June 26, 1951 C. W. ZIES 2,558,408

OUTLET VALVE MECHANISM FOR SOLVENT EXTRACTION PLANTS

Filed Oct. 28, 1946 3 Sheets-Sheet 1

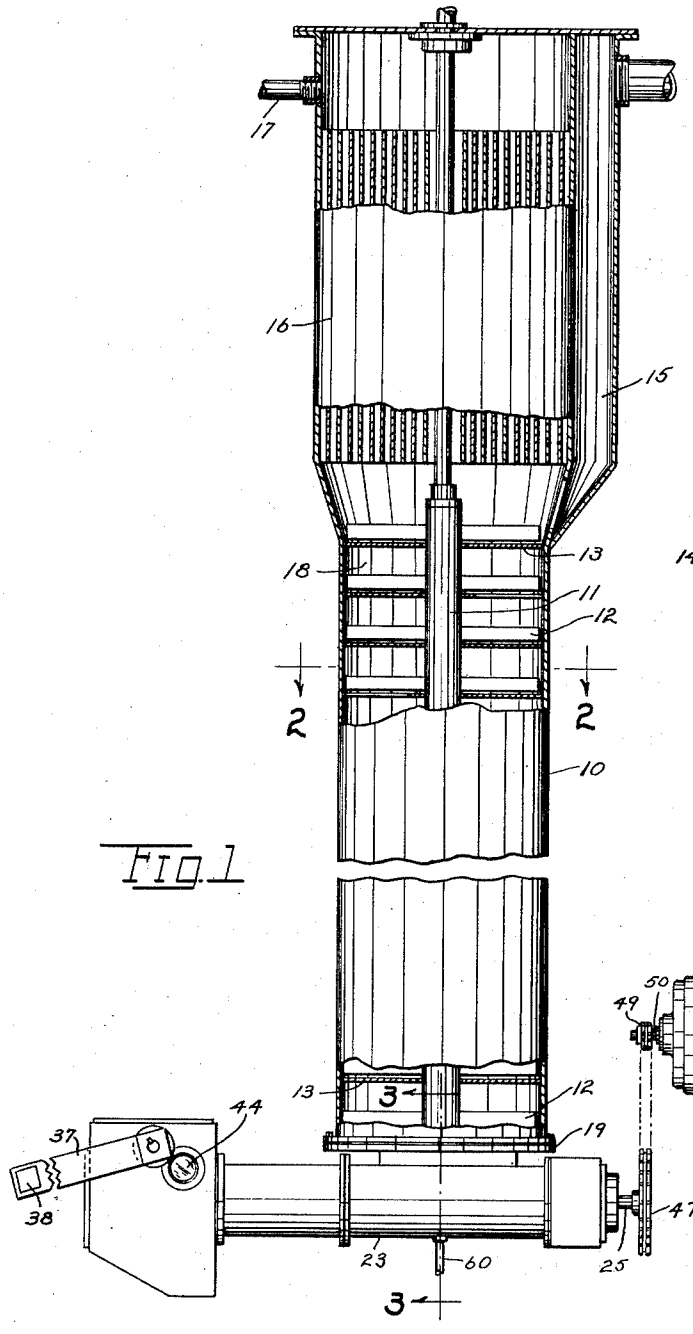


FIG. 1

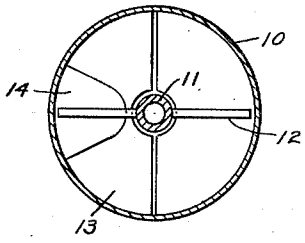


FIG. 2

INVENTOR
CARL W. ZIES
By Hyde, Meyer, Baldwin, & Doran
ATTORNEYS

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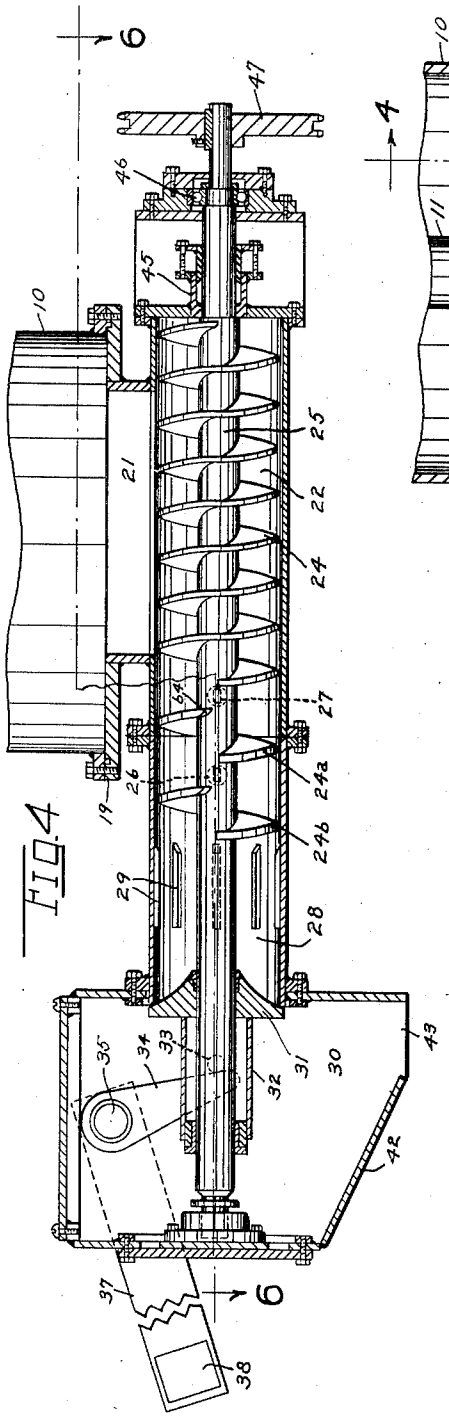


