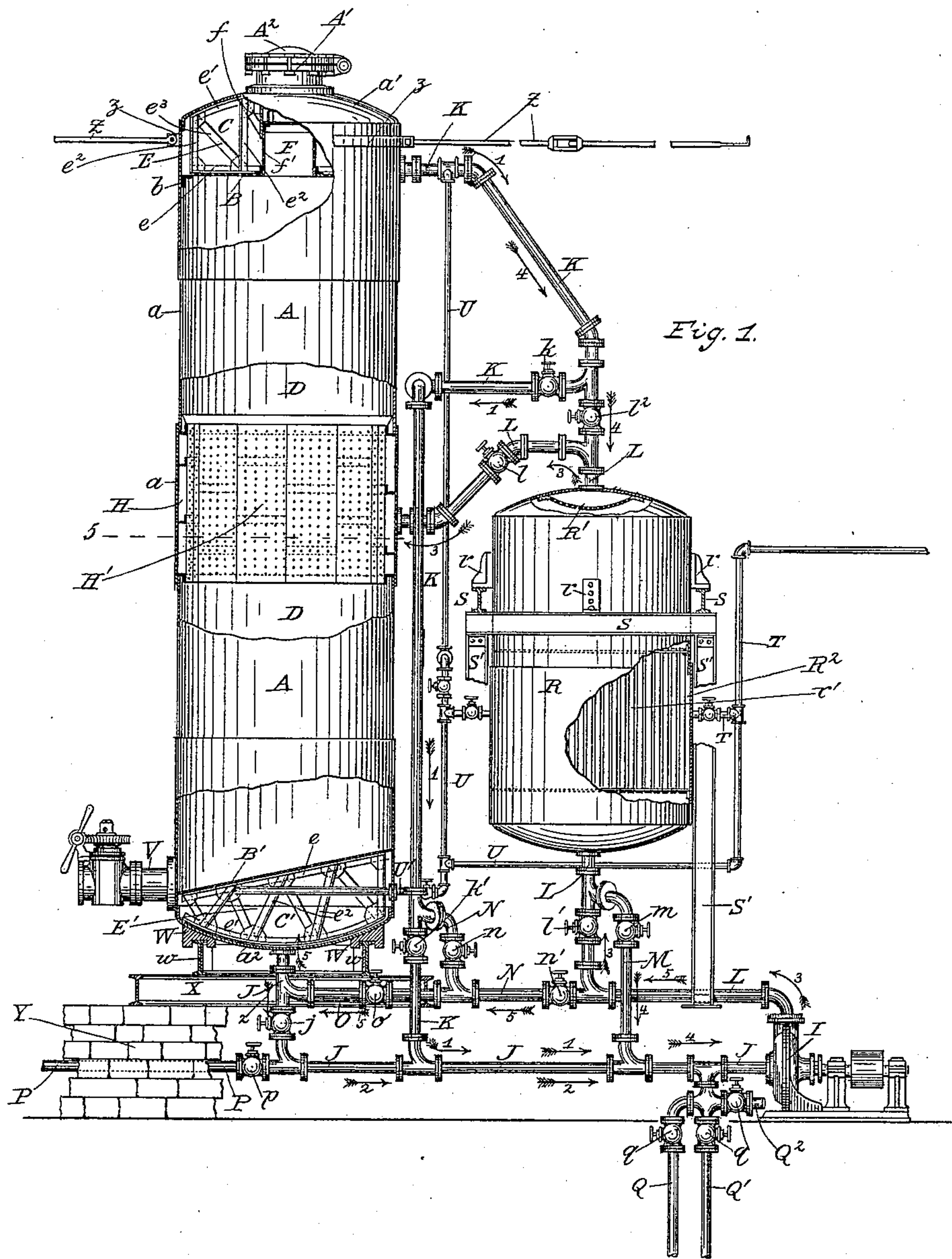


3 Sheets—Sheet 1.

APPARATUS FOR DISINTEGRATING VEGETABLE SUBSTANCES.

Patented Jan. 12, 1892.



Witnesses:
 Cha. J. Pynington
 John Herzog

John Mac Cormack
Harry L. Van Zile
Inventors

(No Model.)

