

Dec. 22, 1936.

J. FLETCHER

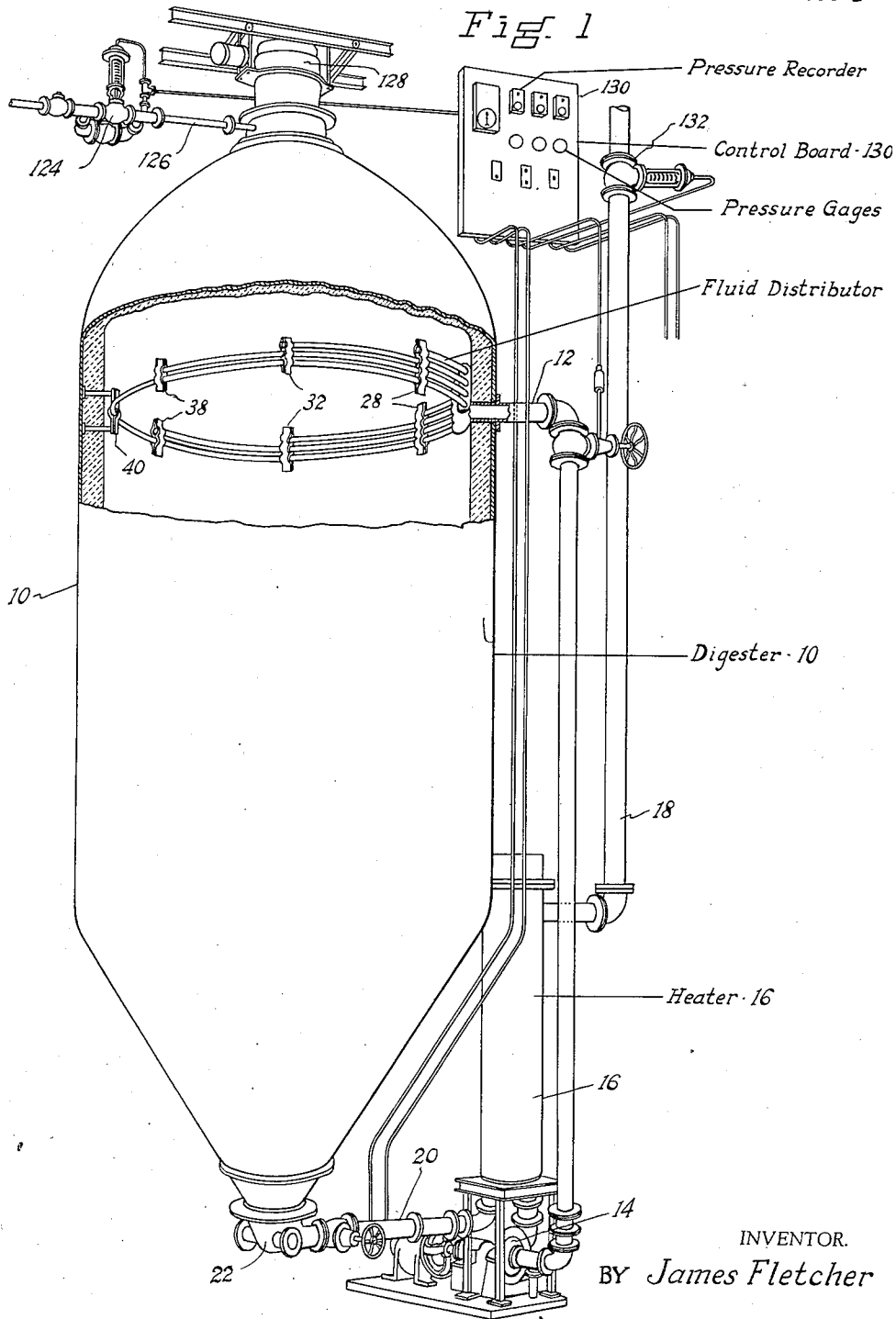
2,064,901

DIGESTER

Filed May 25, 1935

4 Sheets-Sheet 1

Fig. 1



INVENTOR.

BY James Fletcher

Paul R. Hancock
ATTORNEY.

Dec. 22, 1936.

