

W. R. MACKLIND.

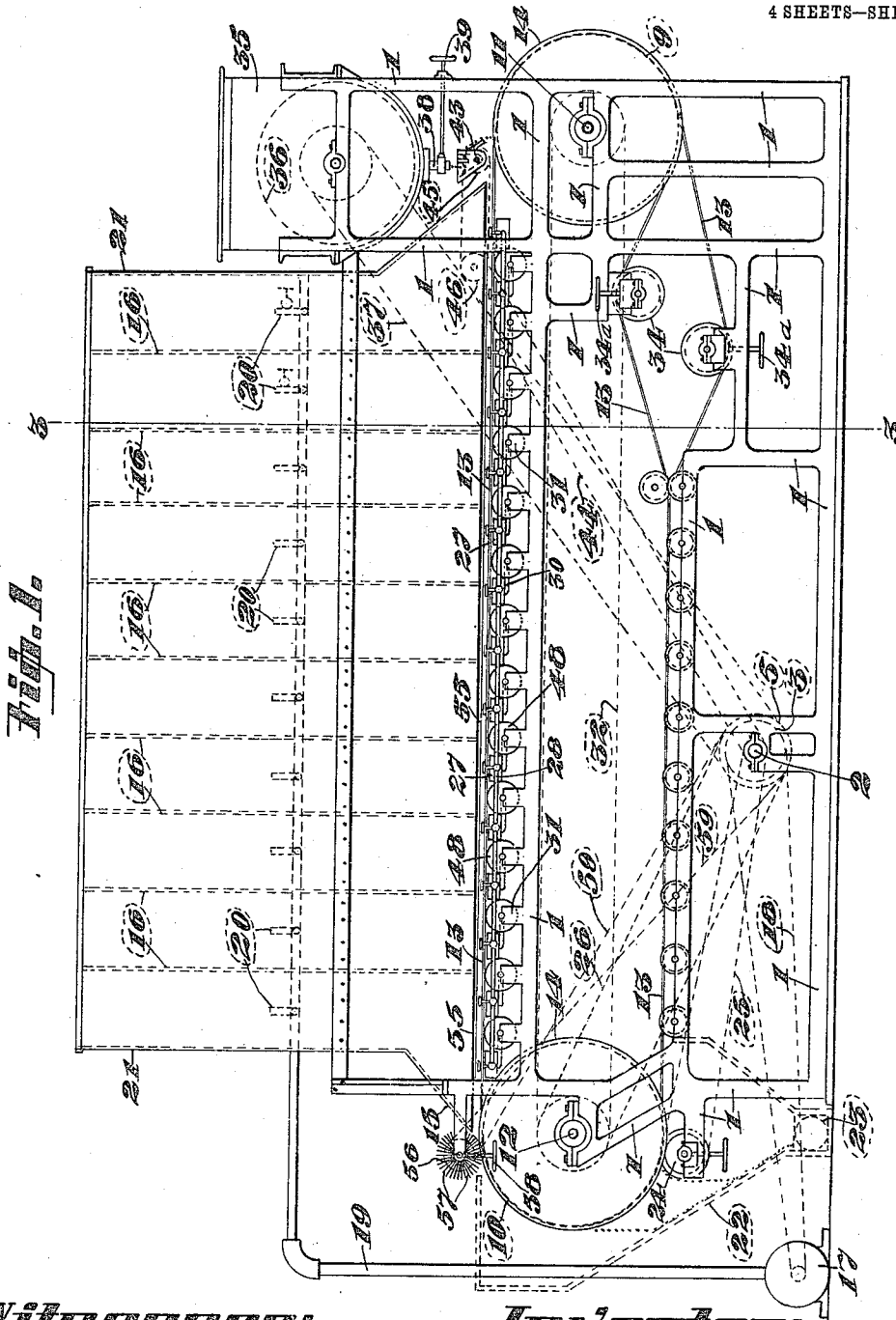
DRIER.

APPLICATION FILED NOV. 9, 1908.