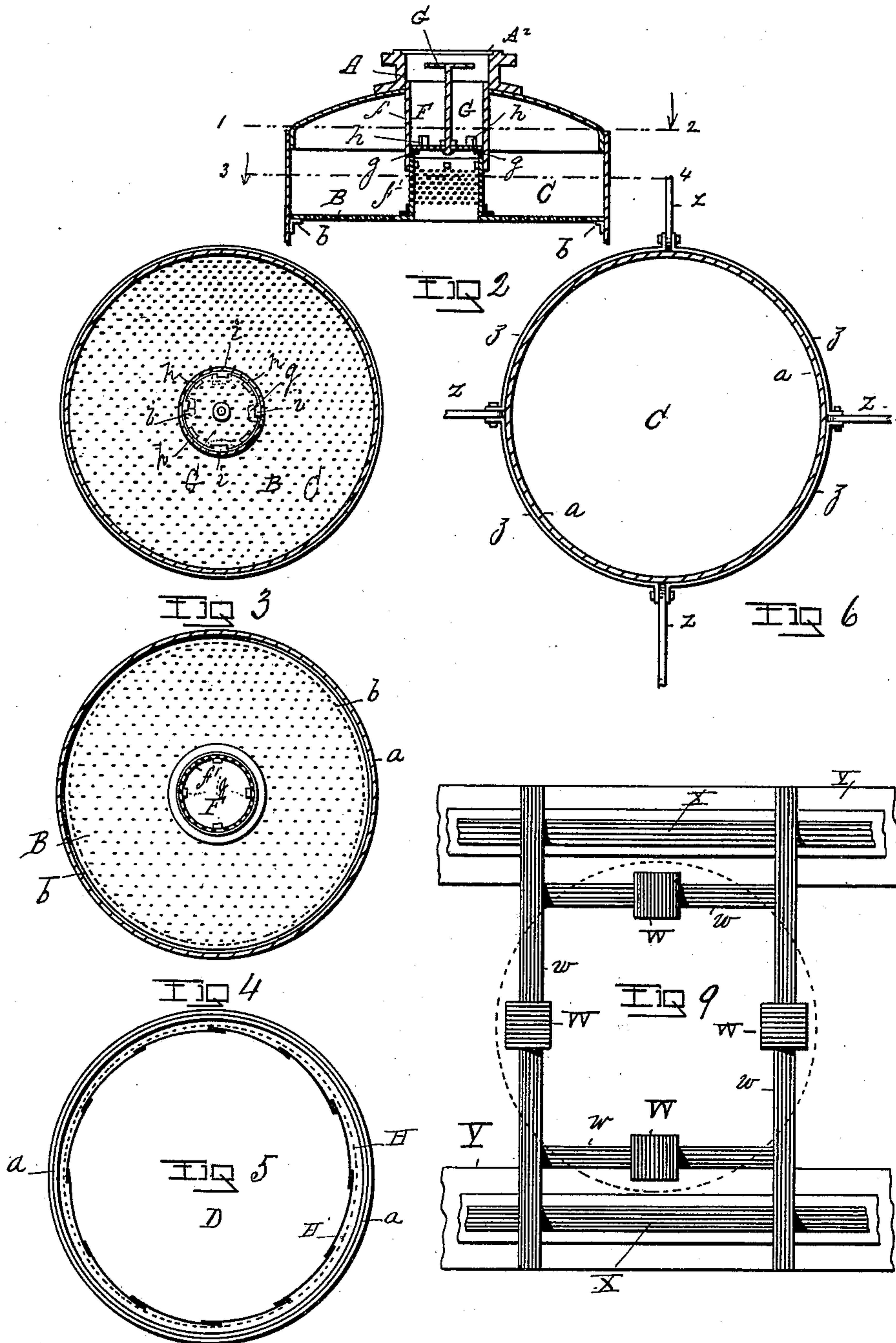
3 Sheets—Sheet 2.

J. MACCORMACK & H. L. VAN ZILE.

APPARATUS FOR DISINTEGRATING VEGETABLE SUBSTANCES.

No. 466,982.

Patented Jan. 12, 1892.



WITNESSES

Charles S. Brintnall
William A. Sweet

INVENTORS

John Mac Cormack
Harry L. Van Zile,
By Webb & Ganley

(No Model.)