FIG. 4

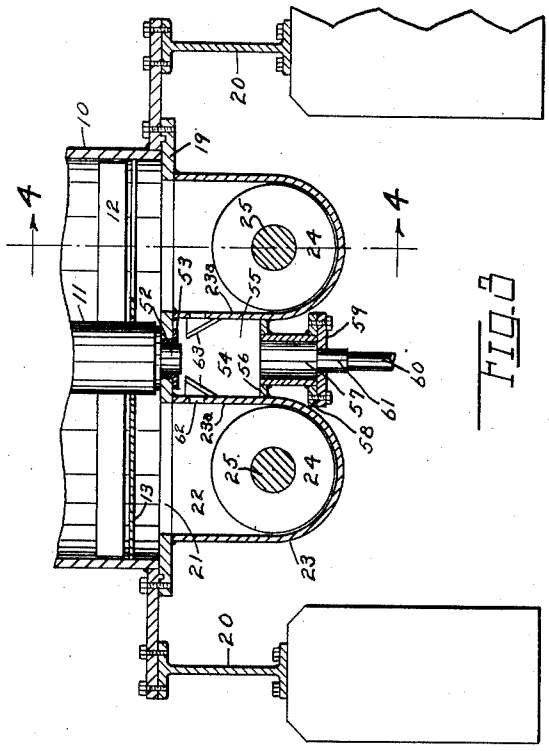


FIG. 3

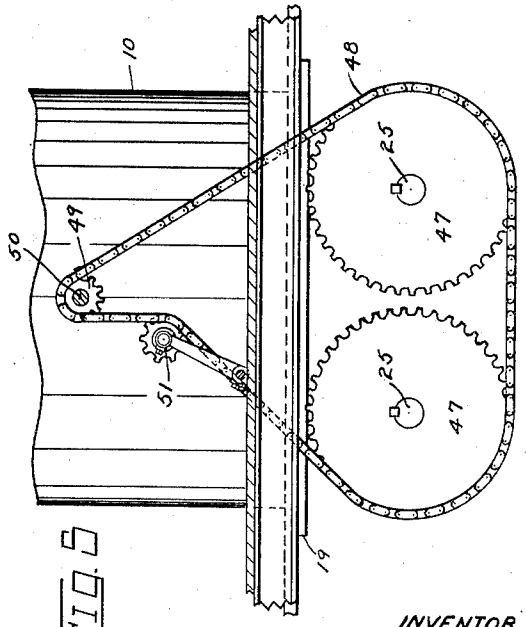


FIG. 5

INVENTOR
CARL W. ZIES
BY Hyde, Meyer, Baldwin & Doran
ATTORNEYS

