

(No Model.)

5 Sheets—Sheet 1.

H. BLACKMAN.

PROCESS OF AND APPARATUS FOR MANUFACTURING PAPER PULP.
No. 369,835.

Patented Sept. 13, 1887.

Fig. 1.

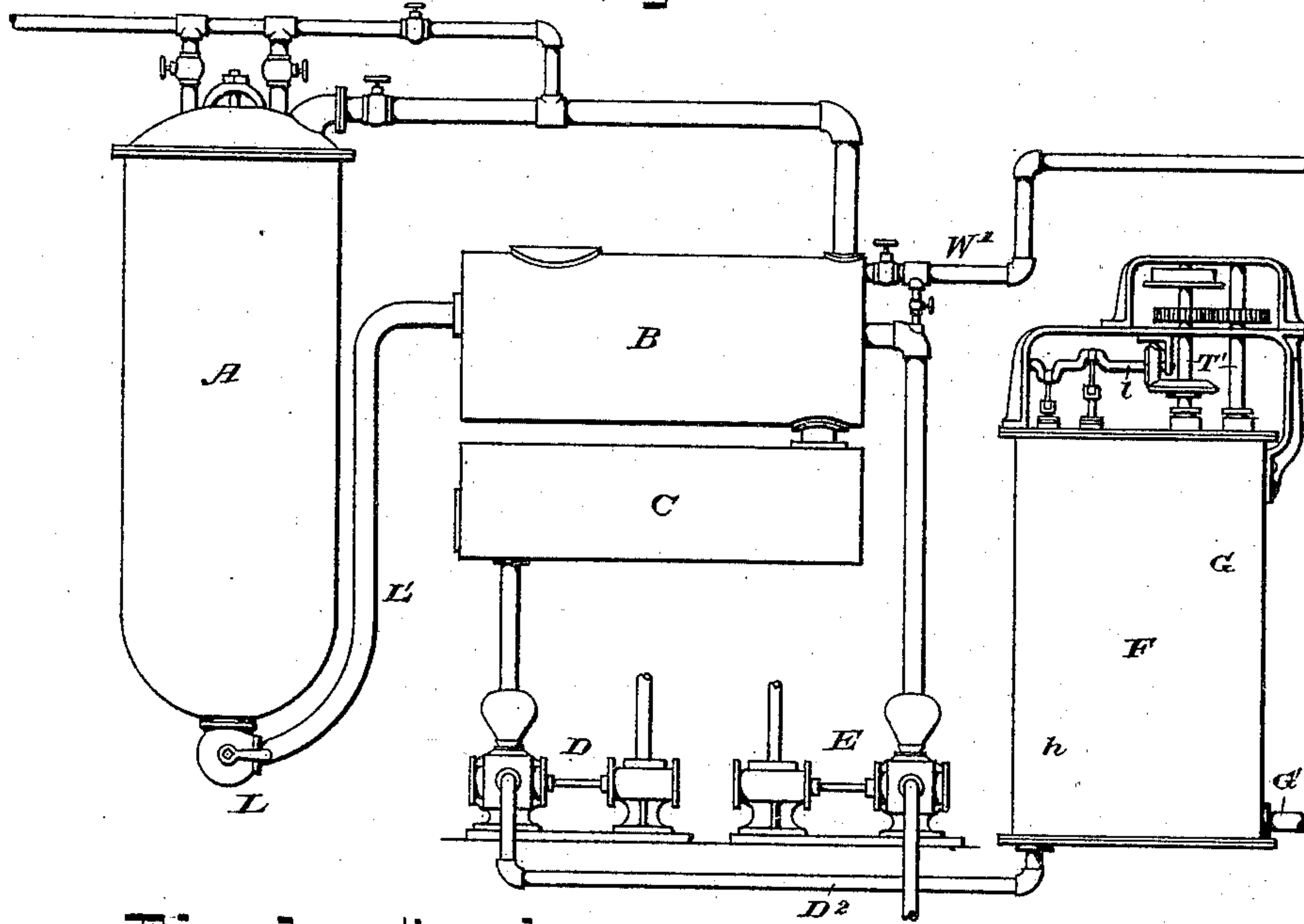
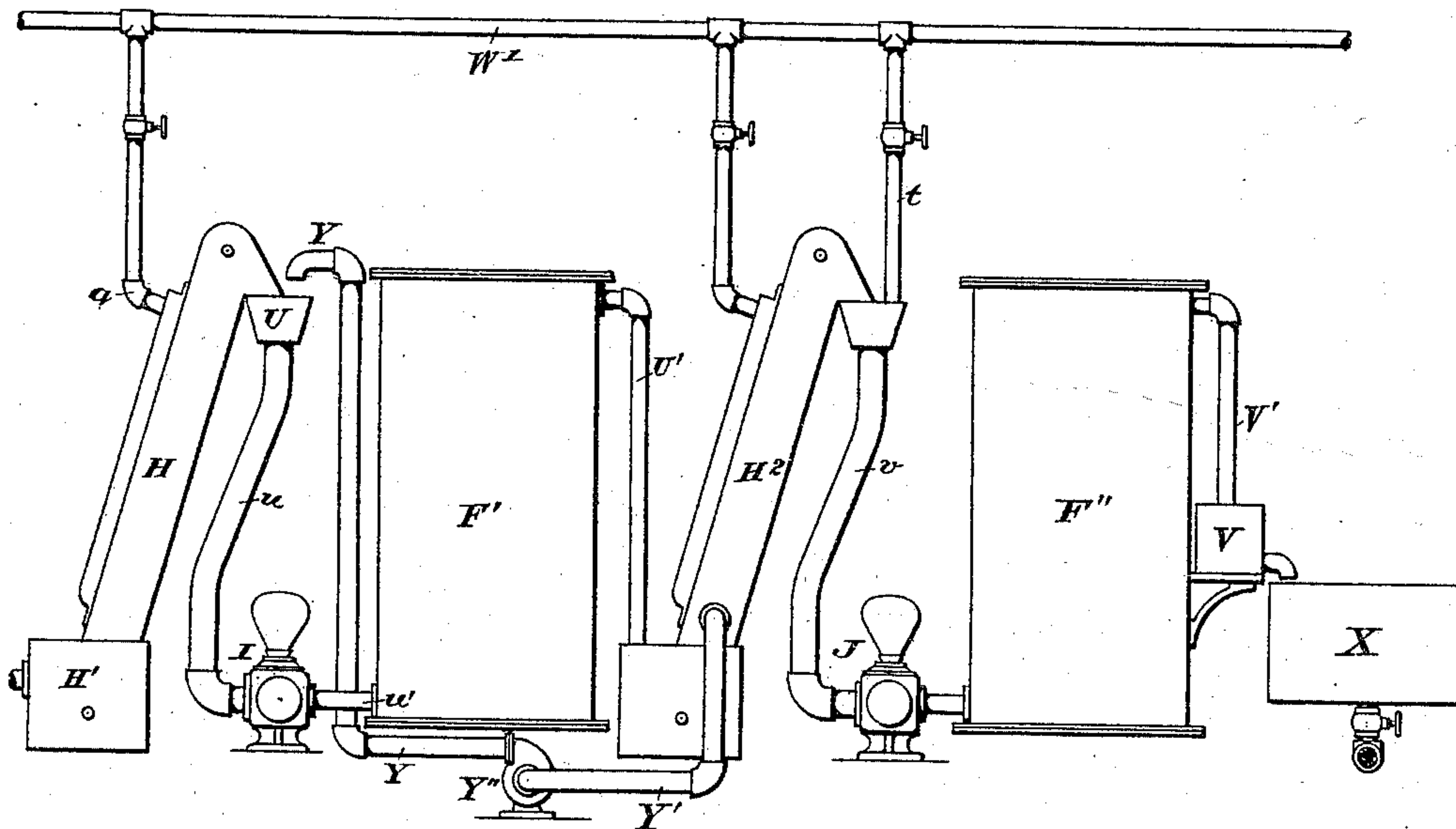


