J. W. PHILLIPS.

CENTRIFUGAL SEPARATOR.

APPLICATION FILED APR. 5, 1909.

945,592. Patented Jan. 4, 1910.

Fig. 1

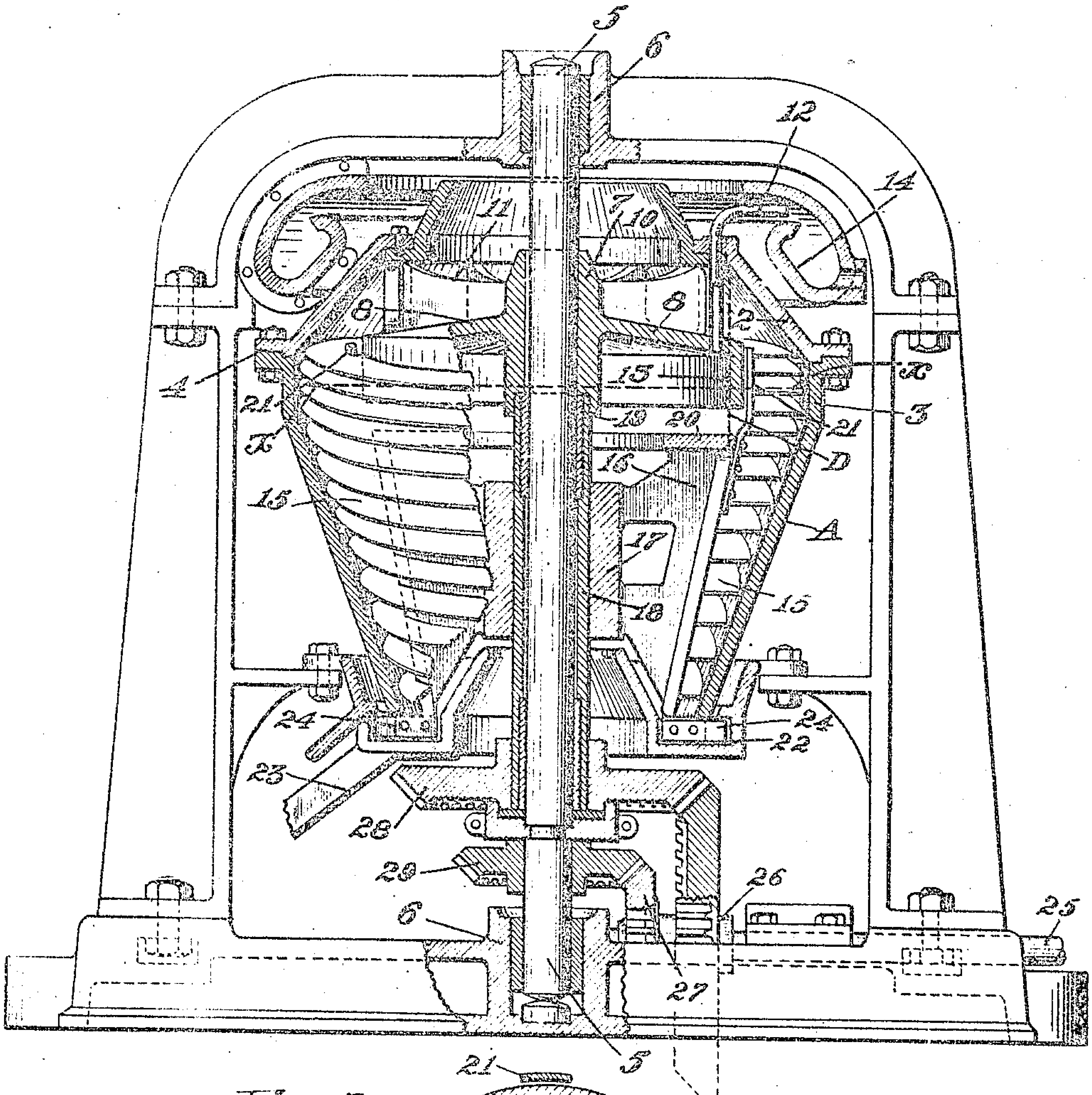
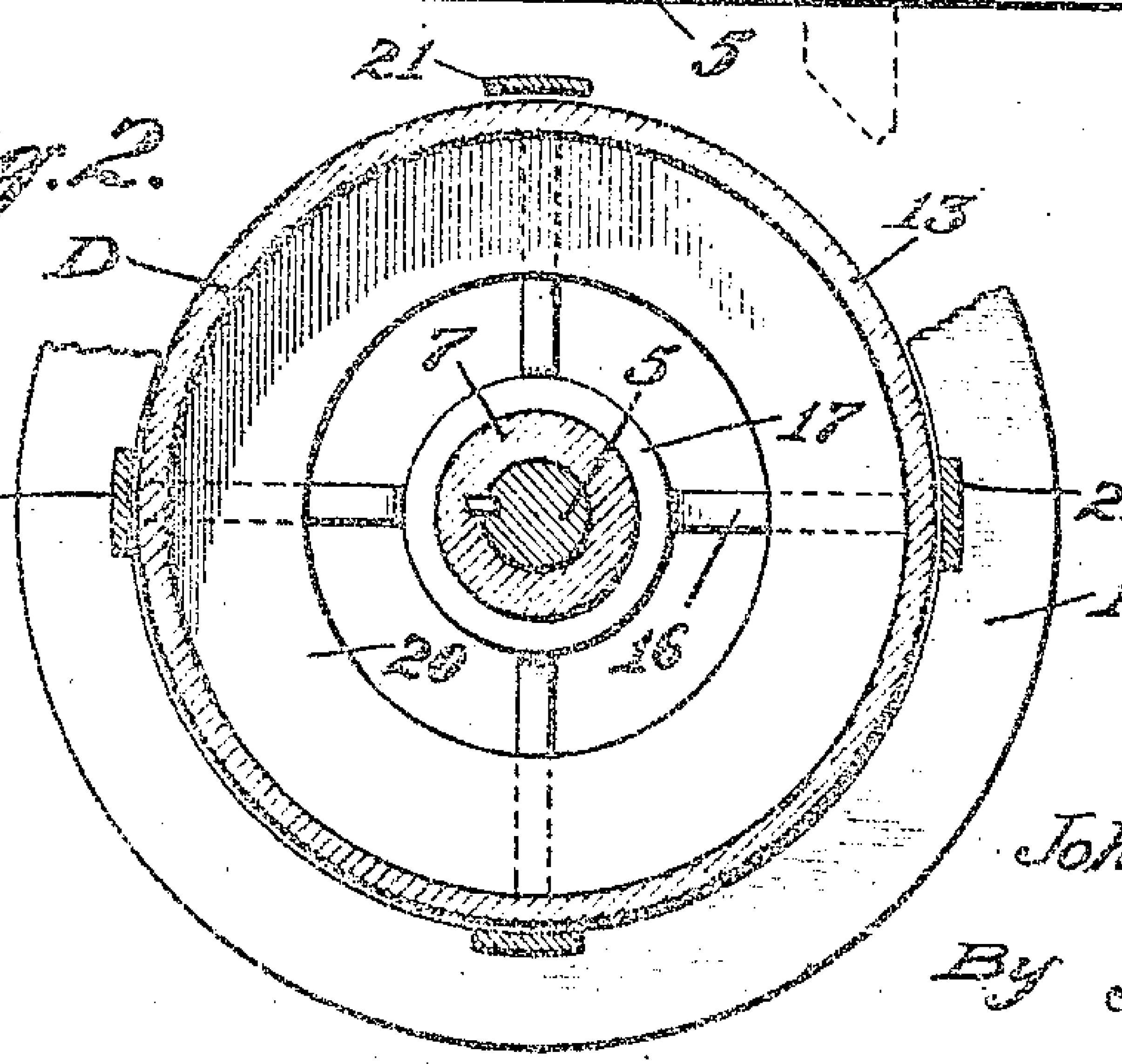