949,487.

Patented Feb. 15, 1910.

4 SHEETS—SHEET 1.



Witnesses:

J. Waldo Chrisinger.
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Inventor:

William R. Macklind,
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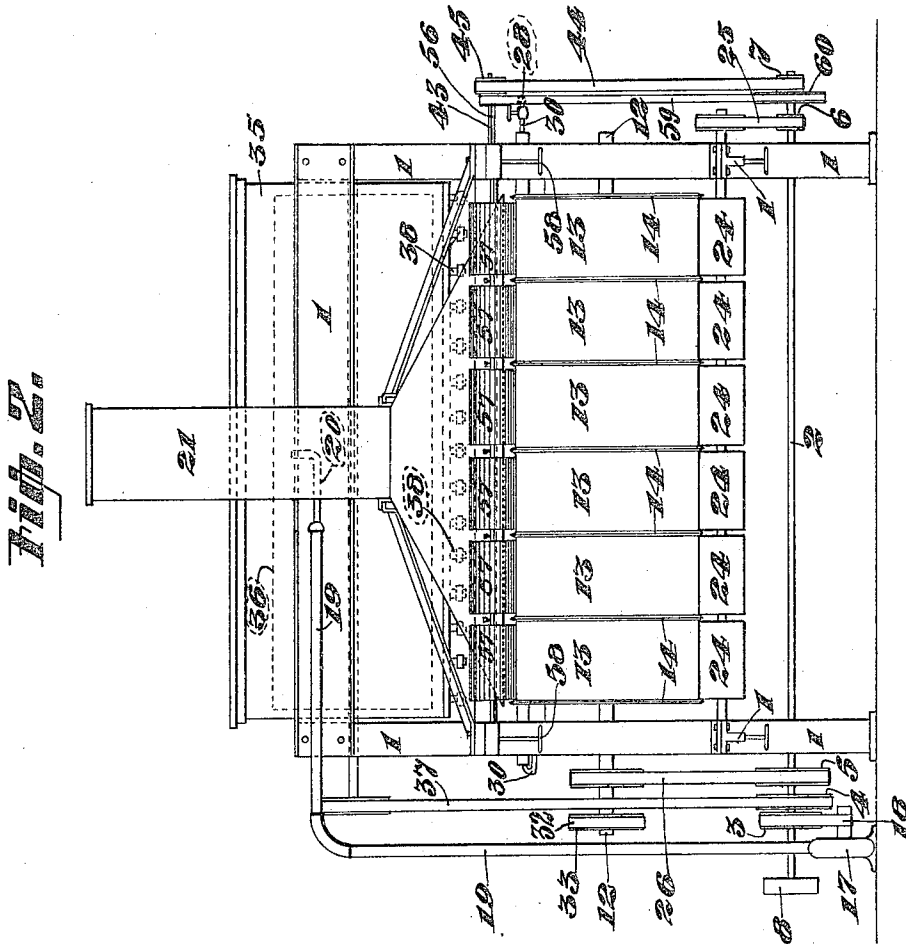
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4 SHEETS—SHEET 2.



Witnesses:

