into the second conveyor. On rotation of the screw thread 44 in the second conveyor 40, the sediment is moved towards the discharge portion 42 of the second conveyor and departs from the second conveyor 40 via this portion in order, either directly or via the transport device 60, to be moved to the receptacle device 29. In those embodiments where a grid is



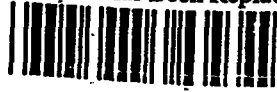
provided in connection with the discharge portion of the conveyor, supplementary dewatering of the sediment takes place in addition to the dewatering which takes place in the conveyor 40 before movement to the receptacle device.

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In one preferred embodiment, the transport device 60 is designed for reduction of the liquid content of the sediment. The drainage openings 47 in the casing of the second conveyor contribute in reducing the liquid content, in those embodiments of the device where such drainage  
10 openings are included. On displacement of the material in the second conveyor 40, continuous relaying of the material as a rule takes place, whereby passages are created for water to run back down towards the in-feed portion of the second conveyor.

15 In certain embodiments, intermittent operation of the device is applied. The intermittent operation is, for example, time-controlled in response to the expected growth of sediment in the pool or container. When a certain quantity of sediment has normally been deposited, the drive means for the conveyors start and, where applicable, the drive  
20 means also for the displacement means 57. The drive means operate during a predetermined time interval, the accumulated sediment being moved from the bottom of the pool or container. In certain embodiments, the drive means are provided with devices which sense the relevant loading, whereupon the drive means are disengaged when the loading  
25 falls below a certain level.

In those embodiments where the mechanical device 50 includes one or more sensors 35, 66, the sensor or sensors, respectively, are generally disposed such that the drive means 55, 45 for the displacement means 57  
30 and for the second conveyor 40 are only started when the level of the sediment in the mechanical device is so high that the screw thread 51



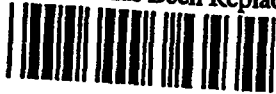
of the displacement device is wholly covered by the sediment. The sediment is generally allowed to accumulate to a level where the distance between the upper surface of the sediment and the screw thread is at least as great as the radius of the screw thread and, as a rule, at least as great as the diameter of the screw thread. In such instance, this is taken to signify the vertical distance between the screw thread and the upper surface of the sediment in a vertical plane through the centre axis of the screw thread. It will be obvious that the sediment has a sloping upper defining surface in the region of the displacement means 57. In certain practical applications, no casing will generally be needed about the displacement means 57 (the thread spiral) in the transition to the second conveyor 40, in particular when the above-disclosed distance is at least as great as the diameter of the screw thread.

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The design of the transition, described with reference to, among others Figs. 5a,b between the first conveyor 22 and the second conveyor 40 is also generally applied in those embodiments which were described with reference to Figs. 1-4 and 6. In those embodiments where a casing 34 is employed to connect the displacement means 57 with the second conveyor 40, a very short casing is generally required for adequate function, e.g. a length corresponding to one thread length. This "casing" is, for example, formed by two flanges which connect the displacement means 57 with the second conveyor 40. In this instance, the one flange is disposed on the displacement means 57 and the other on the conveyor 40. The casing contributes in keeping the displacement means 57 or the screw thread 24 of the first conveyor 22 in place, in particular when these means 22, 24 have no mechanical shaft.

30 The above detailed description has referred to but a limited number of embodiments of the present invention, but it will be readily perceived

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by a person skilled in the art that the present invention encompasses a large number of embodiments without departing from the spirit and scope of the appended claims.

