June 2, 1936. O. S. ANDERSON ET AL 2,042,979

DRIER

Filed April 18, 1934 7 Sheets-Sheet 1

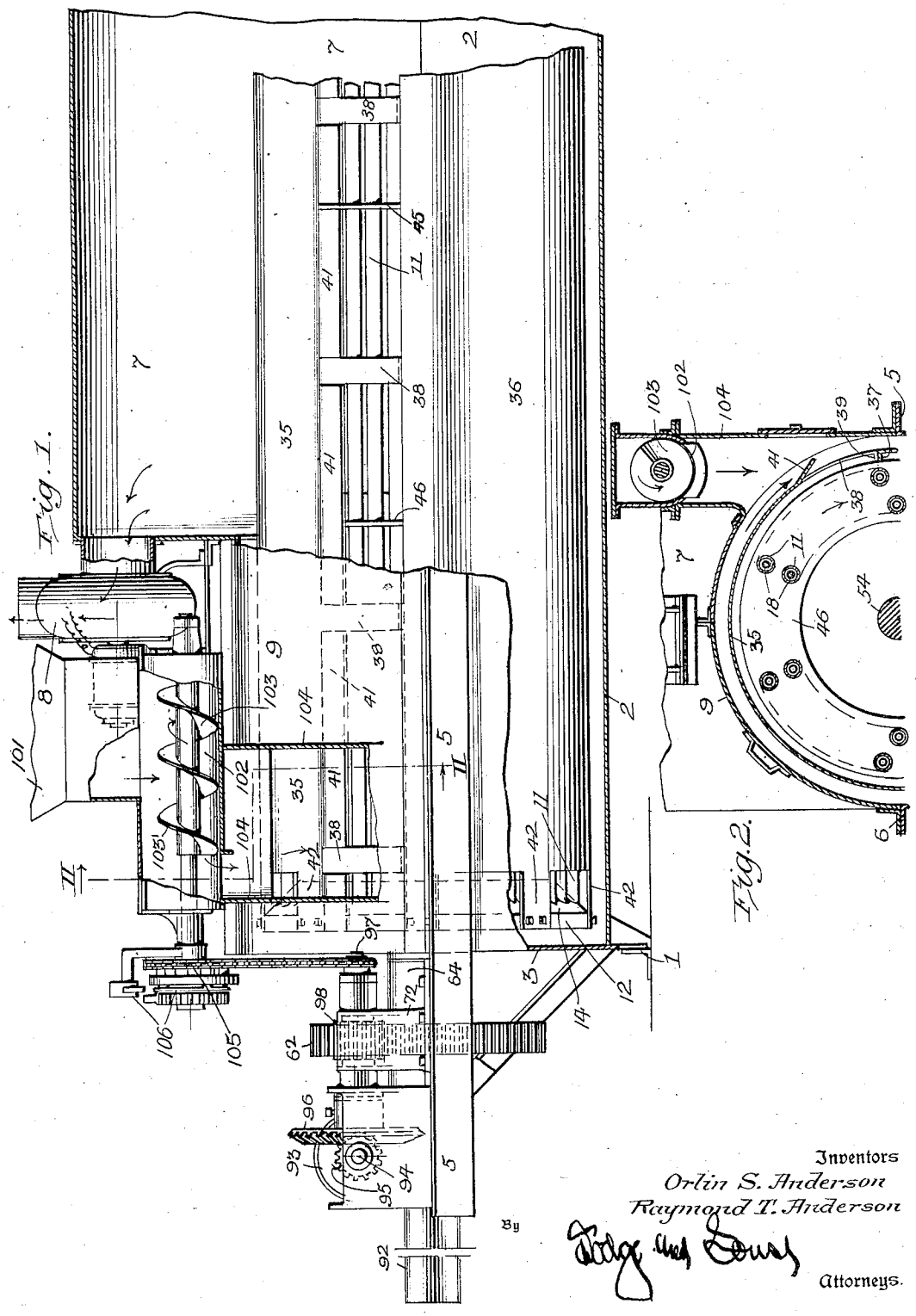


Fig. 1.

Fig. 2.

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DRIER

Filed April 18, 1934 7 Sheets-Sheet 2

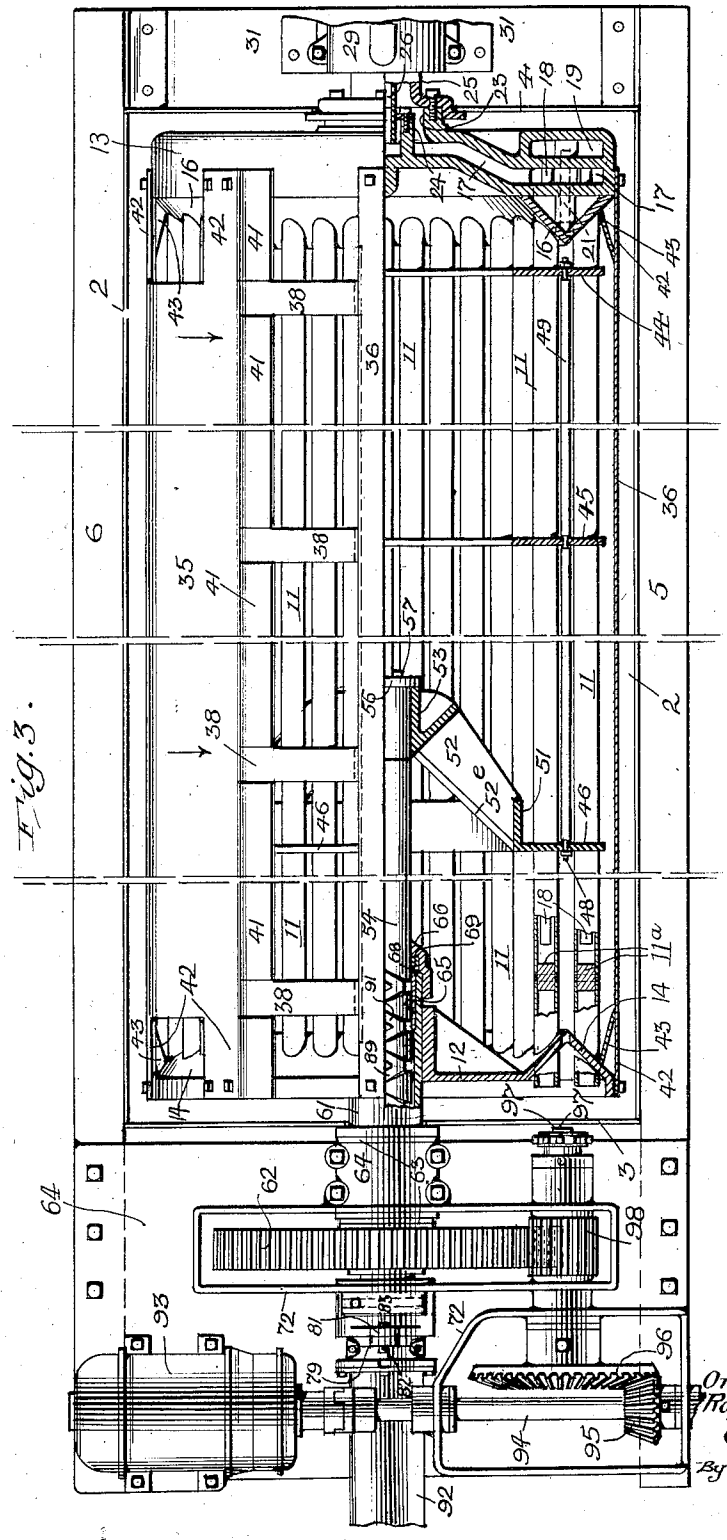


Fig. 3.

