W. BOCK.

DIFFUSION APPARATUS.

APPLICATION FILED DEC. 17, 1907.

923,760. **Patented June 1, 1909.**

2 SHEETS—SHEET 1.

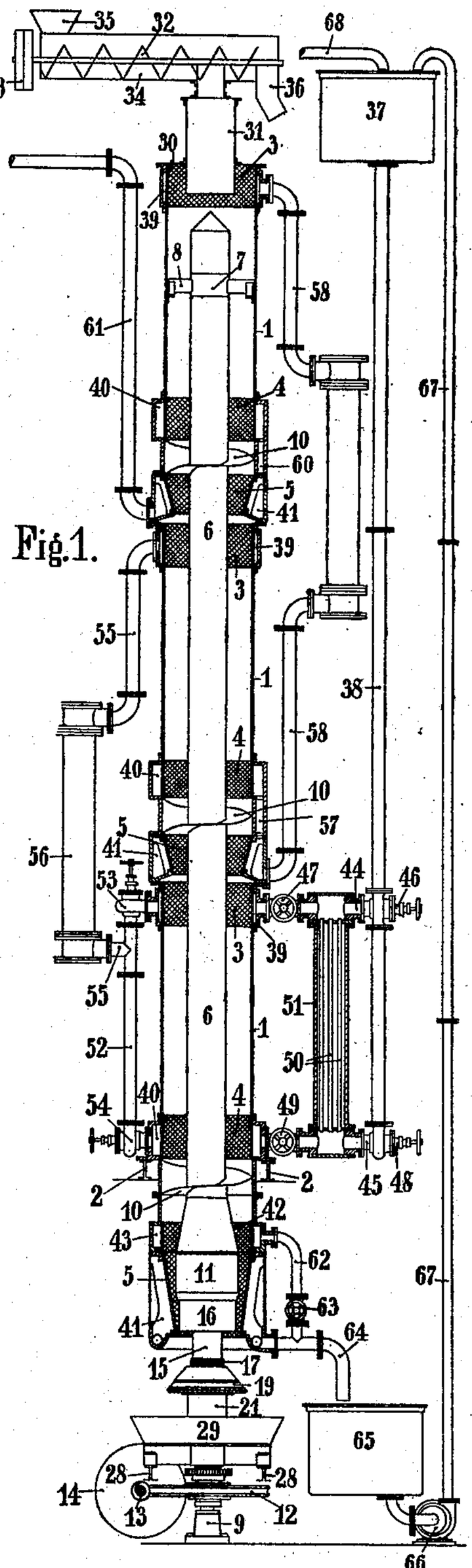

Fig. 1.

