(No Model.)

# W. O. COMSTOCK.

## LINING FOR PULP DIGESTERS.

No. 453,076. Patented May 26, 1891.

Fig. 1.

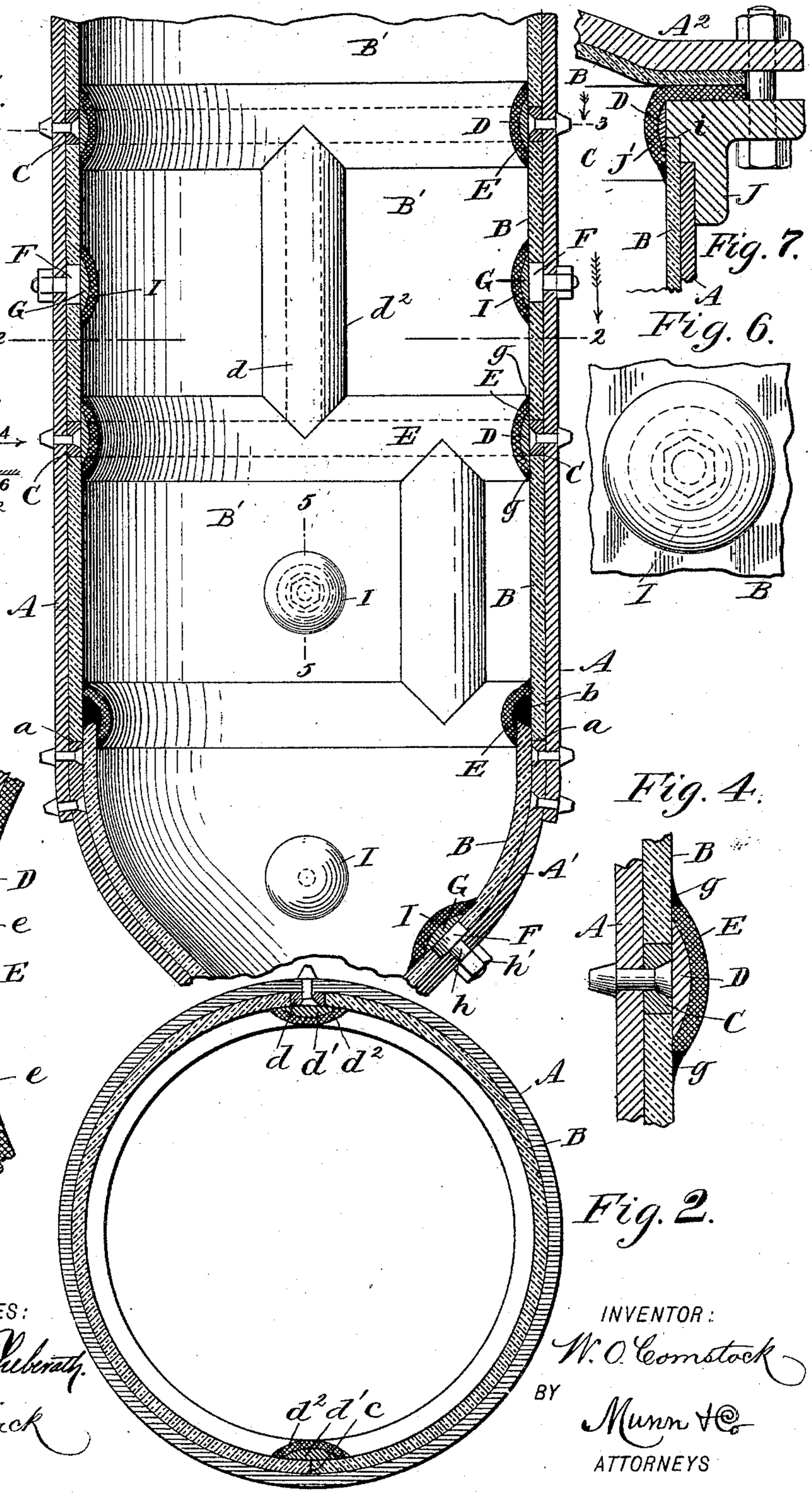


Fig. 7.




Fig. 6.

Fig. 5.