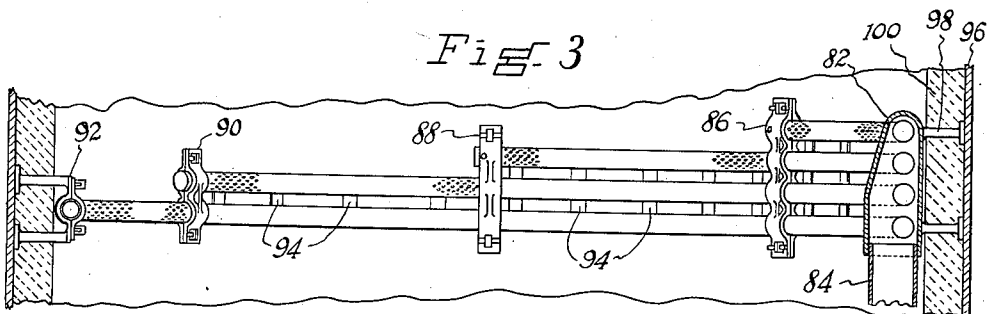
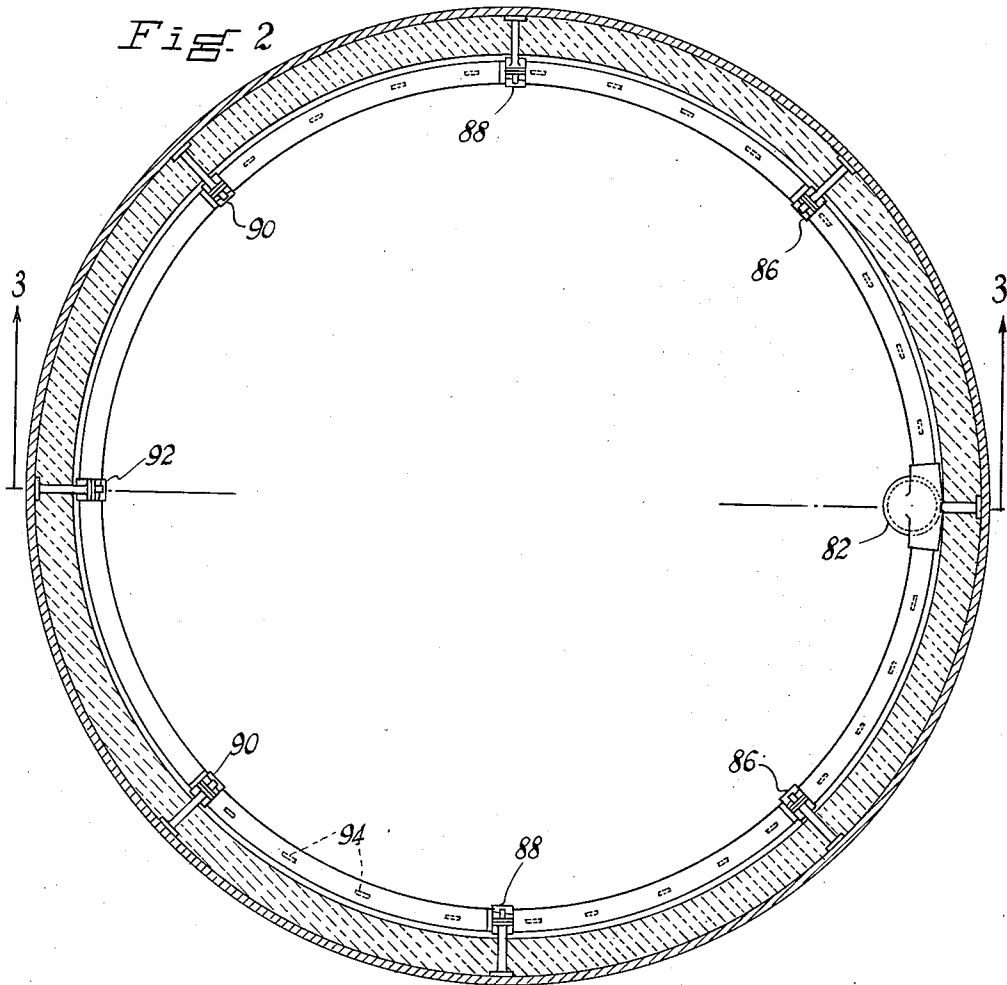
J. FLETCHER

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DIGESTER

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4 Sheets-Sheet 2



INVENTOR.

James Fletcher

BY

Paul R. Newcomb
ATTORNEY.

Dec. 22, 1936.

