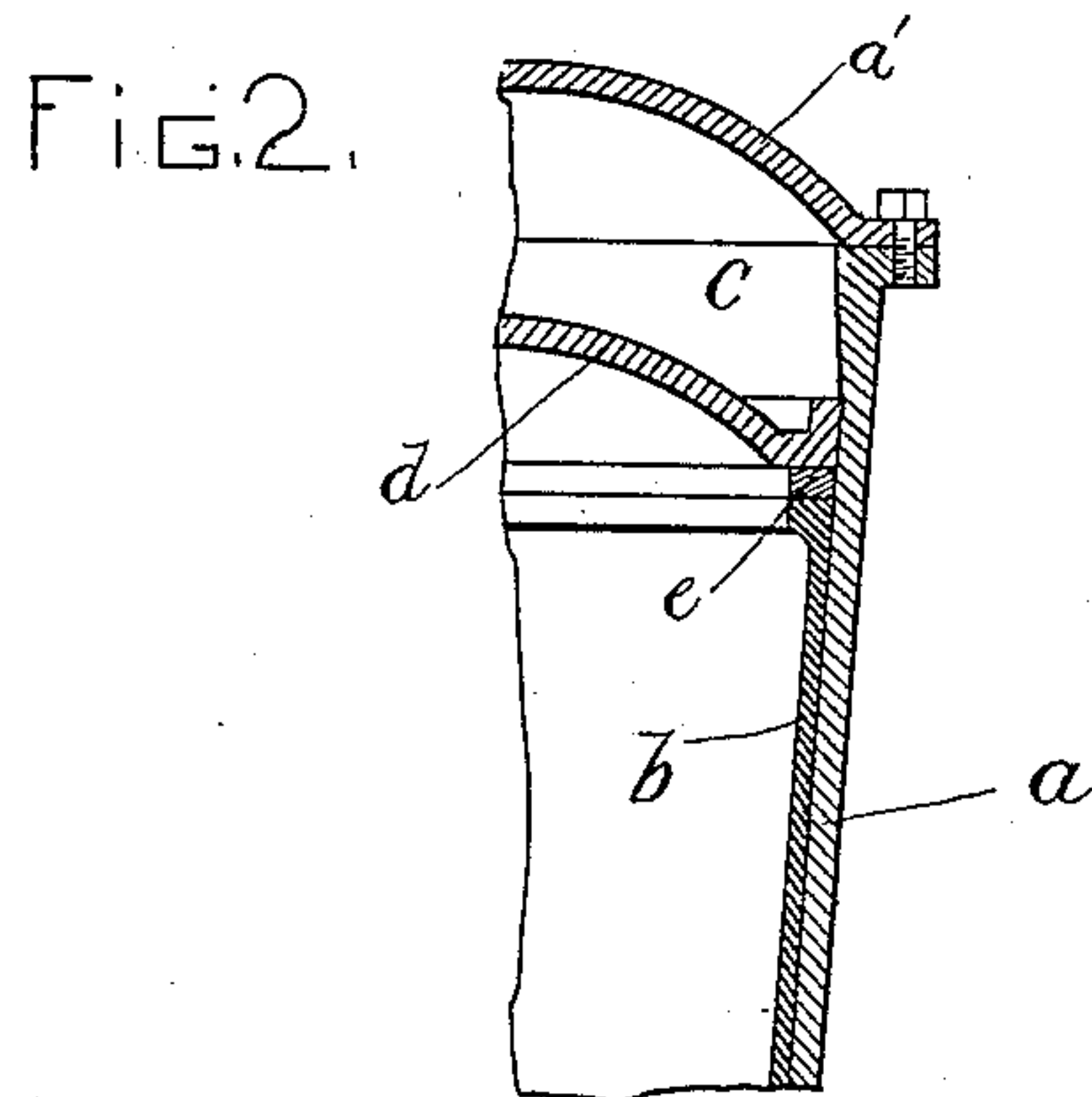
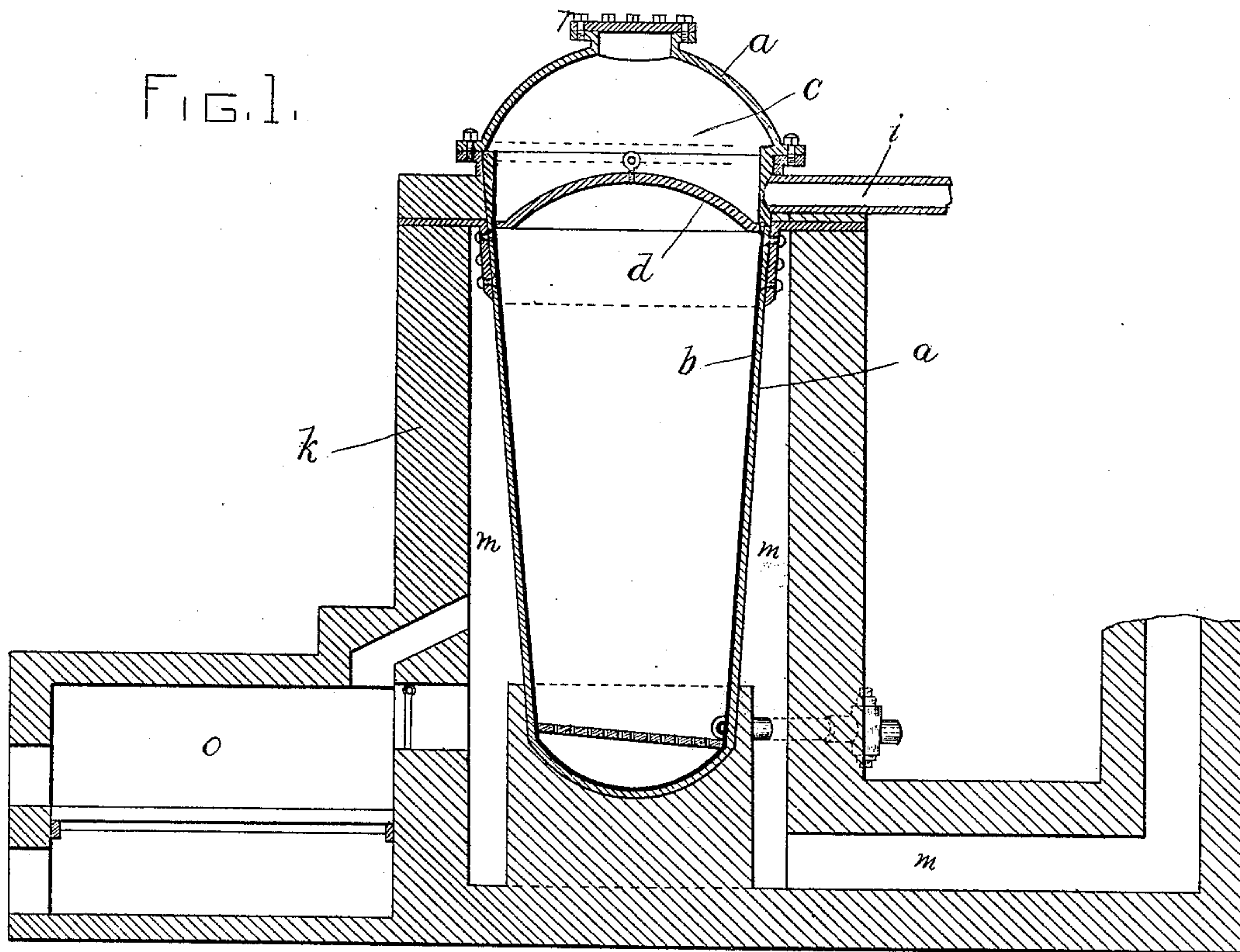