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DRIER

Filed April 18, 1934 7 Sheets-Sheet 3

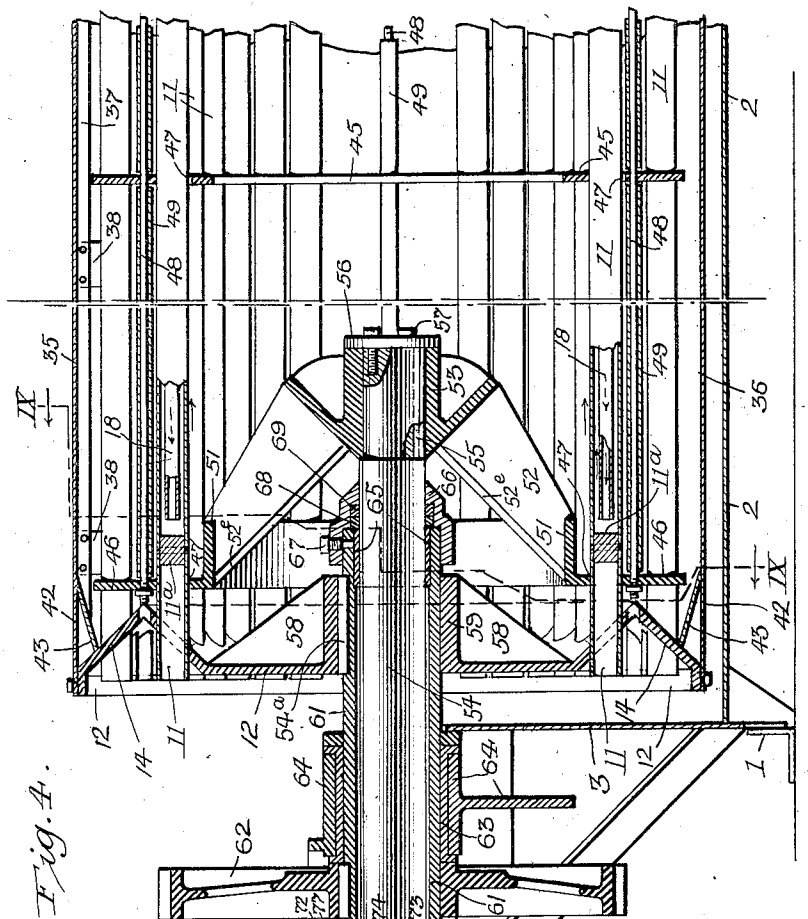


Fig. 4.

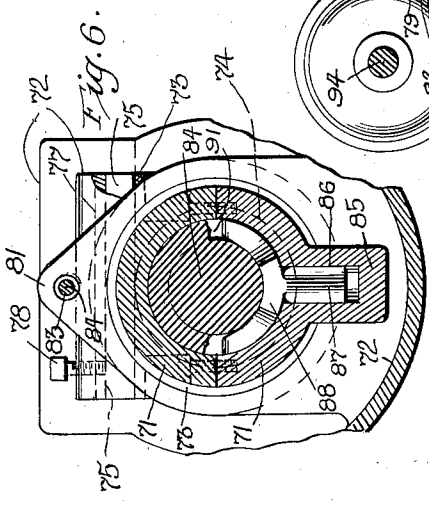


Fig. 6.

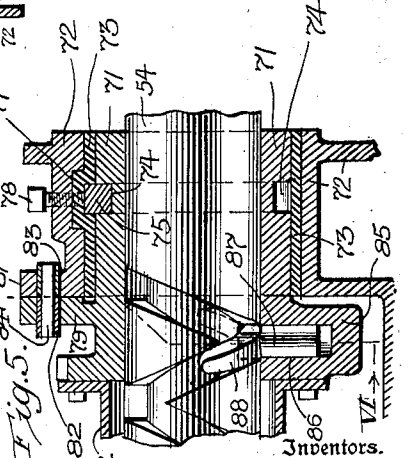


Fig. 5.

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June 2, 1936. O. S. ANDERSON ET AL 2,042,979

DRIER

Filed April 18, 1934 - 7 Sheets-Sheet 4

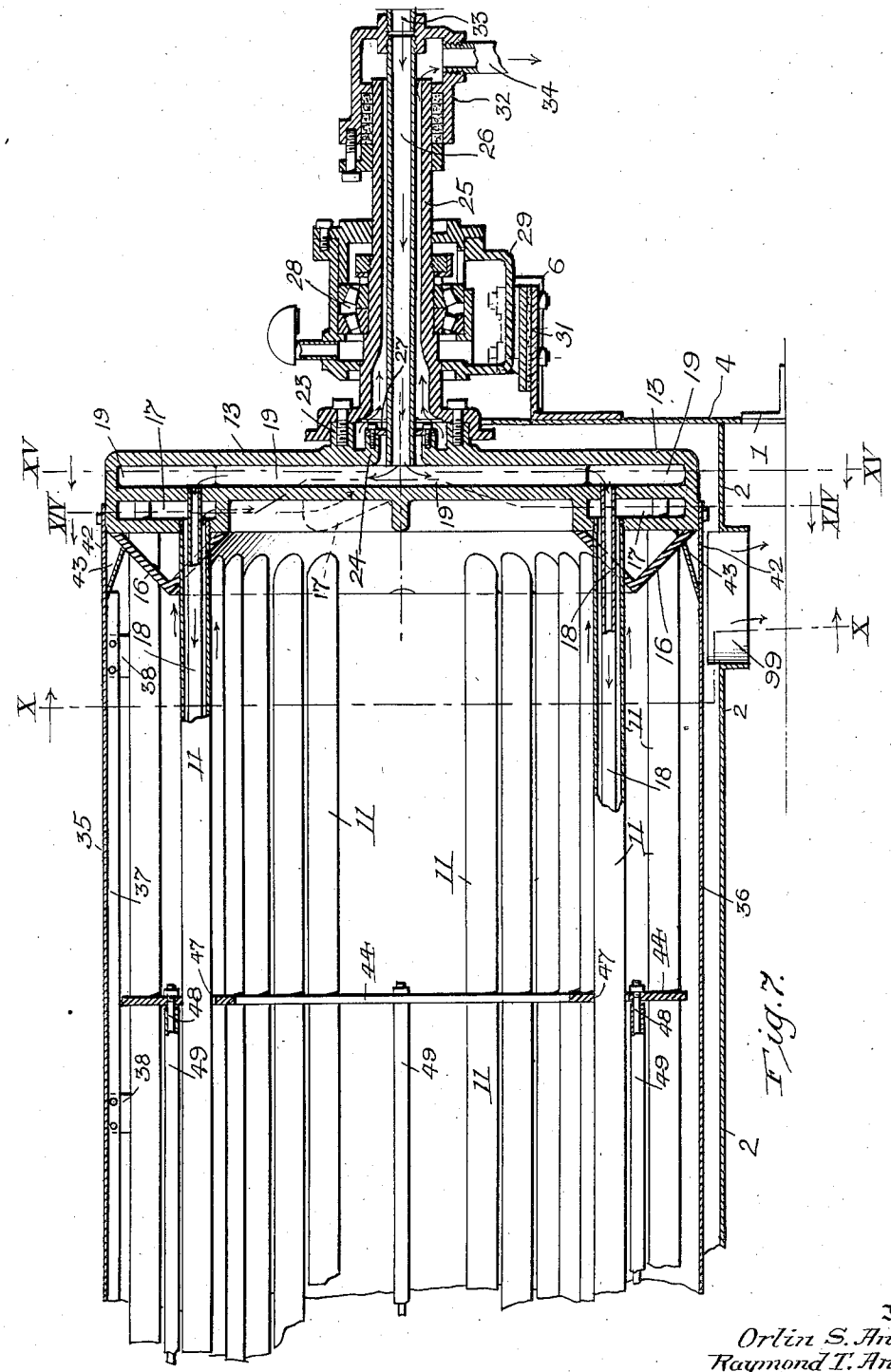


Fig. 7.