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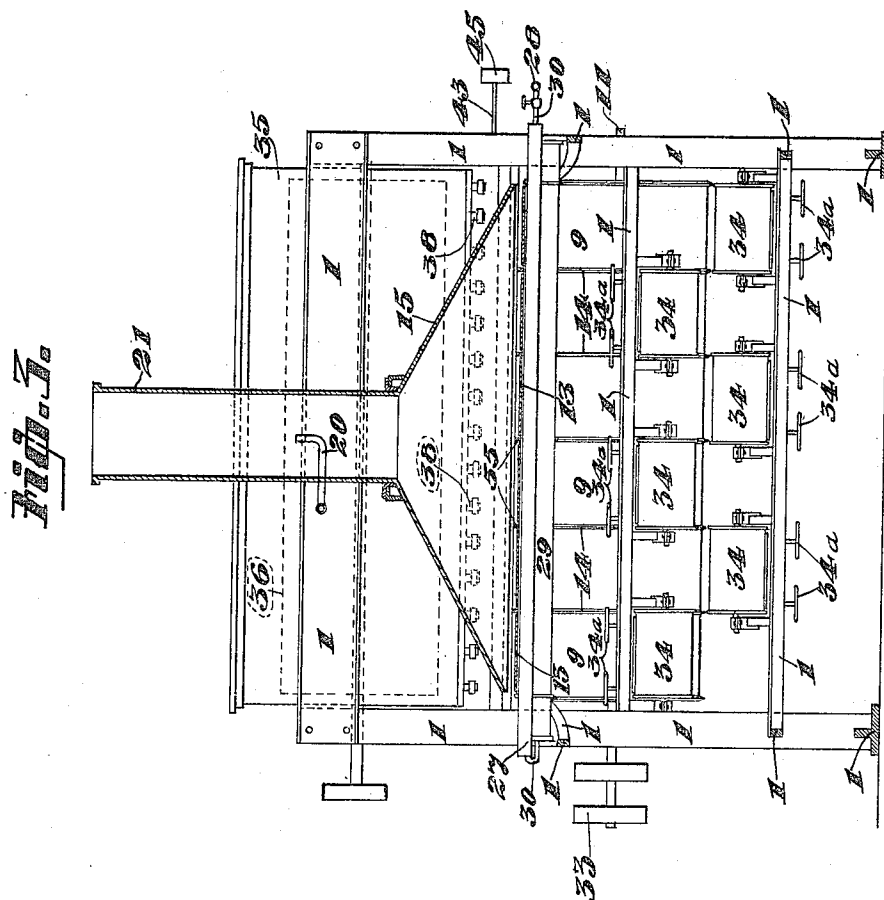
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4 SHEETS—SHEET 3.



