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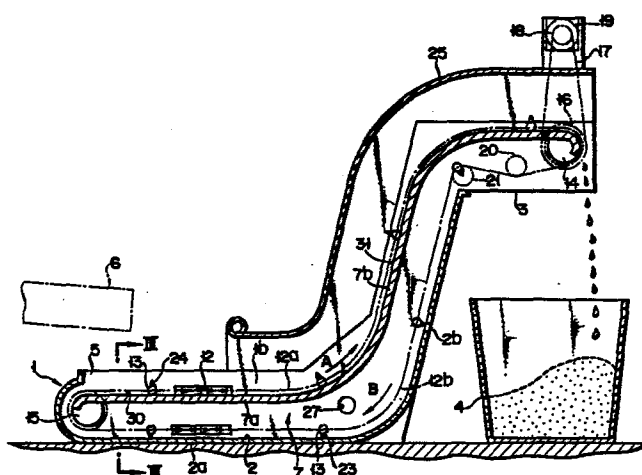
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64 Device for separating cutting chips and cutting dust.

67 A separating device includes a storage tank (1) having an inlet (5) through which used cutting oil containing cutting chips and dust is charged into the tank. A collecting plate (7) is arranged in the tank. The plate has a first portion (7a) which faces the inlet and on which cutting chips and dust in the charged oil are accumulated, and a second portion (7b) extending from the first portion to the outside of the tank. Plurality of scrapers (13) slide over the first and second portion to the extended end of the second portion so as to scrape the chips and dust accumulated on the first portion and then move along a path below the collecting plate from the extended end of the second portion to the first portion.



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Device for separating cutting
chips and cutting dust

This invention relates to a device for separating cutting chips and dust from cutting oil used in cutting machines or like machine tools for re-using the oil.

5 It is desired from the economy standpoint to re-use cutting oil used in a cutting machine or the like. However, the used cutting oil contains cutting chips and dust. These chips and dust should be separated for re-using the oil.

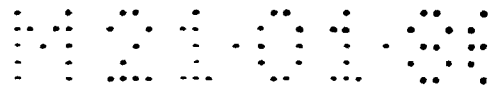
Japanese Utility Model Disclosure 169981/1979
10 discloses a device for separating cutting chips and dust from cutting oil. In this device, used cutting oil containing chips and dust is charged into a storage tank. The cutting chips and dust contained in the charged cutting oil sink and are accumulated on the bottom of
15 the tank. The accumulated foreign particles are scraped by a plurality of scrapers sliding on the bottom of the storage tank to be discharged the outside thereof. The bottom of the tank is provided with a magnet plate. Thus, the cutting chips and dust are attracted to the
20 tank bottom by the magnetic forces of the magnetic plate, thereby improving the efficiency of recovery of the foreign particles. The device has a pair of endless chains, which extend partly inside the tank and partly outside the tank. Each chain has a forward run extending
25 adjacent to and facing the tank bottom and a reverse

run extending above and substantially parallel to the forward run. Each scraper is stretched between the chains and is driven with the chains. As the scrapers proceed along the forward run of the chains, they slide
5 on the tank bottom to scrape the accumulated foreign particles.

In this device, however, foreign particles contained in used cutting oil charged into the storage tank, particularly coil-like or spiral curled cutting
10 chips, are liable to fall onto and get caught by scrapers proceeding along the reverse run of the chains before they reach the tank bottom. Once cutting chips get caught by a scraper, other cutting chips or dust also get caught by these cutting chips. The caught
15 chips or the like thus progressively build up into a mass. If such a situation arises, a gap is formed between the scraper and the tank bottom, thus reducing the scraping performance of the scraper and causing damage to the tank bottom. Further, in an extreme case, it
20 becomes impossible to drive the chains with the scrapers.

The present invention is contrived in consideration of the above circumstances, and is intended to provide a separating device which can prevent cutting chips and cutting dust from getting caught by scrapers, and can
25 thus maintain the high ability of the scrapers for long time.