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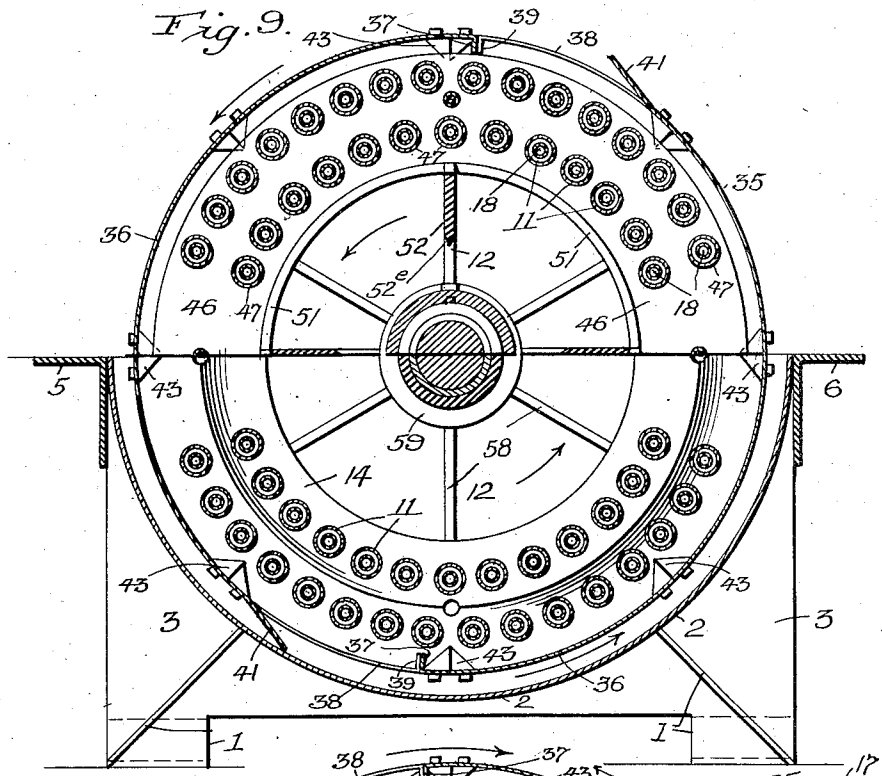
Attorneys.

June 2, 1936. O. S. ANDERSON ET AL 2,042,979

DRIER

Filed April 18, 1934 7 Sheets-Sheet 5

Fig. 9.



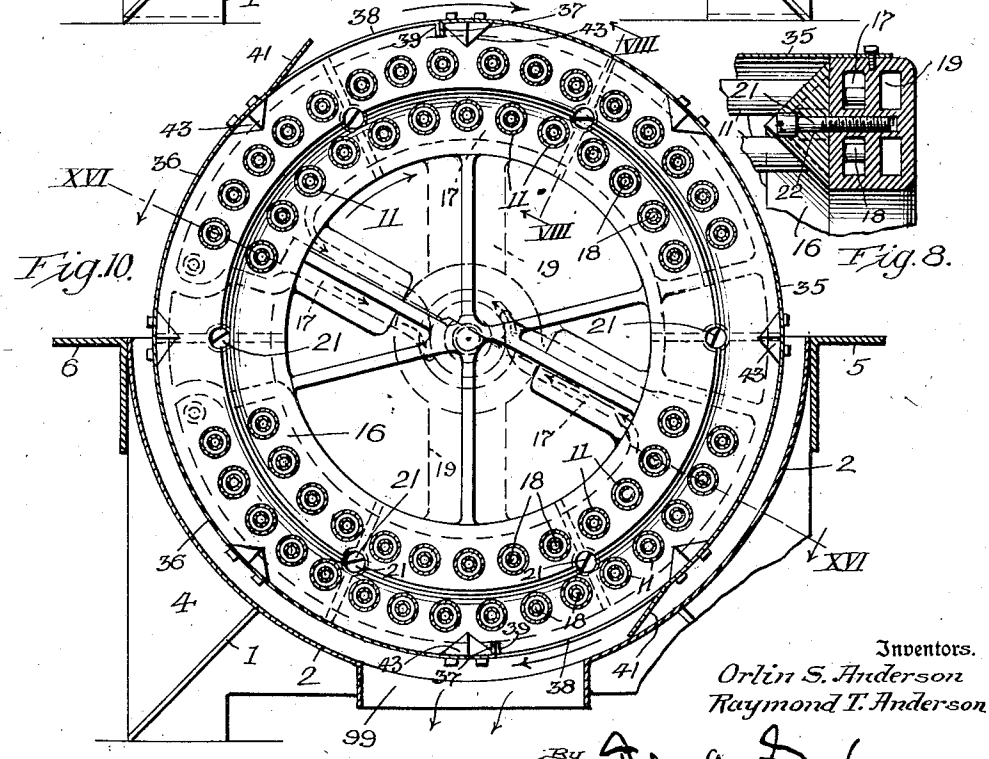


Fig. 10.

Fig. 8.

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June 2, 1936. O. S. ANDERSON ET AL 2,042,979

DRIER

Filed April 18, 1934 7 Sheets-Sheet 6

Fig. 11.

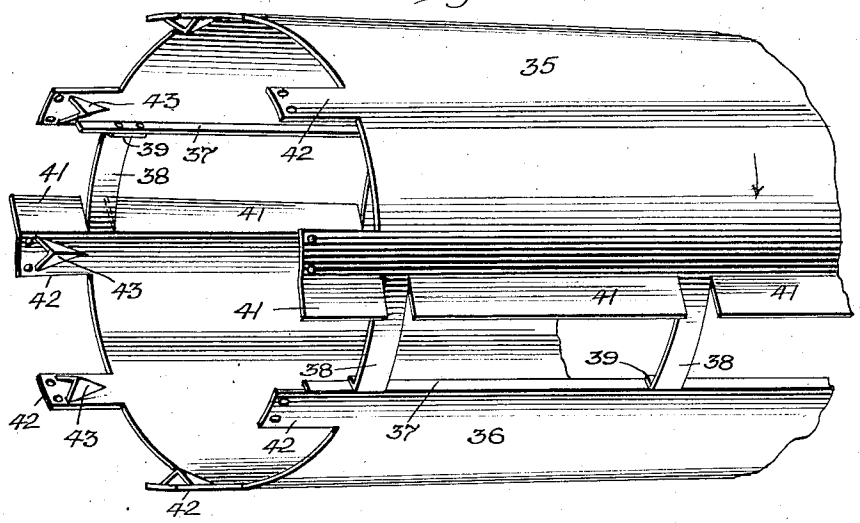
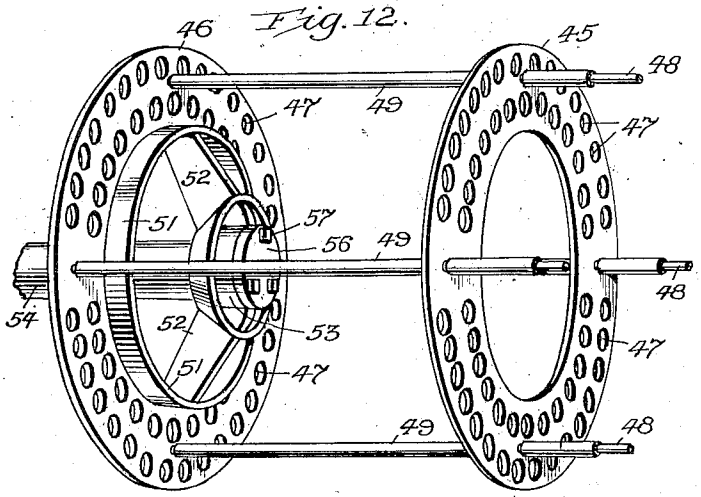


Fig. 12.



