July 1, 1930. E. DÉTAINT ET AL 1,769,336

LIQUID ELEVATOR

Filed April 12, 1928 2 Sheets-Sheet 1

Fig. 7

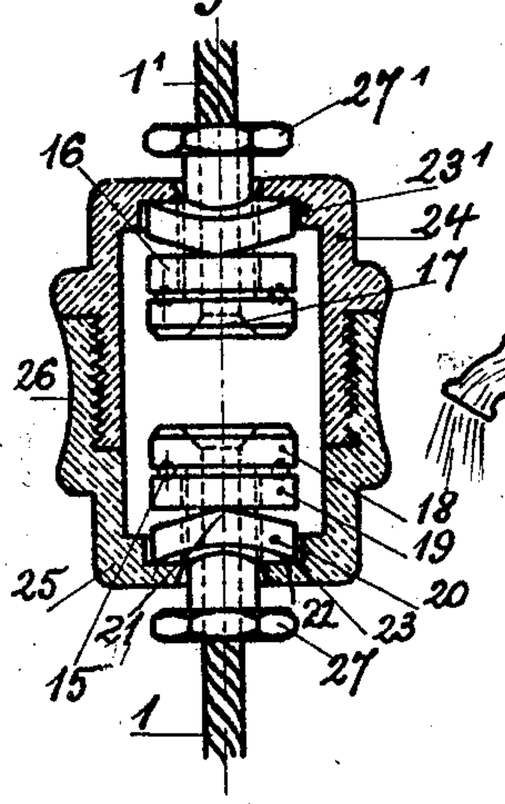


Fig. 1

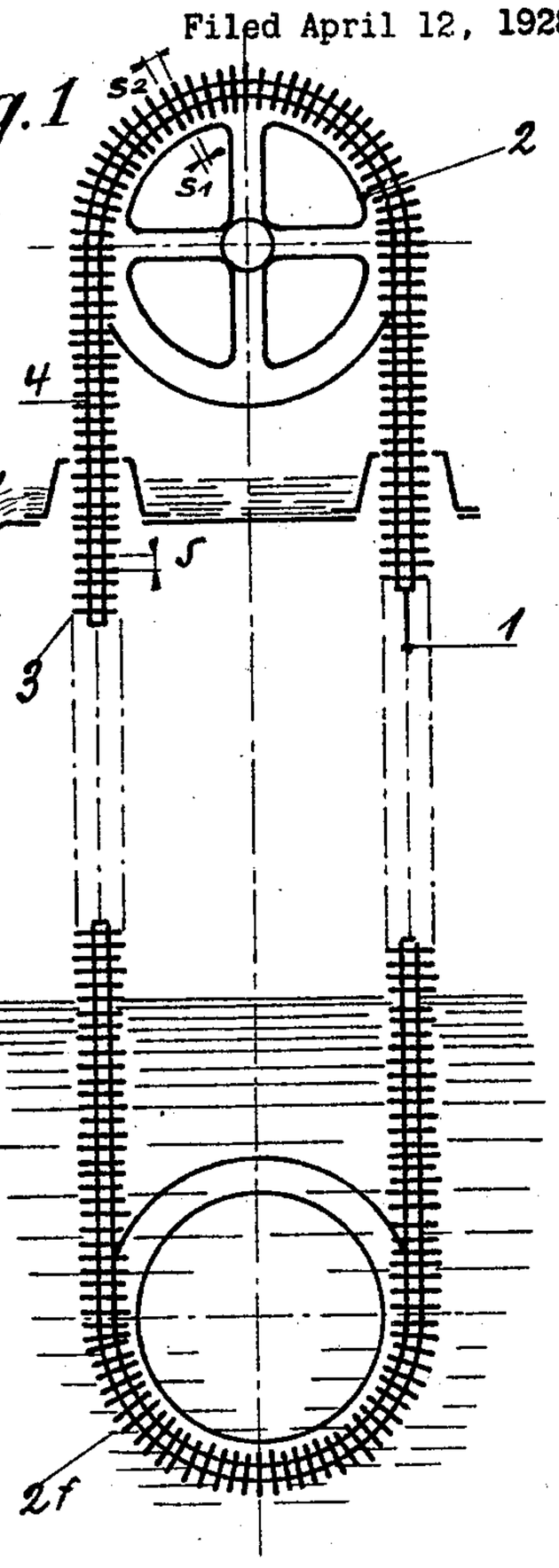


Fig. 3