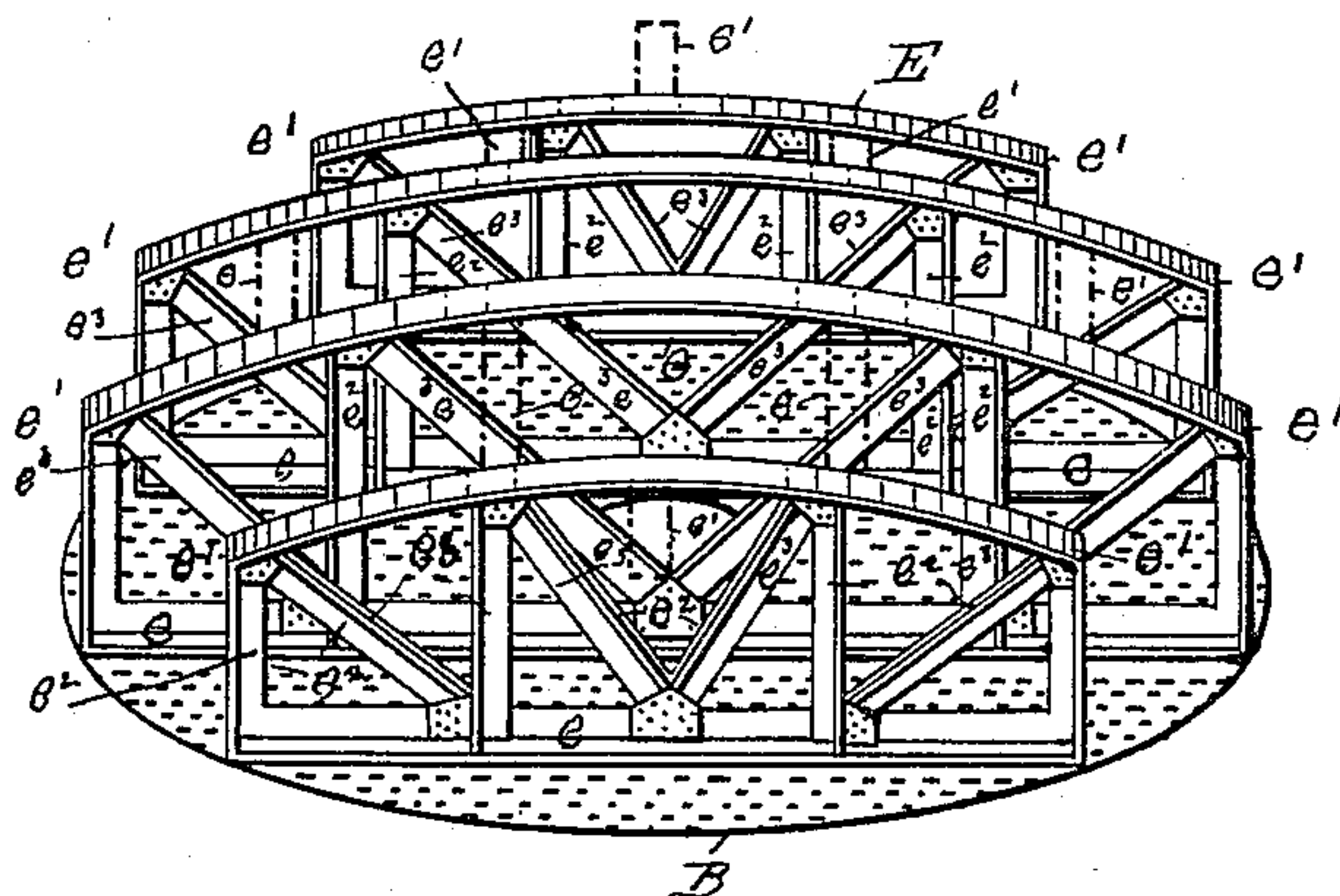
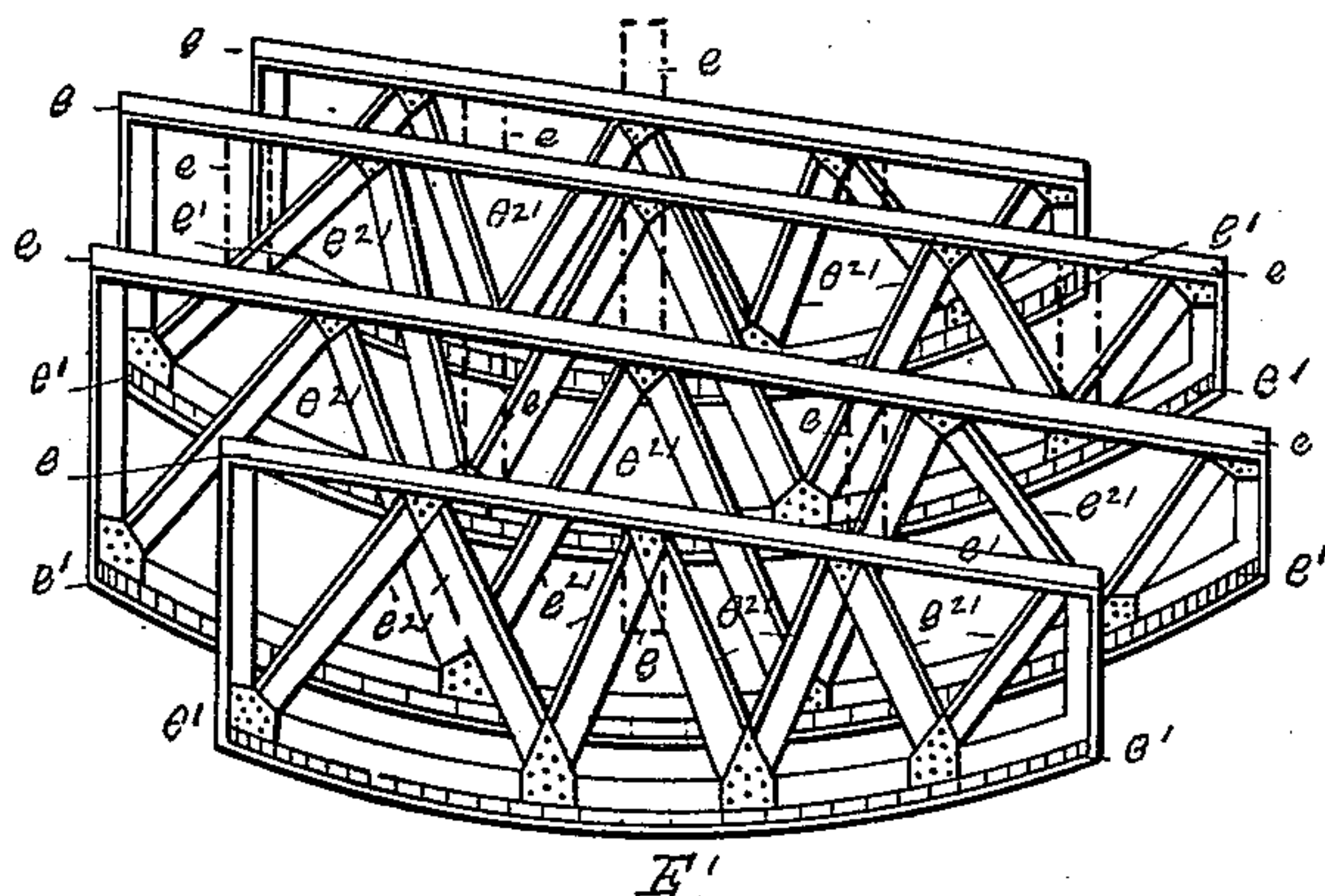
3 Sheets—Sheet 3.