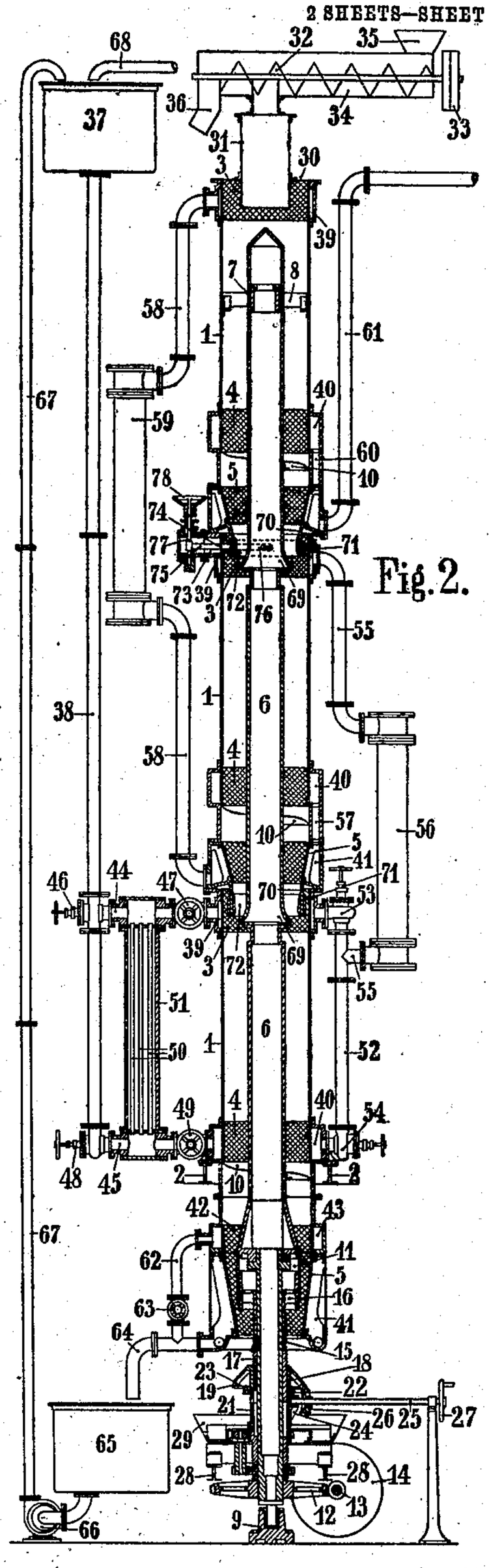

Fig. 2.

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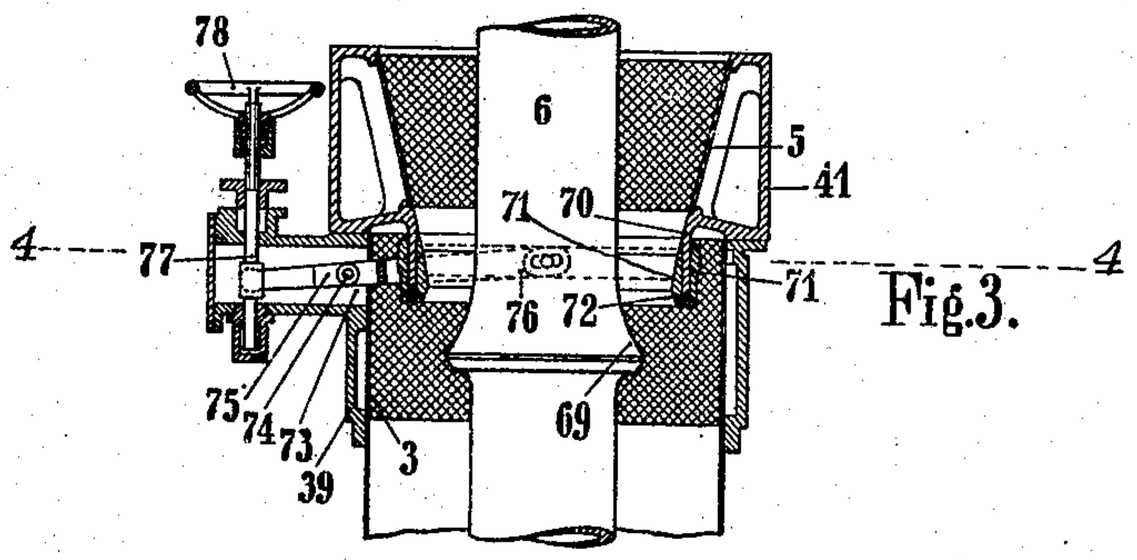

Fig.3.

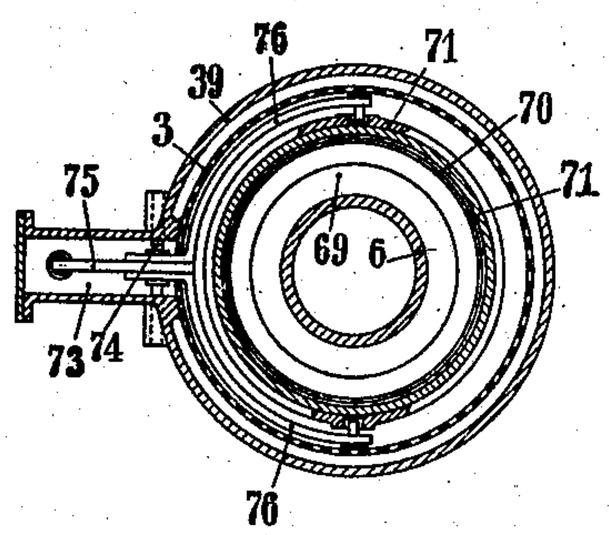

Fig.4.