J. FLETCHER

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DIGESTER

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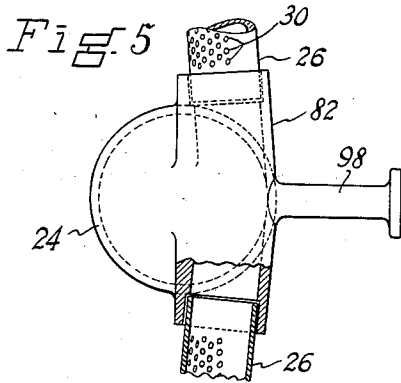
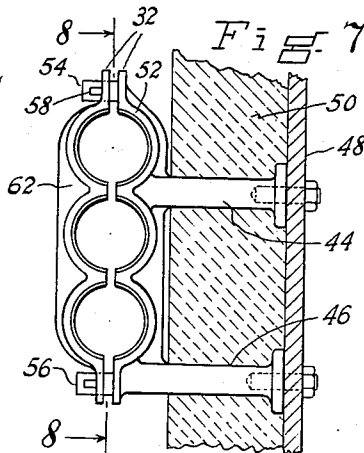
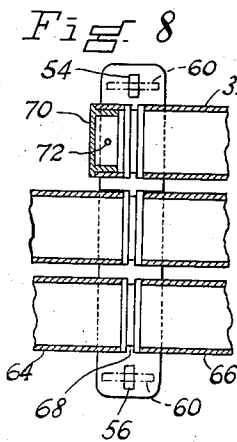
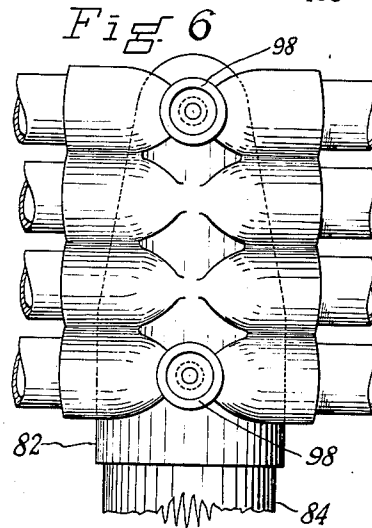
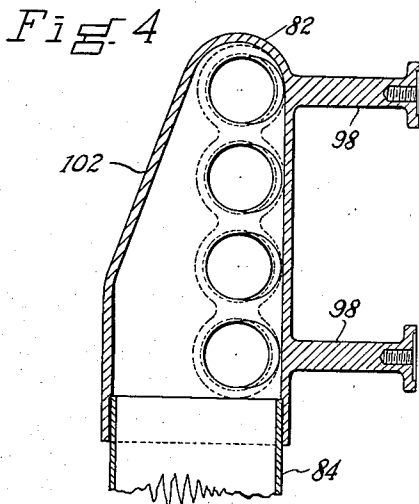
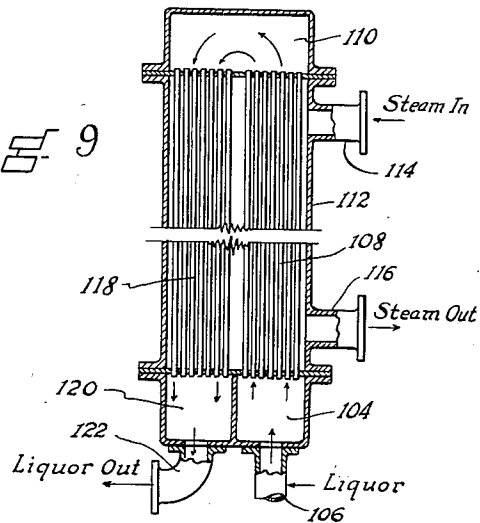


Fig. 9



INVENTOR.
James Fletcher

BY
Raymond H. Sawcous
ATTORNEY.

Dec. 22, 1936.