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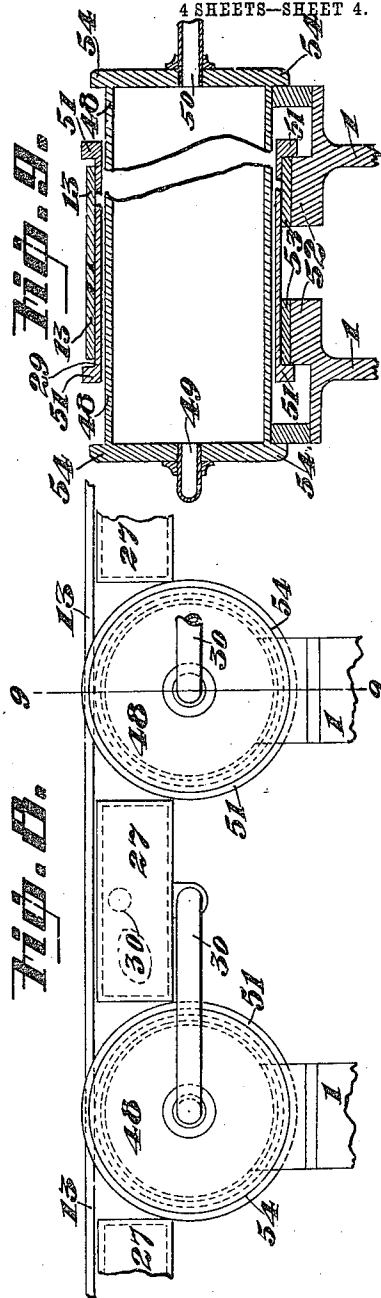
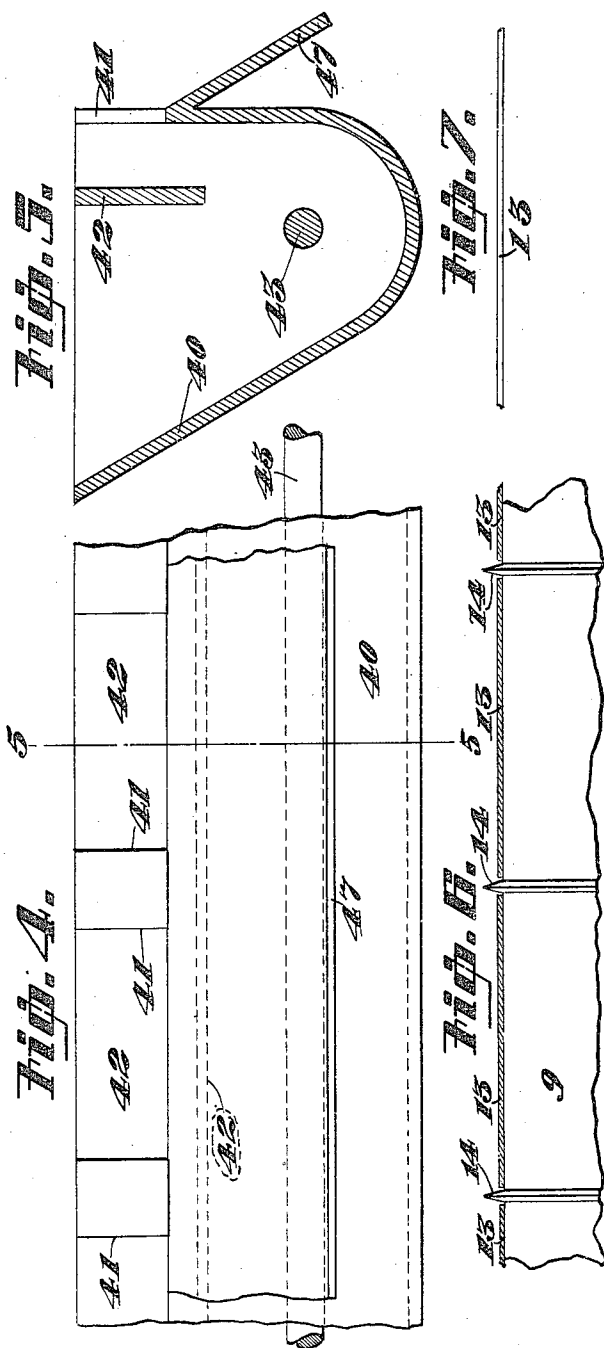
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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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DRIER.

949,487.

Specification of Letters Patent.

Patented Feb. 15, 1910.

Application filed November 9, 1908. Serial No. 461,605.

To all whom it may concern:

Be it known that I, WILLIAM R. MACKLIND, a citizen of the United States, residing at the town of Mineral Point, in the county of Washington and State of Missouri, have invented certain new and useful Improvements in Driers, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention consists in an improved system of, and apparatus for, drying sludge or pulp and like material.

In the drawings, forming part of this specification and in which like numbers of reference denote like parts wherever they occur, Figure 1 is a side elevation; Fig. 2 is an end elevation, looking toward the right in Fig. 1; Fig. 3 is a sectional view on the line 3—3, Fig. 1, looking toward the right; Fig. 4 is a fragmentary view of the feeding trough, partly in elevation and partly broken away, to show the interior; Fig. 5 is a sectional view through the same; Fig. 6 is a fragmentary top plan view of one of the rollers showing one of the belts in section; Fig. 7 is a fragmentary side elevation of the belt; Fig. 8 is a detail, on an enlarged scale, of some of the heating boxes and rollers; and Fig. 9 is a detail, in section, of one of said rollers.

The drying is accomplished by heat, and the heat may be supplied either by steam, gas, electricity, or indirect heating of the ribbons or bands forming the conveyers.

One of the chief merits and advantages of the system of drying which forms the subject-matter of this invention is the convenience, certainty, and regularity with which the heat can be applied to the article treated, and varied according to the nature of the material, and regulated according to necessity. One temperature may be necessary for sludge or pulp of one material, while quite a different one will be necessary or proper for some other kind of sludge or pulp. It may be desirable in treating some sludges or pulps to maintain a gradually ascending temperature, and in treating another kind of sludge or pulp to utilize a gradually descending temperature, or a gradually ascending and then descending temperature may be desirable. Heretofore it has been impossible to regulate and apply the drying temperatures with either the precision or facility hereby secured.