Fig. 1 continued.



WITNESSES:

Arthur Milton.
Chas. B. Barber

INVENTOR:

Henry Blackman.
By his Attorneys,

Arthur C. Brown & Co.

(No Model.)

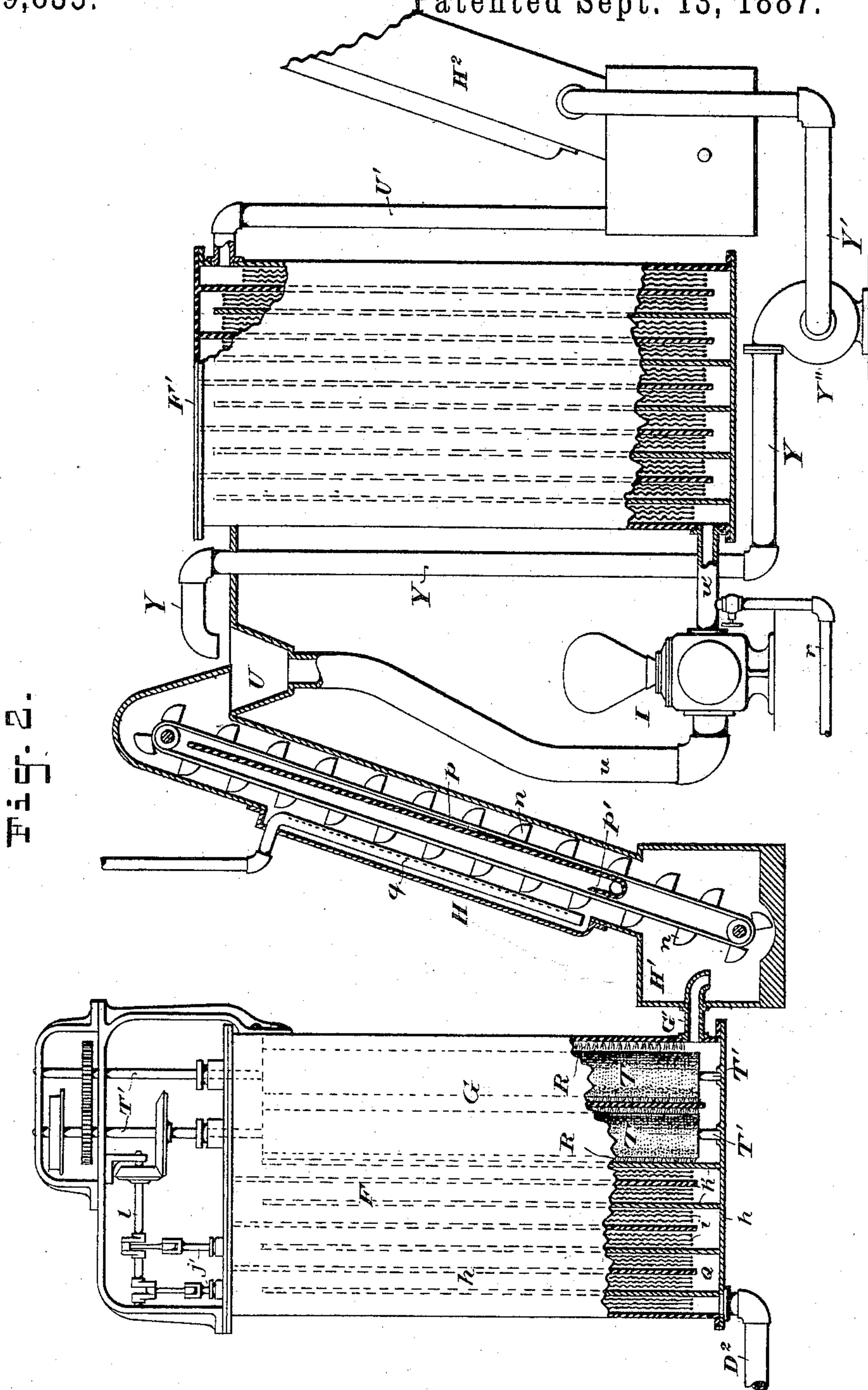
5 Sheets—Sheet 2.

H. BLACKMAN.

PROCESS OF AND APPARATUS FOR MANUFACTURING PAPER PULP.

No. 369,835.

Patented Sept. 13, 1887.



WITNESSES :

Arthur Wilton.

Chas B. Barber:

INVENTOR:

INVENTOR.
Henry Blackman.