To attain the above object, there is provided a device for separating solid particles from a liquid containing the solid particles, which comprises a storage
30 tank having a top provided with a liquid inlet, for storing the liquid charged through the liquid inlet, a collecting plate having a first portion which faces the liquid inlet and on which solid particles contained in liquid charged through the liquid inlet are accumulated,
35 and a second portion extending from the first portion to the outside of the liquid tank, scraping means slidable on the first and second portions, for scraping solid



particles accumulated on the first portion, and driving means for driving the scraping means to slide on the first and second portions to the extended end of the second portion and further driving the scarping means along a path below the collecting plate.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Figs. 1 to 6 illustrate a device according to an embodiment of the invention, in which:

Fig. 1 is a plan view showing the device;

Fig. 2 is a sectional view taken along line II-II in Fig. 1;

Fig. 3 is a sectional view taken along line III-III in Fig. 1;

Figs. 4 and 5 are enlarged sectional views showing different portions of the device; and

Fig. 6 is a sectional view showing a modification of a scraper.

An embodiment of the invention will now be described in detail with reference to the accompanying drawings.

Figs. 1 and 2 show a device for separating cutting chips and dust from cutting oil. The device includes storage tank 1. Tank 1 has bottom wall 2, which has first portion 2a extending horizontally and second portion 2b extending obliquely upwards from one end of first portion 2a. Tank 1 has discharge port 3 formed in the extended end of second portion 2b of the bottom wall. Opposite side walls 1b of tank 1 extend along first and second portions 2a and 2b of the bottom wall. Receiving box 4 is disposed below discharge port 3 to receive cutting chips and dust separated from cutting oil. Storage tank 1 has inlet 5 provided at its top. Dirty liquid, i.e., used cutting oil, is supplied to tank 1 through inlet 5. Inlet 5 faces first portion 2a of the bottom wall. Used cutting oil is led out from

a cutting machine (not shown) through duct pipe 6 and supplied to tank 1 from supply pipe 6 through inlet 5.

In storage tank 1, collecting plate 7 is disposed above bottom wall 2 apart therefrom. Plate 7 has first
5 portion 7a extending parallel to first portion 2a of bottom wall 2 and facing inlet 5 and second portion 7b extending parallel to second portion 2b of bottom wall 2 from one end of first portion 7a up to a position right above discharge port 3. As shown in Figs. 3 and 4,
10 plate 7 includes magnet plate 8 consisting of a plate-like permanent magnet, non-magnetic plate 9 of stainless steel or the like covering the top of magnet plate 8 and magnetic plate 10 made from a steel plate covering the remaining surfaces of magnet plate 8. Opposite ends of
15 non-magnetic plate 9 are secured to side walls 1b of tank 1.

As shown in Figs. 1 to 3, the device further comprises a plurality of scrapers 13 and drive mechanism 11 for driving these scrapers. Drive mechanism 11 has a
20 pair of parallel endless chains 12. Each of chains has forward run 12a running over and along collecting plate 7 and reverse run 12b running along the bottom of tank 1. Each chain 12 is guided by chain guides 26 provided on bottom wall 2 and side walls 1b of tank 1. Chains
25 12 are stretched between drive sprockets 14, which are rotatably supported by side walls 1b of tank 1 at a position in the neighborhood of the end of plate 7 adjacent to discharge port 3, and driven sprockets 15, which are rotatably mounted on the side walls at a
30 position in the neighborhood of the end of plate 7 on the side of inlet 5. Drive sprockets 14 are coupled together by coupling rod 14a. Transmission sprocket 16 is coupled to one of drive sprockets 14. Transmission sprocket 16 is coupled by drive chain 17 to sprocket 18
35 mounted on the rotating shaft of motor 19 as a drive source. When motor 19 is rotated, forward run 12a of each chain 12 proceeds in the direction of arrow A,

while reverse run 12b proceeds in the direction of arrow B.

Each scraper 13 is stretched between chains 12 and extends perpendicular to the traveling direction of the chains. Scrapers 13 are provided at regular intervals in the traveling direction chains 12. When chains 12 are driven, scrapers 13 slide on plate 7 in the direction of arrow A in forward run 12a and proceed along the bottom of tank 1 in the direction of arrow B in return run 12b.

Right above discharge port 3, a pair of direction change sprockets 20 and 21 are mounted on side walls 1b of tank 1. After chains 12 have passed through drive sprockets 14, they proceed obliquely upwards toward the left in Fig. 2 between direction change sprockets 20 and 21. Scrapers 13 also proceed in the same direction.