Another advantage secured by the present

invention is that the material treated is continuously presented to the desired temperature, or, if preferable in any case, an intermittent movement, instead of an interrupted one, may be utilized. Some materials are of such delicate composition as to undergo important chemical changes according to the duration of the application of heat to them, and in some instances it is, therefore, desirable to vary the process, mode, or degree of heating; and this can be done by the present system as by none of its predecessors.

An additional advantage secured by this invention resides in the fact that the heating medium is stationary, while the material to be dried is traveling either continuously or intermittently thereover. It is easier to control the travel of the material than it would be to control the application of the heat if same were to be accomplished by presentation of the heat to the material instead of presentation of the material to the heat. Moreover, for practical reasons, such as a consideration of floor space, it is preferable and of great advantage to install a relatively small heating apparatus and to cause large quantities of the material to pass adjacent to same, so that small quantities of the material may be treated from time to time and removed out of the way, rather than to use a larger heating apparatus and to occupy floor space with a container for a relatively large body of material to be dried. Furthermore, inequality in the chemical action of the heat upon the material to be dried necessarily results from heating a large body of material, due to the fact that the material nearest the heat will be raised to a higher temperature than that part of the material which is farthest from the heat, and that elsewhere in the mass the heat will not permeate all parts alike.

To name only one among many commercial operations to which this system of drying and apparatus therefor may be applied, the preparation of white lead may be mentioned; but this is only by way of illustration, and not enumeration.

A main frame 1, composed of various upright and horizontal portions, supports the moving and other parts hereinafter described. The main driving shaft 2 is journaled in part of said main frame, and pulleys 3, 4, 5, 6, and 7 are mounted on said shaft, and driven thereby. Pulley 8 mounted on shaft 2 receives the motive power from

any suitable source. Drums 9 and 10, borne by shafts 11 and 12, respectively, journaled in said main frame, extend transversely about the width of the machine, and a belt or endless conveyer, preferably (but not necessarily) formed of a metal ribbon or a plurality of metal ribbons 13, travels on said drums, and from one to the other, and around said drums. Ribs 14 may be placed on said drums, to space said ribbons apart and to act as guides therefor. Drums 9 and 10 are preferably hollow cylinders provided with internal heating means. The reason why metal ribbons are preferred is that they transmit the heat more readily to the material to be dried than would a conveyer made of any other material, and, for the same reason, it is preferred that same shall be extremely thin. A hood 15 is located above said ribbons 13 to receive and carry off the vapors arising from the drying sludge or pulp. Said hood is open at both bottom and top, and is divided internally by partitions 16. These partitions make it easier to get rid of the vapors, due to the fact that the partitions prevent the formation of strata (either vertical or horizontal) or differential temperature conditions such as would occur within said hood if one single and relatively large body of air were found therewithin instead of the plurality of relatively small bodies of air due to the presence of said partitions. To assist in carrying off the vapors or anything else that may arise from the conveyer or conveyers, such as dust, for instance, a fan 17 is provided, which is driven by belt 18 from pulley 3, and forces a current of air through pipe 19 and the various branch pipes 20, which latter are located in vent 21 of hood 15. Valves will be provided in connection with said branch air pipes 20, so as to control the induced draft in each part of the vapor hood, thus making it possible to regulate in each compartment the exact amount of suction. By this means, and varying according to the nature of the material treated and the mode of application of the heat thereto, such draft may be caused, for example, to decrease gradually, or step by step, as the material travels from the loading end to the discharging end of the machine. Obviously, when in its wet condition, when first loaded on the conveyer, more vapor will be exhaled than farther on in the process when the material has become drier. It is, therefore, more important to have a strong draft at the beginning than at later stages in the process. Furthermore, when the material has become dried, too strong a draft would be likely to carry off particles of the material and thus same would become wasted.

