

No. 653,186.

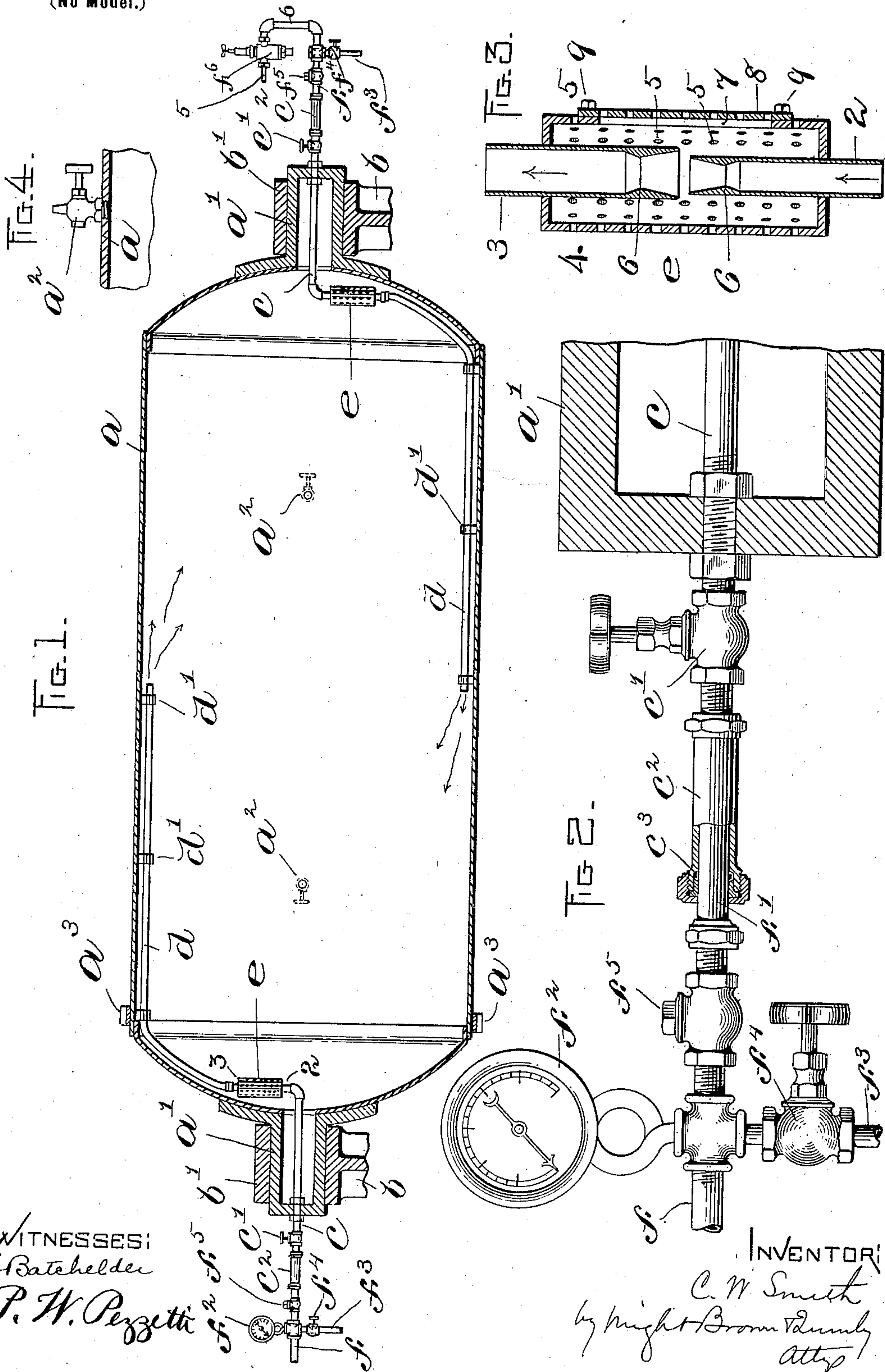
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C. W. SMITH.

CIRCULATING APPARATUS FOR ROTARY DIGESTERS, &c.

(Application filed Dec. 31, 1898.)

(No Model.)



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UNITED STATES PATENT OFFICE.

CLARENCE W. SMITH, OF CAMBRIDGE, MASSACHUSETTS.

CIRCULATING APPARATUS FOR ROTARY DIGESTERS, &c.

SPECIFICATION forming part of Letters Patent No. 653,186, dated July 3, 1900.

Application filed December 31, 1898. Serial No. 700,804. (No model.)

To all whom it may concern:

Be it known that I, CLARENCE W. SMITH, of Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Circulating Apparatus for Digesters, &c., of which the following is a specification.