By his Attorneys,

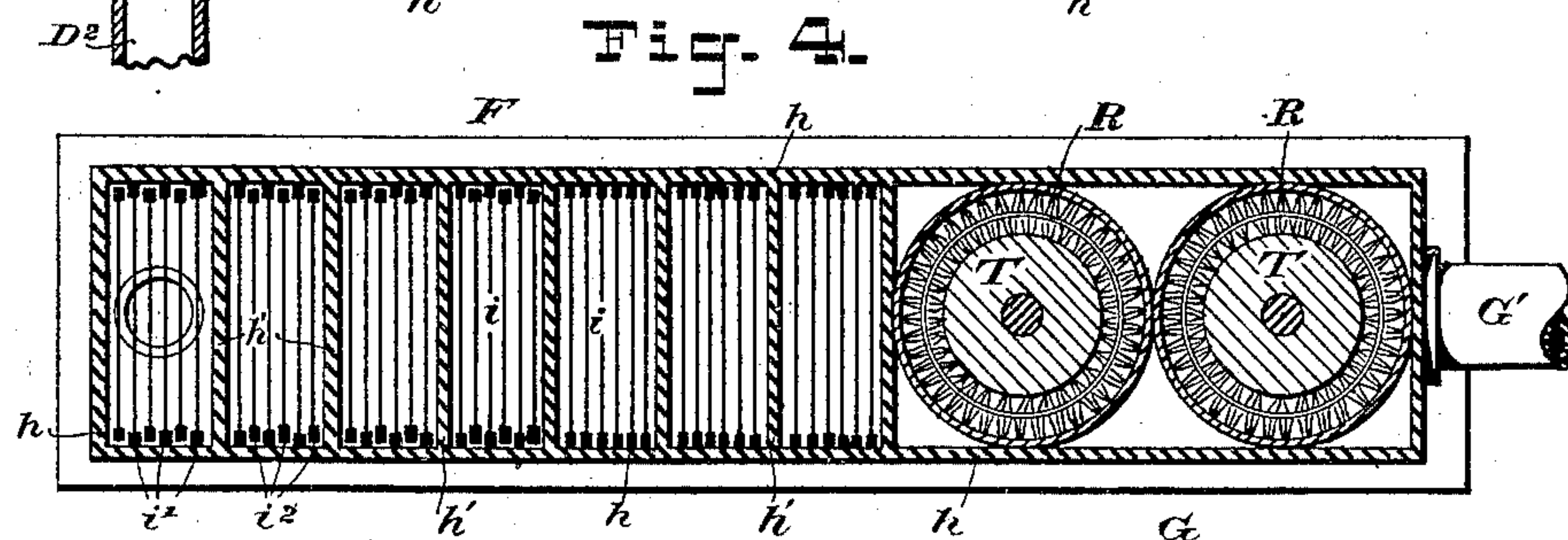
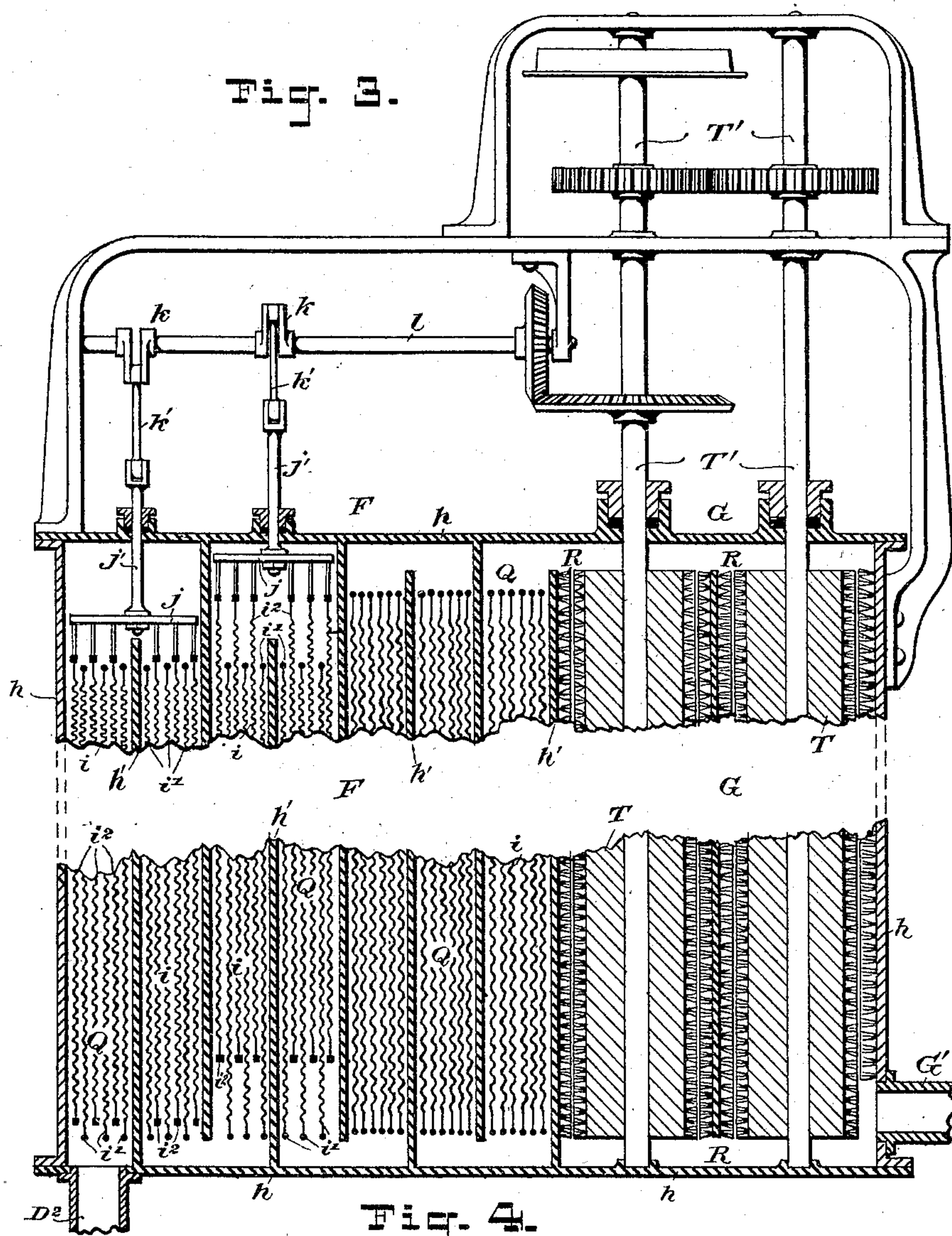
Arthur C. Travers Esq.