As shown in Fig. 3, each scraper 13 has opposite ends coupled by stays 22 to opposite side chains 12. Each scraper 13 is made of oil-resistant rubber and has an elongate rod-like form. It may be made of a metal or synthetic resins as well. As shown in Figs. 4 and 5, scraper 13 consists of round rod having a circular, i.e., non-flattened, sectional profile with a diameter of 27 mm, for instance. In case of using a round rod as scraper 13, its diameter is desirably 20 mm or above.

Each scraper 13 has contact surface 13a, which slides over the top of first and second portions 7a and 7b of plate 7, i.e., first and second surfaces 30 and 31 thereof. One of scrapers 13 has cleaning projection 23 projecting from the side opposite contact surface 13a. Cleaning projection 23 slides over the bottom of storage tank 1 in reverse run 12b of chains 12. Other scrapers 13 each have three spikes 24 projecting from the side opposite contact surface 13a. These spikes are spaced apart along the longitudinal direction of the scraper.

In Fig. 2, reference numeral 25 designates cover which is mounted on tank 1 to prevent scattering of

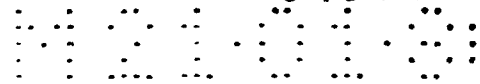
cutting chips scraped by scrapers 13 along collecting plate 7. Reference numeral 27 designates clean cutting oil outlet formed in side wall 1b of tank 1. Clean cutting oil resulting from the removal of cutting chips and dust is led out through outlet 27. Motor 19 is
5 mounted on cover 25.

The operation of the device having the above construction will now be described.

Cutting oil used in a cutting machine or the like
10 is supplied from supply pipe 6 to storage tank 1 through inlet 5. Since first portion 7a of collecting plate 7 extends right underneath inlet 5, the supplied cutting oil falls onto first portion 7a. Foreign particles such as cutting chips and dust contained in the cutting oil
15 tend to sink due to their own weight. At the same time, they experience magnetic forces of attraction to magnet plate 8 constituting part of plate 7. Thus, the foreign particles are collected on the upper surface of portion 7a, i.e., first surface 30. The foreign particles which
20 are collected in this way, are scraped and pushed by scrapers 13, which are sliding over the upper surface of plate 7 in the direction of arrow A, toward the extended end of portion 7b of plate 7 while being guided by cover 25. The foreign particles brought to the extended end
25 of plate 7 are discharged through discharge port 3 into receiving box 4.

Owing to the above function, the liquid remaining in tank 1 becomes clean oil free from cutting chips and cutting dust. The clean oil is let out through outlet
30 27.

In this embodiment, spikes 24 are provided on scrapers 13. As scrapers 13 proceed below and past inlet 5 in the direction of arrow A, comparatively large curled cutting chips or dust contained in used cutting
35 oil supplied through inlet 5 are pierced or otherwise caught by spikes 24. Thus, there is no need for waiting the accumulation of large cutting chips or dust on top



of plate 7, but they are immediately carried forth to discharge port 3. Scrapers 13 sliding over the top of plate 7, therefore, need only scrape and carry forth remaining cutting chips or cutting dust sank on the upper surface of plate 7. Thus, no great burden is applied to scrapers 13.

As chains 12 proceed round drive sprockets 14, each scraper 13 is inverted. That is, spikes 24 which have been directed up while scraper 13 has been proceeding along the upper surface of plate 7, are directed down after scraper 14 has cleared drive sprockets 14. The cutting chips or dust that have been held pierced or caught by spikes 24 are detached from inverted spikes 24 and fall due to their weight.

Subsequently, scrapers 13 are reoriented and directed obliquely downwards by direction change sprockets 20 and 21. In other words, while spikes 24 are merely reoriented by 180 degrees when they proceed round drive sprockets 14 from top to bottom thereof, they are turned by more than 180 degrees when they proceed past direction change sprockets 20 and 21. Therefore, the cutting chips and dust that have been carried by spikes 24 are detached satisfactorily and reliably.

Foreign particles, that are left without being removed, accumulate on bottom wall 2 of tank 1. The accumulated foreign particles on the bottom wall are scraped away by cleaning projection 23 provided on one of scrapers 13 as projection 23 slides over bottom wall 2 in reverse run 12b of chains 12.