This invention relates to digesters and similar apparatus for cooking paper-stock, bleaching cloth, and similar uses; and it has for its object to improve the quality of the work done, to economize in the use of steam and materials, and shorten the process of cooking or digesting.

The invention consists in the improvements which I will now proceed to describe and claim.

In the drawings I have chosen to illustrate as containing an embodiment of my invention a rotary digester such as those employed for cooking paper-stock.

Figure 1 represents a longitudinal sectional view of a rotary digester constructed in accordance with my invention. Fig. 2 represents an enlarged view, in section and side elevation, showing the manner of connecting the steam-pipe to the digester. Fig. 3 represents an enlarged sectional view of one of the circulators employed. Fig. 4 represents a detail view, in section and side elevation, illustrating one of the air-cocks.

The same reference characters indicate the same parts in all the figures.

Referring to the drawings, *a* designates the body of the digester, consisting of an elongated hollow cylindrical receptacle adapted to contain the stock and chemicals used to produce the pulp. To the ends of the receptacle *a* are secured large hollow trunnions or journals *a'*, supported in bearing or journal blocks *b' b'*, carried on standards *b b*.

c c represent inlet-pipes for the steam, said pipes passing centrally through the end walls of the trunnions *a'* and being turned at right angles inside the receptacle *a* and connected through circulators *e e* with discharge pipes or nozzles *d d*, running along the walls of the receptacle, on opposite sides thereof, and retained in place by hangers or brackets *d' d'*. Each of the circulators *e* consists of a cylinder or casing 4, having a number of holes or perforations 5 5 in its walls and two pipes 2 3

placed in alinement inside the casing and slightly separated at their adjacent ends, as shown in Fig. 3, the pipe 2 being the smaller and constituting a prolongation of the steam-inlet pipe *c*, while the pipe 3 is connected with the discharge nozzle or conduit *d*. When steam is passed through the pipe 2 into the interior of the casing 4 and across the open space between the ends of the pipes 2 and 3, it produces an injector action and draws the liquor from the receptacle through the perforations in the casing 4 and into and through the pipe 3. The steam and liquor become intermixed in the pipe 3, and the heated liquor is redischarged from the end of said pipe into the receptacle. For the purpose of obtaining access into the interior of the casing 4 an aperture 7 is formed in one side thereof and covered by a perforated plate 8, which is secured to the body of the casing by means of screws 9. The proper action of the circulator is aided by choking the pipes 2 3 or reducing their internal diameter at their adjacent ends by the formation of thickened portions or ridges 6 6 therein and tapering or divergent portions adjacent to and extending from said ridges. In the pipe 2 the ridge 6 causes the issuance of steam from said pipe in an approximately-parallel stream rather than in a spreading stream. The ridge 6 in the pipe 3 serves to check any backflow into the casing of liquor which has once entered the pipe.

ff represent stationary steam-supply pipes, connected with the inlet-pipes *c c* by means of slip-joints or stuffing-boxes. One of said joints is represented on an enlarged scale and partly in section in Fig. 2. It comprises the sleeve *c²*, secured to the pipe *c* and provided with a gland *c³*, containing packing, and the nozzle *f'*, forming a continuation of the pipe *f*. The inlet-pipe *c* is provided with a cock or valve *c'*, by means of which the flow of steam into the receptacle *a* may be shut off, if necessary. *f²* is a pressure-gage connected with the pipe *f* and designed to show the pressure in the receptacle *a*. Also connected with each pipe *f* is a blow-off pipe *f³*, containing a valve or cock *f⁴*. *f⁵* is a swing check-valve located in each pipe *f* and controlling the passage of steam therethrough, said valve opening toward the digester. The blow-off pipes *f³* are used when the digester

is started up to remove rust or corrosion which may have collected in the steam-pipes and whose entrance into the digester would tend to discolor the stock. In employing said blow-off pipes each valve c' is closed and each valve f^4 is opened. The force of the steam passing through the pipe f and out through the pipe f^3 effectually removes all rust or other corrosion. The cock f^4 may then be closed and the cock c' opened to permit the entrance of steam into the digester. When the boiler-pressure is larger than that required by the digester, the steam-supply pipes $f f$ at either end of the holder may be provided with reducing-valves $f^6 f^6$. The pipe 6, that conducts steam from the reducing-valve f^6 to the digester, is preferably of larger diameter than the pipe 5, which admits steam to the reducing-valve and the digester. This enlarged section 6 accommodates the increased volume of steam which accompanies its reduced pressure.