The sludge, pulp, or other material to be dried is fed upon the conveyer or ribbons 13 at one end of the machine, and by said con-

veyer or ribbons driven either continuously or intermittently, as may be most desirable for the particular kind of material being treated, toward the other end. In the drawings the feeding apparatus is shown as located at the right hand end of the machine (see Fig. 1), and the receiving hopper 22 at the left hand end. Said receiving hopper nearly incases drum 10, and receives all material carried to drum 10 on ribbons 13, said ribbons entering said receiving hopper 22. Since said ribbons encircle the drum 10, the sludge that is borne thereby, sometimes clinging thereto in a viscous manner, automatically strips from said ribbons by reason of the bend necessarily assumed by the ribbons as they follow the curvature of drum 10, allowing the sludge to drop down therefrom in hopper 22 and falling upon or into a conveyer 23, which may be of any preferred or usual form, the drawings indicating that an Archimedean screw may be used. One of the great advantages derived from the present system of handling and drying sludge or pulp and from the use of conveyers passing around a drum, such as drum 10, as hereinbefore described, is the automatic stripping of the sludge from the drying conveyer as hereinbefore described. By way of precaution, and in order that said conveyer may be freed from all adhering particles, however, a cleaning or polishing roller 24, which revolves in the opposite direction to travel of the ribbons, is located adjacent the ribbons 13 in their path of travel after having discharged their load into receiving hopper 22. It is obvious that said cleaning or polishing roller 24 might be placed so close to the ribbons 13 as to brush same without being itself positively actuated except by said friction, and a brush or cleaner in a form other than that of a roller might, therefore, be employed; but it is preferred to utilize a roller as herein shown and described, and it is, also, preferred to impart positive motion thereto as by means of belt 25 driven by pulley 6. Drum 10 is driven by belt 26 from pulley 5, and drum 9 is driven by belt 32 from pulley 33 mounted on shaft 12.

A row of heaters 27 is located underneath the conveyer or ribbons 13 in the upper part of the travel of same, being thus arranged so as to underlie the ribbons 13 during that part of their travel when same are carrying the material to be dried. The heat from said heaters (and from the drums 9 and 10 when, as preferably, same are heated), by reason of their proximity to the ribbons 13, is communicated thereto, and the drying of the sludge results. In the drawings, as a suggested mode among others of supplying heat to the heaters, steam pipes 28 are shown, but, as hereinabove stated, it is not to be understood that steam is the only form

of heat contemplated, nor such pipes the only conductors therefor.

In order that the conveyer or ribbons 13 may be prevented from sagging, and in order that such friction as would necessarily result if same were to travel in contact with the heaters 27 may be obviated, rollers 29 are provided, on which rollers the ribbons 13 travel. In order that, if desired, there may be no intermission in the application of heat to the ribbons 13 in the part of their travel between the heaters, and while in engagement with said rollers, steam pipes or other conductors 30 may be run into same carrying heat from heaters 27 or other suitable source. As one of the objects in using the rollers 29 is to obviate friction from heaters 27, the top of said rollers 29 is preferably made to project slightly higher than the top of heaters 27. The continuous ribbons 13 pass over the adjustable idlers 34, said idlers being made adjustable by hand-wheels 34^a in order to take up slack in said ribbons 13. Since in the form of this machine shown in the drawings a plurality of such metal ribbons is used, and since, for various reasons, the slack in one of same might not be the same as that in another, a separate idler is provided for each ribbon, and in order that each idler may be mounted independent of the other, same are located in different planes, as depicted in Fig. 1. A hopper 35 containing an agitator 36, which, if desired, may be driven as by a belt 37 from pulley 4, is located at the feeding end of the machine and receives the material to be dried, same being allowed to pass from said hopper 35 through a pipe or opening 38 controlled by cock 39. The flowing material falls into feeding trough 40, being caused to feed out of same through openings 41 by the baffle plates 42, and being kept stirred, so as not to solidify in said trough, by means of agitator 43, which in the form shown in the drawings is merely a plain roller rotatable by means of belt 44 on pulley 45, which belt passes over idler 46 and is driven from pulley 7. Of course, other forms of agitators might be used in place of agitators 36 and 43.