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OUTLET VALVE MECHANISM FOR SOLVENT EXTRACTION PLANTS

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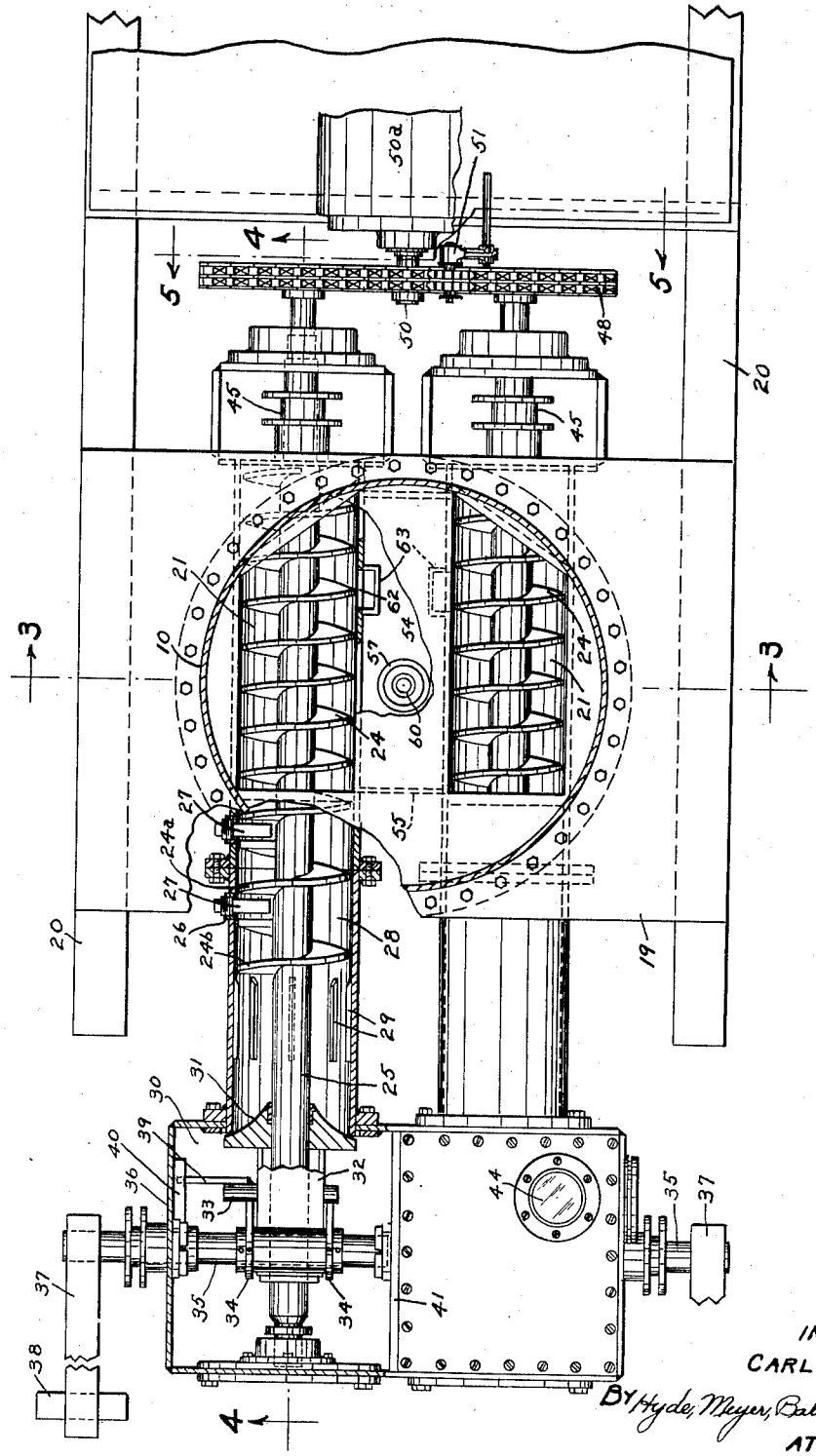