J. FLETCHER

2,064,901

DIGESTER

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4 Sheets-Sheet 4

Fig. 10

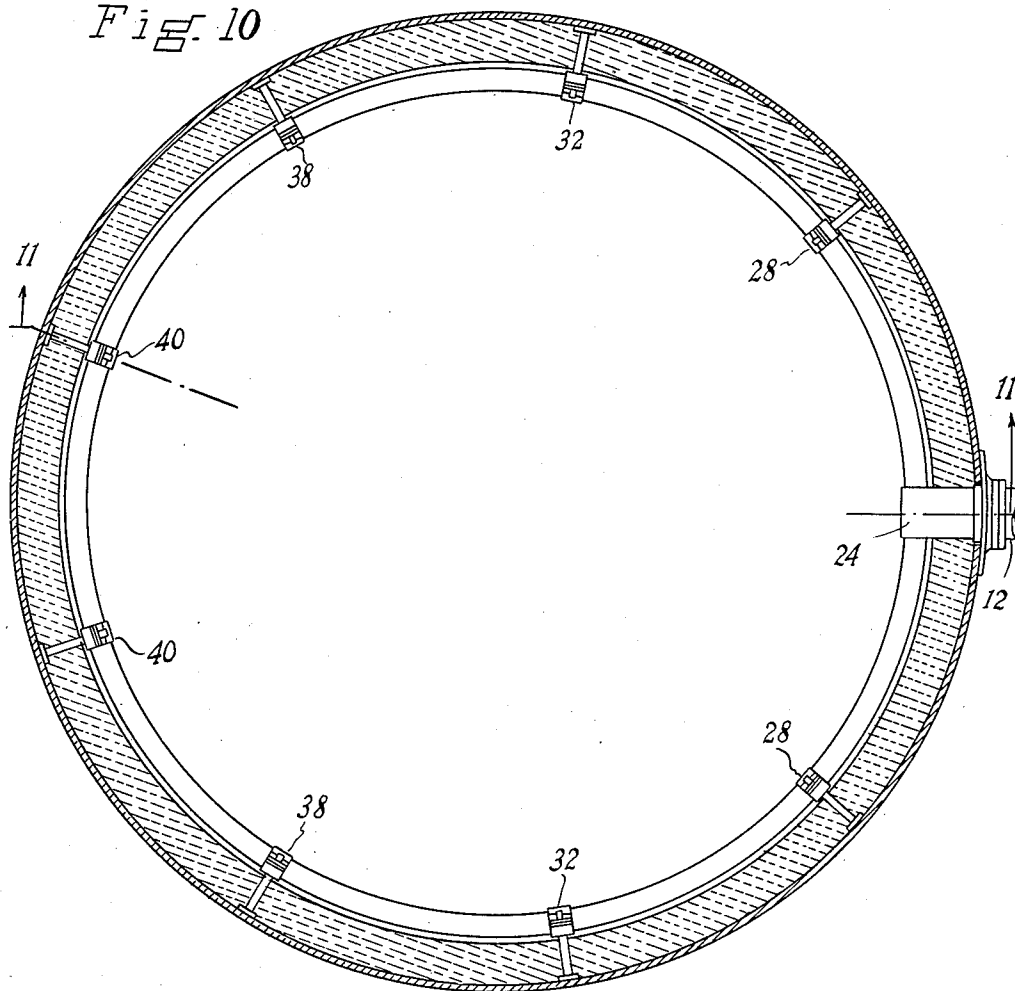
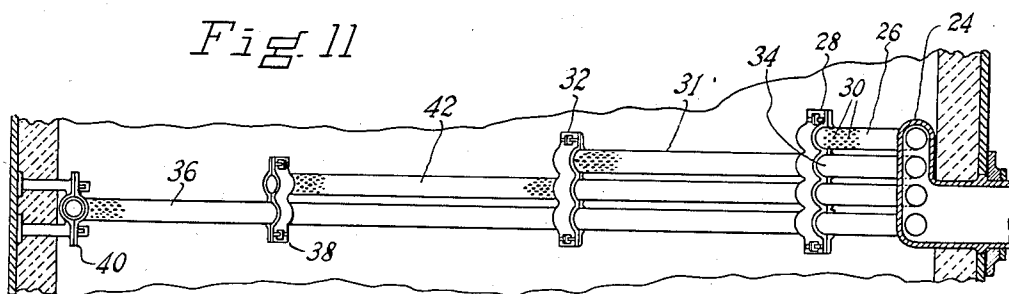


Fig. 11



INVENTOR.

James Fletcher

BY

Ray. R. Newcomb

ATTORNEY.

UNITED STATES PATENT OFFICE

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DIGESTER

James Fletcher, Akron, Ohio, assignor to The
Babcock & Wilcox Company, Newark, N. J., a
corporation of New Jersey

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20 Claims. (Cl. 92-7)

My invention relates to fluid handling apparatus, and it is exemplified herein in connection with a digester which is used in the preparation of pulp.

One object of my invention is to improve digester apparatus to the end that there may be uniform action of the digester liquid in the digester. This is of particular importance in digesters which have external circulating means by means of which the digester fluid is taken from the top of the digester, heated, and then forced into the bottom of the digester in a continuous circulation. It is a specific object of the invention to cause the fluid within the digester to move uniformly upwardly as contrasted with a situation wherein some part of the fluid moves upwardly and another part moves downwardly. The latter condition is one which is not conducive to the manufacture or production of pulp of a high grade.