When the sludge or pulp falls into feeding trough 40 it gradually fills same until the quantity therein rises on both sides of baffle plate 42 higher than the bottom of opening 41, which necessarily produces a flow of sludge or pulp down the oblique wall of trough 40 and up the vertical wall of same and between the baffle plate 42 and said vertical wall, so that it is conducted to opening 41. After passing out of opening 41, the sludge slides down lips 47 which are so shaped and arranged as to deliver the sludge upon the ribbons 13 at the precisely desired point; and the size of the openings 41 and lips 47 can be varied so that the stream de-

livered upon each ribbon 13 will be of any desired width, the thickness thereof being, also, regulatable by the size of the openings 41. Thus, if it is desired that the sludge shall be placed upon one of the ribbons in exactly the middle thereof and in the form of a strip exactly two inches wide, the lip 47 for that particular ribbon 13 will be located opposite the middle of said ribbon, and the corresponding opening 41 will be given a cross-dimension of approximately two inches, more or less, as may be found necessary with the particular material to be treated, so that after running down lip 47 it will form a strip of exactly the desired width, the location of the opening and accompanying lip predetermining at what point same shall fall upon the ribbon 13.

The preferred construction for supporting rollers 29 is to place same upon stationary cylinders 48 held by frame 1 in the manner shown in Fig. 9, 49 indicating the steam inlet, and 50 the steam outlet. Each roller 29 is in the form of a sleeve encircling its respective cylinder 48, and is provided with a flange 51 at each end, which flange, when in the lower part of its revolution, engages shoulder 52 on frame 1, and in the upper part of its revolution acts as a guide for ribbon 13. Each sleeve or roller 29 rests on a pair of Babbitt metal bearings 53, and the movement of ribbons 13 causes same to revolve slowly on said bearings. Cylinders 48 and rollers 29 extend from one side of the machine to the other. Flanges 54 act as stops to retain the sleeves or rollers 29 upon said cylinders. While ribbons 13 are traveling over the rollers 29 they are kept spaced apart by the guides 55 attached to the main frame 1 of the machine. Said guides perform the same function in supporting the ribbons during this part of the travel of the ribbons that is performed by the ribs 14 when said ribbons are passing over the drums 9 and 10.

The operation of the machine is as follows: Sludge or pulp is conveyed into hopper 35, from which, through pipe or port 38 (controlled by valve 39), it enters the feeding trough 40. By reason of the semi-fluidity of the material and the continual flow thereof from hopper 35, it not only fills the bottom of said trough 40, but, also, rises as high as opening 41 therein, out of which it flows on lip 47, which directs it upon one of the ribbons 13 at a point adjacent the top of drum 9. Said ribbon 13 and its companion ribbons, also, loaded in like manner from other openings 41 in the length of said trough 40, travel forward at any desired and predetermined rate of speed, and by any preferred kind of motion, *i. e.*, either continuously or intermittently, or by a motion comprising short periods of rest and comparatively long intervals of movement, or

by a movement comprising long periods of rest and comparatively short intervals of movement. In this manner, the material to be dried is conveyed over heating means, which, as herein shown and described, is composed preferably (but not necessarily) of heaters 27 and rollers 29 encircling heated stationary cylinders 48 and heated drums 9 and 10, and is conveyed to drum 10, from which it automatically strips by reason of bend of the ribbons 13 toward their point of beginning around said drum. When the material thus strips from the ribbon while passing over drum 10, it falls into the receiving hopper 22, and is carried thence by conveyer 23. The vapors are received by the hood 15, and carried upward through the various compartments thereof and through the vent 21, aided in such exit by the fan 17.

Thermostats may be utilized in connection with this machine to regulate the temperatures, and automatic appliances can easily be supplied for producing exactly the kind of movement of the endless conveyer and mode of presentation to the heating and drying means that may be desired.

