(No Model.) 5 Sheets—Sheet 1.

W. R. HARRISON & E. STEPHENSON.

APPARATUS FOR EXTRACTING OIL.

No. 591,041. Patented Oct. 5, 1897.

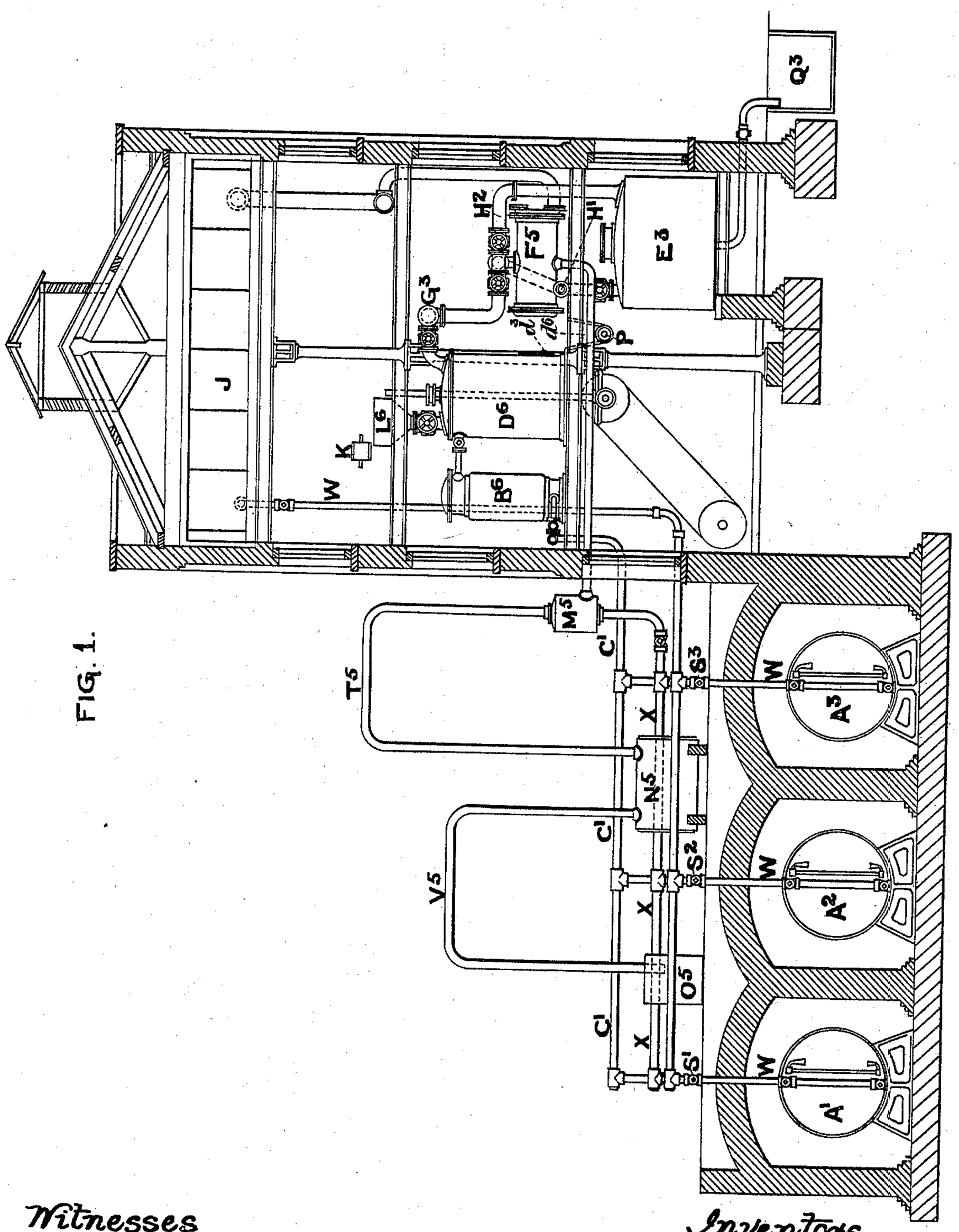

FIG. 1.