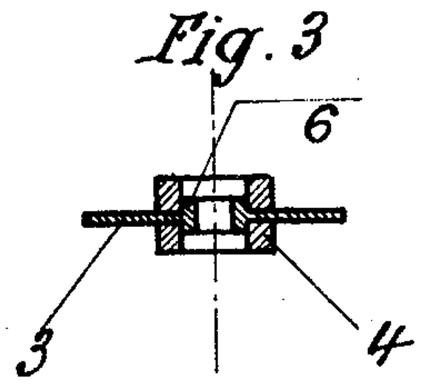


Fig. 4

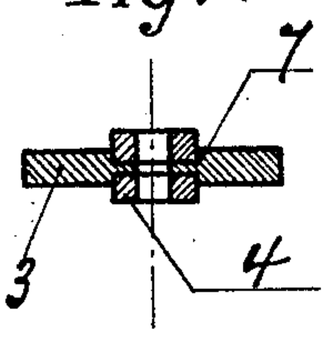


Fig. 12

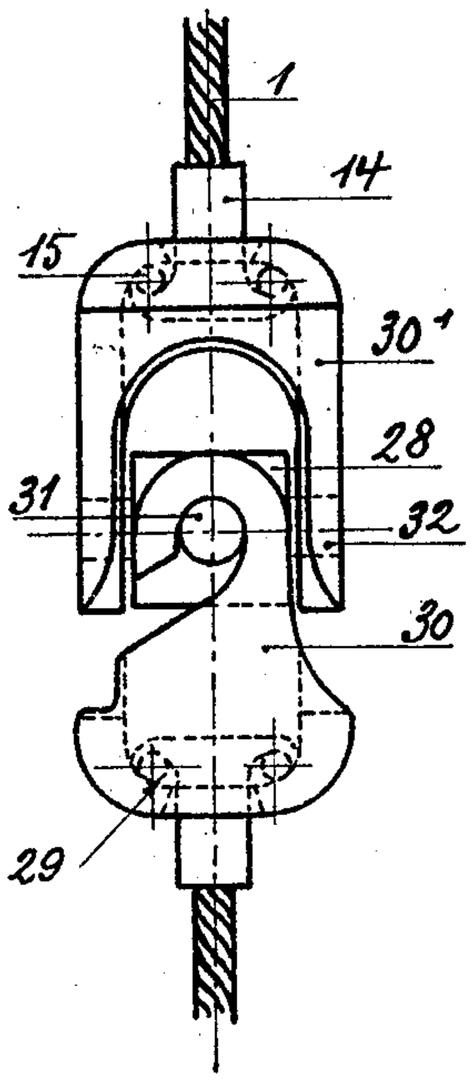


Fig. 2

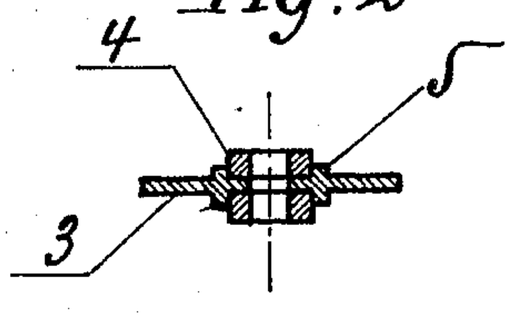
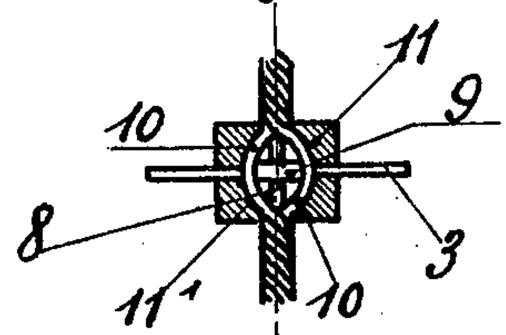