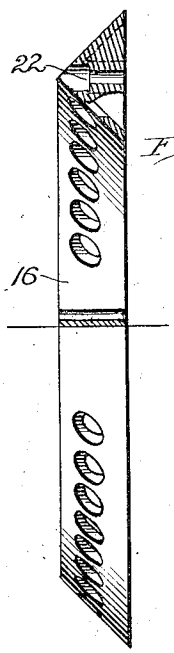


Fig. 13.

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June 2, 1936. O. S. ANDERSON ET AL 2,042,979

DRIER

Filed April 18, 1934 7 Sheets-Sheet 7

Fig. 14.

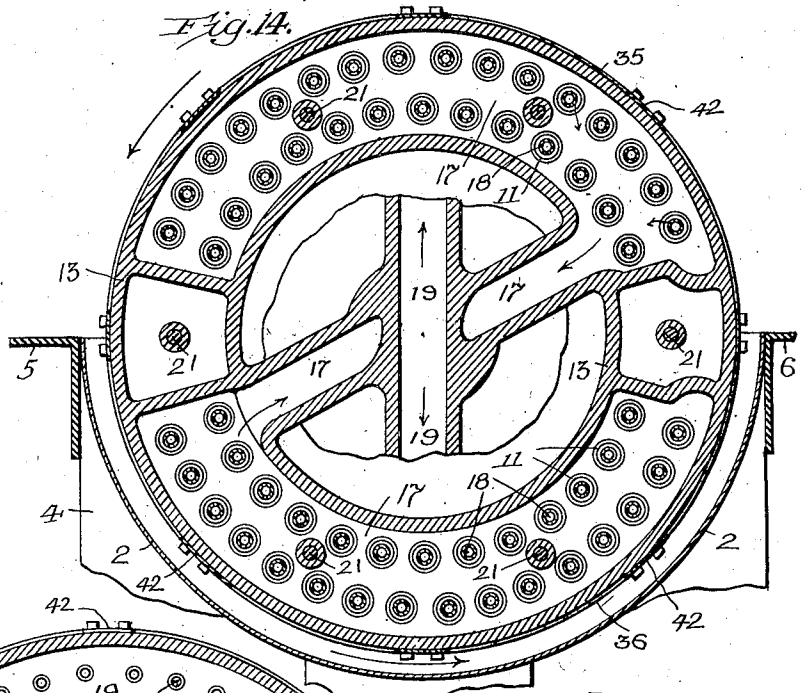


Fig. 15.

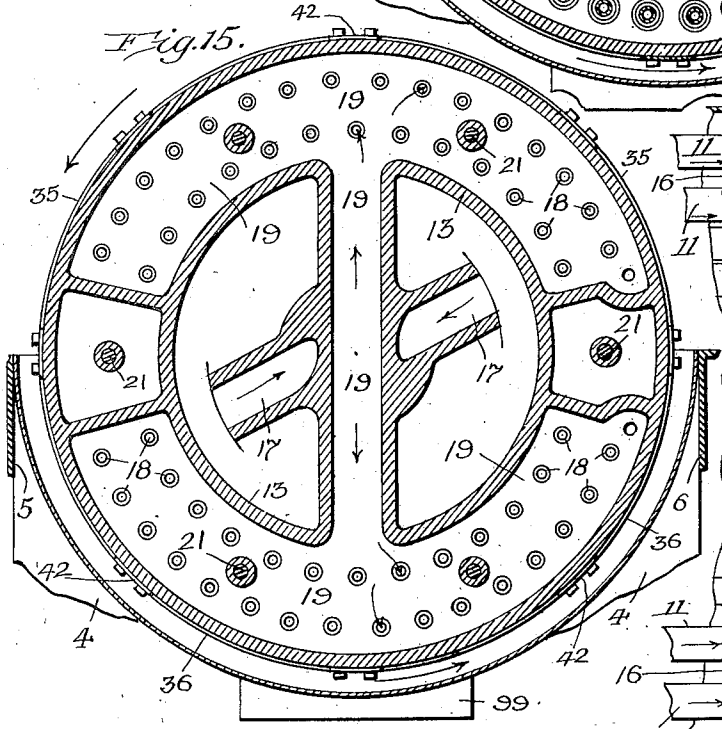
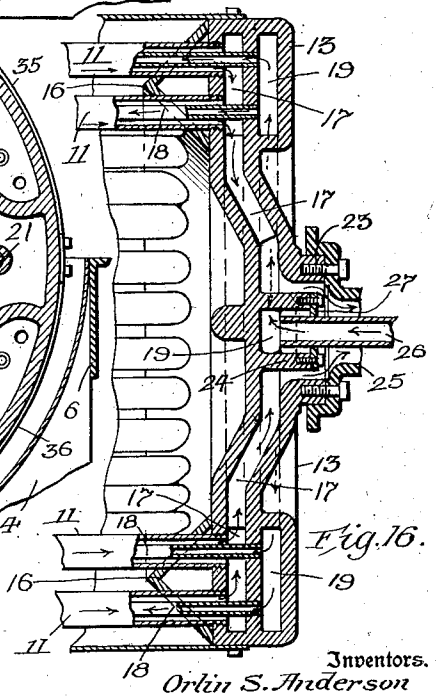


Fig. 16.



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Patented June 2, 1936

2,042,979

UNITED STATES PATENT OFFICE

2,042,979

DRIER

Orlin S. Anderson, Cleveland, and Raymond Tuttle Anderson, Berea, Ohio, assignors to The V. D. Anderson Company, Cleveland, Ohio, a corporation of Ohio

Application April 18, 1934, Serial No. 721,226

33 Claims. (Cl. 257—92)

This invention relates to driers, and pertains more particularly to that type wherein the material to be treated is introduced at or adjacent one end of the structure and travels toward a discharge opening at the other end, the material during its movement being cascaded over a cage or series of heated pipes carried by a rotary structure located within a stationary outer casing. Mounted upon and movable over the pipes are scrapers which act to remove any accumulated material from the pipes, and the manner of connecting and actuating the scrapers forms one feature of the invention.

In driers of the general type above described, particularly where the material is adherent, the scraper elements, or certain of them, have a tendency to compact the material against the ends or heads which support the pipes. One of the objects of the present invention is to provide means whereby this compaction is precluded, or, if it inheres, the compacted mass is disrupted so that the resultant pieces or particles may be readily picked up and cascaded.

With this and other advantages of structure and operation in view, reference is had to the annexed drawings, wherein:

Figure 1 is a side elevation, with parts broken away, and the cover and pan in section, of the forward end of the drier, and illustrative more particularly of the variable feed mechanism, the driving means, and the exhauster or suction fan;

Fig. 2, a transverse vertical sectional view taken on the line II—II of Fig. 1;

Fig. 3, a plan view, partly in section, with the cover or enclosing shell removed;

Fig. 4, a vertical sectional view of the intake end of the machine, illustrating more particularly the driving means for rotating the cascading drum and the heating pipes located therein, as well as moving the scrapers to and fro over the pipes;

Fig. 5, a sectional view on a somewhat enlarged scale, illustrative of certain details of the mechanism employed for driving the scrapers back and forth;

Fig. 6, a detail sectional view on the line VI—VI of Fig. 5;

Fig. 7, a vertical sectional view of the discharge end of the drier, disclosing the outlet for dried material and the means whereby the heating medium is caused to flow through the pipe elements;

Fig. 8, a detail sectional view on the line VIII—VIII of Fig. 10, of the annular spreader for the compacted material at the discharge end of the apparatus and illustrative more particularly of its cross-section form and the manner in which it is secured to the adjacent head;

Fig. 9, a transverse vertical sectional view, taken on line IX—IX of Fig. 4, showing the pan, the drum and allied parts looking toward the intake end of the drier;

Fig. 10, a similar view looking toward the discharge end and taken on the line X—X of Fig. 7;

Fig. 11, a perspective view of the drum body;

Fig. 12, a like view illustrating two of the pipe scraper elements, showing the manner in which they are connected and also the attachment of the forward one (at left of figure) to the shaft employed to reciprocate the scrapers;

Fig. 13, a sectional elevation of the annular cone-shaped member employed to disrupt the compacted material at the discharge end of the drier;

Figs. 14 and 15, transverse vertical sectional views taken on the lines XIV—XIV and XV—XV, respectively, of Fig. 7 and illustrating more particularly the passages for the flow of the heating medium through one of the drum and pipe-supporting heads; and

Fig. 16, a longitudinal sectional view taken on the line XVI—XVI of Fig. 10, and depicting the passages just referred to, together with the pipes.

