(No Model.) 2 Sheets—Sheet 1.

M. LANCASTER.

APPARATUS FOR EXTRACTING OIL BY MEANS OF A SOLVENT.

No. 265,517. Patented Oct. 3, 1882.

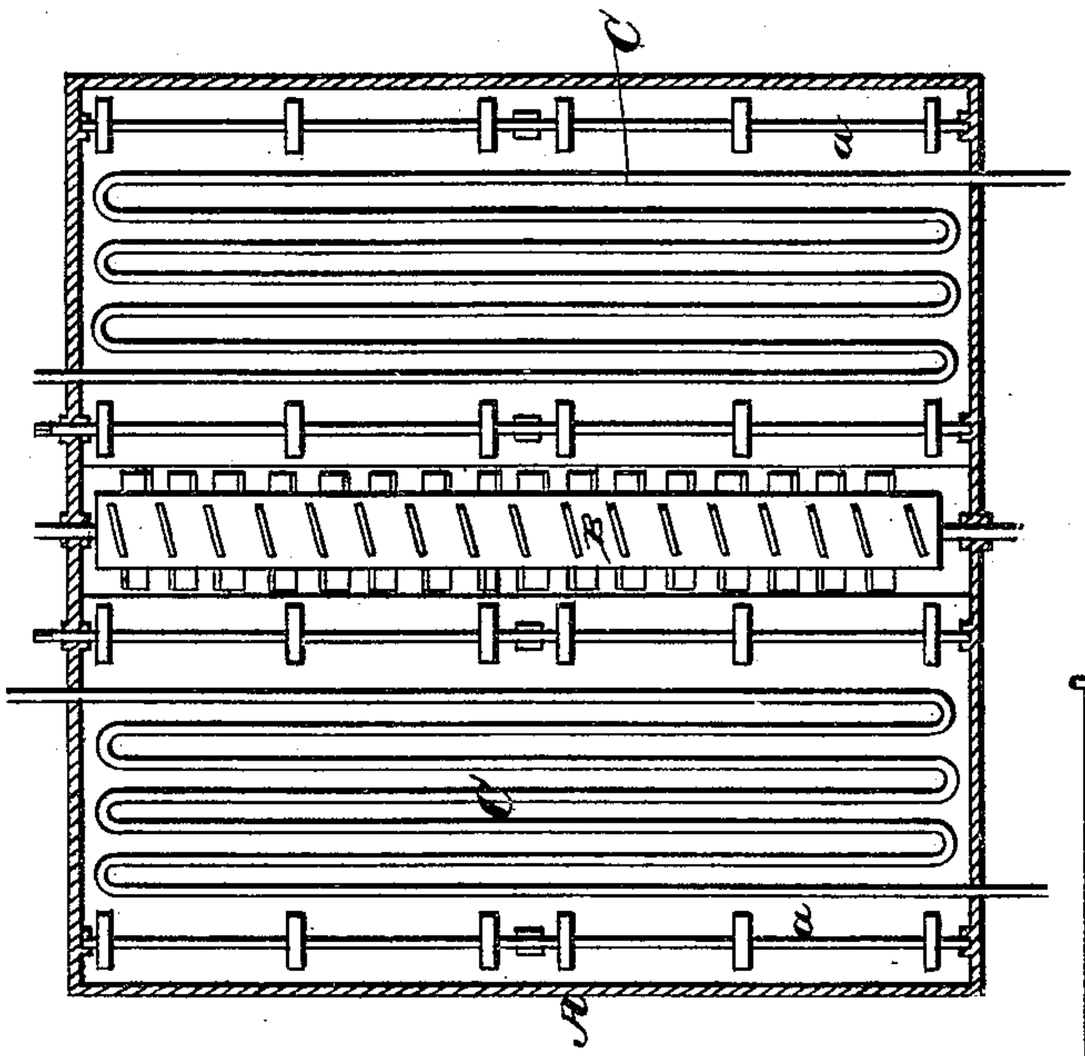

Fig. 1.