Witnesses

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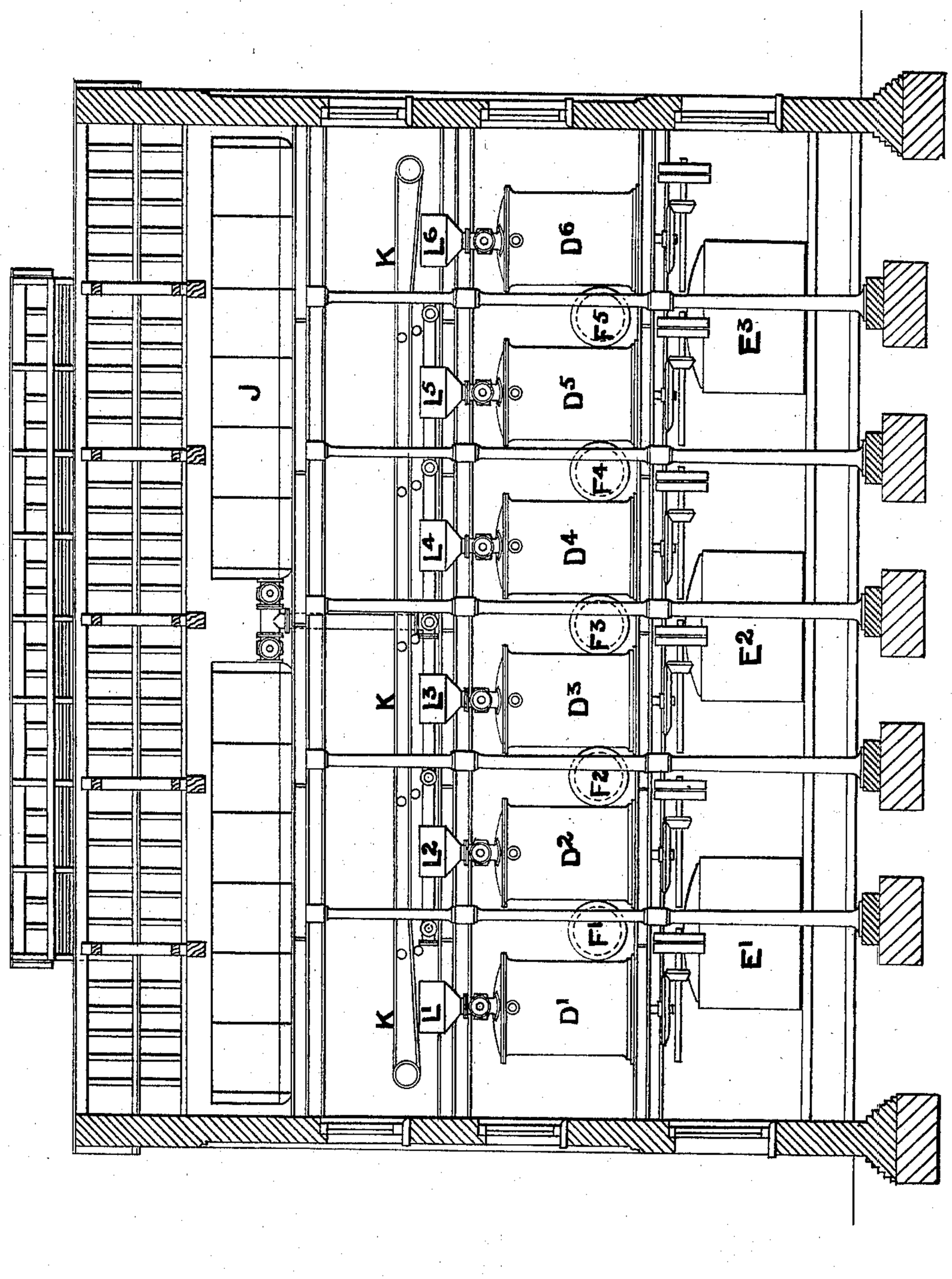
FIG. 2.



Witnesses

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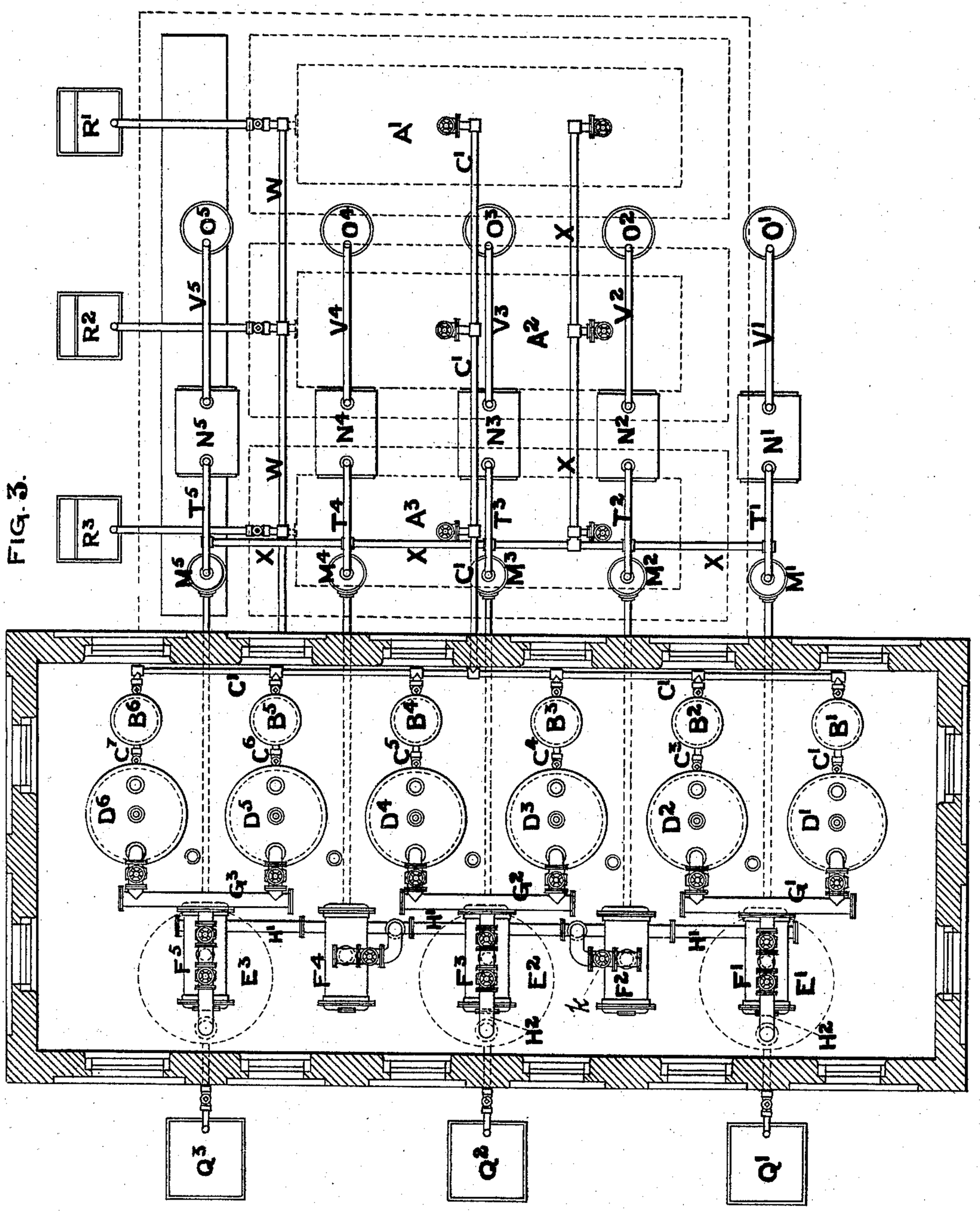
APPARATUS FOR EXTRACTING OIL.