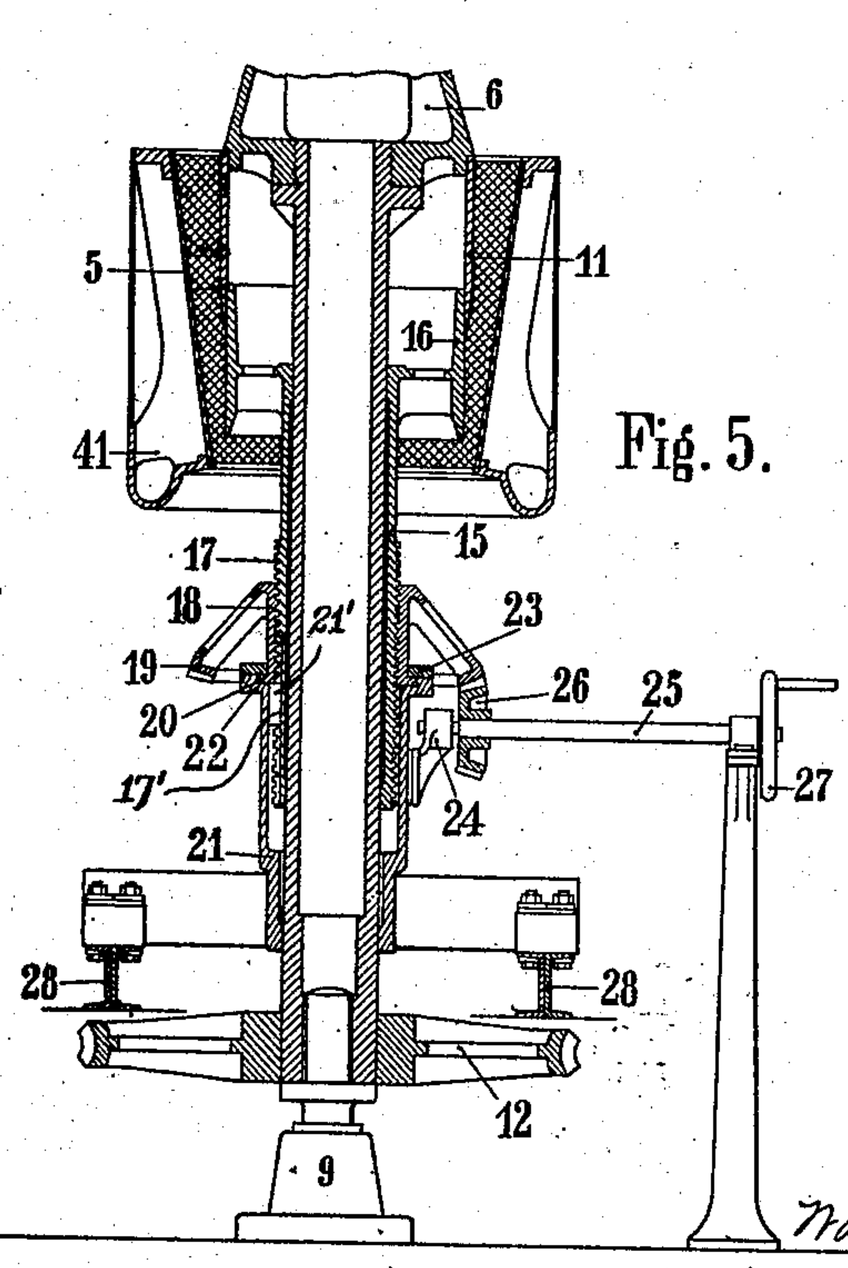

Fig. 5.