In the drawings, 1 denotes a base or frame upon which is mounted and secured a bottom 2 semi-circular in cross section and closed by ends 3 and 4, thus in effect forming a semi-circular trough.

Secured to the base 1 and extending along each of the upper longitudinal edges of the trough are angle irons 5 and 6, respectively, with one element extending outwardly and forming a seat for a cover 7, Fig. 1. Said cover extends throughout substantially two-thirds of the length of the structure and stands well away at its upper portion from the drying means shortly to be described, so that the vapor driven off as the result of the drying action can readily rise away from the material and thus preclude a cooking action in the drier. An exhaust fan 8 is connected to the upper portion of cover 7 and draws off any vapors. A second and lower cover 9, Figs. 1 and 2, is employed to enclose the forward or intake end of the machine.

The heating pipes with which the material to be dried comes into contact, are denoted throughout by 11 and are associated with and serve to rotate the two heads 12 and 13 through means later described. Said heads are located at opposite ends of the drying chamber (members 2, 3, 4, 7 and 9).

The construction of the head 12 is such that the pipes 11 extend through openings formed therein, or, more specifically, through openings formed in the inclined faces of the annular material spreader 14, which is cone-shape in cross section, (see more particularly Figs. 3 and 4), and which, in the form shown, is integral with the head 12. In the instant case, the pipes are shown as provided with blocks or closures 11a inward of the cone-shape spreader or deflector 14, which blocks are permanently held within the pipe. This is brought about by abutting adjacent ends of pipe sections and welding the same together, and to a block 11a which projects into the adjacent ends of the pipe sections. See Figs. 3 and 4.

By leaving the outer ends of the pipes open, air may freely enter the same and maintain those portions of the pipes which extend from the block outwardly through the deflector in a relatively cool condition. At the opposite end, the pipes extend through openings formed in a second cone-shape deflector or spreader 16 (see Figs. 7, 8 and 13), and are threaded into openings formed in the inner face of an annular exhaust chamber 17 formed upon or in the head 13. See more particularly Fig. 16.

A series of smaller diameter pipes 18 is connected with a supply chamber 19, Fig. 7, formed in head 13 extending into and through pipes 11, the opposite ends of the pipes 18 terminating short of the blocks 11a (Figs. 3 and 4). Said pipes are preferably arranged in two spaced annular series, the pipes in each series being spaced from each other as most clearly indicated in Fig. 14.

The annular spreader 16, (see Figs. 7, 8, 13 and 16), is formed separate from head 13 and is secured to the inner face thereof by machine screws 21 passing through openings 22 and into threaded openings formed in the head. Head 13 is formed on its outer face with two concentric outwardly extending collars or annular flanges 23 and 24, to the former of which is secured an elongated and substantially tubular member 25. At its inner end, said member is so contoured as to be in communication with exhaust chamber 17 through the space between the collars.

A steam supply pipe 26 extends through member 25 in spaced relation thereto and is in direct communication with the supply chamber 19. A washer 27 secured to the outer end of collar 24 encircles pipe 26 and shuts off communication at that point between the inlet and exhaust passages. As will be best seen upon reference to Figs. 14, 15 and 16, the head casting 13 is so cored as to ensure proper flow of the heating medium.

Member 25 forms one of the axles or supports for the rotatable elements of the drier, (see Fig. 7). It extends through bearings denoted generally by 28 mounted and secured within a box-like housing 29, adjustably carried for alignment with the bearing elements at the opposite end of the mechanism by a rigid bracket structure 31. At its outer end, member 25 carries a stuffing box 32 into which pipe 26 is secured in communication with a steam supply 33. An exhaust pipe 34 also opens into the chambered portion of the box. Any suitable form of mounting for the head 13 may, of course, be employed with other features of the invention.

Heads 12 and 13 are secured to each other in rigid spaced relation by a drum, preferably of the form shown in detail in Fig. 11. It may be said to be formed of two metallic sheets 35 and 36, each of semi-circular form. One edge of each section is provided with an inwardly projecting flange 37, while the opposite edge is cut away to produce a plurality of arms 38, the ends whereof are bent inwardly as at 39, said ends overlying the flange of the adjacent flange to which they are riveted or otherwise secured.

To each side of each of the arms, the metal on the downgoing side or edge of each of the elements 35 and 36 is bent outwardly, forming scoops or lifters 41 which act to gather the material from the lower portion of the drier and to introduce it into the drum through the longitudinally disposed openings formed to each side of the straps. The drum at each end, see Figs. 3 and 11, is formed with a series of longitudinally extending arms or fingers 42, which overlie the heads 12 and 13 and to which they are rigidly secured.

As the drum is rotated, the material thus picked up is cascaded onto the reel of heated pipe within the drum, where it is not only heated but to a great degree broken up should it be in masses. As will be seen upon reference to Figs. 9 and 10, the material as it drops will pass out through the then lowermost opening and be again picked up by the next moving scoop or element 41.

To the inner face of each arm, and so positioned that they abut the respective annular spreaders 14 and 16, are wedge elements 43, V-shaped in cross-section and inclined to the inner surface of the drum. In other words, each of these elements presents an exposed inclined edge which slants upwardly toward the outer end of the drum or the adjacent annular spreaders, and two side faces which latter diverge toward the end of the drum at which they are located. These wedge-shaped elements likewise act as disrupters or spreaders upon the material as the same is or may be compacted through the action of the pipe scrapers. Said scrapers, see more particularly Figs. 3 and 12, may be said to comprise a series of spaced plate-like members, annular in outline.

Three of such members are shown and are numbered 44, 45 and 46, respectively, and each is provided with openings as 47 through which the heating pipes 11 extend. These scrapers are not rigidly affixed to each other but are connected somewhat loosely by rods 48 having nuts on their ends with spacing tubes 49 placed on the rods and intermediate adjacent plates. This manner of connection permits the scrapers to accommodate themselves to any moderate degree of sag of the pipes which may occur after extended use.

The length of the spacing tubes is made slightly shorter in the aggregate than the overall length of the rods 48 between the nuts secured upon the outer ends thereof, so as to provide a degree of lost motion in the movement of the scrapers back and forth. Being suspended loosely upon the rods, the scraper plates take different bearing positions on the pipes during the revolution of the same, thus securing a scraping of pipes on all sides as the scrapers do not reach the same position on the pipes when a certain pipe is at a certain part of the arc of its travel around the center of the drier. Thus the weight of a loosely controlled scraper falls against all sides of all pipes eventually in a number of passes back and forth over such pipes. In this manner, the pipes are kept free of accumulated material.

The reciprocation of the scraper elements and

the rotation of the drum, including the heads and the pipes, are effected through a mechanism about to be described, all of the driving parts for producing such motions being located outside of the drier proper.