In order to accomplish the above indicated objects the fluid movement must take place with a minimum possible obstruction of the free area of the cross section of the digester. Such obstruction would interfere with the operation of the apparatus and make it difficult to obtain a satisfactory product.

I have discovered that I can secure substantially equal rates of removal of fluid from all parts of the cross section of the digester without obstructing the free area, in the following manner. I arrange a plurality of outlet sections around the circumference of the digester and arrange these sections near the shell of the digester. The number of the sections will depend upon the circumference of the digester and the dimensions of other parts of the apparatus. The number may vary according to other conditions, but in the present disclosure I have indicated eight fluid outlet positions around the circumference of the digester. They are afforded by arcuate conduits which are connected with a common manifold which is in turn connected to a circulating pump. Preferably these arcuate conduits are arranged adjacent to but not in contact with the inner face of the digester so that the contents of the digester may flow with a minimum of obstruction upwardly or downwardly. The spacing of the conduits from the wall of the digester also permits a flow of fluid around them so that any solid or semi-solid material which would have a tendency to lodge above them may be carried from the digester by the movement of the fluid.

The arcuate distributor conduits above described are curved in the form of the inner face

of the digester and are formed along a curve of smaller radius. They are held against unitary displacement vertically within the digester by brackets which are secured to the shell of the digester around its circumference. These brackets are spaced apart and are arranged so as to permit the conduits to slide within the brackets to accommodate thermal expansion with reference to a fixed position. To avoid damage to the tubes between the spaced brackets they are made to be mutually supporting so that several of them at different levels are tied together at intervals. The entire structure may be so arranged that the tubes as a whole (between adjacent brackets) act as a unitary girder, the assembly being strengthened and stiffened against vertical displacement due to vertical forces. All of the conduits meet at a common junction position where they are connected to a common header. From this header a connection leads through the wall of the digester to the inlet side of a circulating pump.

The circumferentially spaced outlet sections of the conduits are located at the ends of the conduits remote from the common header. As shown, these sections are provided with holes so that they act as strainers, the fluid of the digester entering any one of the outlet sections flowing through the conduits to the common outlet afforded by the header. The length of flow path from the sections to the common outlet is not the same for all of the conduits. For one section there is a minimum length of flow path and for another there is a maximum length with as many intermediate flow path lengths as may be necessary for the particular digester involved, but the outlet sections are preferably distributed equidistantly around the circumference of the shell. If all of the openings in the outlet sections of all of the tubes were of the same size as the others the differences between the lengths of the flow paths would make the amounts of liquid withdrawn unequal, that part of the fluid traversing the longest path would be less because of the greater friction of that longer flow path. This inequality could be corrected by providing smaller inlet holes, or smaller openings in the sections for the liquids traversing the shorter paths, and I may employ this corrective measure, but I also provide another corrective measure which may in itself be sufficient. This is a feature of my invention. This feature includes the arrangement of a plurality of withdrawal tubes in different horizontal planes. In fact, each of the conduits is in its own horizontal plane different from that of

the horizontal planes of the other tubes. The conduit providing the longest flow path from the inlet to the outlet is located at the lowest level, and its inlet section is, therefore, subjected to a greater hydraulic head of fluid outside it than the hydraulic heads at the inlets of the conduits at higher levels. I preferably arrange the conduit which has the shortest flow path at the highest level.

The above indicated differences in hydraulic heads whereby the maximum head is applied to the longest flow path of the fluid withdrawal conduits constitute hydraulic means for equalizing the flow through the paths of different lengths, independently of any other corrective differences in the outlet areas. Also, as shown herein, the shortest flow paths involve two 90° turns where, in the same range, the longest flow paths involve but one 90° turn.

Specific embodiments of the invention are illustrated in the accompanying drawings, in which:

Fig. 1 is a view generally in the nature of a perspective view illustrating a commercial type of digester installation with a part of the digester wall broken away to disclose the flow equalizer.

Fig. 2 is a horizontal section through a digester illustrating an embodiment of the equalizer in plan.

Fig. 3 is a partial vertical section of the digester shown in Fig. 2, this view being taken on the section line 3—3 of Fig. 2.

Fig. 4 is a vertical section showing in detail the form and construction of an equalizer header indicated in Figs. 2 and 3.

Fig. 5 is a detail view of the header of the Fig. 2 embodiment, illustrating in horizontal section the relation of one of the arcuate equalizer sections to the header.

Fig. 6 is an elevation of the header shown in Fig. 4.