No. 591,041. Patented Oct. 5, 1897.

FIG. 3.



Witnesses

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(No Model.) 5 Sheets—Sheet 4.

W. R. HARRISON & E. STEPHENSON.

APPARATUS FOR EXTRACTING OIL.

No. 591,041. Patented Oct. 5, 1897.

FIG. 4.

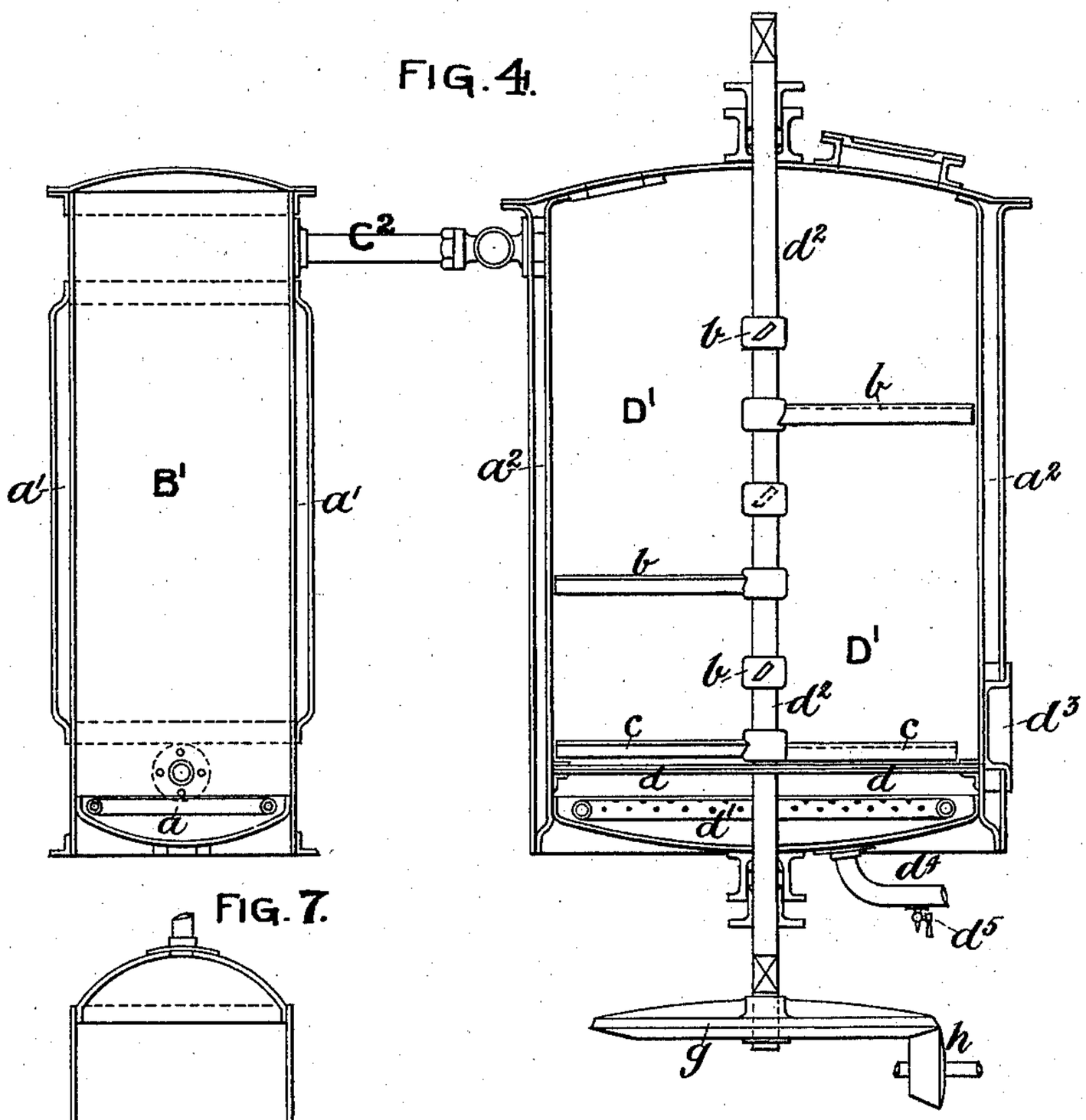


FIG. 7.

