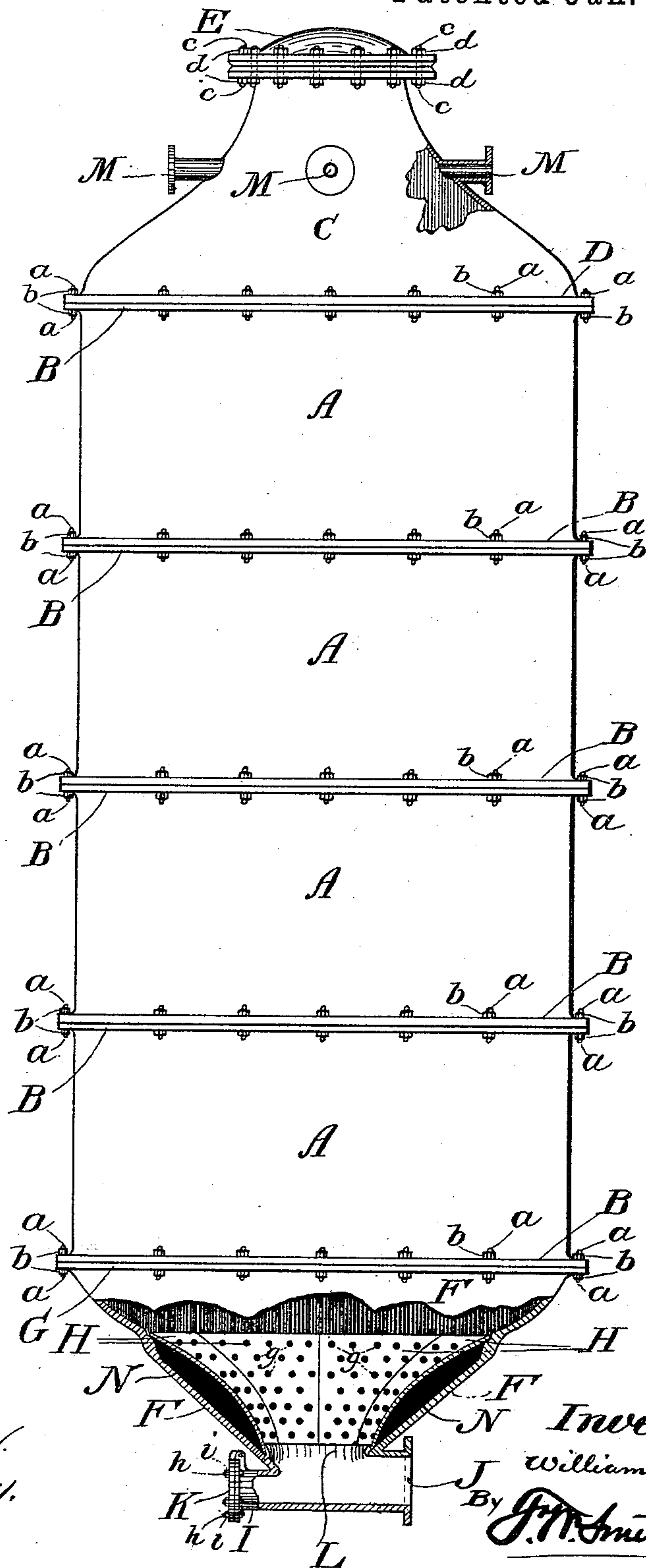


(No Model.)

W. W. KEYS.  
PAPER PULP DIGESTER.

No. 420,275.

Patented Jan. 28, 1890.



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# UNITED STATES PATENT OFFICE.

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## PAPER-PULP DIGESTER.

SPECIFICATION forming part of Letters Patent No. 420,275, dated January 28, 1890.