Fig. 2.



Witnesses:

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[illegible]

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CENTRIFUGAL SEPARATOR.

945,592. Specification of Letters Patent. **Patented Jan. 4, 1910.**

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To all whom it may concern:

Be it known that I, JOHN W. PHILLIPS, citizen of the United States, residing at Silver City, in the county of Lyon and State of Nevada, have invented new and useful Improvements in Centrifugal Separators, of which the following is a specification.

My invention relates to centrifugal separators, and pertains especially to separators of the type employing an outside rotary conoidal shell and an inside spiral conveyer, the blades of which conveyer have a differential rotary motion to discharge the solids at the lower end of the apparatus separate from the liquid which is discharged at the top.

The object of this invention is to devise a satisfactory means by which a minimum amount of agitation of the liquid undergoing separation will take place, so that the finer impalpable particles of solid matter or solid matters which have apparently no measurable dimensions will be separated and collected.

The invention consists of the parts and the construction and combination of parts as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is a vertical section, partly in elevation, of the invention. Fig. 2 is a horizontal section on the line *x*—*x* of Fig. 1.

In this improved machine I employ a shell made in two parts or sections A—2, each section being essentially in the form of a truncated cone, with the upper larger end of the lower section A extended in cylindrical form, as shown at 3, and the abutting ends of the shell sections being suitably connected together, as shown at 4. The shell is open at both top and bottom and is supported on a vertical shaft 5, which latter is mounted in suitable bearings 6 in the main frame of the apparatus.

A collar 7 is keyed to the shaft and carries an inclined deflecting and distributing disk 8 which is arranged proximate to the waist or wider portion of the interior of the shell. The disk 8 does not extend to the shell, there being an annular space left between the disk and shell, around and through which all of the liquid and matter to be acted on passes. The disk 8 constitutes the floor of the receiving hopper, and should not be perforated. The upper surface of the disk carries a number of radial webs or vanes 11 which may be straight or curved. The function of these vanes 11 is to force all the material, both solids and liquids, heavy and light, through the space around disk 8 into the greatest diameter of the machine and through the area of greatest separating force. These webs or vanes act similarly to the vanes of a centrifugal pump, and force the affluent material through the stationary wall of water and solids in suspension which is formed at D above and below disk 8, when the machine is running.

On the under side of the disk 8 is a downwardly extending, peripheral, cylindrical flange 13 which is parallel with, and spaced from, the cylindrical section 3 of the shell, and with the interior of this flange coincident with, and in fact, locating the waterline D. The affluent material which is fed in through the hopper is forced by the action of the vanes 11 outward and over the edge of the plate 8 and down through the annular space between the parts 13—3 and driven through this imaginary barrier D, and all material subjected to the greatest separating action of the machine. No material or water can get out of the machine except it passes down through this space between the parts 13 and 3. The clear liquid is strained inwardly from the space of greater diameter of the shell underneath and behind the ring 13 and discharged thence through the pipes 12 into the trough 14.

All liquid before it can be discharged from the machine must pass first through the area of greatest separating force in the machine, and then strain back to the outlets 12 against centrifugal force. In doing so the liquids are thereby separated from the solids, which latter are thrown against the casing 2 and removed by the spiral scrapers 15. These spiral blades or scrapers 15 are fixed to the radially disposed webs 16, which latter are carried by a hub 17 secured to a sleeve or hollow shaft 18 rotatable on suitable bearings 19 about, and concentric with, the shaft 5; the two shafts 5 and 18 having motion in the same direction, but at slightly different rates of speed.

To the top of the supporting webs 16 is fixed a ring 20 suitably spaced from the disk 8 above, the disk 8 and ring 20 inclosing a space which opens outward to the shell for the reception of the separated liquid. The ring 20 prevents the liquid which passes below it from rushing upward and out through

the discharge pipes 12; the water below the ring usually being more or less muddy, owing to the operation of the blades.

The peripheral flange 13 on disk 8 has its lower edge approximately in the horizontal plane of the lower end of the cylindrical section 3, where it joins the conical part A of the shell, and the ring 20 is disposed enough below the lower edge of the flange 13 to provide a suitable egress passage for the clarified liquid from the space of greatest centrifugal action in the machine.