Fig. 7 is a partial vertical section through the digester, showing one of the supporting brackets in elevation.

Fig. 8 is a view in the nature of a vertical section showing the ends of the equalizer conduits in operative position within one of the brackets, this view being taken on the line 8—8 of Fig. 7.

Fig. 9 is a view in the nature of a vertical section illustrating an external heater which may be used in connection with the apparatus shown in Fig. 1, a part of this heater being parallel flow, and the remaining part counterflow.

Fig. 10 is a horizontal section through a digester illustrating in plan a modified form of the equalizer.

Fig. 11 is a partial vertical section taken on the line 11—11 of Fig. 10 and showing another embodiment of a header construction.

In the drawings, Fig. 1 shows a digester 10 from the top of which the digester fluid or liquor passes through a conduit 12 to the inlet of a circulating pump 14. The outlet of this pump is connected to an external heater 16 which is preferably heated by steam passing thereto through the steam line 18. After the digester fluid is subjected to the action of the heater it passes to the conduit 20 through a fitting 22 communicating with the lower end of the digester as shown.

Figs. 10 and 11 indicate the details of a flow equalizer having a header 24 extending through the wall of the digester to the conduit 12. This header communicates with a plurality of curved conduits which are of relatively small diameter and located one above the other near the wall of

the digester. These conduits are of different lengths, depending upon the distances between their fluid inlet sections and the header, and they are subjected to different hydraulic heads, all of them being located below the normal level of the digester fluid. As shown, the upper conduits 26 extend only between the brackets 28 and the header. They may be perforated throughout their lengths to provide inlet openings 30.

The conduit next beneath the section 26 has its inlet section 31 between the brackets 32 and 28 and its section 34, between the bracket 28 and the header 24 is imperforate.

The lowermost equalizer conduit has its inlet sections 36 positioned between the brackets 38 and 40, its remaining sections supported by the brackets 28, 32 and 34 and the header 24 being preferably imperforate. The uniform positioning of the equalizer inlet sections is completed by the position of the inlet sections of the remaining conduits 42, between the brackets 32 and 38.

The relation of the conduits and the header is indicated in Fig. 5 of the drawings, and Figs. 7 and 8 illustrate the arrangement of the different conduits relative to one of the digester wall brackets. In Fig. 7 the bracket indicated in general by the numeral 32 is shown as having posts 44 and 46 fixed to the metallic shell 48 and extending through the corrosion resisting lining 50. The body of the bracket is formed with tube receiving sockets 52 and is provided at its upper and lower ends with clamp lugs 54 and 56. These lugs are formed with openings 58 for receiving wedge keys 60 which cause the conduit sections to be clamped in position between the cap section 62 and the body of the bracket.

Fig. 8 shows the lower conduit sections 64 and 66 positioned within the lower sockets of the bracket. They are spaced from the socket rib 68 in order to provide spaces accommodating thermal expansion of the sections. The conduit section 31 is located opposite a cap 70 which is preferably held in position by a pin 72 fastened through the cap and the opposite parts of the bracket. This closes the conduit 31.

With the arrangement of conduit sections described, thermal expansion of the conduits indicated in Fig. 10 of the drawings may be accommodated when the brackets 28 are tightened so as to hold all of its associated sections rigidly. The brackets 38 may be similarly tightened while the intervening brackets 32 and 40 act as expansion joints or slip joints to permit the conduit sections to move relative thereto under the influence of expansion or contraction caused by thermal changes.

In the embodiment indicated in Figs. 2, 3 and 6 of the drawings, the header 82 is in communication with a conduit 84 which leads downwardly therefrom towards a lower position in the digester and the brackets have a different spacing. The brackets 86 are located at positions angularly spaced 45 degrees from the header and the remaining brackets are similarly spaced from each other, the bracket 92 being directly opposite the header. The brackets 86 and 90 preferably hold the conduit sections rigid therein while the intervening brackets 88 and 92 are the slip joint brackets.

When all of the conduit sections between successive brackets are rigidly joined by struts 94 welded at the top and bottom to the sections, girder-like structures are provided and the equalizer is thereby rigidified against unitary displacement.

ment by vertical forces. These struts are shown clearly in Fig. 3 of the drawings. The header 82 is secured to the digester shell 96 by posts 98 and the upper part of the wall of the header remote from the digester lining 100 has a downwardly sloping portion 102. The accumulation of digester materials on the header is thereby minimized.