With the device having the above construction, after sliding over collecting plate 7 to scrape foreign particles on the plate, each scraper 13 proceeds along the reverse run below plate 7. Therefore, cutting chips and dust containing in cutting oil supplied through inlet 3 will never be caught by scrapers 13 traveling along the reverse run below plate 7. In the case of the Japanese utility model Disclosure noted earlier, where

the scrapers proceed along the reverse run extending above the surface on which cutting chips or dust are accumulated, these foreign particles are liable to be caught by the scrapers in the reverse run before they reach the accumulation surface. When foreign particles are caught by the scraper, the scraper slides with the caught foreign particles along the accumulation surface. As the scraper proceeds along the accumulation surface, other foreign particles are caught on the already caught foreign particles. The caught foreign particles thus progressively build up into a mass. With the device according to the above embodiment, it is possible to prevent foreign particles from being caught by scrapers and maintain the high ability of the scrapers for long time. Therefore, the device can easily be maintained.

Further, since each scraper 13 consists of a round rod with a diameter of approximately 27 mm, it has a sufficiently large thickness compared to the gap or distance between adjacent turns of a helically curled cutting chip. Therefore, there is no possibility for the scraper to advance into between adjacent turns of the chip, that is, there is no possibility for curled cutting chips or cutting dust to remain caught by the scraper. The scraper thus can maintain satisfactory scraping performance for long time.

The embodiment described above is by no means limitative, and various changes and modifications are possible without departing from the scope of the invention.

For example, in the above embodiment a round rod with a diameter of approximately 27 mm is used as the scraper. However, it is possible to use a hollow cylindrical scraper as well. Further, the scraper may have any sectional profile other than a circular one, e.g., oval or polygonal profile, but can not be a flattened one. In a modification shown in Fig. 6, scraper 13 has

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an octagonal sectional profile.

Further, in the above embodiment cutting chips and dust in used cutting oil are magnetic particles such as iron particles. In this case, the use of magnet plate 8
5 for collecting plate 7 is effective for the collection of foreign particles such as cutting chips and dust. Where foreign particles contained in used cutting oil are non-magnetic particles such as aluminum particles, however, plate 7 need not consist of magnet plate 8.

Claims:

1. A device for separating solid particles from a liquid containing said solid particles comprising:

a storage tank having a top with a liquid inlet, for storing the liquid charged through said liquid inlet;

a collecting plate having a first portion which faces said liquid inlet and on which solid particles contained in liquid charged through said liquid inlet are accumulated, and a second portion extending from

said first portion to the outside of said liquid tank;

scraping means slidable over said first and second portions, for scraping solid particles accumulated on said first portion; and

driving means for driving said scraping means;

characterized in that:

said driving means (11) drives said scraping means (13) to slide over said first and second portions (7a, 7b) to the extended end of said second portion and further drives said scraping means along a path below the collecting plate (7).

2. The device according to claim 1, characterized in that said driving means (11) includes a pair of parallel endless chains (12) having a forward run (12a) extending over said collecting plate (7) along said first and second portions (7a and 7b) thereof and a reverse run (12b) extending below said collecting plate, sprockets (14, 15) engaging with said chains, and a drive source (19) for rotating said sprockets to drive said chains such that said forward run proceeds from said first portion toward said second portion, and said scraping means (13) is coupled to and proceed in unison with said chains.

3. The device according to claim 2, characterized in that said scraping means (13) includes a plurality of scrapers (13) each bridging said chains (12), said

scrapers being spaced apart at a predetermined interval in the direction of running of said chains.

4. The device according to claim 3, characterized in that each of said scrapers (13) has an elongate rod
5 having a non-flattened sectional profile.

5. The device according to claim 4, characterized in that each of said scrapers (13) has a circular sectional area with a diameter of 20 mm or above.

6. The device according to claim 4, characterized
10 in that each of said scrapers (13) has a polygonal sectional profile with a maximum width of 20 mm or above.

7. The device according to claim 3, characterized in that each of said scrapers (13) has a contact surface (13a) to be in contact with the upper surfaces (30, 31)
15 of said first and second portions (7a, 7b) and a plurality of spikes (24) projecting from the side opposite said contact surface for hooking said solid particles.