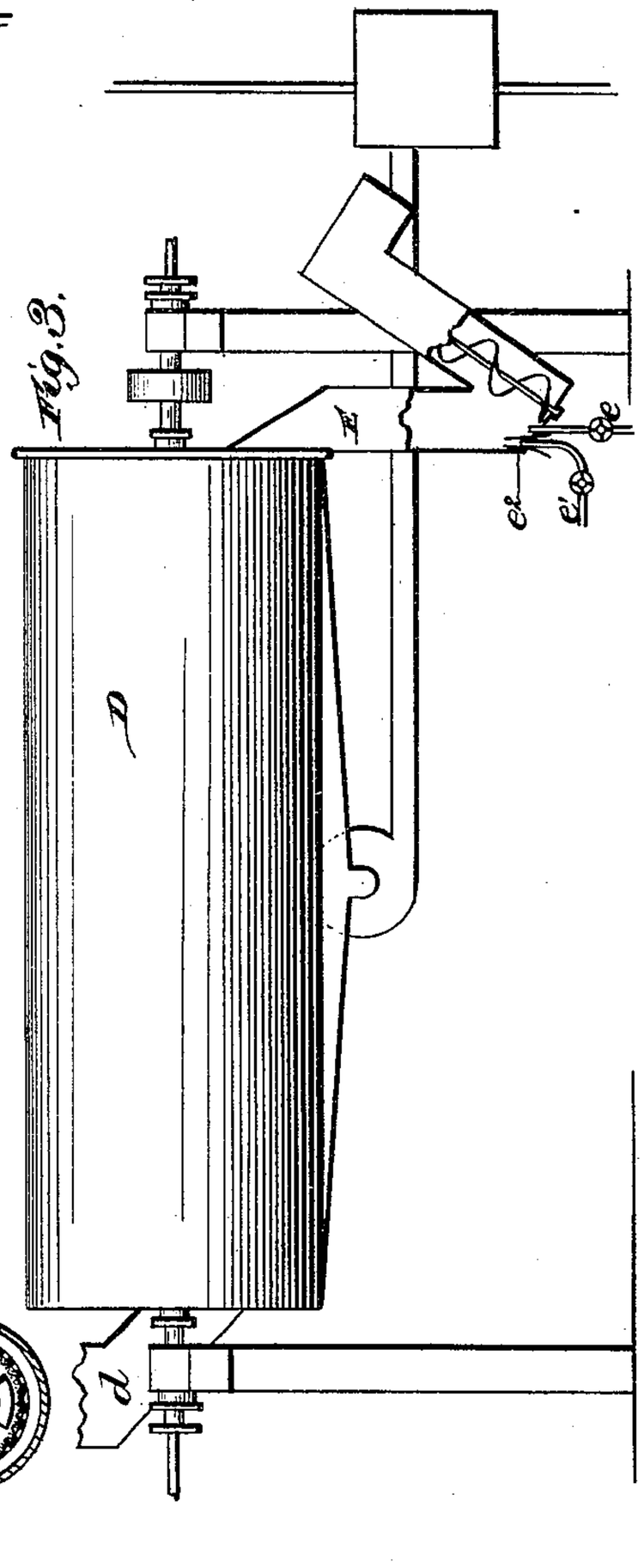

Fig. 3.