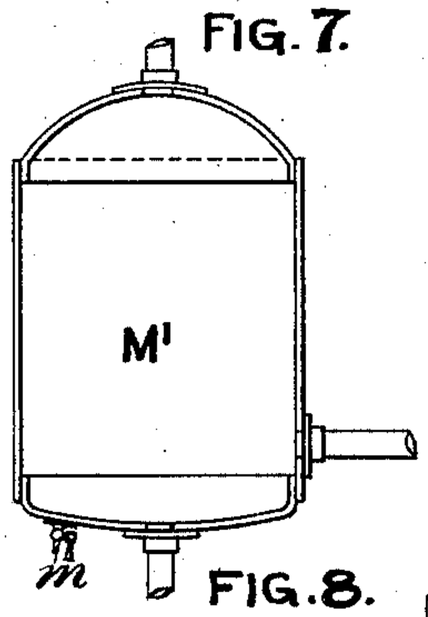


FIG. 8.

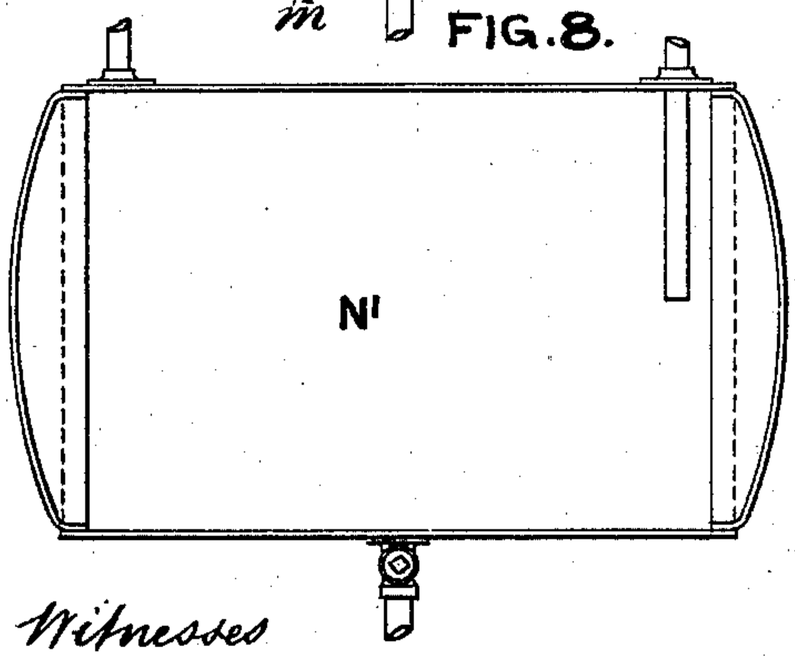
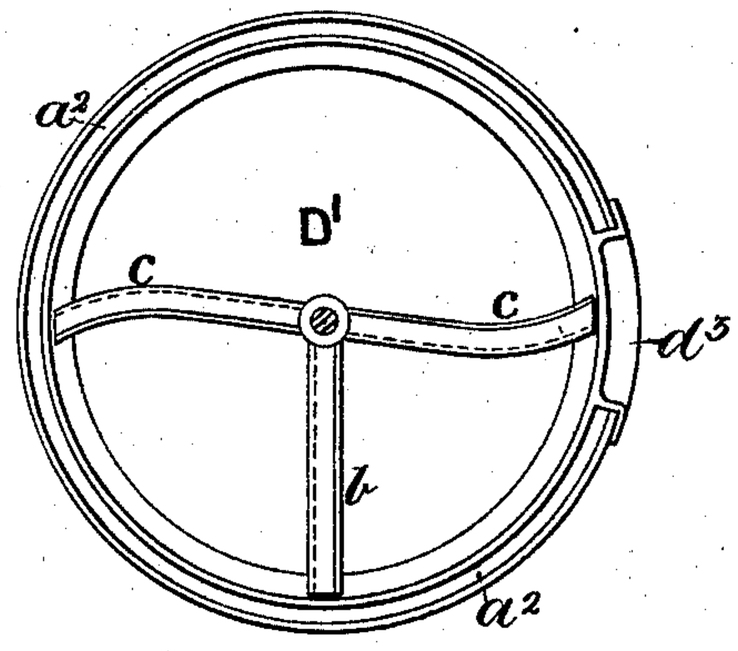


FIG. 9.



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(No Model.) 5 Sheets—Sheet 5.

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APPARATUS FOR EXTRACTING OIL.

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FIG. 5.