The blades 15 which are spaced about two inches apart are given a flat pitch in the widest portion of the machine, the pitch gradually increasing as the space narrows toward the bottom of the interior of the shell. These blades in the present case are made to extend above the ring 20 and up into the cylindrical space between the parts 13 and 3, the upper ends of the blades being suitably supported by the bracket arms 21 which are carried by the webs 16. It is understood that the outer shell and the parts 8 and 13 are rigidly fixed to the shaft 5, and all turn in unison; but that the blades 15 have a slight differential movement within and with respect to the shell and the part 13. By the cylindrical arrangement of the parts 3 and 13, and the extending of the blades up into this cylindrical space, the liquid and material to be separated which is fed into the hopper is thrown outward by centrifugal action and the pumping force of the vanes 11 against the outer shell 2, this liquid and material to be separated almost immediately assuming the speed of the machine, so that separation soon gets under way.

It has been found necessary, in order to save the finest slimes, that all agitation of the matter undergoing treatment should be avoided as far as possible, so as to prevent the finest solids being stirred up, and which stirring prevents their settling against the outer side of the shell. In this present machine, the portion of the blades 15 which extends up into the cylindrical space between the parts 3 and 13, forms cells or chambers in which the liquid and material to be separated is carried around, and practically all stirring action is avoided, and the finest of slimes are found to collect on the shell in the form of solids, thence to be scraped and worked gradually downward to the solids outlet and into the trough 22.

In the gradual working of the material downward along the outer face of the peripheral flange 13, the confined liquid and material is subjected to only such agitating influences as the slipping of the shell and flange 13 past the edges of the blades; but since these surfaces are smooth, and since the relative difference in motion between the parts is slight, this agitation is almost *nil*, and consequently, by the time the liquid reaches the bottom of the flange 13 it is practically freed of all its solids, and the water passes out of the machine through the discharge pipes 12 practically clear. This cylindrical arrangement of the parts 3 and 13, with the intervening blade sections 15, constitutes the main features of this present invention. As the shell contracts toward the lower end, the pitch of the blades 15 increases so as to compensate for the gradually narrowing space. The solids which are scraped into the pan 22 are discharged therefrom through the outlet 23 by suitable means, as the scrapers 24 on the ends of the blades 15. The discharge for the solids at the lower end of the machine takes place nearer the axis of the machine than the water-line D; the spiral scrapers 15, in scraping the solids downward to the outlet, working the solids along the space inside the water-line, thereby drying the solids before discharging them.

The two shafts 5 and 18 are operated at suitable differential speeds, from any suitable source of power, by any appropriate means. As here shown, 25 represents a power-shaft provided with two bevel gears 26—27 of different size engaging corresponding gears 28—29 on the respective shafts 18 and 5; the pitch of these connecting gears varying according to the difference in speed at which it is desired to drive the shell and the conveyer blades 15.

In principle, the parts 13 and 3 may be considered inner and outer cylindrical shells which cöperate with the upward extension of the blades to inclose a spiral tubular chamber which is rectangular in cross-section, and through which chamber all of the liquid and material to be separated is forced, and in which chamber all the separation takes place; the outer shell forming a wall to the chamber, which wall has a slight differential motion from the blades, so that at the same time that separation takes place through centrifugal action, there is a gradual progression of the solids along this outer wall. The main feature, however, is the separation in a rapidly revolving spiral tubular chamber.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

A centrifugal separator comprising in combination a shell open at the ends and having an enlarged circumferential portion between its ends, said enlarged portion being in part cylindrical and concentric with the axis of rotation of the shell, a shaft to which the shell is fixed, an imperforate disk rigid with the shaft and shell and within the latter, said disk having a downwardly extending, peripherial, annular flange, which latter is concentric with, and spaced from,

the enlarged cylindrical portion of the shell, a sleeve surrounding said shaft, spirally-arranged blades inside the shell and carried by said sleeve, means for giving the blades and shell a differential rotary motion, and said blades extending upward into the cylindrical space between said flange and said enlarged circumferential shell portion, the space behind said flange having a discharge for the liquids, the lower end of the shell contracted, and the discharge for the solids from said contracted lower end of the shell being nearer the axis of the shell than said liquid discharge.

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

JOHN W. PHILLIPS.

Witnesses:
CHARLES A. PENFIELD,
CHARLES EDELMAN.