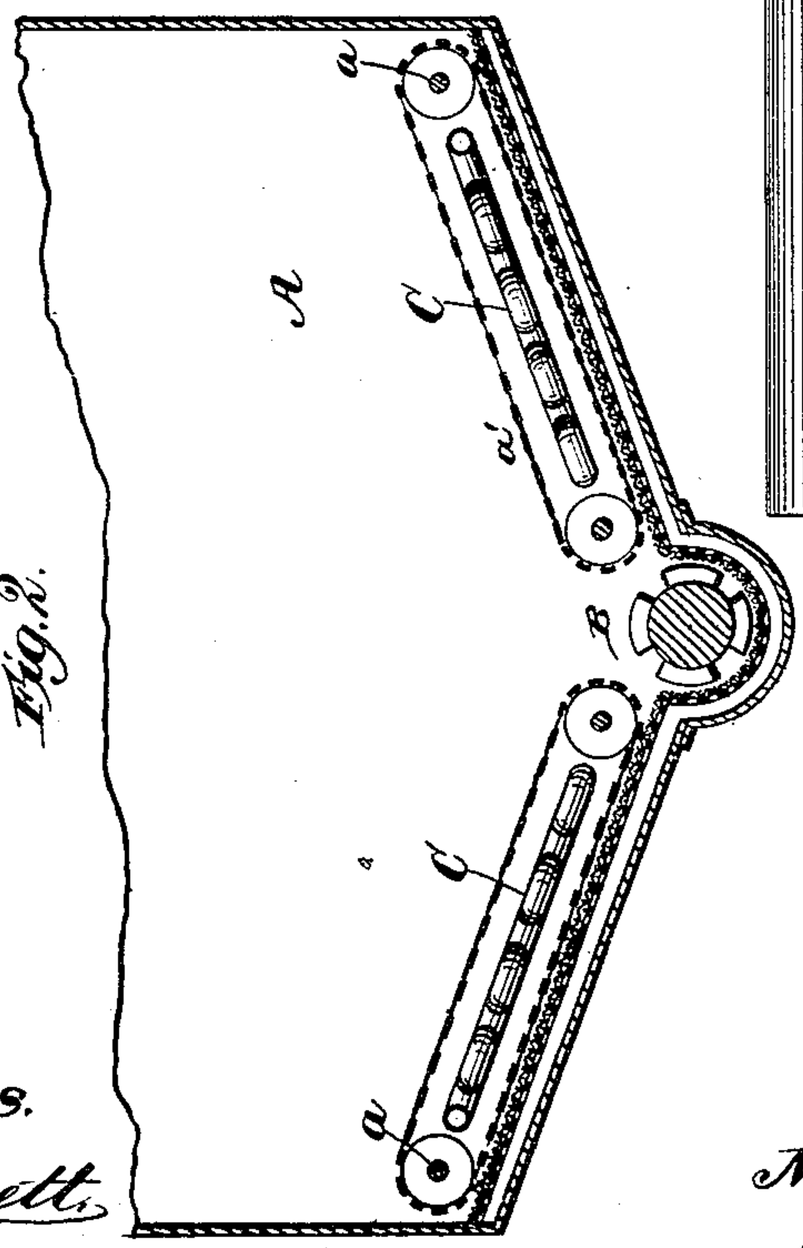

Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

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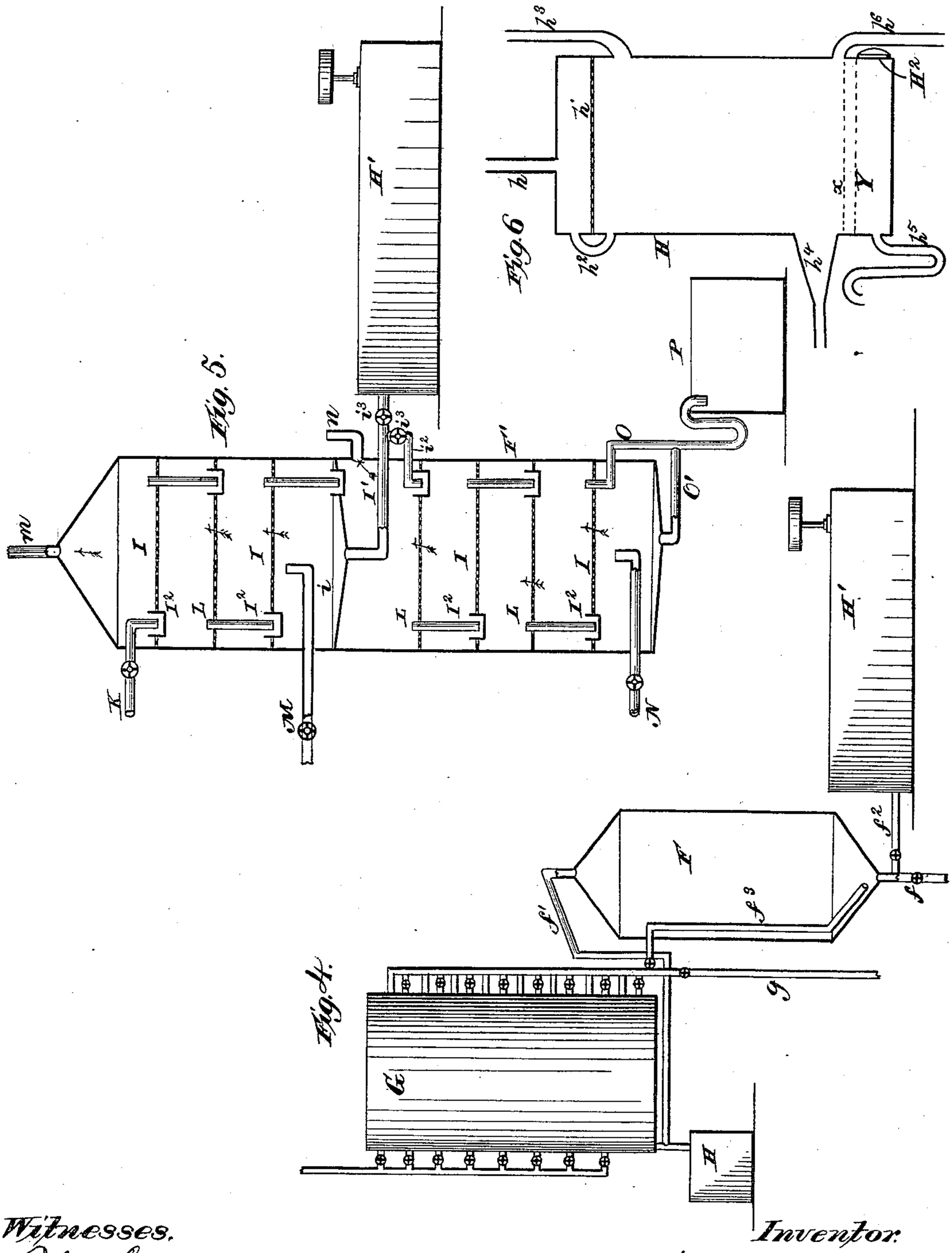

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Atty.

UNITED STATES PATENT OFFICE.

MORRIS LANCASTER, OF RICHMOND, INDIANA.

APPARATUS FOR EXTRACTING OIL BY MEANS OF A SOLVENT.

SPECIFICATION forming part of Letters Patent No. 265,517, dated October 3, 1882.

Application filed April 13, 1882. (No model.)

To all whom it may concern:

Be it known that I, MORRIS LANCASTER, a citizen of the United States, residing at Richmond, in the county of Wayne and State of Indiana, have invented new and useful Improvements in Apparatus for Extracting Oil by Means of a Solvent, of which the following is a specification.

This invention relates to an apparatus for the extraction of oil or fats from vegetable substances by means of a solvent and the recovery for reuse of the solvent employed.

The object of my present invention is to provide certain improvements on the apparatus shown in Letters Patent of the United States No. 253,722, granted to me February 14, 1882, so as to render the operations of said patented apparatus more rapid, and to adapt the same to more perfectly and economically remove the solvent from the treated meal and oil. This object I attain by means of the apparatus illustrated in the accompanying drawings, in which—

Figure 1 is a section taken through the extracting-tank, and shows in plan the lower portion of the same with its several operative parts. Fig. 2 is a vertical section taken transversely through the said extracting-tank. Fig. 3 represents in elevation the evaporator and a condenser, with the chute or outlet-spout connected with the evaporator, a portion of said spout being broken away in order to more clearly illustrate the arrangement of pipes for introducing steam or steam and air into the same. Fig. 4 represents, partly in elevation and partly in section, my combined oil and solvent separator, and also illustrates the superheater and condenser connected with said portion of the apparatus. Fig. 5 illustrates a modification of the same. Fig. 6 illustrates the condenser.