As the nature of the materials that can be dried by the use of such apparatus as that herein shown and described is extremely varied, it may happen that with one such material it is desirable to feed a very thin layer upon the endless conveyer, while with a different material a relatively thicker layer will be placed thereon. In the case of such very thin layer, or in the case of material of considerable viscosity, or under certain particular circumstances as to temperature, climate, or the like, it may be found that the material does not strip with facility from the conveyer merely by reason of the bend assumed by said conveyer in following the curvature of drum 10, and to assist such stripping, when necessary or desirable, a cutter may be utilized adjacent to said drum 10, one form of which is illustrated in the drawings as composed of a rotary shaft 56 bearing radially-disposed knives or cutters 57. The shaft 56 is mounted on adjusting screws 58, so that it can be raised and lowered, in order that the knives 57 can reach through the particular thickness of material lying upon the conveyer in such a manner as to cut therethrough nearly, if not entirely, to the conveyer, when said knives 57 are rotated in succession into position to penetrate same. The shaft 56 with the knives borne thereby is rotated by means of belt 59 driven from pulley 60 on the main driving shaft.

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

1. In a machine of the character described, the combination of a pair of drums, and a plurality of metal ribbon endless conveyers

adapted to travel therearound, said drums being common to all the ribbons and having guide ribs thereupon to maintain the proper spacing of the ribbons.

2. In a machine of the character described, the combination of heating means, a hood overspreading same larger at the bottom than at the top and divided into vertical compartments, and means for carrying the material to be dried into relation with said heating means.

3. In a machine of the character described, the combination of heating means, a support for the material to be dried thereby, a vapor hood divided into compartments and located adjacent said support, a fan, and a pipe leading from said fan and having branches entering each of said compartments.

4. The herein-described drying process consisting in passing the material to be dried adjacent to heating means, while subjecting same to an air current and so regulating said air current that its force is greater when the material to be dried is wettest.

5. The herein-described, drying process consisting in passing the material to be dried adjacent to heating means, while subjecting same to an air current, and so regulating said air current that its force is greatest when the material to be dried is wettest, and least when it is driest.

6. The herein-described drying process consisting in passing the material to be dried adjacent to heating means, while subjecting same to an air current, and so regulating said air current that its force is greatest when the material to be dried is wettest and gradually decreases in force as the material becomes drier.

7. In a drying machine, in combination, a conveyer, positive means for creating and maintaining separate a plurality of air currents to act successively on the material on the conveyer and means for separately regulating the air currents.

8. In a drying machine, in combination, a plurality of movable conveyers, a hopper common to all of said conveyers and means for causing said hopper to simultaneously discharge separate charges of material upon each conveyer.

9. In a drying machine, in combination, a plurality of parallel conveyer bands, a common feeding hopper extending transversely of said bands and means for causing said hopper to feed a separate charge of material to each band.

10. In a drying machine, in combination, a plurality of parallel metallic conveyers and heating devices common to all of said conveyers and associated therewith as supports.

11. In a drying machine, in combination, conveyer means, means for heating the material thereon, positive means for maintain-

ing a plurality of independent air currents to act successively and separately on the material and means for separately regulating each air current.

- 5 12. In a drying machine, in combination, conveyer means, means for heating the material thereon, and positive means for maintaining a plurality of independent air currents to act successively on the material.
- 10 13. In a drying machine, a movable conveyer band and a heating device therefor comprising a stationary heated inner cylinder, an outer cylinder rotatably surrounding the inner cylinder and having side
- 15 flanges to guide the band, and a bearing for

the outer cylinder, the bearing being disposed between the side flanges.

14. In a drying machine, the combination with a movable conveyer band and means for heating the same, of means for maintaining a plurality of independently regulating air currents to act successively with a suction influence upon the material on the band.

In testimony whereof I have affixed my signature in presence of two witnesses.

WILLIAM R. MACKLIND.

Witnesses:

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