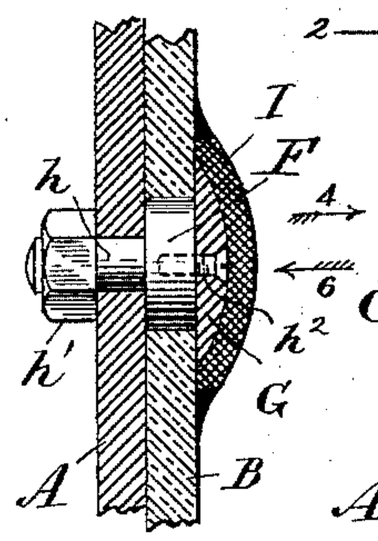


Fig. 3.

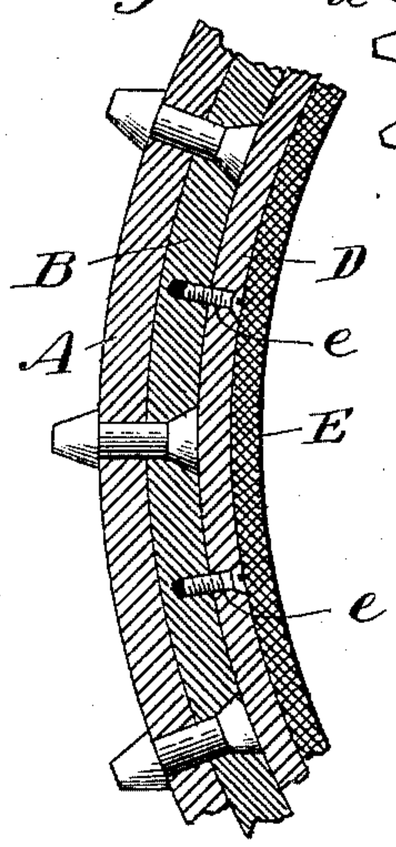


Fig. 4.




Fig. 2.

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## LINING FOR PULP-DIGESTERS.

SPECIFICATION forming part of Letters Patent No. 453,076, dated May 26, 1891.

Application filed November 12, 1890. Serial No. 371,149. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM O. COMSTOCK, of New York, in the county and State of New York, have invented a new and useful Improvement in Lining for Pulp-Digesters, of which the following is a full, clear, and exact description.

The invention relates to improvements in the lining for pulp-digesters having walls of iron or steel; and it has for its objects to furnish an acid-proof sectional lining therefor, which by its formation and composition will be adapted to remain intact and acid-resistant when in service and be non-liable to rupture at its joints, which might result from a want of support for the several lining-sections or from unequal expansion and contraction as compared to that of the shell.

To these ends my invention consists in the construction of the lining, its manner of support within the shell, and the use of a peculiar combination of metals to produce said lining, whereby efficiency in service is secured at a moderate cost for material and manufacture, as is hereinafter shown, described, and claimed.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a side elevation in section of a principal portion of a digester-shell and its lining, showing improved means for the support and attachment of the lining to the shell. Fig. 2 is a plan view in section of a shell, its lining, and supports for the lining, taken on the line 2 2 in Fig. 1. Fig. 3 is an enlarged plan in section of a portion of the digester-shell and interior parts connected therewith, taken on the line 3 3 in Fig. 1. Fig. 4 represents an enlarged broken section, vertically taken, of a portion of the digester-shell and interior parts, showing the supports for a lining-section, two sections at their adjacent edges, and means to seal the joints between the lining-sections and supports therefor, the view indicating a portion of the device opposite the arrow 4 in Fig. 1. Fig. 5 is an enlarged vertical section of the digester-wall, the lining, and a supporting device for said lining, which also binds the lining and shell together, the section being taken on the line 5 5 in Fig. 1. Fig. 6 is a view, enlarged, of a portion of the lining and securing device therefor, viewed in the direction of the arrow 6 in Fig. 5; and Fig. 7 is a detached vertical sectional view of a portion of the digester-cover, its lining, the digester-shell, an angle-iron top ring on its exterior at the upper edge of the shell, a lining-ring of alloy, a re-enforce ring, and a joint-covering ring.

The disintegration of wood in digesters to afford pulped fiber for the manufacture of paper requires a strong acid solution and the application of heat, and as the acid will corrode the iron or steel shell preferably employed to form the digester-chamber, and by the formation of rust discolor the paper-stock, a lining of acid-resisting material or composition must be provided therefor.

Digester-chambers for wood pulping are made of considerable capacity. Hence it is desirable, in order to facilitate the manufacture of the lining, that it be made in several pieces or sections, which are of proper form to fit in and completely cover the interior surface of the exterior shell, and such sections must be joined so as to seal the points of junction to prevent leakage. An acid-proof lining for the purpose indicated (to avoid injury to its body and preserve the integrity of its joints) should be composed of material that will have about the same ratio of expansion and contraction when exposed to fluctuations of heat as are incidental to the iron or steel shell of the digester, and each section of the lining should be independently supported from the shell, so as to avoid injury to lower sections of the lining when in service. The essential features which have been indicated as necessary to secure the continued service and avoidance of injury to the apparatus or product are embodied in the improved device, which will now be specifically described.