J. MACCORMACK & H. L. VAN ZILE.

APPARATUS FOR DISINTEGRATING VEGETABLE SUBSTANCES.

No. 466,982.

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WITNESSES

Charles S. Prinnall
William A. Sweet

William A. Sweet

INVENTORS

John Mac Cormack

Harry L. Vanzile

by W. C. Hagan atty

UNITED STATES PATENT OFFICE.

JOHN MACCORMACK AND HARRY L. VAN ZILE, OF ALBANY, ASSIGNORS OF
ONE-THIRD TO OSCAR E. VAN ZILE, OF TROY, NEW YORK.

APPARATUS FOR DISINTEGRATING VEGETABLE SUBSTANCES.

SPECIFICATION forming part of Letters Patent No. 466,982, dated January 12, 1892.

Application filed December 14, 1889. Serial No. 333,692. (No model.)

To all whom it may concern:

Be it known that we, JOHN MACCORMACK and HARRY L. VAN ZILE, both citizens of the United States, and residents of the city of Albany, in the county of Albany and State of New York, have invented certain new and useful Improvements in Apparatus for Disintegrating Vegetable Substances, of which the following is a specification.

Our invention relates to improvements in apparatus for treating vegetable cellulose to adapt it for paper-stock and other uses; and our invention has for its object to provide by an improved construction and arrangement of the apparatus a means to make more efficient the circulation of the liquor through the material contained in the digesting apparatus, so as to improve the value of the product and quicken and make more uniform the treatment, and to increase the durability of the digester by an improved construction of the parts.

Accompanying this specification to form a part of it there are three sheets of drawings, containing nine figures, illustrating the apparatus that contains our invention, with the same designation of parts by letter reference used in all of them.

Of these illustrations, Figure 1 is an elevation of a digesting-vessel, a heating apparatus, and connecting pipes and valves for circulating liquor through the digester, with parts of the side walls of the latter and parts of the walls of the heater shown as broken out to illustrate their interior construction. Fig. 2 is a vertical section, taken through the upper end of the digester, through the man-hole passage, the tubular continuation of the man-hole passage, the diaphragm in the upper end of the digester, the mechanism for closing the tubular continuation of the man-hole passage, and with the truss-supports omitted. Fig. 3 is a section taken horizontally through the outer wall of the digester, the man-hole passage on the line 1 2 of Fig. 2, with the plate for stopping off the man-hole passage below where the section is taken, as well as the upper diaphragm illustrated in plan. Fig. 4 is a transverse section, taken on the line 3 4 of Fig. 2, through the digester-wall, the downwardly-extended tubu-