FIG. 6

INVENTOR
CARL W. ZIES
BY Hyde, Meyer, Baldwin & Doran
ATTORNEYS

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UNITED STATES PATENT OFFICE

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OUTLET VALVE MECHANISM FOR SOLVENT EXTRACTION PLANTS

Carl William Zies, Lakewood, Ohio, assignor to The V. D. Anderson Company, Cleveland, Ohio, a corporation of Ohio

Application October 28, 1946, Serial No. 706,221

1 Claim. (Cl. 23—270)

1

This invention relates to extraction towers, such as are used for solvent extraction of oil from seed or other oil bearing vegetable or animal materials. The invention has more particular relation to the means or mechanism by which the liquid solvent is supplied and the solid residue, after extraction is completed, is released, withdrawn or discharged from the tower.

One object of the invention is to provide improved discharge mechanism for the solid material which not only is efficient and of high capacity, but also produces satisfactory discharge without loss or escape of solvent liquid.

Another object is to provide improved discharge mechanism which forms and maintains a uniformly dense plug of solid material at the outlet, thus preventing escape and loss of liquid.

Still another object is to provide improved discharge mechanism embodying rotatable screw means equipped with the necessary instrumentalities to advance the solid material toward the outlet as the screw rotates, thus preventing rotation with the screw of a mass of the solid material, such as might open a channel to permit liquid to escape, or prevent the forward movement of the material.

Another object is to improve the relation between the inlet for solvent liquid and the outlet for solid material, to insure maximum exposure of solid to liquid, and increase the quantity of oil extracted.

Another object is to provide a simple and improved arrangement of the solvent supply channels with respect to the passages for discharge of solid material, and of both with respect to the agitating shaft, not only for ease of assembly, inspection and repair, but also to avoid caking or collection of solid material around or near the lower end of the shaft.

Finally, the invention aims to generally improve the mechanism so that it operates satisfactorily over long periods of time without special attention, but nevertheless is of generally simple form with all parts readily accessible for repair, replacement or the like.

Further advantages of the invention in part are obvious and in part will appear more in detail hereinafter.

In the drawings, Fig. 1 represents an elevation, partly broken out and in section, through one form of extracting tower embodying the invention;

Fig. 2 is a sectional plan view, on the line 2—2, Fig. 1;

Fig. 3 is a detail sectional elevation, through the lower portion of the apparatus, on the line 3—3, Fig. 1;

Fig. 4 is a sectional elevation, on the line 4—4, Fig. 3;

Fig. 5 is a sectional elevation, on the line 5—5, Fig. 6, showing the driving mechanism, certain parts being omitted; and

Fig. 6 is a sectional plan view on the line 6—6, Fig. 4.

2

While the invention is capable of use in any form of solvent extraction plant, for the purpose of supplying solvent liquid and discharging or ejecting the settled solid material, it has been shown in the drawings, solely for purposes of illustration and in no sense of limitation, in a form suitable for use with the same general type of extraction tower and fines separator illustrated in an application for Method and Apparatus for Separating Prepared Oil-Bearing Seed Oil and Solvent Mixture, Serial No. 551,244, filed August 25, 1944, by Louis F. Langhurst, and now abandoned, to which reference may be had if desirable or necessary.

In the drawings, 10 represents the tall cylindrical extraction tower provided with a central vertically extending rotatable agitating shaft 11 having arms 12 which sweep over stationary horizontal disc form plates or shelves 13 having openings 14, staggered or out of line on successive plates, through which the solid material finds a path in its course from the upper supply channel 15 to the bottom outlet by way of the valve mechanism to be described. The solvent liquid, such as hexane, is supplied to the bottom of the tower, as will appear later in detail, and rises through the descending solid material, then through a fines separator, marked generally 16, and is discharged from an upper outlet 17, the counter current manner of operation insuring high solvent extraction of oil from the solid material.

The extracted solid material moving downwardly in the tower becomes a more or less compact mass near its bottom, but cannot be permitted to flow freely out of the chamber, as by gravity, without loss of solvent liquid. Consequently, I employ for the purpose outlet valve mechanism including one or more rotatable conveyor screws and a choke arranged to build up the pressure against which the solid matter is advanced and thus form a definite plug or stopper for the outlet. A single screw may be employed but the drawings show two for the purpose.