Fig. 5



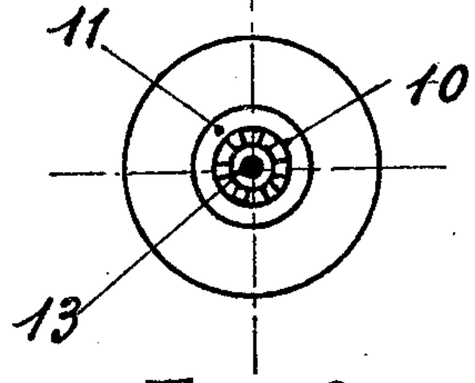


Fig. 6

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LIQUID ELEVATOR

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Fig. 17

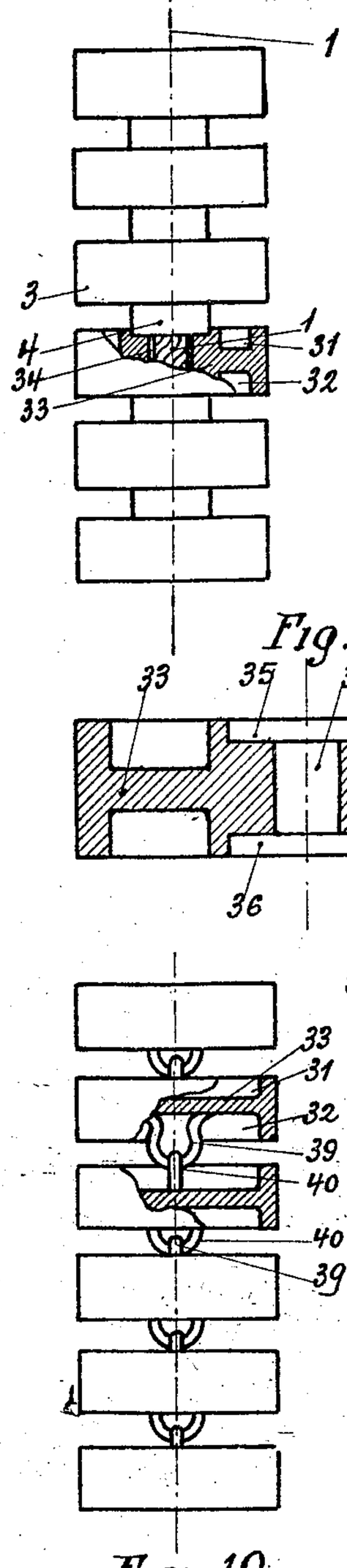

Fig. 8

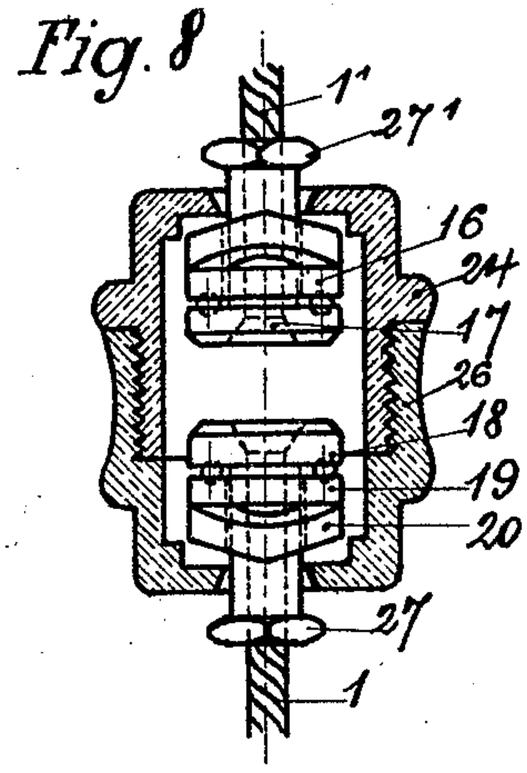

Fig. 11

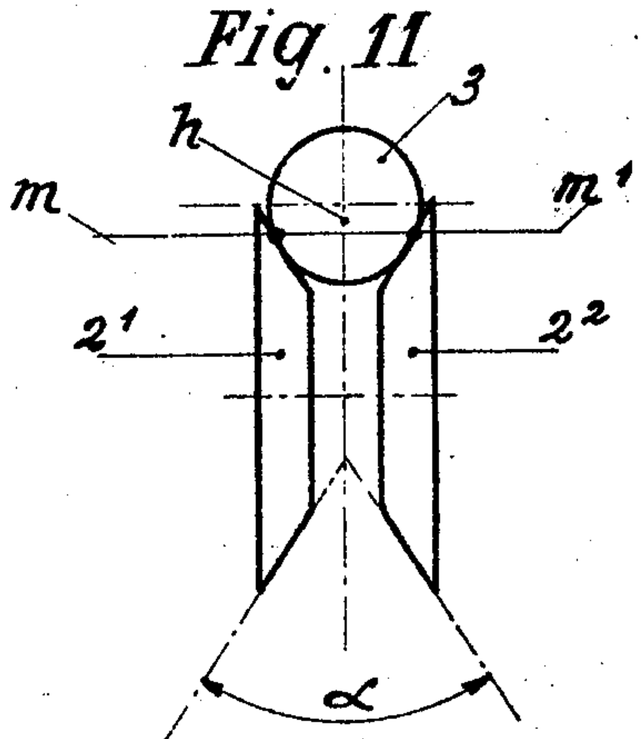

Fig. 9

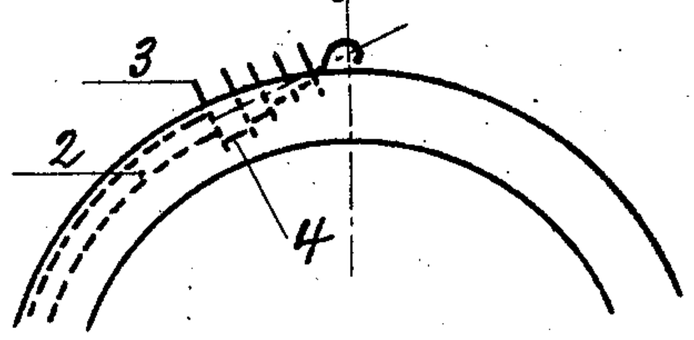

Fig. 16

Fig. 10

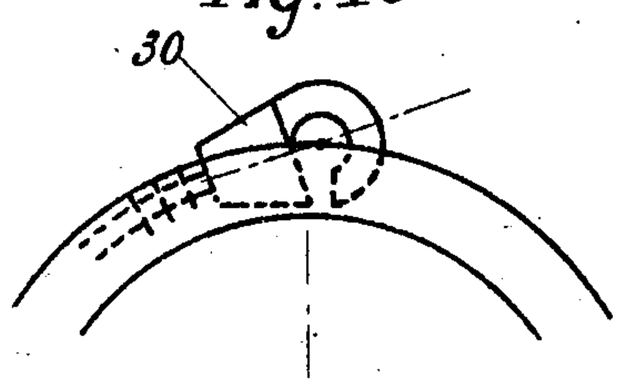

Fig. 18

Fig. 13

Fig. 15

Fig. 19.

Fig. 14

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Atty's

Patented July 1, 1930 1,769,336

UNITED STATES PATENT OFFICE

EDMOND DÉTAINT AND ALFRED SOURBÉ, OF PARIS, FRANCE

LIQUID ELEVATOR

Application filed April 12, 1928, Serial No. 269,534, and in France April 20, 1927.

The elevator, according to the invention, consists of a cable, on which are threaded washers made of a plastic material, retaining between them smaller spacing washers of an elastic material, in order that they may confine with these small washers as many transverse annular spaces surrounding the cable as there are pairs of washers. On the passage of the elevator through the liquid this latter enters these annular spaces in which it is held by reason of molecular adhesion until it has been elevated to the required height. The rubber washers do not simply rest against the larger washers but they occupy seatings formed in the material of which the large washers are made. When the cable passes around the pulley the large washers are prevented from opening out radially and forcing the elastic washers towards the outer periphery.