In operating the digester the stock and chemicals are introduced into the receptacle a through a suitable opening until the desired level has been obtained. Said opening is then closed over and steam is admitted at both ends through the pipes $f f$, the receptacle at the same time being rotated at a slow speed by any suitable means, as by a power-driven gear engaging gear-teeth a^3 on the periphery of the receptacle a . The steam instead of coming immediately into contact with the stock first passes through the circulators e , where it becomes intermixed with the liquor, and the latter is redischarged through the pipe or conduit d into the body of the receptacle. By a continuous circulation kept up in this way the liquor is gradually heated. In the usual method of cooking the steam comes immediately into contact with the stock, with the result that the colors, dirt, &c., become more or less firmly set or fixed in the fiber, owing to the suddenness of the rise in temperature, and are with great difficulty removed, and seldom completely. In my improved apparatus, however, the steam and liquor are brought together before coming in contact with the stock, and the liquor warmed by the condensed steam strikes and permeates the stock at a primary low temperature. This temperature is gradually and constantly increased as the cooking advances. At the same time a constant circulation is kept up throughout the whole digester. The liquor is drawn through the stock again and again, removing the color and dirt and preventing the lodgment of the same in the fiber, which is apt to occur when the liquor remains sluggish and inert in contact with one part of the stock for a considerable period of time. The improved apparatus provides for an even cooking and yields a very white product free from streaks and discolorations. Furthermore, the rapid movement of the liquor around and around in the digester into the circulator and pipe d and out again gives a

maximum effect for a given amount of steam and chemicals, and thus reduces the demand for both. The freedom from overcooking tends to the production of a stronger fiber.

The circulators $e e$ have a true injector action; but the amount of steam condensed to produce the circulation described under the existing conditions and aside from any desired heating of the contents need not be very great, because the circulator receives the liquid through the perforated casing at the same gage-pressure against which it discharges through the pipe d , and the liquid is supplied to the circulator without any suction-lift, and this injector action continues from the beginning to the end of the cooking process, the audible rush of the liquid through the circulator at the beginning continuing for ten hours or more, according to the time fixed for the process. It has been found in practice that the contents of the digester rise comparatively slowly in temperature and that there is always sufficient difference in temperature between the temperature of the entering steam and that of the liquid contents to insure the condensation upon which depends the injector action even to the end of the process and the completion of the proper cooking of the stock. In addition the mechanical forcing action of the steam, aside from the condensing action, drives the liquid along the path of least resistance through the pipes $d d$, especially when the latter are in course of rotation above the surface of the liquid.

$a^2 a^2$ represent air valves or cocks fixed in the wall of the receptacle a and adapted to be opened from time to time when they are brought uppermost by the revolution of the receptacle, so as to liberate the air contained in the latter. A certain amount of air is always contained in the body of stock and liquor, and some air is introduced with the incoming steam. The heating of this air expands it and produces a pressure which tends to prevent the free entrance of the steam, and hence retards the cooking process. By the operation of these air-valves from time to time the cooking process may therefore be shortened.

Although I have illustrated my invention as applied to a rotary digester, I do not limit myself thereto and may apply the improvement herein described to any receptacle, closed or open, fixed or movable, in which a circulation of the contained liquid is desired.

I claim—

1. A digesting apparatus comprising a digesting-receptacle, steam-inlets thereto, discharge-pipes horizontally arranged within said receptacle and adapted to be immersed in the liquor therein, and automatic injectors interposed between said discharge-pipes and steam-inlets and having provisions for combining the steam and liquor and introducing them to the discharge-pipes, condensation ensuing owing to the immersion of the injector,

each injector consisting of steam and discharge nozzles inclosed in a perforated casing, the steam-nozzle being the smaller, and each nozzle being narrowed or constricted and expanding both ways from the constriction, as shown, the injector with its discharge-pipe constituting a circulator, the discharge-pipe of one circulator having its outlet directed toward a neighboring circulator.

2. A digesting apparatus comprising a digesting-receptacle mounted for rotation on a horizontal axis, a steam-inlet to said receptacle, a discharge-pipe located horizontally along the wall of the receptacle, and an automatic injector interposed between the steam-inlet and the discharge-pipe, and having provisions for combining the steam and liquor and introducing the completely-condensed steam and liquor to the discharge-pipe, said injector being located in the neighborhood of the axial line of the receptacle, whereby it may be kept constantly immersed, and consisting of steam and discharge nozzles inclosed

in a perforated casing, the steam-nozzle being the smaller, and both nozzles being narrowed or constricted and expanding both ways from the constriction, as shown. 25

3. A digester comprising a hollow receptacle for the stock and liquor, a steam-inlet pipe connected therewith, a valve in said pipe controlling the passage of steam into the receptacle, a steam-supply pipe connected with said inlet-pipe and discharging into the receptacle through said pipe only, a blow-off leading off from said supply-pipe, and a valve controlling said blow-off, the said arrangement providing for the removal of accumulations of rust or other sediment from the piping before steam is admitted through said piping into the receptacle. 30 35 40

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

CLARENCE W. SMITH.

Witnesses:

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E. BATCHELDER.