(No Model.)

S. SMITH.
LEAD LINED DIGESTER.

No. 428,149.

Patented May 20, 1890.



WITNESSES.

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UNITED STATES PATENT OFFICE.

SIDNEY SMITH, OF CAMBRIDGE, MASSACHUSETTS.

LEAD-LINED DIGESTER.

SPECIFICATION forming part of Letters Patent No. 428,149, dated May 20, 1890.

Application filed April 9, 1889. Serial No. 306,591. (No model.)

To all whom it may concern:

Be it known that I, SIDNEY SMITH, of Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Lead-Lined Digesters, of which the following is a specification.

This invention has for its object the construction of a boiler, either upright or horizontal, which is heated either by a suitable furnace or by the introduction of steam produced in a separate boiler. The boiler constitutes what is known in the manufacture of paper from wood or any vegetable fiber as a "digester." The proper vegetable fiber is boiled or "cooked" in such digester with some suitable solvent agent capable of completely freeing the fiber from all incrusting substances, like gums and resins. In all cases where this solvent agent is liable to attack the metal of which the digester is composed it is necessary to interpose between the solvent agent and the metallic walls of the digester some medium in itself unaffected by the solvent agent which shall protect the digester from solvent action during the process of cooking. Whenever lead has been used for a protecting medium or lining for an iron or steel digester, it has been found that the lead is subject to so much wear and tear, owing to the extremes of temperature, that it is a matter of great expense and annoyance to keep the lining in proper condition.

In practice the lining of sheet-lead is held in place against the iron or steel shell by a great variety of fastenings, and as the coefficients of expansion of lead and iron are widely different, and as they are both heated through a wide range of temperature, the lead finds no outlet for its excess of expansion over that of the iron, and the result is constantly repeated—folding or "buckling" of the lead and an equivalent racking strain upon the iron shell. Cracks and holes are thus produced in the lead, while the iron is dangerously weakened. To provide for the free expansion of the lead is the object of my invention.