lar-form man-hole passage, with the upper diaphragm-plate shown in plan. Fig. 5 is a transverse section taken on the line 5 at the waist of the digester. Fig. 6 is another transverse section taken through the digester on a line immediately below the guy-rods and guy-rod straps, showing the latter and parts of the rods. Fig. 7 is a perspective of the truss-supports used to sustain the bottom diaphragm of the digester, with said truss-supports shown as removed from the latter, and which when in position within the digester are arranged between the diaphragm and the bottom head of the digester. Fig. 8 is a perspective of the truss-supports that when in position within the digester are arranged between the upper diaphragm and the top head of the digester, the truss-supports and the diaphragm being shown in this illustration as removed from the digester. In Figs. 7 and 8 the cross-bar connections of the truss-supports are shown by dotted lines. Fig. 9 is a plan or top view of the supports on which the lower head of the digester rests.

The several parts of the apparatus thus illustrated are designated by letter reference, and the function of the parts is described as follows:

The letter A designates the digester, which is cylindrical in form and preferably made of iron or steel and adapted to sustain pressure.

The letter *a* designates the exterior walls of the digester; *a'*, its upper head; *a²*, its bottom head.

The letter B designates a diaphragm that is perforated and arranged transversely within the digester below its upper head *a'*, so as to produce the liquor-chamber C between said diaphragm B and the head *a'*. The letter B' designates another perforated diaphragm that is arranged within the digester near its bottom head *a²*, so as to produce between the latter and said diaphragm the liquor-chamber C'. These diaphragms separate the chambers C and C' from the chamber D within the digester wherein the stock is treated. Both of these diaphragms are perforated for the passage of the liquor (used in treating the stock) into the chambers they each inclose in connection with that one of the heads of the digester to which they are separately adjacent.

The diaphragm B is held in place within the digester by means of a flange *b*, that is inwardly projected from the interior walls of the digester, on which annular flange the perimeter of the diaphragm B rests for support. This inwardly-projecting flange *b* is produced by means of an angle-iron that is bent to conform to the interior of the digester, having its vertical side riveted to the digester-shell, with the other side of the angle-iron extended inwardly to form said flange.

The letter E designates a truss-support that is arranged between the upper diaphragm B and the upper head *a'* of the digester. This truss-support consists of a series of bars *e e e*, arranged horizontally across the upper face of the diaphragm B and united together, as shown at Fig. 1. The letter *e'* designates another series of bars that are concavely curved to correspond to the inner face of the top head *a'* of the digester, as shown at Fig. 1. These two series of bars *e* and *e'* are preferably made of angle-iron and have secured between them at intervals the posts *e²* and braces *e³*, as shown at Figs. 1 and 8. The function of these truss-supports as thus made and arranged in connection with the diaphragm B is to hold the diaphragm in position and to prevent its displacement by pressure operating outwardly and upwardly from the chamber D, and the object of thus constructing the diaphragm to rest upon the flange *b* (instead of forming a flange on the edge of the diaphragm and then rigidly riveting this flange to the digester-wall, as is usually done) is to take the strain produced by outward pressure from the shell, where the diaphragm has usually been attached by a line of rivets, and transfer it to the head, where the strain is, by means of the truss E, divided up over the whole area of the head. Another advantage produced by having the diaphragm unattached to the side walls of the digester is that in expanding and contracting by heat under pressure there is no rivet-line of connection to become loosened and leaky thereby. The diaphragm B', arranged in the lower end of the digester and on which in a measure the weight of the material rests, is arranged on an incline with its lower end below the discharge-opening V and its upper end above the latter. This diaphragm B', like the other, is perforated, and is arranged to rest on a truss-support E', as shown in Fig. 1. This truss-support E' is made of bars (preferably of angle-iron) *e e* and *e'*, with the bars *e e* conforming to and attached to the slant of the under face of the diaphragm B', and the bars *e'* bent to correspond to the concavity of the head *a²*, and braces *e²¹*, connecting at their upper ends with the bars *e* and at their lower ends with the bars *e'*, each of the braces *e²¹*, where connecting at their lower ends with the bars *e'* and at their upper ends with the bars *e*, making such connection at a V-form angle, as shown at Fig. 1. The function of the truss E' is to support the diaphragm B' independ-

ently of the sides of the digester whereat the edges of the diaphragm are located and to enable the diaphragm to sustain the weight of the charge and to prevent its being forced outwardly and downwardly by interior pressure.

The letter A' designates a man-hole seat formed in the head *a'* of the digester, and this man-hole is provided with a cover A².

The letter *f* designates a tube that downwardly extends from the man-hole to produce the passage F, extending down through the diaphragm B, the lower part of the tube *f* being perforated at *f'*, as shown at Fig. 2.

The letters *g* designate lugs that are inwardly projected from the tube *f* above where perforated at *f'*, as shown in full lines at Fig. 2 and by dotted lines at Fig. 3.