The cable which supports the washers forms the subject of improvements tending to ensure efficient operation without introducing restraint in the movement of its different parts, which restraint leads to wear, which is converted into a deleterious action affecting the stability of the column of liquid which has been raised.

Care has been taken to reduce the weight supported by that washer which is the last to emerge from the liquid in which it is immersed. It is this last washer which is affected most as it has to support the weight of the liquid column and the weight of the pile of washers which precede it. There are therefore provided along the length of the cable, at suitable intervals, enlargements or stops which form a number of supporting points on which is distributed the weight of the column of liquid and the weight of the washers. Known stops, by reason of tightening, pinning, and so forth, are apt to obstruct the free play of the strands and thus rapidly wear the cable. For this reason the strands of the cable are spaced apart at certain points by washers in such a manner as to cause a swelling of the cable at these points, the swelling being enclosed by covering washers forming caps.

Care has also been taken to form the connection between the two ends of the cable in such a manner as to allow a gyratory movement, which if prevented produces wear or breakage of the cable. According to the invention the connection may comprise a ball joint, a hooked universal joint, or a joint with tightening nuts, but any other suitable joint may be used.

In order not to bend the strands which are tightened or soldered in the connections at the two ends of the cable and which run a danger of breakage, flexion has been eliminated for a short length by using a suitable juxtaposition of washers of different diameters and a fitting which has an external frusto-conical shape.

If pulleys with an ordinary groove are used, the radial unfolding of the large washers when passing over the pulley has the disadvantage of preventing the free movement of the cable, as the washers bear on the edges of the cavity of the pulley and cause a tightening of the cable incompatible with uniform flexure. In order to obviate this disadvantage, the pulley is formed in two parts separated by a space which permits of the passage of liquid, the lateral wall of each half pulley on which the washers bear being suitably beveled according to the distance between the centre of the cable and the line of the points of contact of the washer.

It is an object of our invention to increase the ratio between the quantity of liquid elevated and the volume of the washers, i. e. to increase the output of the elevator while diminishing the amount of materal used and consequently diminishing the number of washers. To accomplish this object, these washers are hollowed out on both sides and between the two hollowed-out portions the wall is provided with a central orifice for threading the washers on a cable, band or the like, with or without the interposition of elastic washers to form joints for ensuring the necessary spacing and flexibility, or the wall is provided with means for connecting a washer to the adjacent washers, these means being such as to ensure that the elevator has the necessary flexibility for the passage of the washers over the pulleys.

The washers may be suitably strengthened or reinforced by radial, concentric or other ribs or projections, or by reinforcing plates, as required in any particular case, the reinforcing means either forming part of the washers or being mounted on the same.

When the elevator is in operation, the upper or rear hollowed-out portions or basins of the descending washers are filled with liquid upon immersion therein, whilst their lower or front hollowed-out portions entrap and draw along air. Prior to their ascent, the washers are inverted and the front hollowed-out portions become filled with liquid and allow the entrapped air to escape while the rear hollowed-out portions maintain their liquid contents by suction under the influence of the pressure of the atmosphere.

When the ascending washers leave the surface of the liquid, the liquid between the hollowed-out portions of adjacent washers is held in position by surface tension. This liquid runs away from the washers in known manner as they pass over the upper pulley.

The improvements will now be described in detail with reference to an example of construction shown in the accompanying drawings, wherein:

Fig. 1 shows a diagrammatic view of the entire apparatus;

Figs. 2, 3 and 4 show in section, three methods of assembling the supporting washers and the spacing washers;

Fig. 5 shows an elevation of a swelling or stop point formed in the cable, the washers covering the swelling being seen in axial section.

Fig. 6 shows a plan of the same swelling;

Figs. 7 and 8 show sections of the connecting device in any two axial planes at right angles to one another, the ball cages being in elevation.