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UNITED STATES PATENT OFFICE.

WALTER BOCK, OF PRINZENTHAL, NEAR BROMBERG, GERMANY.

DIFFUSION APPARATUS.

No. 923,760. Specification of Letters Patent. Patented June 1, 1909.

Application filed December 17, 1907. Serial No. 406,939.

To all whom it may concern:

Be it known that I, WALTER BOCK, mechanical engineer, a subject of the King of Prussia, and citizen of German Empire, residing at Prinzenthal, near Bromberg, in the Kingdom of Prussia and German Empire, have invented certain new and useful Improvements in Diffusion Apparatus, of which the following is a specification.

The present invention relates to diffusers.

Ordinary diffusion apparatus consist of a number of receptacles placed one beside another through which the diffusion liquid, usually water, flows in succession. These diffusion apparatus admit of the substance which is to be extracted from the diffusion material being completely obtained. Nevertheless there remains in the exhausted material a large quantity of liquid which must be drawn off from the receptacles when the material is removed, and owing to the circumstance that this liquid contains parts of the material it easily becomes corrupted and is difficult to remove. For this reason other diffusion apparatus have been constructed in which the diffusion material continuously moves forward, it being pressed by a conveyer or other device in a compressed state through the apparatus. These apparatus, however, are deficient in that the diffusion material cannot be completely exhausted, because it is not sufficiently lixiviated in the compressed state.

Now my invention consists in providing for the diffusion material a receptacle where the material in loose layers, and not compressed, can be rinsed with water, and in providing on the bottom of this receptacle or at an otherwise suitable place a conveyer or the like, by means of which the lixiviated material is pressed out of the receptacle under pressure without the water leaving the receptacle at this place.

My invention further consists in the combination of the parts further described hereafter to one operative diffusion apparatus.

According to the nature of the material in each case, I employ one or more such receptacles. When there are a plurality of the latter, they are preferably placed superimposed.

In order that the invention may be clearly understood reference is made to the accompanying drawing in which various embodiments are represented by way of example and in which:—

Figure 1 is a vertical section through one form of the diffusion apparatus, and Fig. 2 is a modified form of the same. Fig. 3 is an enlarged vertical section of an upper portion of the form shown in Fig. 2. Fig. 4 is a section on line 4—4 of Fig. 3. Fig. 5 is an enlarged vertical section of the lower end of Fig. 2.

In Fig. 1 three cylindrical receptacles 1 are placed one over another and built upon suitable supports 2. Each receptacle 1 has at its upper end a perforated part 3 and at a suitable distance below the latter part a perforated part 4. Further, at their lower ends of the receptacles have a conical perforated part 5. All three receptacles are connected with one another directly and without an intermediate bottom. A hollow and for the most part cylindrical spindle 6 is journaled in the central line of the three receptacles. For this purpose in the uppermost receptacle there is a bearing 7 attached by means of several arms 8 passing transversely through the receptacle and fastened to the side, whereas the spindle rests at the bottom end in a step bearing 9 on the ground. The spindle carries a worm or helix 10 in each receptacle between the perforated part 4 and the conical perforated part 5 of the receptacle. Below the lowermost worm the spindle is enlarged conically and immediately under this place it has an enlarged cylindrical part 11. An annular chamber constricted below is formed by the part of the spindle enlarged conically together with the cylindrical receptacle, and by the cylindrically enlarged part 11 with the conical perforated part 5 of the lowest receptacle 1. Above the bearing 9 of the spindle there is a worm-wheel 12 rigidly attached to the spindle which is driven by a worm 13. The worm 13 is driven from any suitable motor by means of the pulley 14.