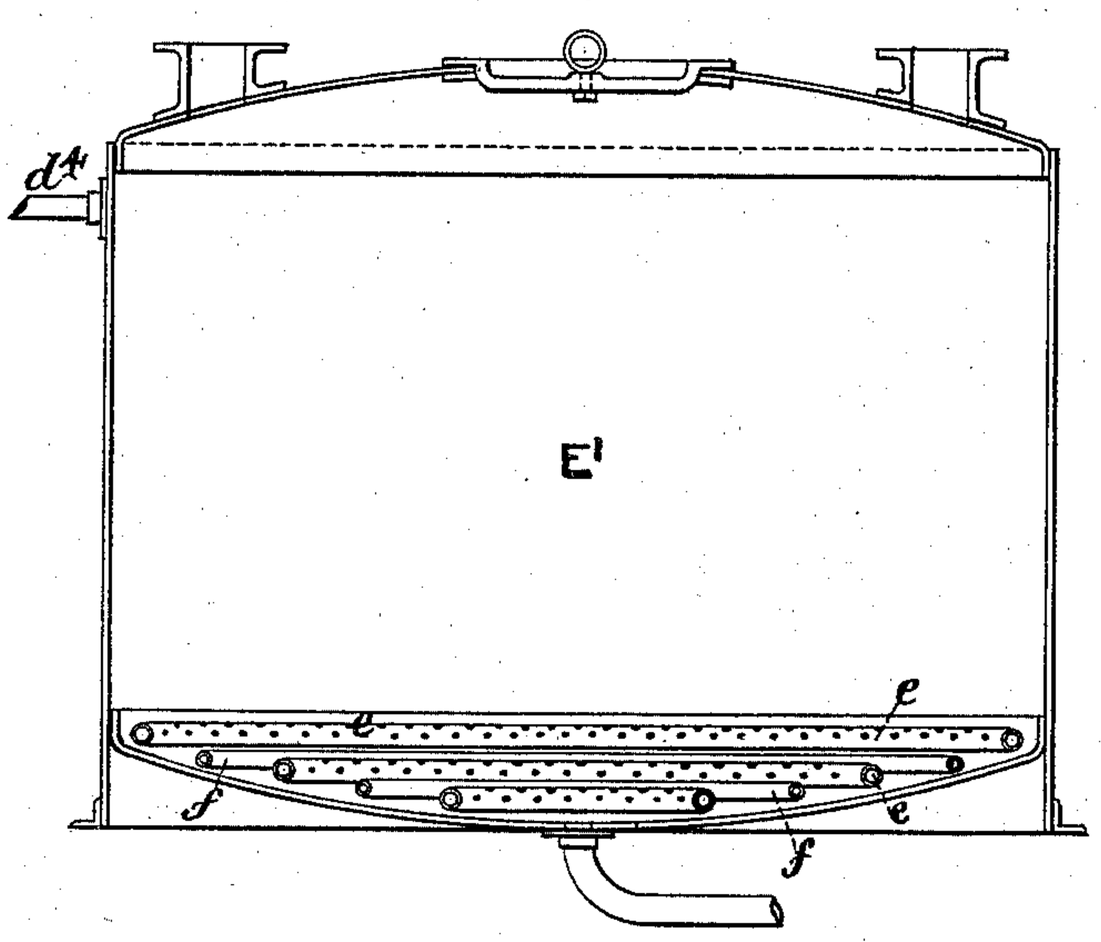
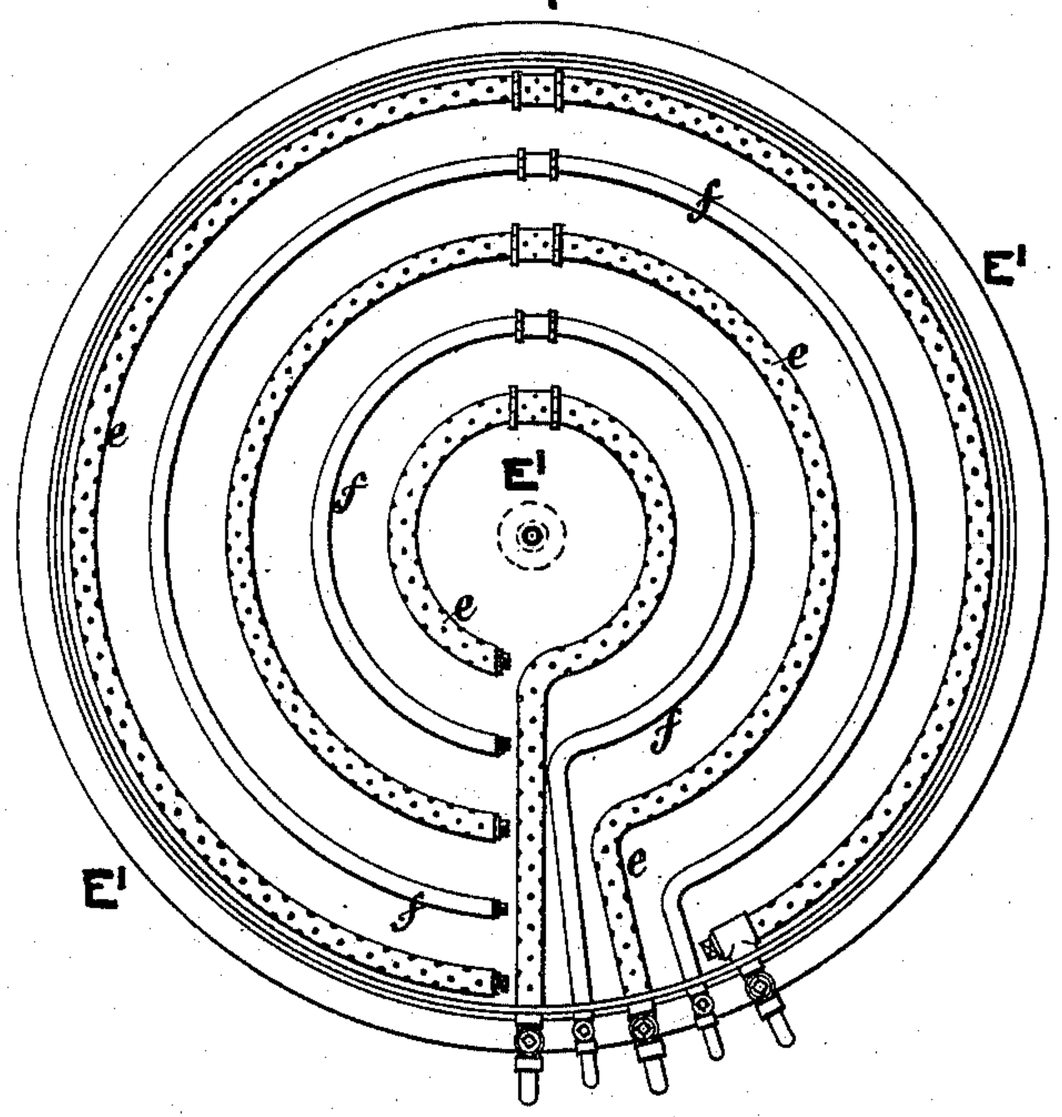