Fig. 9 of the drawings shows an external heater for maintaining the digester liquor at the desired temperature. It has an inlet chamber 104 receiving the digester liquor through the conduit 106. From this chamber the liquor flows through the first pass tubes 108 to an intermediate header or chamber 110. When steam enters the jacket 112 through the inlet 114 and passes from the jacket through the outlet 116 the second section differs from the first section in that it has a parallel flow heating action. The jacket surrounds the tubes 108 and also the second pass tubes 118 through which the fluid flows downwardly from the chamber 110 to the outlet chamber 120. From this chamber it passes through the fitting 122 back to the digester.

Some of the auxiliary equipment used in digester operation is indicated in Fig. 1 of the drawings. Of this equipment, the automatic relief valve 124 communicates with the interior of the digester through a pipe 126, and above the top of the digester there is shown a chip distributor 128. The automatic relief valve, as well as other valves controlling the temperature and pressure conditions within the digester, are actuated from a control board 130 appropriately fitted with recorders and the necessary temperature indicators and pressure gages. One valve, for instance, the valve 132, may be automatically controlled with reference to the temperature of the fluid within the digester.

Whereas, the invention has been described with reference to the particular embodiments shown in the drawings, it is to be understood that it is not limited to all of the various structural details of these embodiments. The invention is rather to be taken as of a scope commensurate with the scope of the sub-joined claims.

What is claimed is:

1. In a liquid system, a pump, a fluid chamber conduit connections between the pump and the chamber, a plurality of conduit terminals, means locating the terminals at different levels beneath the normal level of the liquid and at positions uniformly circumferentially spaced relative to said body, and curved conduit sections of uniform lengths affording separate communications between the separate terminals and the connections.

2. In fluid handling apparatus, a fluid circulating system including a pump, a fluid chamber, circulating connections between the pump and the chamber, a plurality of separate system terminals, means supporting the terminals circumferentially and vertically spaced at positions beneath the normal level of the fluid and distributed throughout its mass, means providing separate communications between the separate terminals and the system, and means compensating for the hydraulic head differences of said terminals whereby there is uniform liquid movement in said separate communications.

3. In a liquid system, a pump, a fluid chamber, conduit connections between the pump and the chamber, a plurality of conduit terminals, means locating the terminals beneath the normal level of the liquid and at circumferentially spaced positions relative to said body, and means afford-

ing separate communications between the separate terminals and the connections.

4. In apparatus for treating cellulosic material for making paper stock, a digester, a liquor circulating pump, a series of superposed perforated flow equalizer inlet sections located within the digester near its top and disposed at intervals around the digester, a header connected with the inlet of the pump and having a number of inlets corresponding to the number of said inlet sections and separately communicating therewith, and means for connecting the outlet of the pump to the lower part of the digester to complete a circulation system.

5. In apparatus for treating vegetable substances for making paper stock, a digester, a liquor circulating pump, a series of flow equalizer inlet sections located within the digester near its top and disposed at substantially uniform intervals around the digester, means for supporting said sections at different levels, a header connected with the inlet of the pump and having a number of inlets corresponding to the number of said inlet sections and separately communicating therewith, conduit sections separately connecting said sections to the header, means for connecting the outlet of the pump to the lower part of the digester to complete a circulation system, and means for rigidly joining the equalizer inlet sections with similarly shaped conduit sections immediately below them to form girder-like constructions offering a minimum of obstruction to the flow of fluid within the digester.

6. The method of digesting material containing cellulose with positive circulation of the liquor through a digester and through a heating apparatus by withdrawing liquor through a strainer located in the digester near its top, consisting of effecting a circumferentially uniform withdrawal of the liquor from the upper part of the digester, forcing the liquor through an external heater, and inducing the heated liquor into the lower part of the digester.

7. A strainer or distributor for effecting a uniform withdrawal of digesting liquor from cellulose digesters comprising, the combination of a flow equalizer section adjacent the withdrawal point provided with a relatively small number of perforations on its surface, a second distributor section at a greater distance from the withdrawal point provided with a large number of openings, and intermediate withdrawal or distributor sections having intermediate numbers of openings, means for separately connecting the separate withdrawal sections to a circulating pump, and means for positioning and supporting the separate sections at spaced positions around the interior wall of the digester.

8. Apparatus for use in the manufacture of paper stock comprising, in combination, a digester, an external heater, a pump, pump connections between the heater and the digester for completing a circulatory system withdrawing digester fluid from the top of the digester and conducting heated fluid to the bottom of the digester, separate flow equalizer sections supported within the digester and spaced circumferentially around its inner wall, a header, separate tubular connections between the separate equalizer sections and the header superposed relative to each other adjacent the wall of the digester, and means for rigidly joining correspondingly positioned parts of said separate connections to form girder-like structures.