The letters *h* designate blocks that are secured to the inner face of the tube *f* above where perforated, as shown at Figs. 2 and 3. These blocks are set at intervals apart and with their lower ends transversely in line and located far enough above the upper ends of the lugs *g* for the entrance between the tops of said lugs and the bottom ends of said blocks *h* of the closing-plate G. This plate G is of a disk form and has made in its perimeter notches *i*, which will register with the blocks *h*, so as to pass down over the latter to rest on the tops of the lugs *g*.

The letter G' designates a handle that is upwardly projected from the closing-plate G. When the latter is passed down over the blocks *h* and turned to a point where the notches *i* do not register with the said blocks, said closing-plate is held in position between said blocks and said lugs when it is desired to close the passage F. When it is desired to open said passage, the plate G is turned by its handle until its notches *i* register with the blocks, when it can be drawn out. This plate G may be made with perforations, and, if desired, the whole of the tube *f* may be made without perforations. When the closing-plate is removed, then the passage F connects with the digester-chamber D.

The letter H designates an annular chamber that is arranged to encircle the digester at its waist, and this annular chamber is produced by the perforated wall H', arranged within the chamber D of the digester between said wall H' and the outer wall *a* of the digester. This perforated wall is preferably connected to the wall *a'* by means of angle-iron or any other well-known means.

The letter I designates a pump that is provided with an inlet-pipe J and a main outlet-pipe L. This inlet-pipe J has branch pipes Q, Q', and Q², each of which is provided with a valve *q*, and this pipe is extended laterally at P and thereat provided with a valve *p*. The function of the pipes Q, Q', Q², and P is to supply liquor to the pump from other sources than the digester. This pump-supply pipe J is extended laterally and upwardly to connect with the bottom chamber C² of the digester, so as to draw liquor therefrom, and

this upward extension of said pipe J is provided with a valve *j*. This supply-pipe J also connects with a branch pipe M, having a valve *m*, and also with the pipe K, having a valve *k'*, from either or both of which connections, when the proper valves are opened and others closed, liquor can be drawn by the pump from the digester, as will be subsequently described. The pump-discharge pipe L has connected lateral extension-pipes N and O, the latter connecting with the upward extension of the pipe J above its valve *j*, and where extended toward the pump to connect with the pipe part N said pipe part O is provided with a valve *o*. The pipe part N is provided with a valve *n'*, and has an upwardly-extended branch that is provided with a valve *n* below where it connects with the pipe K. The pipe L has an upwardly-extended branch that connects with the heater R, and this upward extension of the pipe L, below where it connects with the branch M of the pipe J, is provided with a valve *l'*. The upper part of the pipe L, where it connects with the top of the heater R, is made with a horizontally-extended branch that connects with the chamber H, surrounding the digester at the waist, and where thus laterally extended this pipe L is provided with a valve *l*. Above the heater and from where thus laterally extended this pipe L connects with the pipe K, and between the latter connection and the top of the heater it is constructed with a valve *l''*. The pipe K at its upper end connects with the chamber C' at the top of the digester and therefrom extends downwardly on an incline to connect with the pipe L, as before described, and from the latter connection extends toward the digester, it having in this lateral extension a valve *k*, and from thence it extends downwardly to connect with the branch pipe N and the pump supply-pipe J, as before described, said pipe K having a valve *k'* arranged thereon below where it connects with the pipe N. With the pipes J, K, L, M, N, and O, with their branch connections, as thus arranged and provided with valves, by means of the pump I a series of novel circulations of the liquor through the digester are easily accomplished. Thus by opening the valve *j* on the pipe J and the valves *k* and *k'* on the pipe K, opening the valve *l* on the pipe L, opening the valve *l* on the upper lateral extension of the pipe L, and closing all the other valves, liquor can be drawn from the top and bottom of the digester and forced by the pump into the annular chamber H, surrounding the digester. By opening the valves *k* and *k'* on the pipe K, opening the valve *l* on the upper lateral extension of the pipe L, opening the valve *m* on the pipe M, opening the valves *n'* and *o*, and closing all the other valves liquor can be drawn from the top and waist of the digester and discharged into the bottom of the latter. By opening the valve *j* on the pump supply-pipe J, opening the valves *l'* *l* *l''* on the

pipe L, and closing all the other valves liquor can be drawn from the bottom of the digester-vessel and delivered in two streams, one of them entering the annular chamber H and the other the top of the digester. By opening the valve *j* on the pump supply-pipe J, also the valves *n'*, *n*, and *k* on the pipes N and K, opening the valve *l* on the upper lateral extension of the pipe L, opening the valve *m* on the pipe M, and closing all the other valves liquor can be drawn from the bottom of the digester and the annular chamber of the latter and discharged into the top of the digester. The pipe L, leading from the pump I, as before described, enters and leads from the heater R, and when steam is applied to the latter it serves to heat the liquor passing through it. When steam is not applied thereto, the heater R acts as a continuation of the pipe L. By thus circulating the liquor through the mass alternately in different directions the stock is prevented from becoming impacted through the action of gravity and outdraft, and the action of the liquor is more prompt in treating the material than where the material is quiescent, and to these varying currents means is furnished to re-heat the liquor while passing from one part of the digester to another.