FIG. 6.



Witnesses
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R. W. H. Whitehead

Inventors
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UNITED STATES PATENT OFFICE.

WILLIAM ROBERT HARRISON AND EDWIN STEPHENSON, OF HULL, ENGLAND.

APPARATUS FOR EXTRACTING OIL.

SPECIFICATION forming part of Letters Patent No. 591,041, dated October 5, 1897.

Application filed November 30, 1896. Serial No. 613,946. (No model.) Patented in England April 7, 1896, No. 7,379.

To all whom it may concern:

Be it known that we, WILLIAM ROBERT HARRISON and EDWIN STEPHENSON, subjects of the Queen of Great Britain, residing at Hull, in the county of York, England, have invented new and useful Improvements in Apparatus for Extracting Oil from Seeds or other Oleaginous Substances, of which the following is a specification.

A patent for this invention has been obtained in Great Britain, No. 7,379, dated April 7, 1896.

The object of our invention is to provide improved apparatus and means for extracting oil from seeds or other oleaginous substances by a benzolin process, whereby there is a great saving of time and expense in extracting oil, together with a greater yield of oil. Also we may employ naphtha or any other suitable solvent in place of benzolin.

In the drawings, Figure 1 is a sectional end elevation of the plant. Fig. 2 is a sectional side elevation of Fig. 1. Fig. 3 is a plan view. Fig. 4 is an enlarged sectional elevation of gas-generator and extracting-kettle. Figs. 5 and 6 show enlarged elevation and plan of oil-separator. Figs. 7 and 8 show enlarged views of air-separator and air-receiver. Fig. 9 shows sectional plan of oil-extractor, showing stirrers and sweepers.

A′ A^2 A^3 are cylindrical ground-tanks for storing and supplying the liquid solvent, one being used as the supply-tank, another as the return-tank, and the third as a supplementary store-tank. These tanks are preferably about twenty-four feet long by seven feet diameter, and are placed in brick vaults under ground, so as always to keep the temperature sufficiently low to be below the flashing-point of the spirit and yet to enable the tanks to be easily accessible all over for detecting leakage.

B′ B^2 B^3 B^4 B^5 B^6 are the solvent-vaporizers or gas-generators for volatilizing the liquid solvent, and for this purpose are preferably about six feet high by two feet six inches diameter, with or without an internal steam-coil *a* and surrounded by a steam-jacket *a*, so as to rapidly increase the temperature of the cold solvent which enters them near the bottom, being supplied by the rising main C′ from the ground store-tanks, the lower part of these vaporizers being dished, so as to form a receptacle for the heavier part of the solvent, the lighter parts passing upward through the piping C^2, C^3, C^4, C^5, C^6, and C^7 into the extractors as they become volatilized by the heating of the steam-jacket *a*′, the heavier parts remaining in the receptacle at the bottom.

D′ D^2 D^3 D^4 D^5 D^6 are the oil-extracting kettles, consisting of vertical cylindrical vessels, having each a capacity of about one and a half tons of crushed seed or other matter to be treated and fitted with a perforated false bottom *d*, over which is stretched cocoanut-matting or other form of strainer, and having underneath the false bottom a perforated steam-coil *d*′, also with or without a steam-jacket a^2. Inside each of these oil-extractors is placed a vertical shaft d^2, having keyed upon it stirrers or beater-bars *b* for making the contents into meal after the oil is extracted, the two lower ones being curved to form sweepers *c* for throwing out the meal into the worm conveyers after the oil has been extracted and the solvent recovered. This vertical shaft, with the stirrers and sweepers upon it, is driven by bevel-gear *g h*, preferably placed underneath and receiving motion from the line of main shafting running near the ground-floor of the building.