It will be understood that in this apparatus many of the parts are constructed and arranged in a manner similar to those shown in my said Letters Patent. Such parts will not therefore require a minute description.

The separating-tank A, like that shown in my former Letters Patent, has its bottom made slanting toward a central transverse depression, and is provided with the screen A′, located above said bottom, the rotary shafts *a* for the endless chains *a′*, that serve to break the impact of the meal, and a rotary conveyer, B, for removing the meal from the tank. In my present apparatus I provide, near the bottom of the tank and above the perforated screen, between the shafts *a*, return-coils of steam-pipes C, for the purpose of heating the contents of the extracting-tank. These pipes are of sufficient length and number to cover the entire available area at the bottom of the extracting-tank, and are arranged over each inclined portion of the bottom, as shown in Fig. 1. I may, however, employ other analogous means for heating the contents of the tank—such, for example, as a steam-jacket or false bottom—arranged to leave a suitable steam-space at the bottom of the tank, the steam-pipes, however, being a simple and economical mode of supplying the requisite heat. A chute will be connected with the extracting-tank for the purpose of conducting the meal to the evaporator D after the meal has been treated in the extracting-tank and is discharged therefrom by the conveyer, a portion of said chute being shown at *d*, Fig. 3. This evaporator is the same as the evaporator which is fully shown and described in my aforesaid Letters Patent, the meal being rolled over hot surfaces composed of pipes, so that it is heated and agitated for the purpose of freeing the meal from the remaining solvent.

E indicates the chute that is connected with the evaporator. In lieu of forming air-holes in the lower portion of this chute, as in my former patent, I introduce into the chute a small steam-pipe, *e*, from which a jet of steam can be discharged into the chute; or I can introduce into the chute a jet of steam mingled with air, and for this purpose I provide a steam-pipe, *e′*, having its discharge end located in a funnel-shaped opening, e^2, so that as the steam is injected into the chute through said opening it will carry the air along with it. The meal can, however, be treated after its final discharge from the evaporator in a separate apparatus.

Referring now to Fig. 4, F indicates a tank for receiving the oil as it comes from the separator G, which latter device is constructed and arranged in the same manner as the separator shown in my former Letters Patent. This tank F has a funnel or conical shaped top and bottom, and it should be of sufficient size to hold all the oil from a single charge of the extract-

ing-tank. The tank F is provided with a steam-pipe, *f*, connected to its bottom, and a vapor-pipe, *f'*, connecting its top end with the condenser H, which latter will be hereinafter more fully described. It is also provided with an oil-discharge pipe, f^2, connecting its bottom end with a superheater and agitator, H', constructed similarly to that shown in my former patent; or the oil may be simply discharged from tank F into a settling-tank. The pipe f^3, which extends down through the tank F to a point near its bottom, passes out through the side of said tank and connects with the pipe *g* of the separator. In place of the oil-tank F, however, the oil tank or column F' shown in Fig. 5 can be employed. This column consists of a galvanized-sheet-iron tank inclosing a series of horizontal perforated shelves or partitions, I, and it is divided centrally by means of a solid disk-shaped shelf or partition, *i*, having a central opening only, in which is fitted a pipe, I', which leads outside of the column and connects with the superheater and agitator H'. If desired, the oil which passes down through the column F' above the partition *i* can be returned to the column below said partition for further treatment by means of a pipe, i^2, that connects with the pipe I' and enters the column below its central partition. These pipes I' and i^2 are provided with suitable cocks, i^3, for controlling the flow of oil. The perforated shelves are each provided with a cup, I^2, which said cups are arranged alternately at opposite sides of the vertical axis of the column, as shown, the central cup-shaped partition, *i*, being also provided with one of these cups. The oil-pipe K from the separator enters the column at its upper end, and is formed with an arm which extends down into the cup of the top-most shelf. The oil-pipe i^2 has a similar arm, that extends into the cup of the shelf next below the central partition, *i*, in the column, while all of the shelves except the lowest shelf in the series have each a vertical pipe, L, extending down into the cup of the next lower shelf.