Scraper element 46 is formed with an inwardly projecting annular flange 51, and extending inwardly therefrom are a series of spokes 52 which terminate at their inner ends in a hub-like element 53. Said hub is fitted on the inner reduced end of a shaft 54, being keyed thereto as at 55. A cover plate 56 of a diameter such as to cover the shaft end as well as the adjacent end of the hub is secured in place by a plurality of cap screws 57 passing through the plate and into the shaft end. This plate, while assisting in securing the hub to the shaft, likewise provides a cover and prevents ingress of material undergoing treatment or the oil therefrom from passing in between the shaft and hub.

It is to be noted that the edge of each spoke 52 which faces toward the head 12 is beveled or brought to a sharp edge 52e, see Figs. 4 and 9. It will also be apparent upon an inspection of Fig. 4, that said edges lie parallel to the inner edge of webs 58, extending inwardly from the inner face of the head 12 and terminating in the centrally disposed cylindrical hub-like element 59.

Extending through the hub and surrounding the adjacent portion of shaft 54 and in spaced relation thereto is an elongated hollow shaft or sleeve 61, the same being keyed at 54a to head 12 and likewise to a gear 62. The hollow shaft adjacent gear 62 is supported in a bearing denoted generally by 63, secured to a fixed member 64 of the machine frame, (see more particularly Figs. 3 and 4).

To provide a support for the shaft 54 adjacent the head 12, the innermost end of the hollow shaft 61 is cut out to increase its internal diameter, forming a seat for a bearing sleeve 65. Collar 66 is mounted on the outer end of the hollow shaft and is secured thereon by an element 67. Mounted within the collar or cap-piece 66 are two contracting rings 68 and 69, the former bearing directly against the adjacent end of the sleeve 65 and serving to hold the same in its proper position. Furthermore, the rings preclude passage of oil along the shaft in either direction. The construction as above set forth, ensures a proper support for the intake end of the drum and its allied parts, while still permitting free movement of the shaft 54 to move the scrapers as will now be described.

Outward of gear 62 the shaft extends through a bearing 71, composed of upper and lower sections supported by a fixed frame element 72 with an interposed babbitt bearing 73.

Member 71 is formed with an annular groove 74 exteriorly thereof and a transversely extending key or bar 75 is seated in the uppermost portion of the groove, the key, (see Figs. 5 and 6), likewise extending through the seat formed in the inner face of the babbitt at such point, which babbitt in turn extends upwardly into a transversely extending opening or recess 77 formed in the upper portion of the frame element 72. A set screw 78 extends through frame element 72, and at its lower end contacts key 75 preferably adjacent one end thereof, thus locking the key against any movement under normal operation of the machine.

The upper portion of bearing 71 is provided with an extension 79 and frame member 72 is provided with a similar extension 81 and aligning openings are formed therein. Mounted in each of these elements is a tubular member 82 and 83, respectively, preferably formed of hard steel and extending through which is a shear pin 84 produced from a softer steel. This pin holds the parts in the position shown under normal operation of the machine, but should the scrapers become wedged or prevented from moving through their normal paths, the member 71 will be caused to rotate, thereby shearing pin 84 and thus disconnecting the parts and permitting the member 71 to rotate so that reciprocation of shaft 54, which is normally effected through means shortly to be described, is precluded.

By placing set screw 78 toward one end of key 75, the part 71 is not held against rotation when the shear pin is disrupted by abnormal conditions, as might be the case were the screw located directly over the center of the bearing and shaft. This latter arrangement has been found to have a tendency to clamp the parts and to prevent rotation of the member 71 when pin 84 is broken. The babbitt is designed to stand a compression load of approximately 3000 lbs. Said member 71 is provided with an integral projection 85 in which there is formed a vertically disposed socket 86, designed to receive the stem 87 of a follower or shoe 88. Member 71, with which the follower 88 is associated, may be termed the retainer therefor.

Follower 88 is designed to coact with a cylindrical cam formed upon the outer portion of shaft 54, there being present right and left hand spiral grooves 89 and 91, the grooves passing into each other at their ends.

A housing 92 is employed to enclose the shaft, as seen in Fig. 4, the same being secured to element 71. Any suitable means may be employed to impart motion to the shaft, and in the instant case an electric motor 93 secured to member 64 in any suitable manner is shown.

A shaft 94 driven by the motor carries a bevel pinion 95 which meshes with the bevel gear 96 secured to a shaft 97, which latter lies parallel to shaft 54. Said shaft 97 carries a pinion 98 which in turn meshes with the gear 62 keyed to the elongated sleeve or hollow driving shaft 61. Said shaft is likewise keyed to the head 12 through a key 54a, and upon rotation of the shaft through the gearing above described, rotary motion is imparted to the heads 12 and 13, the drum 35, the cage of heating pipes, and, of necessity, the scrapers which are mounted upon said pipes. Thus it will be seen that all of the movable elements within the drying chamber are driven from the shaft 61, and inasmuch as the hub 53 is keyed to shaft 54, as at 55, Fig. 4, rotary motion is likewise imparted to said shaft 54.

As will be readily appreciated, all of the mechanism for actuating the shaft 54 is without the drier proper and, consequently, is not subjected to heat.

As above indicated, the material to be treated is introduced into the head end of the drier or adjacent head 12, and is discharged at the opposite end as through an opening 99, Figs. 7 and 10. The material to be treated may be directly introduced if so desired and the rate of passage of the material through the drier will be controlled by the rate of feed and likewise by the inclination of the bottom 2 toward the discharge end; either or both.

In the instant case, a feeding device, adjustable as to rate of feed is shown, see Fig. 1. It may be said to comprise a hopper 101 which

discharges into trough **102** in which is mounted a feed screw or worm **103** which underlies the hopper and terminates at the upper end of a chute **104**, the lower end whereof stands in a tangential relation to the drum on the downgoing side thereof, see Fig. 2.

The feed screw is actuated by a sprocket chain deriving its motion from shaft **97**, the chain at the upper portion passing over a sprocket **105**, associated with adjustable and variable mechanism denoted generally by **106**, to vary the rate of rotation of the feed screw or worm and consequently the amount of material introduced into the drier during any given period.

As will be seen upon reference to Fig. 1, the variable feed mechanism is such that it may be readily removed and a large opening left at the upper or intake end of the chute. This enables the introduction of material into the drier directly from an attrition mill or other pre-treating mechanism.

It is thought that the operation of the machine will be clearly understood from the foregoing description, but a brief résumé will be given.

Assuming that material is introduced into the drier by the feed mechanism shown in Fig. 1, or directly from an attrition mill, it would pass downwardly onto the rotatable drum and eventually some of it will pass in through the openings in the side of the drum, assuming that one of said openings is uppermost at that time; otherwise, the material will pass to the bottom of the pan and be picked up by the blades **41** and cascaded over the heating pipes as the drum rotates.

During this operation, the scrapers are moved to and fro over the pipes, keeping the surfaces clean and free of any adherent material, which if permitted to rest thereon would cake and char, this latter assuming that the heating is sufficiently high to bring about such charring and possible burning action.

As the scrapers move to the left in Figs. 3 and 4, some of the material will be carried forward by the scraper **46** and as it nears the end of its stroke, that is when it comes within a short distance of head **12**, there will be an accumulation of material ahead of the same. This material would naturally be compressed by the scraper and prevent the scraper from reaching the end of its stroke were it not for the presence of the deflectors or disrupting elements **14**, or **14** and **43**, or **16** and **43**, as the case may be, which members serve to deflect the material inwardly and outwardly, as well as laterally, this latter by the members **43**. So, too, the sharpened edges **52e** of the spokes **52** coacting with the webs **58**, tend to cut up or further disrupt any compacted material.

In this manner, any compacted material is disrupted and drops away from the scraper, and passes into the drum or through the opening in the drum to the pan **2**. The material is not carried by the scrapers in the sense that all the material in the drier is moved at one time thereby; probably not more than 5% or 10% or thereabout of the material in the drier tends to compact at the end of the scraper travel.