Fig. 9 shows a rigid element of the cable, formed adjacent the connection.

Fig. 10 shows a modification of the rigid element shown in Fig. 9.

Fig. 11 is a diagrammatic view of the pulley constructed with two separate halves.

Fig. 12 shows a universal connection for rapid attachment.

Figs. 13 to 15 show details.

Fig. 16 shows an axial cross section of one of our improved elevator washers.

Fig. 17 shows in elevation and on a smaller scale part of an elevator provided with these washers, one of which is shown partly in section.

Fig. 18 shows a plan view of a modified form of washer and

Fig. 19 shows in elevation part of an elevator, the washers of which are provided with connecting means and two of which are shown partly in section.

The cable 1, composed of strands on which are threaded the supporting washers 3 of large diameter and spacing washers 4 of small diameter, passes around the pulley 2 which may be driven by hand or by suitable mechanical means. The ends of the cable 1 are connected together and the lower portion of the loop thus formed dips freely into the liquid. In the loop may be placed an additional pulley 2^f supported by the cable itself. This pulley serves to space the upwardly moving portion of the cable from the downwardly moving portion.

The supporting washers 3, of rigid plastic material, such as ebonite, bakelite, hard rubber, synthetic resin or the like, render the whole unoxidizable and unattackable by the principal agents of deterioration which the liquid may contain. These materials resist corrosion, and also have the advantage of not lending themselves to the formation of electro-chemical couples.

The washers 3 are separated from one another by interposed spacing washers 4, formed preferably of rubber or any other elastic material and which are in intimate contact with the supporting washers. In the vertical ascending or descending portion of the cable, contact between the washers of two different types and the relative position of these washers are effectively maintained, but this is no longer the case when the group of washers in question passes around the pulley. At this moment the cable bends and rigid washers 3 which bear against the pulley assume a radial position. The spacing of the washers originally equal to s (Fig. 1) is reduced to s^1 inside and has increased to s^2 on the outside. It thus results that when passing around the pulley the rubber washers 4 are compressed at s^1 by the rigid washers the planes of which converge towards the centre of the pulley, and are enlarged in the direction passing from the centre of the pulley to the outer periphery. The cable is thus constantly subjected to forces directed from the centre towards the periphery and the rubber washers are consequently subjected to wear owing to friction on the cable. According to the present invention, the diverging movement of the elastic washers 4 is prevented by forming on each of the two faces of the rigid washers 3 an outer annular edge or rib as shown at 6 (Fig. 3). A seating could also be provided adapted to retain the elastic washers 4, by making the rigid washers 3 of greater thickness adjacent their periphery, the annular cavity 7 formed in this manner near the edge of the cable (Fig. 4) being sufficient to hold the spacing washers 4.

Another feature of the device consists in the swellings which are formed at parts of the cable and the object of which is to form intermediate supports for the weight of portions of the liquid column and of the washers. Formed at sufficiently close intervals, the swellings support the washer which

emerges from the liquid and which otherwise would have to support the total weight of the ascending portion. The swellings are made by encircling the central strand 8 of the cable by a washer 9 of half keeper or any other suitable shape. This washer which is slit at 13, for placing it in position, grips the central strand 8 and holds the outer strands 10 spaced apart so that they exert a radial pressure thereon. At this point there is provided a supporting washer 3 (Fig. 5) having central hole larger than usual so as to surround the enlargement. Each of these enlargements is encased by the washers 11 and 11^1 hollowed internally and forming caps. Against the upper and lower walls of the caps 11 and 11^1 bear the other washers corresponding with the portion situated immediately above the enlargement. It will, of course, be understood that these enlargements are designed to be used with the washer structures shown in Figs. 2, 3 and 4.