8. The device according to claim 3, characterized in that said storage tank (1) includes a bottom wall (2)
20 having first and second portions (2a, 2b) respectively extending parallel to said first and second portions (7a, 7b) of said collecting plate (7), and said reverse run (12b) of said chains (12) extends along said first and second portions of said bottom wall.

9. The device according to claim 8, characterized in that each of said scrapers (13) has a contact surface (13a) to be in contact with the upper surfaces (30, 31)
25 of said first and second portions (7a, 7b) of said collecting plate (7), at least one of said scrapers having a cleaning projection (34) for sliding over said
30 first and second portions (2a, 2b) of said bottom wall (2).

10. The device according to claim 1, characterized in that said collecting plate (7) has a magnet plate
35 (8).

11. The device according to claim 1, characterized in that said first portion (7a) of said collecting plate

(7) extends substantially horizontally and said second portion (7b) extends obliquely upwards from said first portion.

12. A device for separating solid particles from a liquid containing said solid particles comprising:

a storage tank having a top with a liquid inlet, for storing said liquid charged through said liquid inlet;

a collecting plate having a first portion which faces said liquid inlet and on which solid particles contained in liquid charged through said liquid inlet are accumulated, and a second portion extending from said first portion to the outside of said liquid tank;

a plurality of scrapers slidable over said first and second portions, for scraping solid particles accumulated on said first portion; and

driving means for driving said scrapers to slide over said first and second portions to the extended end of said second portion;

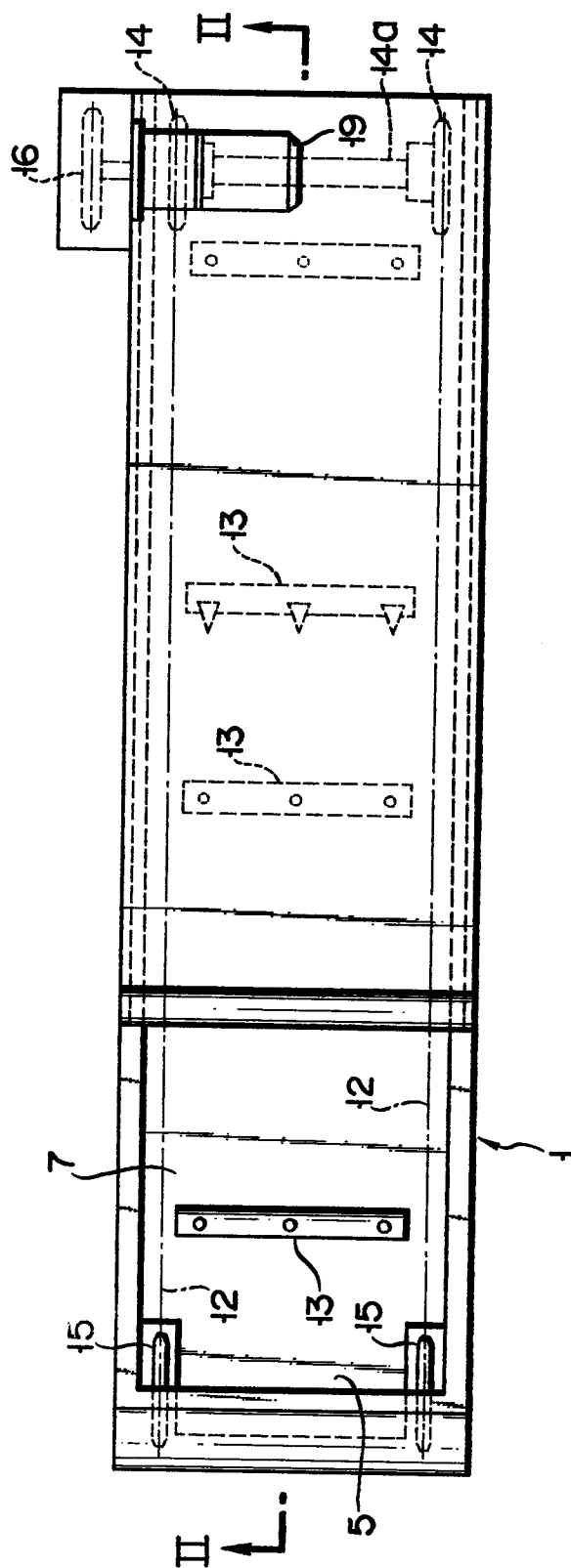
characterized in that:

each of said scrapers (13) extends perpendicular to the sliding direction thereof and has a non-flattened sectional profile.