As illustrated the extraction chamber 18 is provided with and is supported by a flat bottom or floor plate 19 made of heavy sheet steel and

resting upon beams 20. In said floor plate are two generally rectangular slots or openings 21 to which the collected solid material is fed by the lowermost arm 12 which sweeps around over the floor. Each opening 21 leads to a feed chamber 22 in a depending housing 23 in which rotates a feed screw or worm 24 mounted upon a shaft 25. That portion of the worm beneath the opening is of continuous multi-flight form, with about seven turns in the form shown. Beyond the discharge end of the worm 24 (the left-hand end in Fig. 4) the same shaft supports one or more (two being shown) individual worm flights 24*a*, 24*b*, separated from each other and from worm 24 by spaces 26, into each of which projects a stop or knife member 27 screwed into an opening in the imperforate barrel 28 in which worm flights 24*a*, 24*b* rotate. The purpose of these stops or knives is to break up the mass of solid material being advanced by the screw and to compel it to move forward without bodily rotation with the screw around the shaft axis. For the same purpose I may also provide the barrel, internally beyond the screw flights, with longitudinal ribs or vanes 29.

Beyond vanes 29, the channel within the barrel and around the shaft communicates with a discharge chamber 30, the opening to which is controlled by a more or less conical nonrotatable choke member 31 slidable on shaft 25 and connected to a sleeve 32 provided with pins 33 engaged by arms 34 on a shaft 35 extending out through the wall of housing 36, where said shaft supports one or more long arms 37 on which a suitable counterweight 38 is mounted. Rotation of sleeve 32 is prevented by an arm 39 attached thereto and sliding along a guide member 40 on the casing wall.

A single discharge chamber may receive the solid material from both screws or, as shown, a vertical wall 41 may divide the space within housing 36 into two chambers. In either case the floor 42 of the discharge chamber slopes to an outlet opening 43 through which the finished solid material falls into a suitable vessel, such as a bin or cart (not shown).

Inspection windows 44 in the top and side walls of casing 36 enable the operator to see how the solid material is behaving.

The drive end of shaft 25 is usually provided with an adjustable packing 45 and bearing 46, beyond which it is provided with suitable operating means. As shown, the two shafts 25 are each provided with a sprocket wheel 47 to receive a driving chain 48 passing over a sprocket 49 on shaft 50, which may be driven by any suitable variable speed driving mechanism, such as electric motor 50*a*, the speed of rotation of which may be varied in any suitable manner. 51 represents a chain tightening device.

Referring to Fig. 3, it will be observed that the lower end of vertical shaft 11 is reduced at 52, the reduced portion turning in a bearing ring 53 mounted in floor member 19. The weight of the shaft, it will be understood, is supported from a suitable bearing (not shown) at its upper end. Bearing ring 53 is in the roof or upper wall of a chamber 54 lying between the opposed parallel vertical side walls 23*a* of housings 23, depending end walls 55 (Fig. 3) and a bottom member 56, from which depends a large diameter tube 57 having a flange 58 to which may be removably secured a plate 59 provided with suitable means for attachment thereto of the liquid supply conduit 60, such as a coupling 61. In the side walls of housing 23 are openings 62 partially blocked by funnel or hopper members 63 welded to said walls and opening at their upper ends to chamber 54.

The extraction tower described is utilized in the customary manner for the extraction of any desirable value from solid material by the use of an extracting solvent. The solid matter, rolled, crushed, macerated or otherwise comminuted, and either wet or dry, is supplied continuously at the top of the tower through the channel 15, moving slowly downwardly toward the bottom through the staggered openings 14 as the result of slow rotation of the agitating shaft. During its downward motion the solid material at all times is in leaching relation or contact with the solvent liquid introduced at the bottom of the tower and flowing upwardly therein. The product, miscella in the specific instance being described, consisting of a mixture of oil and hexane or other suitable solvent fluid for the oil, passes through the fines separator 16 and is discharged continuously through the outlet 17. Solutions or mixtures of other materials than oil in other fluids than hexane, either gas or liquid, such as water, of course may be treated in the same manner.