When an apparatus of this type is set in motion, a gyratory movement of the cable is produced. In order to prevent this movement from being converted into torsion or twisting of the cable, it is necessary to form a connection between the two ends of the cable in such a manner that each end will be free to turn independently of the other, and the position which the ends assume, without constraint, will correspond to the absence of any torsion. For this purpose, there may be disposed at the point of junction of the ends a universal joint connection, Fig. 12, permitting rapid hooking together of the parts. This joint is formed of two members, the member 30^1 having two eye members and the other member 30 having hooks. These members are connected together by a universal joint formed of a cube 28 having two axes 31 and 32 at right angles to one another. The bottom of the members 30 and 30^1 is hemispherical as at 29 so as to enable the attaching heads 14 to turn and incline in all directions by rolling on balls 15.

It is also possible to provide a connection consisting of tightening nuts and pivots and a turning member such as that shown in Figs. 7 and 8. Each of the free ends 1 and 1^1 of the cable is secured by a tightening screw or soldered joint 17 in the axial perforations 16 of a cage 18—19 and rolls on balls 15. The part 19 of the ball cage bears against the upper stop 21 of a washer 20 indicated in Fig. 7 and the lower stop 22 of this washer which is at right angles to the upper stop bears against an annular recess 23 formed in the base 25 of the connection. There is thus obtained a pivoting in all directions which is added to the turning movement on the balls. The part indicated by 25 is screw threaded at 26 so as to be screwed into the part 24. The other end of the cable is attached in a similar manner to the ball cage which corresponds therewith. At 27 and 27^1 are provided nuts for holding together the various parts.

The strands at the ends of the cable being held in the fitting by soldering or tightening, they cannot operate normally except at a predetermined distance from the soldering or tightening. It is therefore necessary to provide a length of cable without flexion, since flexion near the tightened or soldered points would cause rapid breakage. In order to avoid this drawback the following method is used: A series of washers 3, Fig. 9, is provided, the diameter of which decreases in proportion as the end is approached. These washers are separated from one another by rubber washers 4 of the usual dimensions, the pile thus formed having an external conical contour similar to that shown diagrammatically in Fig. 9. By reason of this arrangement in steps, the apparatus bears on the pulley at this point by the two washers of largest diameter on opposite sides of the connection and by the lateral wall of the connection. In this manner, the enclosed end of the strand is not strained or subjected to flexion. The same result may be obtained by keeping the washers of normal diameter and introducing at the connection 30 end washers of a substantially conical shape (Fig. 10).

The radial position which the washers assume in passing around the pulley, also necessitates constructing the pulley in a particular manner so as to enable the two outer parts of succeeding washers to be spaced by s^2 which the radial position imposes thereon. For this reason the pulleys 2 are formed of two parts 2^1 and 2^2 separated by a space (Fig. 11) and having their driving walls bevelled at an angle α. This angle determines the distance h between the centre of the washer and the chord joining the points of contact m and m^1 of the washer with the pulley and it is advisable to reduce this distance as much as possible. In Fig. 11 there is shown for the sake of clearness a single washer 3, and for the same reason the two halves of the pulley are shown in a diagrammatic manner. It will be readily seen that by reason of this arrangement the lower edges of the washers 3 may approach each other without being constrained. The liquid in the space between the two halves of the pulley falls into a trough which conducts it to its destination.

In the Figs. 16 and 17, each washer has two hollowed-out portions or basins 31, 32 separated by a wall 33 having a central aperture 34 and provided with housings 35, 36 for the elastic joints 4 which serve to space the washers.

In Fig. 18 the cable is replaced by a band or ribbon 37 and the elastic spacing joints 38 are rectangular. In Fig. 19, the cable 1 is done away with, each washer having a

lower hook at 39 and an upper hook at 40 by which hooks it may be connected directly (as shown) or indirectly to the adjacent washers.

We claim:

1. Liquid elevators comprising a cable connected together at its ends, liquid supporting washers freely threaded on the cable, spacing washers of smaller diameter freely threaded on the cable, upper and lower pulleys adapted to carry the cable and enable the liquid to pass from the elevator when the washers are inclined in passing around the upper pulley, enlargements distributed along the cable for supporting the weight of a number of said washers, and connecting members mounted at the point of junction of the two ends of the cable.