On some materials which are granular and not sticky, the scraper may possibly be omitted; however, wherever the material is adherent and may be compressed and sticks together, the deflectors or disrupters are found highly efficient so that the scrapers may be operated without any stoppage or breakdown of the apparatus.

It is evident, of course, that the disrupting element at the discharge end of the machine where the material has become dried to the desired extent may be omitted in some instances, for when the material reaches this point it is no longer sticky or adherent, unless the material is sticky by nature even when moisture-free.

It may be stated that when drying material for use in presses of the type shown in Letters Patent to Anderson, No. 1,773,771, and others of like import, the material is dried below atmospheric moisture. Most driers of which we are aware are made to dry from high percentages of moisture, say 50% to 15%, down to 8% to 10% moisture, and on materials which are granular-like, such as whole corn, whole soya beans, whole barley, etc. When ground or rolled, there is produced a certain percentage of flour-like material which readily adheres to all surfaces, especially when the material contains moisture, or is damp. With the present drier, the moisture content may be reduced to below 1% to 2% moisture from products containing from 8% to 10% moisture, the materials being usually introduced in a ground or rolled condition. In drying copra, for instance, with a view of expressing the oil therefrom, it is dried to $\frac{1}{16}$% to 1% moisture from 4% to 5% moisture.

The scrapers are in these instances necessary to prevent sticking and crusting or burning of the material on the pipes, and to maintain the drier at as near maximum efficiency as possible.

In operation where steam say at 200° F. to 350° F. is used, depending upon the steam pressure employed, burning will take place if the mass of material becomes encrusted, producing charcoal in time, which when it falls off becomes admixed with the other material passing through the drier and results in a dark colored meal and a dark colored oil.

This charred material has been known to burst into flame, which is both dangerous and costly to subdue. By drying as low as we can with the present structure, we also prevent the loss of considerable protein or ammonia from the material when subjected to high pressure in a press of the Anderson type.

It may be stated that when drying materials for use in presses of the type shown in Letters Patent to Anderson, No. 1,773,771, and others of like import, the material is dried below atmospheric moisture, and the process of drawing off the moisture or vapor as fast as it is evaporated, when drying before pressing, improves the protein content of the cake or meal after it is pressed in the type of press mentioned above. By the usual process of cooking the meal preparatory to pressing in a hyraulic press, the cooking action on the material has a tendency of changing certain of the proteins into an indigestible state, while the drying process leaves the protein digestible.

The usual chemical analysis for protein does not show this difference in proteins contained in the material. However, actual feeding tests carried out by various State experimental stations have proven this to be a fact. This is clearly shown in a bulletin published by the Ohio State Agricultural Experiment Station at Wooster, Ohio, entitled "Soybeans and Soybean Oil Meal for Pigs", by W. L. Robison, Bulletin #452.

It has also been found that the casein is preserved in meals that are dried before pressing, so

that they may be used in the manufacture of casein glues. The usual cooking process on the other hand, cooks the casein so that it is not suitable to be used for glue.

Where the material is cooked at high moisture content, some protein or ammonia is driven off in the form of vapor. When, however, the material is dried at low temperatures, as low in moisture as above stated, this loss is practically eliminated when it is further processed in a tempering apparatus and press of the type above specified. The temperature of the material passing through the drier will be regulated and maintained so that the material will not reach a temperature above boiling point, and in most cases the temperature range will be approximately 150° F. The material does not stay in the apparatus for any considerable period of time, fifteen minutes being all sufficient in most cases, and varying of course with the material undergoing treatment.

As above noted, the member **7** stands well away from the drum so that the vapor can readily arise from the material and not produce a cooking action in the drier. This high domed section also prevents the exhaust fan from drawing out the fine particles of the material, because the movement of the vapor is not rapid adjacent the drum.

As will be readily appreciated from the description above given, if for any reason the movement of the scrapers should be impeded and they should become locked, the shear pin will be disrupted and the reciprocating movement of shaft **54** arrested. The shaft, however, will still continue to rotate so long as the motor **93** remains in action.

The actuating mechanism for the shaft **54** employed to reciprocate the same is relatively simple and as above noted, stands well away from the body of the drier so that it is not subjected to temperature changes.

It has been found that wet material, or material having a high moisture content, passing into the feed end of the drier, will burn upon the heating pipes between the head **12** and the nearest position that the scraper **46** may assume with reference to said head, due to the fact that it is impossible to scrape the pipes at this point. This deposit grows in a relatively short time until it eventually obstructs the scraper **46** from completing its stroke toward the head **12**, with the result that the shear pin is ruptured. When this occurs, it will readily be appreciated that the deposit which has accumulated upon the pipes, must be scraped off and another shear pin installed before the drier may be again put into operation.

By providing means whereby the outer ends of the pipes **11** may be maintained in a relatively cool condition, this caking or burning of the material is avoided. At the outlet end of the drier such caking does not take place, by reason of the fact that the moisture content of the material is so lowered before it reaches that end, that the material will not adhere to the pipes or other elements, to any considerable extent.

What is claimed is:

1. In a drier, the combination of an outer casing; means located therein for heating the material to be treated; at least one scraper movable over said heat transferring means to remove any accumulated material therefrom; and means cooperative with the scraper for disrupting any mass of material which may be compacted against said means to a greater or less degree by the scraper.

2. A structure as set forth in claim 1, wherein the casing, and the heat transferring means together with the scraper, are relatively rotatable.

3. In a drier, the combination of an outer casing; a drum mounted for rotation therein and comprising a shell and two heads connected thereto at the ends of the shell; means for heating material to be treated, said means being supported by and between said heads; at least one scraper mounted for movement over the heating means; and means located at at least one of said heads for disrupting the mass of material which may be forced thereagainst by the scraper in a more or less compacted state.

4. In a drier, the combination of a casing having a feed opening at one end and a discharge at the other; a drum mounted for rotation therein and comprising opposite heads and a shell connecting the same, said shell having openings for the passage of material into and out of the same; a cage of heating pipes extending through the drum and supported by the heads; at least one scraper mounted upon said pipes; means for moving the same along the pipes; and an annular wedge-shaped element extending into the drum from at least one of said heads.

5. A structure as set forth in claim 4, wherein there is an annular wedge-shaped member extending into the drum from the inner face of each head.

6. In a drier, the combination of a casing; a drum comprising oppositely disposed heads and a shell connecting said heads; a series of heating pipes extending through the drum and supported by said heads; at least one scraper mounted upon and movable over the pipes toward and from said heads; and a series of V-shaped material disrupting elements on the side of the drum and adjacent the inner face of at least one of the heads.

7. A structure as set forth in claim 6, wherein the head is provided on its inner face with an annular element having an inclined face against which the wider end of each of the V-shaped scrapers abuts.

8. In a drier, the combination of a shell; a drum, said parts being relatively rotatable; a cage of heating pipes extending through the drum and supported thereby; at least one scraper mounted upon and movable over the pipes; and means located at one end of the drum and acting in conjunction with the scraper as the same is moved toward said means to disrupt any material compacted thereagainst by the scraper, said means acting in different zones thereon.

9. In a drier, the combination of a casing; a drum mounted for rotation therein and comprising a shell with oppositely disposed heads; a plurality of heating pipes extending through the drum and supported by the heads; a hollow shaft extending through and connected to one of said heads; webs extending inwardly from the inner face of said head, the edges whereof incline outwardly toward the outer edge of the head; a shaft mounted for reciprocation within said hollow shaft; a scraper mounted upon the pipes for movement thereover, said scraper comprising an annular shaped member having spoke-like members extending inwardly therefrom and terminating in a hub secured to said second named shaft, said spokes inclining inwardly away from the scraper and having their forward edges beveled; and means for securing the hub upon the inner end of the shaft.