Application filed May 29, 1889. Serial No. 312,596. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM W. KEYS, a citizen of the United States, residing at Bridgeport, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Paper-Pulp Digesters; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

It is well known that the digesters employed in the manufacture of paper-pulp from woody fiber are huge hollow structures, which must not only possess great strength for enabling them to successfully resist the requisite high steam-pressures, but they must also be of such a character that the pulp developed therein will not be impaired by that discoloration always resulting from the presence of iron in the acid solutions.

Long prior to my present invention I believe it had been satisfactorily determined that cast-iron would be unreliable for affording the requisite strength in digesters, especially in view of the fact that their great size necessitated their construction in many parts or sections bolted together, and the liability to derangement by the expansion and contraction due to frequent alternations in heating and cooling. Iron or steel boiler-plate has therefore been relied upon as an outer wall or shell for affording the requisite strength; but as wrought-iron or steel plates are even more liable to corrosion than cast-iron those plates have always been employed in the construction of an outer shell, in combination with some other metal in plate or sheet form, applied as a lining with a view to not only protecting the outer shell against destructive corrosion, but, what is of even greater consequence, preventing the discoloration and ruin of the paper-pulp, which always results from the presence of iron in the corrosive liquids employed.

A digester having double walls composed of a boiler-plate shell and any kind of a protecting-lining composed of metal or an alloy is one which obviously involves many fine and critical points in its mechanical con-

struction, as well as an expenditure of much costly skilled labor. However perfect such a double-walled digester may have been initially, the combination of a metallic lining and an outer metallic shell involves much liability of derangement at the numerous joints and seams, solely because of the unequal expansion and contraction obviously incident to large structures composed of many parts or sections bolted or riveted together, and especially in one embodying inner and outer cylinders which are not only of different diameter and thickness, but are respectively composed of metals which are radically unlike as to their expansive and contractile characteristics.

Lead has heretofore been mainly, if not wholly, relied upon for lining digesters, and, although that metal is voraciously destroyed by the acid solutions until well coated with lead salts, the pulp is not seriously impaired by the presence of the lead. The use of lead, however, demands constant watchfulness and close inspection of the interior of a digester after each cooking operation, and frequent repairs, and even under the greatest possible vigilance serious losses are liable to and do quite frequently occur, because of such defects in the lining as result in the ruin or discoloration of pulp whenever the acid solutions gain access to the interior surface of the outer shell.

It has been heretofore proposed to line the iron shells of digesters with lead bronze as a substitute for lead. While lead bronze would be no doubt preferable to pure lead in some respects, a digester lined with such bronze would, like any other lined digester, involve similar inequalities as to expansion and contraction, and also as to complexity as a mechanical structure, as well as to that liability of straining and leaking at the inevitably numerous soldered or brazed joints or seams in the lining, and a consequent liability of exposure of the iron shell to the corrosive action of the acid solutions, with resultant damage and loss in the discoloration of the pulp.

A paper-pulp digester embodying my invention differs structurally from any hereto-



fore known to me, in that it has solid walls, is composed of sections, each of which is a casting of solid homogeneous metal, and I am the first to devise a wood-pulp digester which  
 5 does not involve those mechanical complexities in construction to which I have referred, nor any liability of damaged pulp, nor any necessity for frequent and close inspection, nor the constant outlay for repairs with the  
 10 serious loss of service incident thereto, all of which are well known to be attendant upon the use of all wood paper-pulp digesters as heretofore constructed. This structural novelty in my digesters is rendered possible, because  
 15 the cast sections are composed of a practically non-corrosive bronze of extraordinary strength; or, in other words, a bronze which is free from oxides and sub-oxides.

Some of the digesters made by me are so  
 20 large in diameter that a mounted horseman can freely ride through a detached cylindrical section, and I have discovered that I can cast such sections of deoxidized bronze and have them homogeneous and solid throughout  
 25 while avoiding undue bulk and weight, and to have them as strong as or stronger than the best iron or steel outer shells heretofore used, and also so as to involve no mechanical labor in the construction of the walls of the digester other than that required in merely fac-  
 30 ing the flanges of the cast sections and the application of bolts thereto. All of these advantages would be unavailable had I not also discovered that the deoxidized bronze  
 35 can effectually resist the corrosive action of the acid solutions, so thoroughly, in fact, that after upward of twenty months of continuous use my novel digesters at their inner ex-  
 40 posed surfaces bear neither optical indications of corrosive action nor any enlargement in diameter which is measurable by ordinary calipering.