E′ E^2 E^3 are the oil-separators, which receive the extracted oil and also the solvent from the oil-extractors and then in due course volatilize the solvent out of the oil and so separate it. These extractors have a dished bottom for convenience of drawing off this separated oil, and near this bottom are placed circular coils *e f*, both perforated and unperforated, the former for wet steam and the latter for dry heating, these coils being used for volatilizing the solvent and so driving it out of the oil. A supplementary oil-separator can also by preference be placed near to the others and connected with the same vapor-receiver H′ for receiving and treating any extra quantity of solvent or oil which may have passed down into the other oil-separators from the extractors.

F′, F^2, F^3, F^4, and F^5 are marine or other suitable condensers, F′ being connected by a receiver G′ with the oil-extracting kettles D′ and D^2 and also with the oil-separator E′. F^3 is connected with the oil-extracting kettles D^3 and D^4 by means of the receiver G^2, and

also with the oil-separator E^2. F^5 is connected with the oil-extracting kettles D^5 and D^6 by means of the receiver G^3, and also with the oil-separator E^3, the other condensers F^2 and F^4 being coupled to each of the oil-separators E', E^2, and E^3 by means of the long vapor-collecting pipe or receiver H'.

I and J are cold-water tanks placed on the top of the building for supplying the condensers with cold water and also to give the necessary hydraulic pressure to the store-tanks for elevating the solvent from them into the vaporizers or gas-generators.

K is a band conveyer running the full length of the building for conveying the crushed seed into the oil-extractors by means of the hoppers L', L^2, L^3, L^4, L^5, and L^6.

M' M^2 M^3 M^4 M^5 are air-separators for separating the air from the liquid solvent and condensed steam as it comes from the condensers.

N', N^2, N^3, N^4, and N^5 are the air-receivers for collecting the air as it comes from the air-separators and catching any solvent which may have passed into them with the air, and for better effecting this purpose cold water can be circulated through them or outside them.

O', O^2, O^3, O^4, and O^5 are bubble-tanks for relieving the pressure in the air-receivers, and also to form a second trap for any solvent which had by accident escaped with the air from the air-receivers.

P is a worm conveyer running the full length of the building for receiving the meal from the oil-extractors and taking it away to the meal-house.

Q', Q^2, and Q^3 are oil-tanks placed in the ground outside the extracting-house for receiving the oil from the oil-separators E', E^2, and E^3.

R', R^2, and R^3 are water-trap tanks for receiving the overflow water from the solvent store-tanks and for catching and detaining any solvent which might by accident escape from the overflow.

The action of the apparatus for extracting the oil, recovering the solvent from both the meal and the oil, and also converting the residuum from the crushed seed into meal in a marketable form is as follows: The ground store-tanks A' and A^2 are first charged with a sufficient quantity of solvent, A' being used as a supplementary store and A^3 being used as a return-tank to commence with, and A^2 being opened to the rising main C', which supplies the cold solvent to the six gas-generators. The band conveyer K is then put into motion and delivers into the hoppers L' and L^2 the crushed seed or any other oleaginous substance requiring to be treated until the oil-extracting kettles D' and D^2 are fully charged. The valves or mouthpieces of these latter are then closed and the gas-generators B' and B^2 are then put into operation by opening the water-cock S^2 on the water-pressure piping W from the overhead tanks to the ground store-tank A^2 and so forcing up the solvent by hydraulic pressure into the gas-generators. The solvent being so much lighter than water it continues flowing up through the rising main until eventually the store-tank would become filled with water.

As the solvent steadily rises in the vaporizers it becomes volatilized by the steam-jacket which surrounds it or by the steam-coil *a* in the bottom and passes over into the extractors at preferably about 200° of heat. As soon as the crushed seed in the extractors is completely enveloped in the solvent (which can be ascertained by a gage-glass attached to the extractors) the drain-pipes d^4, connecting D' and D^2 with the oil-separator E', are then opened to allow the oil and solvent to drain down into the separator, and the valve on the vapor-piping H^2, connecting the oil-separator E' with the condenser F', is then sufficiently opened to allow of a passage through to the condenser for the escaping air and vapor, which in turn pass down from the condenser F' to the air-separator M' in the form of liquid solvent, condensed moisture from the seed, and also air. This latter is here extracted from the liquid portions, and the solvent and water pass down into the ground receiving-tank A^3 through the solvent-return piping X, the liberated air rising upward through the air-pipe T', and then down into the air-receiver N', and from that it again passes upward through the air-pipe V' and down into the bubble-tank O', from whence it escapes into the open air. This process is allowed to continue until all the oil is extracted from the crushed seed in the extractors D' and D^2, the supply of solvent from the ground tanks to the generators being so regulated during the process that it passes into the extractors at about the same rate that the extracted oil and solvent are draining out of the crushed seed into the separator E'. As soon as all the oil is extracted from the crushed seed (which is ascertained by means of a petcock d^5, suitably placed in the drain-piping d^4 to oil-separator E') the supply of solvent to the extractors is immediately shut off, and the drain-piping to the oil-separator E' is also closed, and the steam is then turned on into the perforated coil *d'* underneath the false bottom of each of the two oil-extracting kettles D' and D^2, and the vapor-piping from these kettles to the condenser F' is opened fully, so as to allow the steam and solvent to pass freely away into the condenser. The stirrers or beater-bars *b* in the extracting-kettles are then preferably put into operation before any of the solvent has been driven off, and they at once begin to open up the residuum in the extractors and to allow the steam to mix freely with it and pass up through it, and thus the contents are rapidly freed from the solvent and at the same time in proportion as the solvent is vaporized away the residuum is being beaten up and pulverized into a fine meal and thus put into its most