2. Liquid elevators comprising a cable connected together at its ends, supporting washers of non-oxidizable plastic material freely threaded on the cable, spacing washers of smaller diameter and of an elastic material freely threaded on the cable and adapted to inter-engage with the larger washers, upper and lower pulleys adapted to carry the cable, enlargements distributed along the cable for supporting the weight of a number of said washers, and connecting members mounted at the point of junction of the two ends of the cable.

3. Liquid elevators comprising a cable connected together at its ends, supporting washers freely threaded on the cable, spacing washers of smaller diameter freely threaded on the cable, upper and lower pulleys adapted to carry the cable, enlargements distributed along the cable forming supports for a number of said washers, said enlargements being in the form of a split washer surrounding the central strand of the cable, said split washer being adapted to spread apart the outer strands of the cable and to be enclosed thereby and connecting members mounted at the point of junction of the two ends of the cable.

4. Liquid elevators comprising a cable connected together at its ends, supporting washers of substantially rigid material freely threaded on the cable, spacing washers of smaller diameter and of elastic material freely threaded on the cable, upper and lower pulleys adapted to carry the cable and swivel connecting members mounted at the point of junction of the two ends of the cable.

5. Liquid elevators comprising a cable connected together at its ends, supporting washers freely threaded on the cable, spacing washers of smaller diameter freely threaded on the cable, pulleys adapted to carry the cable, swivel connecting members on the ends of the cable, and conical portions formed on the cable adjacent to the connecting members.

6. Liquid elevators comprising a cable connected together at its ends, supporting washers hollowed out on both sides freely threaded on the cable provided with a central orifice for threading the washers on the cable, spacing washers, and pulleys around which the cable passes.

7. Liquid elevators comprising a cable connected together at its ends, supporting washers hollowed out on both sides freely threaded on the cable, spacing washers freely threaded on the cable, pulleys adapted to carry the cable, and swivel connecting members formed at the point of junction of the two ends of the cable.

8. Liquid elevators comprising a cable connected together at its ends, supporting washers hollowed out on both sides freely threaded on the cable, spacing washers freely threaded on the cable, said supporting washers being provided with means for interengaging the spacing washers, upper and lower pulleys adapted to carry the cable, and swivel connecting members at the point of junction of the two ends of the cable.

9. Liquid elevators comprising a cable connected together at its ends, supporting washers freely threaded on the cable, spacing washers freely threaded on the cable, said supporting washers being hollowed out on both sides and provided with means for inter-engaging with the spacing washers, upper and lower pulleys adapted to carry the cable, enlargements distributed along the cable for supporting the weight of a number of said washers, and swivel connecting members in the form of a universal joint mounted at the point of junction of the two ends of the cable.

10. Liquid elevators comprising a cable connected together at its ends, supporting washers freely threaded on the cable, spacing washers of smaller diameter freely threaded on the cable, upper and lower pulleys adapted to carry the cable and enable the liquid to pass from the elevator when the washers are inclined in passing over the upper pulley, enlargements distributed along the cable forming stops for the washers in the form of a split washer surrounding the central strand of the cable adapted to be enclosed by the outer strands and space the same apart and swivel connecting members in the form of a universal joint connection mounted at the point of junction of the ends of the cable.

11. Liquid elevators comprising a cable, supporting washers freely threaded on the cable, pulleys around which the cable passes, enlargements distributed along the cable to support the washers at various points and connections mounted at the point of junction of the two ends of the cable.

12. Liquid elevators comprising a cable, supporting washers freely threaded on the cable, pulleys around which the cable passes, en-

largements distributed along the cable for supporting the weight of a number of said washers, connections mounted at the point of junction of the two ends of the cable, and conical portions mounted at the end of the cable and formed of washers suitably assembled.

13. Liquid elevators comprising a cable, supporting washers freely threaded on the cable, pulleys around which the cable passes, enlargements distributed along the cable for supporting the weight of a number of said washers, connections mounted at the point of junction of the two ends of the cable, and conical bearing members mounted at the ends of the cable adjacent the connection.

In witness whereof we have hereunto set our hands.

ALFRED SOURBÉ.
EDMOND DÉTAINT.