The discoloration of a charge of pulp involves a loss so great that to avoid that liability ordinary lined digesters are cooled  
 45 down after each cooking operation to admit of a critical inspection of the lining and the making of such repairs as are frequently required, whereas my novel digesters may be  
 50 and are in practice promptly charged after each discharge of finished pulp, thus indicating that one of my digesters is equal in practical effective service to two or more ordinary lined digesters of the same size.  
 55 Economy in steam is also of great practical consequence, and the use of my novel digesters involves a minimum expenditure thereof, because they need never be cooled down, and can be operated constantly night  
 60 and day without as yet any known limit to their durability and capacity for continuous service.

Deoxidized bronze suitable for my purposes is described in general terms in Letters  
 65 Patent No. 212,077, issued to N. W. Williams and myself February 4, 1879, although I have since that date made many costly and labori-

ous experiments in compounding alloys and devising methods for best working them with special reference to the successful production  
 70 of my novel digesters.

The accompanying drawings represent, partly in elevation and partly in section, a paper-pulp digester constructed in accordance with my invention.

As shown in the drawings, my novel digester has solid walls composed of several parts—viz., a cap or dome, a pit or base, and certain intervening cylindrical parts, and each of these parts or sections is a casting of solid  
 80 homogeneous deoxidized bronze.

The sections A are circular in cross-section and provided at each end with flanges B. These sections are secured together by bolts  
 85 *a*, passed through said flanges and clinched by nuts *b*. The dome or cap section C, having a flange D, is similarly bolted to the upper flange of the section below. A cap E is bolted to the top of the dome by bolts *c* and  
 90 nuts *d*. The pit F has a flange G bolted to the lower flange of the adjacent section by bolts *a* and nuts *b*.

Pieces H are placed side by side to constitute a false bottom in the pit F. These pieces  
 95 H are composed of bronze, and are perforated, as seen at *g*. At the side of the pit is a bronze steam-connection I and a blow-out J. A cover-plate K for the steam-connection is composed of bronze, and is hinged to the pit and secured in closed position by the bolts *h* and  
 100 nuts *i*. The pieces H are inclined and lead down to the mouth L of the pit.

The wood or vegetable matter to be made into pulp is introduced within the digester at the top of the dome, while the acid is run  
 105 in through the inlets M. When the pulp has become sufficiently cooked, both the acid and the pulp settle at the bottom of the digester, the pulp gravitating through the mouth L of the pit, while the acid partly follows the  
 110 course of the pulp, but mainly percolates through the perforated bottom sections H within the chamber N, and is led thence to any suitable receptacle. The object in thus separating the acid and pulp is to facilitate  
 115 the massing of the latter, and at the same time to afford egress to a greater amount of pulp in a given time. Steam being introduced through the connection I, the pulp, as it drops through the mouth of the pit, is  
 120 blown through the opening J into the usual receptacle. (Not shown.)

It is obvious that no iron or steel should be used in or about the apparatus where it will be liable to exposure to contact with  
 125 liquids employed within the digester.

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

1. The paper-pulp digester, substantially  
 130 as hereinbefore described, consisting of several flanged sections bolted together, each section being a solid homogeneous casting composed of bronze, which is substantially



non-corrosive under contact with hot acid solutions and has sufficient strength to withstand the heavy steam-pressures requisite in the manufacture of wood pulp.

- 5 2. A paper-pulp digester having solid walls composed of cast deoxidized bronze, substantially as and for the purposes specified.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM W. KEYS.

Witnesses:

S. S. WILLIAMSON,  
F. W. SMITH, Jr.