On the spindle 6 below the enlarged part 11 there is arranged a sleeve 15; the latter can be pushed up and down the spindle and carries at its top end a drum 16 which is pushed into the enlarged part 11 of the spindle. The sleeve 15 has at its lower end a screw-thread 17 (see Figs. 2 and 5) which engages with the female thread of the hub 18 of a bevel-wheel 19. The hub 18 has at its bottom end a flange 20. A bearing 21 surrounding the spindle 6 has at its upper end a flange 22 on which the flange 20 of the hub 18 lies. A ring 23 which consists

of two parts and which engages over the flange 20 is screwed to the flange 22, so that the hub 18 of the bevel-wheel 19 is held revoluble on the bearing 21. The thread 17 is slotted at 17′, see Fig. 5, parallel to the axis of the sleeve 15, and a wedge 21′ attached to the bearing 21 engages in the slot so that the socket 15 cannot rotate with the spindle 6.

On the bearing 21 (see Fig. 5) there is a plumber-block 24 attached in which a shaft 25 resting in a suitable second bearing is journaled. The shaft 25 carries a bevel-wheel 26 in engagement with the bevel-wheel 19 At the other end of the shaft there is attached a hand-wheel 27. The bearing 21 rests on supports 28 and carries in addition a revoluble collecting dish 29 for the diffusion material.

The uppermost of the cylindrical receptacles 1 has a cover 30, in the inlet of which a cylindrical hopper 31 is inserted. Above the hopper there is arranged a conveying device for the material which is to be lixiviated consisting of a feeding-screw or conveyer 32. The latter is driven by the pulley 33. The material is thrown into the channel 34 of the conveyer through the hopper 35, and when conveyed to the hopper 31 falls into the same and into the uppermost receptacle 1. The excess passes the hopper 31 and falls through the chute 36 into an optional receptacle not shown in the drawing from which it is brought into the hopper 35 again from time to time.

A reservoir of water is arranged above the top receptacle 1 so that the level of the water in the reservoir 37 is higher than the cover 30 of the top receptacle, but lower than the conveyer 32, so that even if the flow of the liquid is cut off, the liquid in the diffusion apparatus can never overflow. A pipe 38 leads downward from the reservoir 37.

The cylindrical receptacles 1 are surrounded at all their perforated parts 3, 4 and 5 with jackets 39, 40 and 41. The lowest receptacle 1 has another cylindrical perforated part above the conical perforated part 42 which is surrounded by a special jacket 43 at a little distance from the worm 10.

The fall-pipe 38 is connected by means of a branch pipe 44 with the jacket 39 of the perforated part 3 of the lowest receptacle 1, and by means of the branch pipe 45 with the jacket 40 of the perforated part 4 of the lowest receptacle 1. Stop-valves 46 and 47 are inserted in the branch pipe 44, and stop-valves 48 and 49 in the branch pipe 45. Further, the branch pipes 44 and 45 are connected one with the other through a number of narrow tubes 50. The latter are surrounded by a jacket 51 into which steam can be introduced for heating the tubes. The jackets 39 and 40 on the lowest receptacle 1 are also connected together by means of a pipe 52 in which the valves 53 and 54 are inserted at suitable places.

The jacket 39 of the central receptacle 1 is connected with the pipe 52 by means of the pipe 55; in the latter there is inserted a heater 56 consisting of narrow tubes with a jacket, like the tubes 50 and the jacket 51. The jacket 40 of the middle receptacle 1 is connected with the jacket 41 by a pipe 57, and the jacket 41 of this receptacle is connected with the jacket 39 of the top receptacle 1 through a pipe 58, a heater 59 being inserted in the latter. The jacket 40 of the top receptacle 1 is likewise connected with the jacket 41 of this receptacle by a pipe 60, and a pipe 61 conducts away the liquid from the diffusion apparatus from the jacket 41 of the top receptacle for it to be further worked up. The jacket 43 of the bottom receptacle has an outlet pipe 62 which can be closed by a valve 63 and joins with the outlet pipe 64 of the jacket 41 of the lowest receptacle. The pipe 64 leads to a reservoir 65, the contents of which can be conveyed by a pump 66 or the like and the pipe 67 to the water reservoir 37 again. A pipe 68 supplies so much water to the reservoir 37 that the latter remains constantly filled without overflowing.