The letter R designates the heater, which is arranged adjacent to the digesting-cylinder A, and is so connected with the pipes before described that the liquor when drawn from one part of the digester A to be discharged into another part thereof shall pass through the heater under the draft action of the pump, or by an arrangement of the valves and pipes before described liquor may be drawn from the parts of the digester and then forced through the heater to be discharged into the digester. In either instance the liquor will be reheated while passing through the heater. This heater R is shown as supported on brackets *r*, resting on beams S, supported on posts S'. It is shown as cylindrical in form. This heater is provided with steam-supply pipes T, connecting with a steam-boiler, (not shown,) and these steam-pipes communicate with the steam-chamber R² of the heater to supply steam thereto, with means provided for the escape of the condensation, which are not shown.

The letters *r'* designate the pipes through which the liquor passes, and these pipes are vertically arranged in the steam-chamber, and at their ends these pipes communicate with the liquor-chambers at the top and bottom of the heater. Liquor is forced into and through said heater by the pump I and its connecting pipe L or drawn through said heater by said pump by means of the pipe L, connecting with the top of the heater and the digester, and the branch pipe M, connecting with the pipe L and the bottom of the heater, and with the pump-supply pipe J when the valves on the pipes L, M, and J are arranged for such movement of the liquor. As thus made

and connected said heater is adapted to heat liquor by having it drawn from the digester to pass through it, or to heat liquor when drawn from the digester by the pump, and by the latter forced through the heater, which is advantageous in various ways in the treatment of stock within the digester, enabling the operator to apply hot liquor to either or any part of the digester.

The letter U designates a live-steam pipe leading from a boiler (not shown) or from the heater R and connecting with the upper end of the pipe K, which latter communicates with the chamber C. This pipe U has a branch pipe U', that connects with the chamber C' of the digester. These pipes T U U' are provided with valves for controlling or directing the passage of the steam into the chamber R² of the heater and the chambers C and C' of the digester, as may be required.

The letter V designates a blow-off pipe provided with a valve, by which the contents of the digester are discharged.

The letters W designate blocks, the upper ends of which are concavely rounded out to correspond to the convexity of the lower head a^2 of the digester when the latter rests thereon. When the head of the digester is square and at right angles to the sides and without convexity, then the tops of the blocks are made coincidently square. These blocks rest upon a foundation sufficiently strong to sustain the weight they have to support. As shown in the drawings, this foundation is produced by I-beams w , which are connected together and secured in any suitable manner for holding each member thereof securely joined to the others, so as to rest on a supporting-beam X, resting on masonry. When masonry is employed in lieu of the I-beams, we prefer to make said masonry in its ground plan of a U form, so as to admit of access to the bottom of the digester, with the blocks W resting on the masonry Y. Where the lower end of the digester rests on three or more blocks W, the usual brackets or lugs, which are riveted to the digester sides to rest on beams or masonry, are omitted, and thus all the consequent contingency of leakage caused by the hanging strain of the digester upon the rivets connecting the brackets or lugs with the digester are avoided, and the expansion and contraction of the digester between its heads is uniform and not interfered with by the brackets or lugs on which the digester hangs.

The letters $z z$ designate a guy-strap which encircles the digester near its upper head, and Z guy-rods connected to said strap, running to any convenient point of connection to steady the digester, thus standing with its lower end upon the supporting-blocks W and to prevent any lateral tendency of movement.

To render the circulation of the liquor more diffusive within the tubes of the heater, a plate R' is placed between one of the end chambers of the heater R and the pipe L.

This plate R' can, if desired, be made to have a diameter equal to that of the heater-chamber in which it is placed, although we prefer to make it about half the diameter of the heater. This plate is perforated, so that the area of the perforations will be equal in areal capacity to that of the pipe L. The heater may be made with a man-hole and cover to obtain access to the interior, if desired, and the chamber on the upper end of the heater is preferably made to have the same vertical depth as the pipes r' .