9. In combination, a digester, a pump, a heater, 75

means for connecting the heater and the pump in series with the digester for withdrawing liquor therefrom at its top and passing it through the heater and delivering the heated liquor to the bottom of the digester, separate inlet strainers supported in the digester at its top and at positions circumferentially spaced around the digester, and separate connections leading from the separate strainer sections to a common tubular connection in communication with the inlet side of the pump.

10. In combination, a digester, a pump, a header fixed within the digester near its top and communicating with the inlet side of the pump, brackets spaced circumferentially around the inner wall of the digester and fixed to the shell thereof, a plurality of flow equalizer inlet sections supported by the brackets and uniformly spaced around the circumference of the digester to maintain uniform fluid conditions during the circulation of the digester fluid, said inlet sections being so arranged with reference to the level of the digester fluid that they are at successively greater distances below said levels as their distances from the header increase, and means for rigidly connecting the inlet sections with tubular sections immediately below them to constitute girder-like constructions between successive brackets, alternate brackets providing slip joints between the brackets and the tubular sections connected thereto while the intervening brackets are clamped tightly to the tubular sections with which they contact.

11. In combination, a digester, a header supported in the digester near its top, a plurality of uniformly circumferentially spaced flow equalizer inlet sections communicating with the header, means for supporting said sections at successively greater distances below the level of the liquid within the digester as their distances from the header increase, and separate means for separately connecting the inlet sections with the header, said separate inlet sections being provided with openings forming uniform flow areas.

12. In fluid handling apparatus, a fluid circulating system including a pump, circulating connections providing communication between the pump and a body of fluid, a plurality of separate system terminals in direct contact with the fluid, means locating the terminals beneath the level of the fluid at positions distributed throughout its mass, and means affording separate communications between the separate terminals and the system.

13. In a liquid system, a pump, a fluid chamber, a header included in conduit connections between the pump and the chamber, a plurality of conduit terminals within the chamber communicating with said connections, means locating the terminals beneath the normal level of the liquid and at spaced positions at successively greater distances from the header, and means affording separate communications between the separate terminals and the connections.

14. In a liquid system, a pump, a digester including a fluid chamber, a header included in

conduit connections between the pump and the chamber, a plurality of conduit terminals separately communicating with the header, brackets locating the terminals beneath the normal level of the liquid and at positions circumferentially spaced relative to said chamber, and arcuate conduit sections affording separate communications between the separate terminals and the header, said terminals being formed of relatively small diameter tubes and disposed directly above said sections near the inner wall of the digester.

15. In apparatus for treating vegetable substances for making paper stock, a digester, a liquor circulating pump, a series of flow equalizer sections located within the digester near its top and disposed at uniform intervals around the digester, a header connected with the inlet of the pump and having a number of inlets corresponding to the number of said inlet sections and communicating therewith, means for connecting the outlet of the pump to the lower part of the digester to complete a circulation system, and means for rigidly joining the equalizer inlet sections with similarly shaped conduit sections immediately below them to form girder-like constructions offering a minimum of obstruction to the flow of fluid within the digester.

16. An indirect fluid heater including a counter-flow part, a parallel flow part, and means whereby a fluid flows through said parts in series.

17. In pulp manufacturing apparatus, a digester, and a flow equalizer extending circumferentially within the digester and consisting of a plurality of arcuate sections joined end-to-end, the individual sections including a plurality of superposed tubes rigidly secured together.

18. A flow equalizer for digesters, comprising, a header, and a plurality of equalizer sections communicating with the header, each of said sections including a plurality of superposed tubes, positioned directly beneath an inlet section tube of the same length and secured rigidly thereto.

19. In a digester, a fluid handling system including a pump, connections providing communication between the pump and a body of fluid, a plurality of fluid system terminals separated from each other and in contact with the fluid, means for supporting the terminals beneath the level of the fluid at distributed positions, and means providing separate and independent passages establishing independent communications between the separate terminals and a part of the system common to said passages, said passages being of different lengths and different flow resistances.

20. In a fluid handling system, means forming a fluid chamber, a pump, a tubular section in communication with the pump, a plurality of system terminals through which the fluid flows, and conduits of different lengths separately connecting said terminals with said section, said conduits being so constructed and arranged with reference to said section and the terminals that the different flow resistances of the conduits are compensated, whereby fluid flows through said terminals are equalized.

JAMES FLETCHER.