H. BLACKMAN.

PROCESS OF AND APPARATUS FOR MANUFACTURING PAPER PULP.

No. 369,835.

Patented Sept. 13, 1887.



WITNESSES:

Arthur Milton.

Chas. B. Barber.

INVENTOR:

Henry Blackman.

By his Attorneys,

Arthur G. Crocker & Co.

(No Model.)

5 Sheets—Sheet 4.

H. BLACKMAN.

PROCESS OF AND APPARATUS FOR MANUFACTURING PAPER PULP.

No. 369,835.

Patented Sept. 13, 1887.

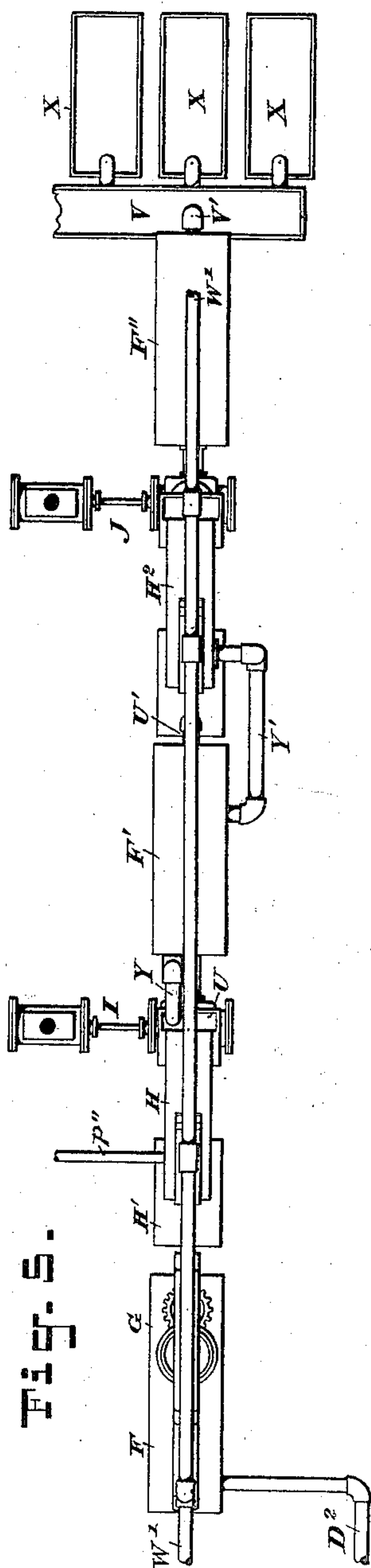


Fig. 5.