The shell A of the digester-chamber is preferably made of iron or steel plate, as usual. The complete upper and lower portions of ordinary formation are not shown, it being well understood that the bottom of the shell is contracted to afford an exit-passage, that is sealed by any preferred means, and the top of said shell closed by a cover which is removable, a portion of said cover being shown

in Fig. 7. Within the shell A A′ an acid-proof lining B is located, which is made of a metallic composition, the formula for the preparation of said composite metal being hereinafter given. As shown in Fig. 1, the lower section of the lining B preferably rests upon the upper and inner edge *a* of the lapped portions of the shell A, where the conical bottom portion A′ of said shell is joined by rivets to the upper cylindrical wall of the same, the edge *a* being the upper terminal of the bottom piece named. The lining of the bottom A′ overlaps the point of junction *a*, and at *b* is brazed or soldered to the inner surface of the lining of the shell A, so that an acid-proof joint is there afforded which renders the bottom lining continuous with the lower lining-section of the side wall, and, as shown, a joint-covering ring E is placed upon the lining of the bottom A′ and shell A over the joint *b*, which ring is adapted to closely fit on the joint and rest on the lining-sections, to which it is brazed or soldered, forming acid-proof joints therewith. The lining of the digester-shell A may be in the form of several cylindrical integral rings of suitable height, or, preferably, each lining-ring may be composed of two or more separate pieces that have their vertical edges in close contact, as shown at *c* in Fig. 2; or the vertical bars *d* may be interposed between the upright edges of the ring-sections, as shown in the same figure. Said bars *d*, being secured to the shell A, provide ledges against which the pieces of a ring B closely impinge. Any necessary number of lining-rings B′ are provided to cover the interior of the shell A, and between the adjacent edges of two rings there is placed an annular ledge C, made of the same metal as the shell A. Said ledges alternate in position with the lining-rings B′ and afford a support for them, as a firm connection is produced between the ledges and shell by bolts or rivets. The annular ledges C are made of an equal thickness with the lining-rings B′, so that a level surface is afforded on the interior of the lining at this stage of construction.

Upon the inner surface of the iron or steel ledges C a preferably iron or steel re-enforce-ring D is secured on each by the screws *e*, which re-enforce rings have a plano-convex form in vertical section, their exterior plain surfaces being in close contact with the faces of the ledges C and their convex surfaces inwardly projected. The width of the re-enforce rings is greater than that of the ledges C, so that a bearing-contact is produced between the rings D and the adjacent surfaces of the lining-rings B′. If the vertical ledges *d* are used, as has been previously explained, the ends of such vertical bars should fit closely against the ledges C and have equal width and thickness therewith.

Over the convex inner surface of each ring D a joint-cover E is imposed, which latter are made of plate-metal or metallic composition, which is slightly yielding in its nature, and preferably has a coefficient of expansion under heat, which is uniform with that of the lining-rings B′. The joint-covering pieces E are made to bear upon the convex surface of the rings D, having sufficient width to impinge upon the lining-rings B′, to which these bearing-edges are brazed or soldered, as at *g* in Fig. 4. Should there be vertical ledges *d* employed to separate the component pieces of a lining-ring B, as before mentioned, these ledges are covered by the re-enforce bars *d′* and joint-covering plates $d^2$, as shown in Fig. 2, these cover-plates having a close contact with the joint-covering pieces E, and are thereto attached by soldering or brazing, so as to produce an acid-proof joint between the parts, and the same construction is observed if the ring-pieces are adjoining, as at *c* in Fig. 2.

In large digesters it is of advantage to afford support at different points to the lining of the side, top, and bottom of the chamber, and to this end the isolated clamping-studs F are provided, the form of which support, with its adjuncts, is plainly indicated in Fig. 5. The studs F are alike, and each consists of a short cylindrical body of a length equal to the thickness of the lining material, having a concentric reduced bolt or rivet-body *h* formed on one end. The portions *h* of the studs F are inserted through perforations made in the shell, bottom, or top of the digester at such points as most need support, and are therein secured by the nuts *h′* or other means, and upon the inner ends of the studs, which are flush with the inner surface of the lining, the re-enforce disks G are placed and preferably secured thereto by the screws $h^2$. The re-enforce disks mentioned are of equal dimensions and have a nearly plano-convex form, and are of such proportionate diameter to that of the studs F as will cause them to overlap the studs and rest upon the lining of the digester side, bottom, or top, as the case may be, and have a close contact therewith, so that the insertion and adjustment of the screws $h^2$ will bind the re-enforce disks on the lining and prevent it from bulging, while the body of the studs afford a support that will counteract a sagging tendency with regard to the lining of the bottom portion A′.