We are aware of the fact that a digester has been patented in which pipes and a pump provided with a two-way cock were arranged so that liquor could be drawn from the upper end of the digester and discharged into the lower end of the latter, and also drawn from the lower end of the digester and discharged into the top thereof, which construction of a pump made with a two-way cock we hereby disclaim. We are also aware of the fact that the liquor drawn from a digester for treating paper-stock and returned thereto has immediately been passed through a heater. We are also aware of the fact that a digester has been constructed with circulating-pipes, and a connecting-pump by which liquor can be drawn from an annular chamber at the waist of the digester and discharged in two currents, one of them entering the top of the digester and the other the bottom, as is shown in English Letters Patent No. 11,848, of 1888. Our improvements upon these older constructions before named enable the person operating the apparatus to apply to the digester circulations of the liquor which could not be had by these older patented mechanisms alluded to.

It is well known that the stock within a digester as it becomes cooked and softened by the action of the alkaline liquor is made more pulpy, and that while in this condition the liquor circulates less freely through it. Hence liquor supplied in alternating currents either into or from out the ends of the digester will cook more rapidly that portion of the material that is nearest to the point of its entrance and affect less those portions which are more remote. With this portion of the better-cooked material arranged at the points at which the liquor enters and is drawn in, where it will retard the circulation of the entering liquor through the mass, so, also, where the liquor is continuously drawn from the waste and discharged into the ends of the digester.

By our improvement in the arrangement of the circulating-pipes as provided with valves and connected with the pump, a series of short circulations through parts of the digester are made available to meet local conditions of the stock, (found by testing,) and by which the desired local effect of heat and liquor can be applied thereto without overtreating portions of the stock already sufficiently cooked, none of which results can be

performed by liquor drawn continuously from the annular chamber and discharged into the top and bottom of the digester, or by an apparatus adapted to draw liquor from the top of the digester and discharge it into the bottom of the latter or to draw it from the bottom and discharge it into the top of the digester.

By using the ordinary and well-known treatment of the stock had by forcing the alkaline liquor drawn from the top into the bottom, or vice versa, as shown and described in the patent to Harding and Dixon of May 8, 1866, until the material at the upper and lower ends of the digester is sufficiently treated, and then after testing the stock to apply either of the local circulations which we are enabled to use (by the arrangement of pipes, valves, and pump, which we illustrate and describe) to such portions of the stock as are underdone, we are enabled to reach the latter without forcing the liquor through and applying extra heat to those portions of the stock already sufficiently treated, and thus to overcook the latter by such proceeding.

The arrows 1 and 2 designate the currents of the liquor drawn from the top and bottom of the digester to the pump and the arrow 3 the course of the liquor from the pump to the annular chamber, and the arrow 4 designates liquor drawn from the top of the digester from the annular chamber and the arrow 5 the course of this liquor when discharged into the bottom of the digester, and which directions, as thus indicated by the arrangement of the various valves, produces the several circulations named.

What we claim as being our invention, and desire to secure by Letters Patent, is—

1. The combination, with a digester for treating paper-stock, said digester being made with a chamber at each end separated from the digester interior by a perforated diaphragm and having an annular chamber at the waist connecting with the digester interior, substantially as described, of a pump having a draft-supply pipe connecting with the digester-bottom and having branch draft-supply pipes connecting with the annular chamber and top of the digester and having branch discharge-pipes connecting said pump with

the annular chamber the top and bottom of the digester, with valves on said draft and discharge pipes arranged to produce either of the several circulations of the liquor through said pipes into and from out of the digester, substantially as herein described, and for the purposes set forth.

2. The combination, in a liquor-heating device and with a head thereof, of the diffusive plate R, provided with perforations and forming with said head a liquor-chamber between the open ends of the liquor-circulating tubes and the outlet (or inlet) of said heating device, substantially as and for the purposes set forth.

3. The combination, with the digester-vessel and supporting devices *w* X or their described equivalents, of the supporting-blocks W, three or more, having bearing on the lower head of said vessel at intervals apart, substantially as and for the purposes set forth.

4. The combination, with an upright digesting-vessel, of the supporting-blocks W, three or more, and the foundation *w* X or its described equivalents, and the guy-rods Z Z, substantially as and for the purposes set forth.

5. The combination, with the digester A, made with the flange *b* projecting inwardly from its interior wall, of the diaphragm B, arranged to rest on said flange, and the truss E, arranged between said diaphragm and the head of the digester, substantially in the manner as and for the purposes set forth.

6. The combination, with a digester having a perforated diaphragm arranged between its head and the digester interior, substantially as described, of a truss-support arranged between said head and diaphragm, such truss-support being made with posts and braces, each of which at one of its ends is attached to a transverse bar on the interior of the digester-head, and each of which posts or braces at their other ends is attached to a transverse bar on the diaphragm, substantially in the manner as and for the purposes set forth.

JOHN MACCORMACK.
HARRY L. VAN ZILE.

Witnesses:

CHAS. S. BYINGTON,
JOHN HERZOG.