When the diffusion apparatus is in operation the valves 46, 49 and 53 are thought of as closed and all the other valves opened. The receptacles 1 are quite filled with diffusion material, for example slices of beet-root. Steam is supplied through the jackets of the heaters 51, 56 and 59, and the spindle 6 is driven by the pulley 14. Then water will run from the reservoir 37 through the pipe 38, valve 48, tubes 50 where it is warmed, through the valve 47, jacket 39 and the perforations of the part 3 in the lowest receptacle 1, through the chips contained in the latter to the perforated part 4, and through the jacket 40 of the latter and the valve 54 into the pipe 52.

The liquid from the pipe 52 will enter into the pipe 55, will be warmed again in the heater 56, enter through the perforated part 3 into the middle receptacle and for the most part leave the latter again through the perforated part 4. It then flows through the pipe 57 to the jacket 41 of the middle receptacle 1, from which, combined with the liquid which is squeezed out in the conical constricted part 5 of the middle receptacle 1, it enters through the pipe 58 with the heater 59 into the jacket 39 of the top receptacle 1. After flowing through the top receptacle it then passes out again from the jacket 40 into the jacket 41 and is led away through the pipe 61.

The chips of beet-root thrown into the hopper 35 are conveyed into the hopper 31 and settle in loose layers in the receptacle 1 above the top thread 10 of the worm on the

spindle 6. They are soaked by the liquid penetrating through the perforated part 3, and the substance, for example sugar, which is to be obtained from them is for the most part edulcorated.

On account of the spindle 6 with its worm 10 rotating, the chips are pressed into the conical narrowed part 5 of the top receptacle 1 and so firmly compressed there that they do not allow the liquid to pass through them. After passing out of the conical part 5 of the top receptacle, the beet-root chips, or other diffusion material, expand in consequence of their elasticity and settle again loosely in layers in the lower receptacle 1 above its worm 10. The diffusion material then arrives in the same manner in the lowest receptacle 1. The last residue of the substance which is to be obtained is removed from it by the fresh water flowing through it. The lixiviated material is then pressed by the lowest part of the worm 10 into the lowest conical narrowed part 5 which is more constricted than the upper part. In this part all the liquid which is not already conducted away through the pipe 52 is squeezed out of the material and drawn off through the pipes 62 and 64 into the receptacle 65. As this liquid contains only very little of the substance which is to be lixiviated, it can be returned into the receptacle 37. The diffusion material falls almost dry from the mouth of the lowest conical part 5 into the revoluble collecting dish 29 from which it is removed by suitable means. If the valves 47, 48 and 54 are closed and the valves 46, 49 and 53 opened in their stead, water flows from the receptacle 37 in the direction from below upward through the lowest receptacle 1, which, under certain circumstances, is more favorable for the complete diffusion of the material than when the water flows from above downward.

In order to regulate the velocity at which the diffusion material passes through the diffusion apparatus, the mouth of the lowest conical part 5 can be made narrower and wider. This is effected by placing the drum 16 up or down. The gap between the drum 16 and the perforated part 5 becomes narrower, the lower the drum is placed. In Fig. 1 the drum 16 is almost in its lowest position, whereas in Fig. 2 it is shown almost in its highest position. The drum 16 is moved by rotating the hand-wheel 27. When the latter is turned, the bevel-wheel 26 and the bevel-wheel 19 with its hub 18 are rotated. In this manner the sleeve 15 with the drum 16 is moved up or down by means of the thread 17.