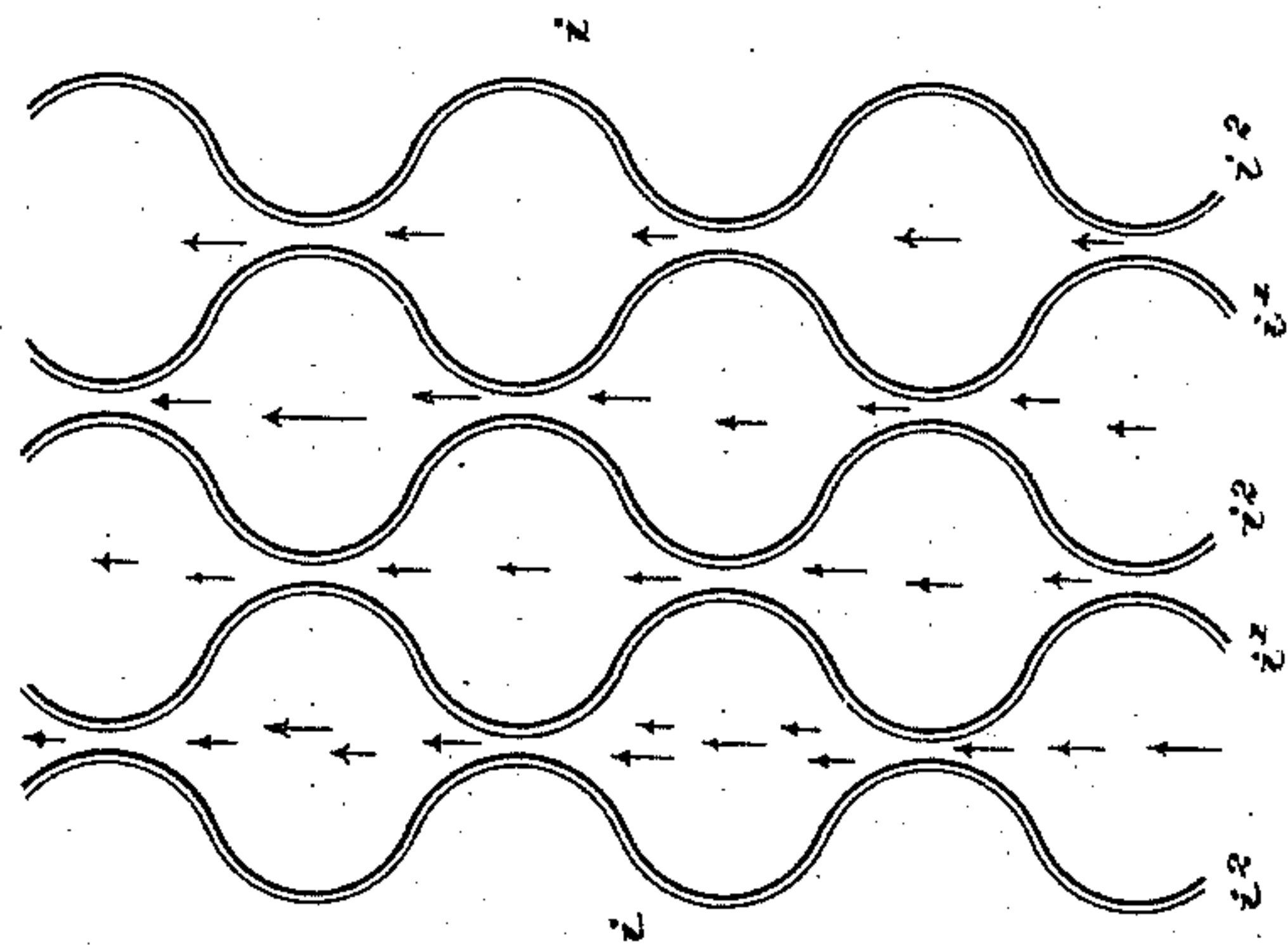


Fig. 7.