M indicates a pipe, which enters the column just above its central partition, whereby the steam admitted by said pipe will ascend through the upper set of perforated shelves, as indicated by the arrows, and then pass off through the vapor-pipe *m*. This vapor-pipe should connect with a condenser for the purpose of recovering any solvent carried out by the jet of steam. The pipe K, connected with the separator, discharges the oil into the cup in the top shelf, and as the oil overflows it will spread over the said shelf, the ascending current of steam preventing the oil from passing down through the perforations in the shelf. The oil is thus maintained on the shelf until it overflows the end of the pipe L, that extends above the shelf, and, passing down through said pipe, it flows into the cup of the next lower shelf, and so on until its final discharge from the column through the pipe I'. As before mentioned, when it is desired, the oil, after having thus passed through the upper portion of the column, can be returned to the lower portion of the same below the central partition, *i*, by means of the pipe i^2, in which case the cock i^3 in pipe I' will be closed and the cock i^3 in pipe i^2 opened. The oil will flow from pipe i^2 into the cup in the first shelf below said central partition, and in passing down from partition to partition, as in the former instance hereinbefore described, it will be subjected to a blast of air, which will be introduced into the column at its base through the medium of a pipe, N, provided with a suitable cock, the air from this pipe ascending through the perforations in the shelves and escaping through the air-discharge pipe *n*, that connects with the column at a point below the partition *i*. As the air that passes out through this pipe contains nothing of value, it is allowed to escape. The oil, after passing down through the tubes L from shelf to shelf of the lower set or series of shelves, is finally discharged through a pipe, O, into an oil-tank, P, said pipe O also having a branch, O', connecting with the concaved bottom of the casing of the column, so as to convey all drippings into the oil-tank.

The mode of operation is as follows: The extracting-tank A, Figs. 1 and 2, being filled with the substance to be treated and flooded with the solvent, steam will be admitted into the pipes C, so that the entire contents of the tank will be warmed by the heat radiated from the pipes, and thereby render the extraction of oil more rapid than if the mass were in a cold condition. This heating also enables me to use a hydrocarbon as a solvent for substances whose oils and fats in a cold condition will not combine with that solvent—such, for example, as castor-beans, or lard and tallow cracklings from rendering establishments, or any other oils or fats that are not fluid in a cold state.

I may here remark that it will be seen that I do not employ the commonly-termed "process of extracting oils by means of vapor," since, as a matter of fact, vapor alone has no efficacy in extracting oils under any conditions, the heat which I use being simply to liquefy the thick oils and fats, so as to enable them to combine with the liquid solvent, and thus be in a condition to be drawn off with the same. The heat absorbed in warming the contents of the extracting-tank is principally utilized in the evaporator for freeing the meal. The hot meal will also drain much drier than cold meal, thus rendering the action of the evaporator much more rapid and effective.

The manner of discharging the treated contents of the extracting-tank and the construction and operation of the evaporator D and the separator G are all fully set forth in my aforesaid Letters Patent. Care should be taken, however, in the construction and fittings of the devices employed for transferring the warm treated material from the extracting-tank to the evaporating-tank, so that all exposure to the air may be avoided.