In the form according to Fig. 1 the openings of the conical parts 5 in the central and upper receptacle 1 are not adjustable. When the diffusion material is always uniform or approximately uniform, adjustability will not be necessary; for by adjusting the mouth of the lowest conical part 5, the diffusion material will pass slower through the opening and will therefore be penned up in the lowest receptacle 1. In this manner it will exercise a back pressure on the material pressed together in the conical part 5 of the central receptacle, so that this also moves forward more slowly. The material in the central receptacle will then also be penned up and likewise act on the movement of the material in the uppermost receptacle. If non-uniform diffusion material is being worked with however, or if it is intended to regulate the diffusion process by the material being compelled to remain longer in the one or other of the receptacles 1, the openings of the upper conical parts 5 can also be arranged adjustable. Fig. 2 of the drawing shows this. The constructional form which is represented in this figure differs from that represented in Fig. 1 only in this adjustability. Consequently all the other parts agree with those of Fig. 1 with the exception of those hereafter described.

The spindle 6 (Fig. 2) has enlarged shoulders 69 (see Figs. 3 and 4) below the conical parts 5 of the top and central receptacles 1. The conical parts 5 have downward cylindrical non-perforated extensions 70. These are surrounded by upwardly and downwardly movable rings 71. The latter are connected below the edge of the extension 70 with a ring 72 which, however, is likewise movable downward and upward within the cylindrical extensions 70. In an additional piece of the jacket 39 there is a lever 75 mounted revolubly around an axle 74, which lever is forked on the one side and carries the ring 71 with its forked end 76. The other end of the lever 75 is mounted in a slot of a spindle 77 which can be moved up and down by means of a screw-thread and a hand-wheel 78. By moving the lever 75, the rings 71 can be raised or lowered in common. When raising the rings 71, the gap between the shoulder 69 of the spindle and the lower edge of the ring 71 is enlarged, and the same is narrowed when the rings 71 are lowered. In this manner the openings of the conical parts 5 at the central and upper receptacle 1 can also be adjusted. The liquid can be conducted as desired through each individual receptacle from above downward or from below upward, and for this purpose the upper receptacles can also be provided with like pipe connections as are arranged on the lowest receptacle.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In a diffusion apparatus, the combination of a cylindrical receptacle having an inlet above, means for feeding the charge downwardly through the receptacle, a per-

forated part near its upper edge and a second perforated part at a suitable distance below the former perforated part, a spindle journaled in the central line of the receptacle, means for rotating the spindle, a worm on the spindle directly below the second perforated part, a conical perforated part on said receptacle directly below said worm, jackets around the perforated parts, a pipe from the jacket of the second perforated part communicating with the jacket of the conical perforated part and pipe connections on the jackets of the first perforated part and of the conical perforated part.

2. In a diffusion apparatus, the combination of a cylindrical receptacle having an inlet above, a perforated part near its upper edge and a second perforated part at a suitable distance below the first perforated part, a spindle mounted in the central line of the receptacle, means for rotating the spindle, a worm on the spindle below the second perforated part, a conical perforated part on said receptacle below said worm, said spindle having an enlargement extending downward below the conical perforated part, said conical perforated part having a cylindrical downwardly extending non-perforated extension, a ring within said cylindrical non-perforated extension, means for holding the ring and for moving it up and down, jackets around the perforated parts, a pipe from the jacket of the second perforated part communicating with the jacket of the conical perforated part and pipe connections on the jackets of the first perforated part and of the conical perforated part.

3. In a diffusion apparatus, the combination of a cylindrical receptacle having an inlet above, a perforated part near its upper edge and a second perforated part at a suitable distance below the first perforated part, a spindle journaled in the central line of the receptacle, means for rotating the spindle, a worm on the spindle below the second perforated part, a third cylindrical perforated part on said receptacle at a small distance below the worm, a conical perforated part below said third cylindrical perforated part, said spindle having a conical enlargement within the third cylindrical perforated part of the receptacle, said spindle having a cylindrical enlargement within the conical perforated part of the receptacle, a drum within the cylindrical enlargement of the spindle, means for holding and pushing up and down the drum, jackets around the perforated parts and pipe connections to the jackets of all perforated parts.