As the solid material arrives in the region of the bottom of the solvent chamber 18, it becomes more and more dense or compact. The lower agitating blade 12 sweeps it across the floor formed by plate 19, so that it falls through the openings 21 into the receiving chambers in which the feeding worms 24 rotate. Each worm, therefore, begins to advance the material lengthwise of the shaft and to introduce it into the tubular barrel 28, where it is further advanced by the interrupted screw flights 24*a*, 24*b*. Discharge of the solid material from the barrel 28, however, is impeded by the choke 31 in an amount depending to a great extent upon the load imposed by the counterweight 38, according to its position. As the result of the resistance to discharge, the advancing solid material becomes more and more dense and, indeed, in the region of the choke becomes a dense solid plug which substantially completely blocks or prevents any escape of liquid past the choke. The knives or stops 27 serve to prevent rotation, bodily, of the solid material with the screw, while the interrupted screw flights, whose leading edges are beveled off or sharpened to knige edge form, as shown at 64, Fig. 4, cut the solid material, to facilitate their entrance into it, and cause it to move forward without rotation, rotation being further prevented, beyond the last screw flight, by the longitudinal ribs 29 before referred to.

The net result of the screw mechanism described, is to provide continual discharge of solid material from the barrel of each screw, past its choke, into the discharge chamber or chambers 30 and thence to the outlet 43, without any possibility of loss or escape of solvent liquid.

In addition, it will be observed that the solvent liquid is supplied, by way of the supply pipe 60, the channel in tube 58, chamber 54 and opening 62, to the supply chamber in which rotates the screw 24. Thus, the solvent liquid is supplied to and mixed with the solid material as close to the final outlet for the solid material as is possible, insuring maximum leaching contact of liquid with solid and insuring high efficiency in extraction. Further, the shielded or guarded openings 62, of which any number may be employed for each screw, together with the hopper-shaped

guards 63 adjacent thereto, serve as traps to collect and deliver to the chambers 22 any solid material which otherwise might escape into chamber 54. Of course, liquid flow through chamber 54 and around the lower end of shaft 25 assists materially in maintaining its bearing surfaces clean and free from deposits of solid material thereon.

By removing plate 59 open access is provided to chamber 54 not only for cleaning it out, but also for purposes of inspection of the lower end of the shaft and the bearing in which it rotates, if that is desirable.

The construction described is of relatively simple form but is durable and efficient in operation.

Other advantages of the invention will be apparent to those skilled in the art.

What I claim is:

Extraction apparatus of the character described comprising an extracting tower having a bottom floor provided with a pair of parallel elongated openings spaced from each other, a trough-shaped feed casing below each opening and having a chamber communicating therewith, an imperforate cylindrical barrel communicating with the chamber of each feed casing, a shaft extending through each casing and barrel and provided with a multiple flight feed screw having a plurality of spaced worm flights thereon within said barrel, stop means in the barrel extending into the space between said flights, a yieldable choke device for each screw at the outlet end of its barrel, means for simultaneously rotating said shafts, a series of peripherally spaced, parallel ribs extending longitudinally of the inner wall of the barrel between said outlet end and the nearest said screw flight, each said rib projecting radially inwardly part way towards the barrel axis, the space between said trough-shaped feed casings being enclosed by means of a bottom transverse partition to provide a solvent liquid distributing chamber, the adjacent walls of the

two feed casings being each provided with an opening constituting a liquid inlet port to a respective feed casing, liquid supply connecting means in said transverse partition whereby solvent liquid may be introduced to said distributing chamber and thence through a respective port to each said feed casing, said outlet ports being each in registry with a screw-flight-containing portion of a respective casing whereby liquid entering through each said port passes through settled solid material being discharged through said casings by said screw flights, a vertical shaft in said tower having a lower end rotatably supported in the aforesaid bottom wall of said tower and having a part extending into said distributing chamber, shielding means for the said inlet ports consisting of a wall portion inclined inwardly and upwardly from the bottom edge of each said port whereby to direct the incoming liquid upwardly against the bottom end of said shaft portion before said liquid leaves said distributing chamber through each said port, means for simultaneously rotating each said shaft, said distributing chamber having a wall portion removable to afford access to the interior of said chamber.

CARL WILLIAM ZIES.

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