In my former patent, as a final treatment of the meal for the purpose of removing any remaining traces of the solvent, the meal is subjected to a blast of air. I have found, however, that even after such treatment the meal is left with a bitter taste, which, in the case of human-food preparations—such, for example, as corn-meal for export to foreign or tropical countries—is not desirable. In the place of air, therefore, I introduce a jet of steam through pipe *e*, or steam and air combined, by means of pipe *e'* and the funnel e^2. It is not desirable to vaporize the solvent by the use of free steam, as no appreciable quantity of solvent can be vaporized without condensing the steam, which will injure the meal both in color and quality. It is intended, therefore, that the solvent shall be vaporized in the evaporator by dry heat and agitation, and that the steam shall only mingle with the meal after the latter is so hot and dry that only the slightest amount of condensation will take place. Under these conditions the steam will remove any trace of either the odor or bad taste of the solvent. The oil, as it flows from the separator G, enters the tank F through the pipe f^3, it being discharged from said pipe near the bottom of the tank, where it meets a jet of steam entering the tank through the steam-pipe *f*. The steam rising through the oil carries with it all remaining traces of the solvent, and, escaping through the vapor-pipe *f'*, is discharged into the condenser H, where the steam and vapor are condensed and the solvent retained for future use. As soon as the tank F is full of oil the action of the separator is suspended, the jet of steam stopped, and the oil drained from the tank F through the pipe f^2, all of these said pipes being provided with suitable cocks, which can be closed or opened as required. This oil can be deposited in another tank and the water of condensation from the steam allowed to settle, or it may be passed through the superheater and agitator H', which is operated as in my former patent, and there cleared of the water.

Another way of treating the oil with a blast of steam is illustrated by Fig. 5, the operation of which has already been described.

In the case of linseed-oil or any drying-oil I prefer not to use a blast of air, as the air has a tendency to oxidize the oil and injure its drying properties, and hence the oil, as it comes from the column after being subjected to a blast of steam, is introduced to my superheater and agitator H' and treated as set forth in my aforesaid patent for the purpose of removing any water it may contain.

In the case of non-oxidizing oils—such as castor-oil and all animal oils and fats, and also cotton-seed oil, which in a crude state is only a partially-drying oil—after treatment in the upper portion of the column to a jet of steam, the same can be returned to the column by closing the cock in pipe I' and opening the cock in pipe i^2, and then subjecting the oil to a blast of air to remove any water introduced by the condensation of steam, the oil being finally discharged into the tank P. In this last-described instance the superheater and agitator can be dispensed with. Also, a modified application of the blast of steam to the oil can be made as it comes from the superheater and agitator, as described in my said Letters Patent, which will remove any bad taste or odor, and as the temperature of the oil is greater than that of boiling water no condensation will take place and no further treatment will be required. Also, as the steam will carry away nothing of value, it can be allowed to escape.

The condenser H indicated in Fig. 4 is more fully illustrated in Fig. 5, which shows a condenser of the preferred form. It is composed of a galvanized-sheet-iron tank about thirty inches in diameter and eight feet high, a cold-water pipe, *h*, at the top, a perforated shelf, *h'*, near the top, an overflow-pipe, h^2, connecting the space above the shelf with the space below the shelf, an air-escape pipe, h^3, a pipe, h^4, for the entrance of the vapor to be condensed, the outlet-pipes h^5 and h^6, connected with the tank at different heights, for conducting away the water and solvent, and the hand-plate H^2 for opening the condenser, so as to allow the cleaning out of any deposited sediment.

In operation a stream of cold water flows into the condenser through pipe *h* and falls upon and spreads over partition *h'*. The whole area of this shelf being filled with fine perforations causes the water to fall through the space below the shelf in an innumerable number of small streams or showers. The overflow-pipe h^2 is provided to conduct surplus water below. The vapor enters the condenser through pipe h^4 near the bottom, and coming in contact with the shower of water is quickly condensed, and with the water falls to the bottom of the tank. The dotted lines X and Y respectively indicate the level of water and solvent where the specific gravity is less than that of water. When the gravity of the solvent is greater than the water their respective positions would be reversed. The advantages of this over any form of surface-condenser are, first, particles of fine meal cannot clog it; second, the entire condensing capacity of the water can be utilized; third, the stream of air that is constantly passing through the condenser is more perfectly freed from the solvent; fourth, the cost will not exceed one-third of a surface-condenser of same capacity.