4. In a diffusion apparatus, the combination of a plurality of vertically superimposed perforated upper cylindrical and lower conical receptacles each of which has means to feed downwardly and contain a portion of the diffusion material in loose condition, means between the cylindrical and conical receptacles for removing under pressure in the conical receptacles the diffusion material from each cylindrical receptacle, a water-reservoir having its upper edge higher than the upper edge of each pair of superimposed receptacles, pipes from said reservoir communicating with that part of the cylindrical receptacle in which the diffusion material is in loose condition, and pipes from each receptacle to the next.

5. In a diffusion apparatus, the combination of a plurality of superimposed cylindrical receptacles the uppermost of which has an inlet, each receptacle having a perforated part near its top edge and a second perforated part at a suitable distance below the former perforated part, a spindle mounted in the central line of the receptacles, means for rotating the spindle, a worm on the spindle under the second perforated part of each receptacle, each upper receptacle having a conical perforated part under its worm, the lowest receptacle having a third cylindrical perforated part at a little distance below its worm, a conical perforated part under said third cylindrical perforated part, said spindle having a conical enlargement extending downward within said third cylindrical perforated part and having a cylindrical enlargement within the conical perforated part of the receptacle, a drum within the cylindrical enlargement of the spindle, means for holding the drum and pushing it up and down, jackets around all the perforated parts of the receptacles, pipes from the jackets of the second perforated parts of the upper receptacles to the conical perforated parts of the upper receptacles, a water-reservoir having its upper edge higher than the upper rim of the uppermost receptacle, pipes from the reservoir to the part of the lowest receptacle above its worm, pipes connecting the part of each receptacle above its worm with the next higher receptacle, a discharge pipe from the top receptacle, heaters in the pipes to each receptacle, a collecting receptacle, discharge pipes leaving the latter and connected with the jackets of the third cylindrical part and with the conical perforated part of the lowest receptacle, and means for raising liquid from the collecting receptacle and conveying the same into the water-reservoir.

6. In a diffusion apparatus, the combination of a plurality of superimposed cylindrical receptacles, the uppermost of which has an inlet opening, each receptacle having a perforated part near its top rim and a second perforated part at a suitable distance below the former perforated part, a spindle journaled in the central line of the receptacles, means for rotating the spindle, a worm on the spindle under the second perforated part of each receptacle, each recep-

tacle having a conical perforated part under its appertaining worm, said spindle having downwardly extending shoulders below the conical perforated part of each of the upper receptacles, the conical perforated part of each upper receptacle having a cylindrical non-perforated downwardly extending extension, a ring within each of the latter extensions, means for holding and moving up and down the rings, said lowest receptacle having a third cylindrical perforated part at a little distance below its worm, a conical perforated part under the latter cylindrical perforated part, said spindle having a conical enlargement extending downward within said third cylindrical perforated part, and having a cylindrical enlargement within the conical perforated part of the receptacle, a drum within the cylindrical enlargement of the spindle, means for holding the drum and pushing it up and down, jackets around all the perforated parts of the receptacles, pipes from the jackets of the second perforated parts of the upper receptacles to the conical perforated parts of the upper receptacles, a water-reservoir having its top rim higher than the top rim of the top receptacle, pipes from the reservoir to the part of the lowest receptacle above its worm, pipes connecting the part of each receptacle above its worm with the next higher receptacle, a discharge pipe from the top receptacle, heaters in the pipes to each receptacle, a collecting receptacle, discharge pipes leading to the latter and connected to the jackets of the third cylindrical part and with the conical perforated part of the lowest receptacle, and means for raising liquid from the collecting receptacle and conducting the same into the water-reservoir.

In testimony whereof I have hereunto set my hand in presence of two witnesses.

WALTER BOCK.

Witnesses:

FELIX MENLANE,

HENRY HASPER.