13. The device according to claim 12, characterized in that each of said scrapers (13) has a circular sectional profile with a diameter of 20 mm or above.

14. The device according to claim 12, characterized in that each of said scrapers (13) has a polygonal sectional profile with a maximum width of 20 mm or above.

FIG. 1



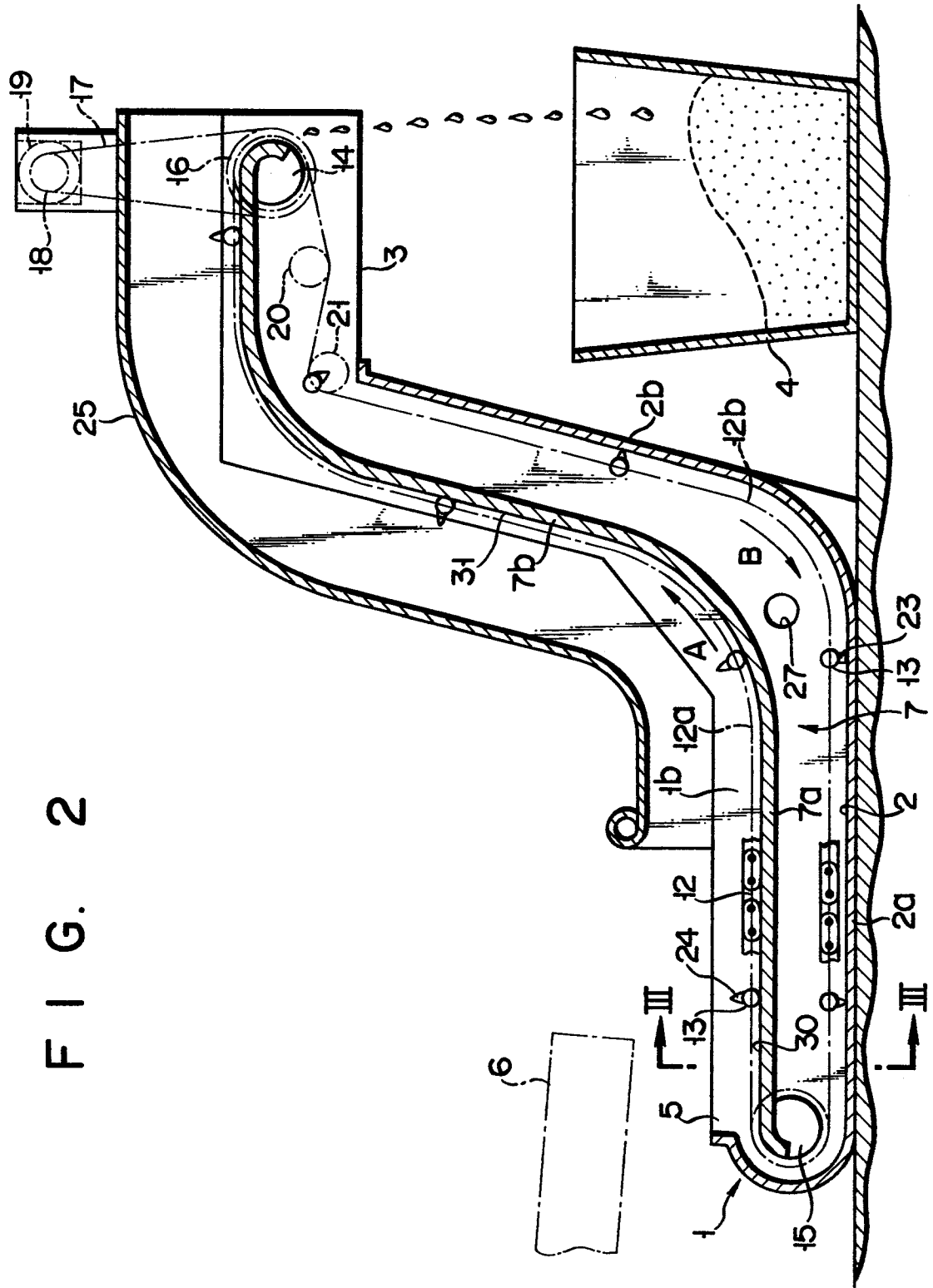


FIG. 2

FIG. 3

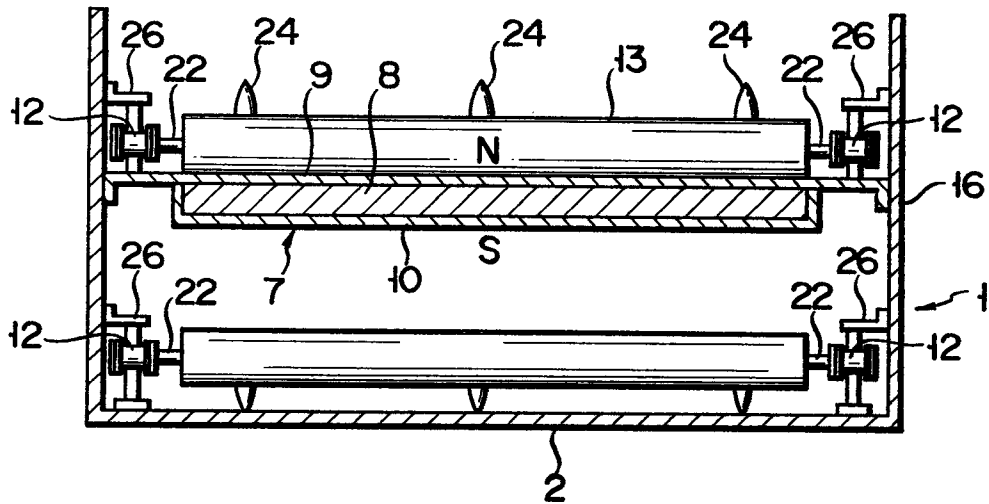


FIG. 4

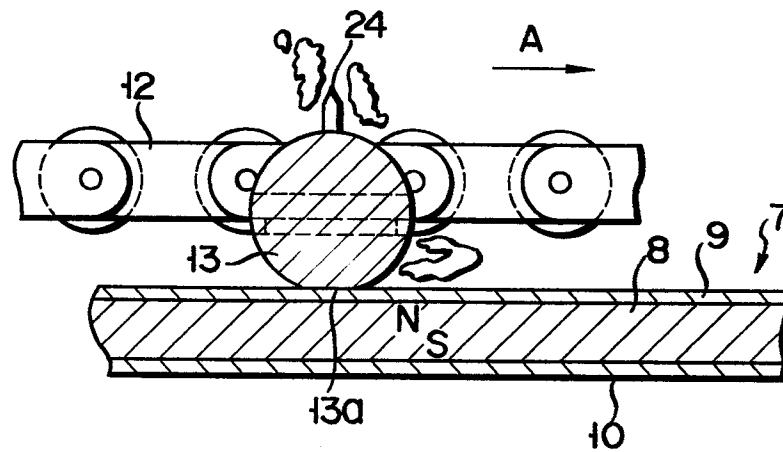


FIG. 5

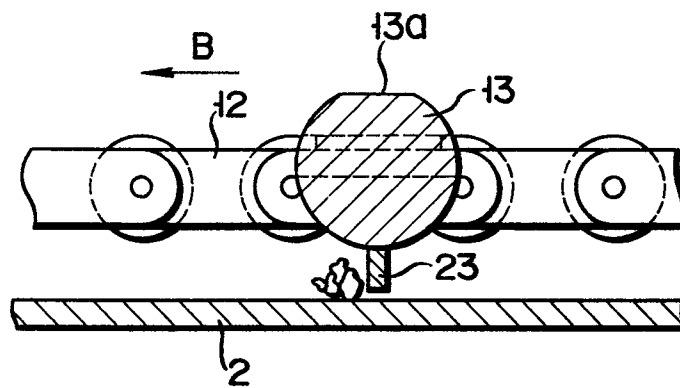


FIG. 6