It will be observed from the explanations hereinbefore given that my invention comprises a new process of treating the oil-bearing matter for the extraction of oil, the essential and important steps in the process consisting in delivering the meal or other material from the oil-extracting tank or vessel to the evaporating tank or vessel through a passage-way, or in any other suitable manner which will not permit the material in such removal to be subjected to the influence of the external atmosphere. Further, the solvent remaining in the material is vaporized or evaporated by agitating such material in the evaporator while in

contact with heated surfaces, such as coiled pipe; and, further, after the said solvent is evaporated by the radiated heat from the heated surfaces or pipes, the meal, as it is passed from the evaporator or after it has been removed therefrom, is subjected to the action of a jet of steam or steam and air combined, the object of which is to entirely free the treated meal from all taint, odor, and objectionable taste. This manner of removing the final traces of the solvent by dry or radiated heat is of importance in treating flaxseed or other grain or seed which possesses or is rich to a considerable degree in albuminous matter, for the reason that if the meal is subjected to the action of steam for the purpose of removing the remaining traces of solvent the nature and character of the product are entirely changed, and the taint, odor, and taste cannot be effectually removed from the meal.

What I claim is—

1. The process herein described of treating oil-bearing matter with a solvent to remove the oil, which consists in removing the treated matter from the oil-extracting tank to an evaporating-tank without exposure to the air, then evaporating the remaining solvent by agitation of the material while in contact with hot surfaces—such as heated pipes—and afterward freeing the treated matter from any taint or odor by subjecting it to the action of a jet of steam and air combined.

2. The process of treating oil-bearing matter with a solvent for the removal of its oil, the same consisting in extracting the oil from the meal while in a heated condition, removing the treated matter from the oil-extracting tank while in a heated state to an evaporating-tank without exposing the treated matter to the air, evaporating the remaining solvent by heat and agitation, and then freeing the meal from any taint of taste or odor by a jet of steam or steam and air combined, substantially as described.

3. The combination, with the extracting-tank A, having an inclined bottom, the inclined screen, the conveyer arranged centrally in the bottom of the tank, the rotary shafts *a a'*, and the chains carried thereby, of the coils of steam-pipes, located respectively between the shafts carrying the chains and above the inclined screen, an evaporator, D, and an air-tight chute connecting the evaporator with the extracting-tank, substantially as described.

4. The combination of the evaporator D, the oil-extracting tank A, the coil of steam-pipe C, located within the latter and above a screen therein, an air-tight chute connecting the tank and the evaporator, and a conveyer located within the extracting-tank for delivering the heated meal from the same to the air-tight chute, substantially as described.

5. The combination, with the separator and the condenser H, of the oil-tank F, the steam-pipe connected with said tank at its bottom, the vapor-pipe f', leading from the upper portion of the tank to the condenser, and the pipe f^3, leading from the separator to the lower portion of the oil tank, substantially as described.

6. The combination of the extracting-tank A with the evaporator D, the chute E, the pipe *e*, adapted to admit a jet of steam only into the chute, and the steam-pipe e', entering the funnel e^2 in the chute, whereby air will be carried along with the jet of steam entering the chute from said pipe, substantially as described.

7. The combination of the separator with the oil-tank F and pipe f^3, the steam-pipe F, the vapor-pipe f' and condenser H, and the superheater and agitator H' with pipe f^2, substantially as described.

8. The combination, with the condensing-tank H, of the water-inlet pipe at its top, the perforated shelf below its top, the water-escape pipe connecting the space above and below the perforated shelf, the vapor-pipe connecting with the lower portion of the tank, and the outlet-pipes h^5 h^6, respectively connecting with the tank at different heights, substantially as described.

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

MORRIS LANCASTER.

Witnesses:

WM. MENDENHALL,

A. L. HAMPTON.