marketable form. If there had been no agitation of the crushed seed at this juncture, it would simply have settled down into a hard cloggy mass, and wherever the steam had got a road through it would have so rapidly evaporated the solvent from that part as to have a tendency to freeze those parts where the steam had not reached, but by the agitation previously described the steam passes evenly through, and consequently the solvent is continuously taken out of the meal without any of the difficulties above mentioned and is returned through the condensers in a perfectly pure state to the ground store-tank A^3.

As soon as the meal has been completely freed from the solvent (which can be ascertained by another petcock *m* conveniently placed under the air-separator M′) the lower mouthpiece d^3 of each of the extracting-kettles D′ and D^2 is opened and the meal is then thrown out by the lower sweepers on the stirrer-shaft into a hopper d^6, placed underneath and immediately connected with the worm conveyer P, by means of which it is passed out of the building to the meal-house.

While the before-described operation of extracting the oil has been going on in the kettles D′ and D^2 the other kettles D^3 and D^4 and also D^5 and D^6 have each in turn been charged in pairs and put into similar operation substantially as described for D′ and D^2, so that the whole of the extracting-plant is practically working concurrently and *seriatim*, and while the extracting is going on the oil-separating is also taking place and is put into operation as follows: As soon as the oil has ceased flowing from the crushed seed in D′ and D^2 and while the process of driving off the solvent from the meal is taking place in these two kettles the valve *k* in the vapor-piping connecting the oil-separator E′ with the condenser F^2 by means of the vapor-piping H′ is opened wide and moist steam is then blown into the separator by means of the perforated coil or coils previously described, and thus the extracted oil, together with the liquid solvent which has drained into the separator E′ from the kettles D′ and D^2, is put into violent agitation by the globules of steam passing through them, and by this means the solvent is rapidly freed from the oil and passes upward with the escaping steam through the vapor-piping into the condenser F^2, and there getting condensed it passes from thence into the air-separator M^2, which frees it from the air contained in it, the liquid solvent then flowing down quite pure into the ground store-tank A^3 and the liberated air rising up from the air-separator M^2 through the air-piping T^2, and then down into the air-receiver N^2, then again rising through the air-piping V^2, and afterward down into the bubble-tank O^2, from whence it escapes into the atmosphere. The same process is continued in due course with the other separaters. E^2 and E^3 coincident with the working of the oil-extractors D^3 and D^4 and D^5 and D^6, and so the process is continued day and night throughout the week of, say, one hundred and thirty-two hours.

The oil from the oil-separators (having been completely cleansed by the steaming process from all the solvent with which it was mixed) is passed after each charge into the ground oil-tanks Q′, Q^2, and Q^3, respectively, from whence it is pumped in due course to the oil-storage tanks, where it is contained in its marketable form of crude oil.

It will be seen that by this process the oil is not only extracted out of the meal to a very low percentage, but in addition to this the solvent by means of which the oil has been extracted is practically nearly all recovered and taken back to the store-tanks for use again, and by the process of distillation previously described it becomes each time purer and better fitted for its extracting purposes, being freed by means of the vaporizers or gas-generators from its heavy parts, which remain in the bottom of the said generators and from whence they are drawn off from time to time and have a good salable value. The solvent being freed of these heavy particles more readily escapes by evaporation from both the meal and also the oil, and thus reduces to a minimum the small percentage of solvent which remains in them.

Having now particularly described and ascertained the nature of this invention and in what manner the same is to be performed, we declare that what we claim is—

1. The combination, with an extractor D provided with means for heating it and a pipe for the admission of steam to its interior, and agitating mechanism inside the said extractor of a generator B for vaporizing solvent said generator being connected to the extractor by a pipe provided with a stop-valve, an oil-separator provided with means for heating it and connected to the extractor by a pipe provided with a stop-valve, a condenser, a pipe provided with a stop-valve and connecting the oil-separator with the condenser, and a second pipe provided with a stop-valve and connecting the extractor with the condenser, substantially as set forth.

2. The combination, with an air-separator M, and a pipe for admitting condensed steam, condensed solvent, and air, thereto; of an air-receiver N, a pipe T connecting the upper parts of the said separator and air-receiver, a bubble-tank O, a pipe V connecting the upper parts of the said air-receiver and bubble-tank, and pipes connected to the lower parts of the said separator and air-receiver for removing the water and solvent from them, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

WILLIAM ROBERT HARRISON.
EDWIN STEPHENSON.

Witnesses:
LOUIS C. KIPPAS,
R. W. E. WHITEHEAD.