The shell of my digester is best made of iron or steel plates solidly butt-welded by electricity in such a manner as to produce

one homogeneous piece composing the boiler; but the sheets may be butted nearly together and both edges beveled, so as to form a slight open dovetailed joint, and bound together by a band of steel or iron, which covers the joint on the outside of the boiler and is riveted to both plates. The open dovetailed joint is then to be fitted with lead or any substance known to withstand the liquid contents of the boiler. By such a joint a perfectly smooth interior to the boiler is produced. Said joint is described and claimed in another application filed concurrently herewith.

The cylindrical shell is made larger at one end than at the other, and accordingly has a true taper externally throughout its entire length. The lead lining is made either of sheet-lead fitted and soldered together on the interior surface or the lead is melted and poured into the space between the boiler, and a suitable form let down into the boiler-shell, of a size such that the lead casting or lining thus produced shall be of the desired thickness and entirely cover the bottom and sides of the boiler. If the lining is made of sheets, the latter can be fitted and joined in the boiler, or may be fitted together outside and then let down into the boiler. The latter proceeding is facilitated by the taper shape of the boiler.

One end of the boiler is provided with an expansion-joint analogous to the joint of the same name in steam-pipes. Upon the lead lining, which reaches nearly to the head of the digester, rests a movable circular head, which is tightly packed between the lead and itself by asbestos or any suitable substance known to resist the chemical action of the liquor in the digester. The space between the two heads—viz., the outer or true head and the movable inner head—may receive steam, or may be provided with springs or other means for exerting a holding-down yielding pressure upon the movable head. The movable head constitutes a piston working against a regulated resistance and adapted to rise and fall as the lead lining expands or contracts. Furthermore, owing to the tapering form of the digester, which is larger at the end provided with the expansion-joint, expansion from all parts of the digester tends to find a relief or outlet

at this end. Both of the heads mentioned may be provided with man-holes for the introduction of stock, &c., and the digester is fitted with all gages, valves, and connections necessary for safety and for determining the condition of the contents during the cooking.

In the accompanying drawings, forming a part of this specification, Figure 1 represents a vertical section of my improved digester and a setting or casing therefor. Fig. 2 represents an enlarged section of a portion of the digester.

The same letters of reference indicate the same parts in all the figures.

In the drawings, *a* represents the outer shell of the digester, which is preferably of cylindrical form and tapers or increases gradually in diameter from its lower to its upper end, said shell being made of steel or iron plates suitably connected.

b represents the lead lining, which is formed to fit the interior of the digester and extends nearly but not entirely to the top of the same, its upper end being open. A space *c* exists between the upper end of the lining and the upper end or head *a'* of the digester. In said space is fitted the movable head or piston *d*, which bears on a packing *e*, of asbestos or other acid-resisting material, interposed between the said head and the upper end of the lead lining, and constitutes a vertically-movable cover for said lining. I make the portion of the outer shell which projects above the lining of uniform diameter, instead of tapering, like the major portion of the digester, so that the vertical movements of the movable head will not affect the closeness of its contact with the inner surface of the digester, it being desirable that the movable head fit the interior of the outer shell at all times. The movable head has a sufficiently close bearing on the packing *e* at the upper end of the lining to prevent the escape of liquid therefrom into the space *c*, and this bearing is maintained by a constant downward yielding pressure which is exerted on the movable head. I prefer to exert said pressure by steam introduced into the space *c* through a pipe *i*, the pressure of said steam being regulated

by a reducing-valve or otherwise, so that it will permit the head *d* and the upper end of the lining to rise and fall by expansion and contraction of the lining without permitting the head to be forced off from the lining by the internal pressure.

Instead of steam as the means for applying yielding pressure to the movable head, I may employ a spring or springs for the same purpose.

The digester may be heated externally or may be heated internally by steam or other suitable medium. I have here shown the digester inclosed in a casing or setting *k*, having flues *m*, through which the products of combustion pass along the external surfaces of the digester from a furnace *o*. The digester should have the usual accessories, such as a gage-tube, safety-valve, &c. The outer head *a'* is detachably secured, and may have a man-hole *r*, which coincides with another man-hole in the movable inner head, said man-holes enabling the digester to be charged and emptied.

I claim—

1. A digester-body or outer shell of tapering form, having a correspondingly-tapering lining resting on the inner surface of the outer shell without positive connection therewith.

2. The combination of a digester-body or outer shell, an open-mouthed lead lining placed therein without positive connection therewith, and a movable head or piston bearing on the upper end or mouth of the lining, as set forth.

3. The combination of a digester-body or outer shell, an open-mouthed lead lining therein without positive connection therewith, a movable head or piston bearing on the upper end or mouth of the lining, and means for holding the piston against the end of the lining with a yielding pressure, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 2d day of April, A. D. 1889.

SIDNEY SMITH.

Witnesses:

C. F. BROWN,

A. D. HARRISON.