10. In a drier, the combination of an enclosing

casing; a drum mounted for rotation therein; a cage of heating pipes extending through and supported by said drum; a plurality of scrapers mounted upon and supported by the pipes, said scrapers being connected to each other by rods extending therethrough and provided with nuts upon the outer ends thereof; spacer sleeves surrounding the rods intermediate the adjacent scrapers; and means for moving said scrapers over the pipes.

11. In a drier, the combination of an enclosing casing; a drum mounted for rotation therein; a series of heating pipes extending longitudinally through and attached to the heads of the drum; scrapers mounted upon said pipes for movement thereover; a hollow shaft extending outwardly through one end of the drier and rigidly connected to the adjacent head of the drum; means for rotating said hollow shaft; a second shaft mounted, for rotation with and reciprocating movement in said hollow shaft, said second shaft being rigidly secured to that scraper adjacent the head to which the hollow shaft is secured; and means for imparting reciprocation to said second shaft, whereby the scrapers will be caused to traverse back and forth over the pipes as the drum and scrapers are rotated within the housing.

12. A structure as set forth in claim 11, wherein the reciprocating movement of the shaft which is connected to the scraper is produced by a double cylindrical cam formed upon the outer portion of the shaft which is attached to the scraper.

13. A structure as set forth in claim 12, wherein the scraper adjacent the head end of the drier is carried by an element secured to the inner end of shaft ad rotatable with said shaft.

14. In a drier, the combination of a drum; a casing surrounding the same; a driving shaft secured to one end of the drum; heating means extending through and carried by the drum; scraping means cooperating with said heating means, said scraping means being mounted upon and movable over said heating means; a second shaft connected to said scraping means for moving the latter, said shaft extending outwardly of one end of the drier; a double cylindrical cam formed upon the outer portion of said shaft; a follower mounted in a normally fixed element, said follower extending into the cam grooves and effecting reciprocation of the shaft upon rotation of the latter; and a shear pin connecting the member in which the follower is mounted to a fixed portion of the structure.

15. In a drier, the combination of a casing; a drum mounted for rotation therein, said drum being formed from a plurality of curved or arcuate sections each section having one edge inturned or flanged, a series of spaced arms extending from the opposite edge of each of said members and secured to said flanges and a plurality of scraper elements formed upon that edge from which the arms extend, said scraper elements extending outwardly from the body of the drum in an inclined direction; and a head secured to each end of the drum.

16. A structure as set forth in claim 15, wherein a plurality of arms extend outwardly from each end of the drum-like member and are secured directly to the head elements.

17. A structure as set forth in claim 15, wherein the drum is provided at each end with a plurality of outwardly extending arms secured to the adjacent heads and each of said arms upon its inner face is provided with a V-shaped or wedge-like element extending inwardly toward the axis of the drum, the wedge increasing in height toward the outer end of the arm.

18. In a drier, the combination of a fixed casing; a drum mounted for rotation therein, said drum comprising a substantially cylindrical body and heads at the opposite ends thereof which are secured thereto; a series of heating pipes extending through the drum and secured at their opposite ends to the heads; means for introducing heating medium into said pipes; a plurality of scrapers mounted upon and reciprocable over said pipes; means for securing said scrapers in spaced relation; means for rotating the drum; and means for imparting a reciprocatory motion to the scrapers.

19. In a drier, the combination of a casing; a drum mounted for rotation therein; a series of pipes connected at their outer ends to the opposite heads of said drum; means connected to one of said heads for rotating the latter, and thereby rotating the drum and pipes; means for introducing fluid heating medium into said pipes; and means for imparting reciprocatory movement to the scrapers back and forth over the pipes.

20. In a drier, the combination of a casing; a drum mounted for rotation therein, said drum comprising a shell and oppositely disposed heads at the ends thereof, that head at the intake end at least having an element extending inwardly into the body of the shell; a plurality of pipes secured to the opposite heads, said pipes at the infeed end of the drier being open at their ends and stopped off inwardly of the inwardly extending element formed upon the head; and a scraper for the pipes, said scraper acting with the inwardly extending element to disrupt any compacted material.

21. In a drier, the combination of a casing; a heating drum for the material to be dried mounted within said casing; heating means located therein; a reciprocating scraper movable over the heating means to prevent accumulation of material thereon; and means located within, associated with and projecting into the drum at least at one end thereof, said means coacting with the scraper to disrupt any compacted material moved toward said last named means by the scraper.

22. A drier as set forth in claim 21, wherein disrupting means is provided at each end of the drum and cooperates with the scraping means.

23. In a drier, the combination of a drum; means for heating the same; a casing for the drier, the upper portion whereof at least at one end of the heating means is elevated to an appreciable extent above the heating means; and an off-take leading from said elevated portion, whereby vapors resulting from the drying action readily arise and cooking action within the drier is thereby precluded.

24. In a drier, the combination of an enclosing casing; a drum mounted for rotation therein; a cage of heating pipes extending through and supported by the heads of said drum; a plurality of scrapers mounted upon and loosely supported by said pipes, said scrapers being connected to each other by rods extending therethrough with spacer sleeves surrounding the rods intermediate the adjacent scrapers, the sleeves being shorter in the aggregate than the length of the rods and the thickness of the scrapers; nuts secured to the ends of the rods; and means for moving said scrapers over the pipes.

25. A structure as set forth in claim 24, wherein the openings in the scrapers through which the pipes pass are of a diameter larger than the diameter of the pipes.

26. In a drier, the combination of an enclosing casing; a drum mounted for rotation therein; a cage of heating pipes extending through and supported by said drum; a plurality of scrapers loosely mounted upon and supported by the pipes; means for securing said scrapers with reference to each other, said means being such as to admit of slight relative movement between the scrapers; and means for moving the scrapers back and forth over the pipes.

27. In a drier, the combination of a drum comprising heads and a connecting body, one of said heads being provided with inlet and outlet passages for a heating medium; and a plurality of pipes connected to said passages, said pipes being supported by the heads and the pipes at that head opposite that which is provided with the inlet and outlet openings being closed off short of the inner face of said last named head thereby preventing the passage of the heating medium to the outer portion of the pipes, whereby said outer portion is maintained in a relatively cool condition.

28. A structure as set forth in claim 27, wherein the pipes at that end remote from the head having intake and exhaust openings for the heating medium have blocks or stoppers secured therein at a point inward of the inner face of the head at such end, whereby the flow of heating medium through such end is prevented.

29. A structure as set forth in claim 27, wherein scrapers are mounted for movement over the pipes, and that head at which the pipes are closed off is provided with material disrupting means.

30. A structure as set forth in claim 1, wherein the disrupting means which cooperates with the scraper is V-shaped in cross section.

31. A structure as set forth in claim 1, wherein the disrupting means which cooperates with the scraper is annular in outline and has the form of an inverted V in cross section.

32. In a drier, the combination of an outer casing; means located therein for heating the material to be treated; at least one scraper movable over said heat transferring means to remove any accumulated material therefrom; and means located at at least one end of the drier cooperating with the scrapers for disrupting any material which may be compacted against said means, this to a greater or less degree by the scraper, said means being rotatable with the heat transferring means.

33. In a drier, the combination of an outer casing; means located therein for heating the material to be treated; at least one scraper movable over said heat transferring means to remove any accumulated material therefrom; and means located at at least one end of the drier cooperating with the scrapers for disrupting any material which may be compacted against said means, this to a greater or less degree by the scraper, said means being rotatable with the heat transferring means and being V-shaped in cross section.

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CERTIFICATE OF CORRECTION.

Patent No. 2,042,979 June 2, 1936.

ORLIN S. ANDERSON, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, first column, line 35, claim 13, for the reference numeral "12" read 11; and line 38, same claim, for "ad" read and; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of July, A. D. 1936.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.