Upon the re-enforce disks G concavo-convex joint-covering pieces I, which are of suitable proportionate dimensions, are placed and secured by their edges to the lining B in an acid-proof manner. The support afforded by the form of construction hereinbefore described by compensating for the slight difference in expansion and contraction between the parts serves to produce durable acid-proof joints at all points liable to rupture from that cause.

Referring to Fig. 7, wherein the form of the joint between the lid $A^2$ and the digester-shell A is shown, it will be seen that an angle-iron ring J is secured on the shell and affords a level top surface for the support of the lid $A^2$,

which is bolted thereon, a re-enforce ring D, of plano-convex form, serving to seal the joint at *i*, and upon said ring a joint-covering ring J′ is imposed, which has its lower edge secured to the lining B, while the upper portion is extended to lie upon the horizontal face of the angle-iron ring J. The cover or lid $A^2$ is also provided with a lining B, which extends to the periphery of the lid and ring J, so that a tight joint is produced when the lid is bolted in place on the shell A.

A coating of acid and heat proof paint or varnish is applied to the inner and outer surfaces of the digester-shell wall, bottom portion A′, and lid $A^2$ to protect the same from acid, gas, or steam, so that any minute leaks from the interior will not injuriously effect the durability of the structure.

The metallic alloy preferably used for the manufacture of the entire lining B consists of the following-named metals in about the proportions given: lead, seventy-five parts; antimony, seventeen parts; tin, eight parts. To the metals mentioned a small percentage of copper should be added, which will supplement the amount of that metal usually found in lead of commerce sold under the trade-name of "chemical" lead. The alloy resulting from the melting together of the metals named and in the proportions about as stated will afford a hard acid-proof alloy, having a co-efficient of expansion nearly equivalent to that of the iron or steel shell, so that if the device is manufactured in a workmanlike manner a durable and comparatively cheap digester will be produced.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with a cylindrical shell and circular ledges riveted or bolted on the interior surface of the shell, of non-corrosive lining-rings composed of metal or alloy softer than the shell and ledges, each ring supported on a ledge, and a joint-covering ring secured at its edges over the ledges and upon the edge portions of adjacent lining-rings, substantially as described.

2. The combination, with a cylindrical shell, a series of inwardly-projecting ledges bolted or riveted on the shell at spaced intervals, and a series of lining-rings composed of alloy softer than the shell or ledges having a co-efficient of expansion and contraction nearly equal thereto, of re-enforce rings secured on the ledges and loosely overlapping the lining-rings at their adjacent edges, and joint-covering rings of metal or alloy similar to the lining-rings in composition and soldered or brazed at their edges to said lining-rings, substantially as described.

3. The combination, with a cylindrical shell, a series of annular spaced ledges secured on the inner surface of the shell, and a series of lining-rings of alloy having their edges in contact with the ledges, of re-enforce rings which overlap the ledges and have contact with them, and joint-covering rings of slightly-yielding metal, which are imposed upon the re-enforce rings and have their edges secured acid-tight upon the adjacent lining-rings, substantially as set forth.

4. The combination, with a cylindrical shell, interior spaced ledges of metal similar to the shell and riveted or bolted thereto whereon lining-rings are seated, and lining-rings of lead or alloy, which are divided vertically into sections, of vertical ledges bolted or riveted to the interior of the shell between the edges of the lining-ring sections, re-enforce pieces secured on the circular ledges and vertical spacing-ledges having a plano-convex form in cross-section and adapted to loosely bear upon the edges of the lining-ring sections, and joint-covering rings which are adapted to loosely bear in the re-enforce bars and rings, and which are secured by their edges to adjacent lining-rings, substantially as described.

5. The combination, with the cylindrical shell, conical bottom, and lid of a digester and linings therefor made of alloy, of supporting-studs affixed to the outer wall of the digester, which project inwardly and penetrate the lining, re-enforce disks secured on the inner ends of the studs, and concavo-convex cover-pieces for the disks, which have their edges secured to the lining material with acid-proof joints, substantially as set forth.

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Witnesses:
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