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CLAIMS



1. A device for displacement of sediment, for example, sand from the  
bottom of a container (20) filled with liquid to a receptacle  
device (29), characterized in that there is  
disposed, [in the edge region (21) of the container (20)] in asso-  
ciation with the bottom (28) of the container, an upwardly open  
first conveyor (22) for receiving sediment which is accumulated  
towards the bottom of the container; that the first conveyor (22)  
includes a path (23) and a screw thread (24) disposed in the path  
and rotary by drive means (25) about its longitudinal axis (26);  
that the first conveyor (22) is provided with at least one dis-  
charge portion (27); that the device further includes a second  
conveyor (40) comprising a casing (41) and a screw thread (44)  
rotary by drive means (45); that the second conveyor (40) has at  
least one infeed opening (43) located in association with the lower  
portion of the container and the discharge portion (42) located  
above the maximum filling level of the container (20); that the  
discharge portion (27) of the first conveyor is, via a mechanical  
device (50) in which the sediment is displaced, connected with said  
infeed opening (43) of the second conveyor (40); and that the dis-  
charge portion (42) of the second conveyor (40) is disposed to dis-  
charge the sediment to said receptacle device (29) direct or via  
transport means (60).
2. The device as claimed in claim 1, characterized in  
that the screw thread (44) of the second conveyor (40) includes  
an upstanding vane (46).



3. The device as claimed in claim 2, characterized in that the upstanding vane (46) includes a first upstanding part-blade (73) and a second upstanding part-blade (74) which are fixed relative to one another; that the first part-blade (73) is of smaller outer diameter than the second part-blade (74); and that the defining surface of the first blade directed away from the geometric centre axis (71) of the thread abuts against the defining surface of the second blade directed towards the geometric centre axis of the thread.
4. The device as claimed in claim 3, characterized in that the drive surfaces of both of the part-blades (73, 74) for displacing material are disposed substantially flush with one another.
5. The device as claimed in any one of claims 1-4, characterized in that the discharge portion (27) of the first conveyor (22) forms the mechanical device (50) connecting the first conveyor (22) to the second conveyor (40); or that the mechanical device (50) includes displacement means (57) including a screw thread (51) and a discharge portion (52); and that the previously mentioned discharge portion (52) connects to the infeed device (43) of the second conveyor.
6. The device as claimed in claim 5, characterized in that the geometric axis (54) in the transport direction of the screw thread (51) of said displacement means (57) is, at least in the discharge portion (52), directed towards the centre of the screw thread (44) of the second conveyor (40).

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7. The device as claimed in claim 6, characterized in that, in a plane through the geometric axis of both of the conveyors (22, 40), the geometric axis (54) in the transport direction of the screw thread (51) of said displacement means (57), at least in the discharge portion (52), makes an angle of at most approx. 30°, preferably at most approx. 20° and as a rule at most approx. 10° with the horizontal plane; or that, in a plane through the geometric axis of the two conveyor (22, 40) the geometric axis (54) in the transport direction of the screw thread (51) of said displacement means (57), at least in the discharge portion (52), makes an angle  $\alpha$  of at least approx  $\pm 60^\circ$ , preferably at least approx.  $\pm 70^\circ$  and generally at least approx.  $\pm 80^\circ$  with the geometric axis (71) of the second conveyor (40).
8. The device as claimed in any one of claims 1-4, characterized in that the mechanical device (50) consists of the end portion of the path (23) of the first conveyor (22), which connects directly to the infeed opening (43) of the casing (41) of the second conveyor (40).
9. The device as claimed in any one of the preceding claims, characterized in that the casing (41) of the second conveyor (40) is provided with drainage openings (47) for liquid in a region above maximum filling level.
10. The device as claimed in any one of the preceding claims, characterized in that the mechanical device (50) includes a portion sloping towards said displacement means; and that the slope of said portion exceeds the angle of repose in liquid for the sediment.





11. The device as claimed in any one of claims 5-7, 9 or 10, characterized in that the displacement device (51) is provided with at least one detector device (35, 66) for sensing the level of sediment in the infeed portion of the displacement device.

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12. The device as claimed in claim 11, characterized in that the spiral (51) of said displacement means (57) in the infeed portion is placed in an upwardly open U-path.

10 13. The device as claimed in any one of claims 5-7 or 9-11, characterized in that the displacement means (57) are disposed substantially parallel with the first conveyor (22); or that said displacement means (57) are disposed at an angle with the first conveyor (22), preferably substantially a right angle.

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14. The device as claimed in any one of the preceding claims, characterized in that the screw thread in at least one of the conveyors (22, 40) and/or in said displacement means (57) has no mechanical shaft.

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