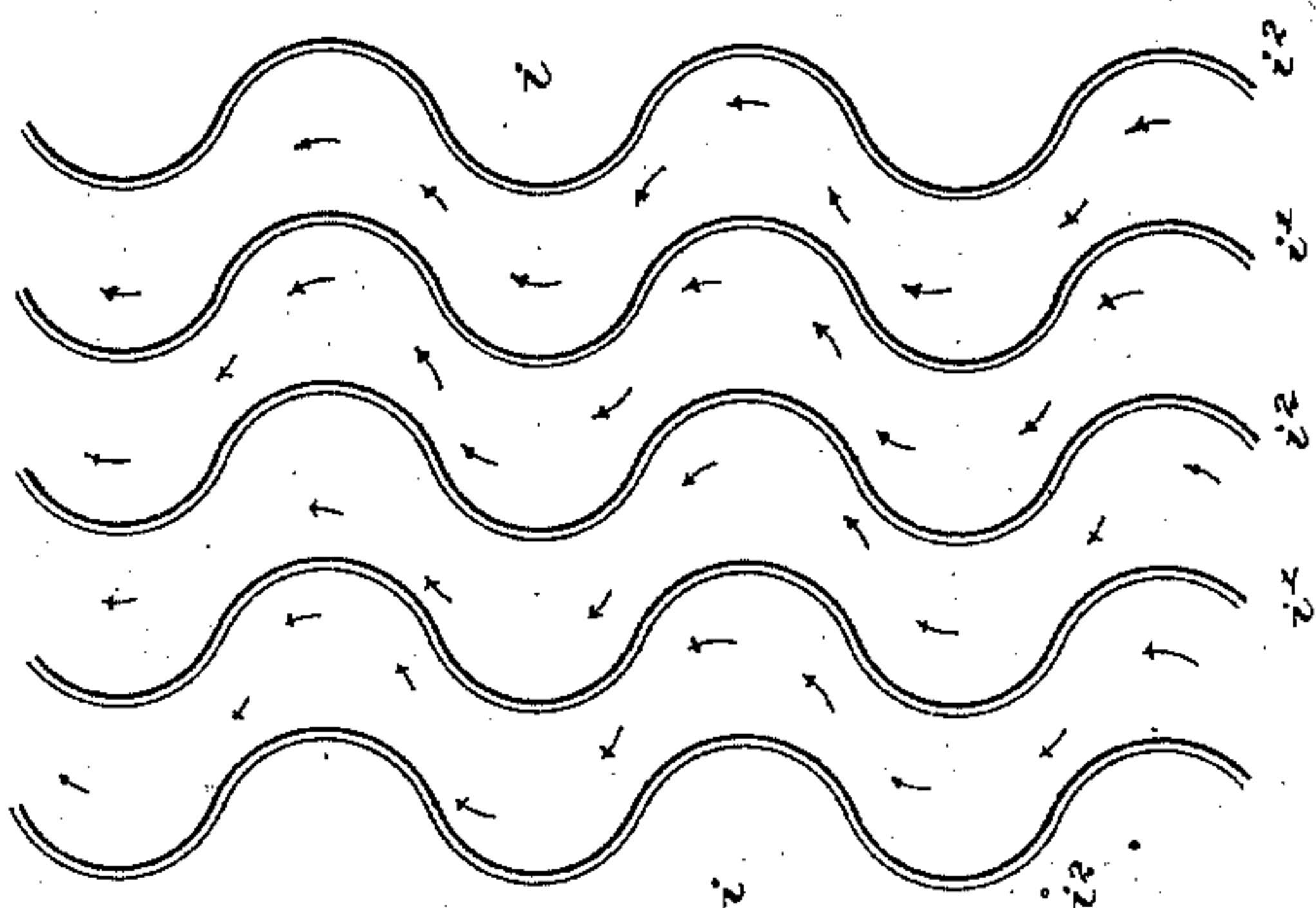


Fig. 8.

WITNESSES:

Arthur Wilton.
Chas. B. Barber.

INVENTOR:

Henry Blackman.
By his Attorneys,

Arthur C. Brown & Co.

(No Model.)

5 Sheets—Sheet 5.

H. BLACKMAN.

PROCESS OF AND APPARATUS FOR MANUFACTURING PAPER PULP.

No. 369,835.

Patented Sept. 13, 1887.

Fig. 10.

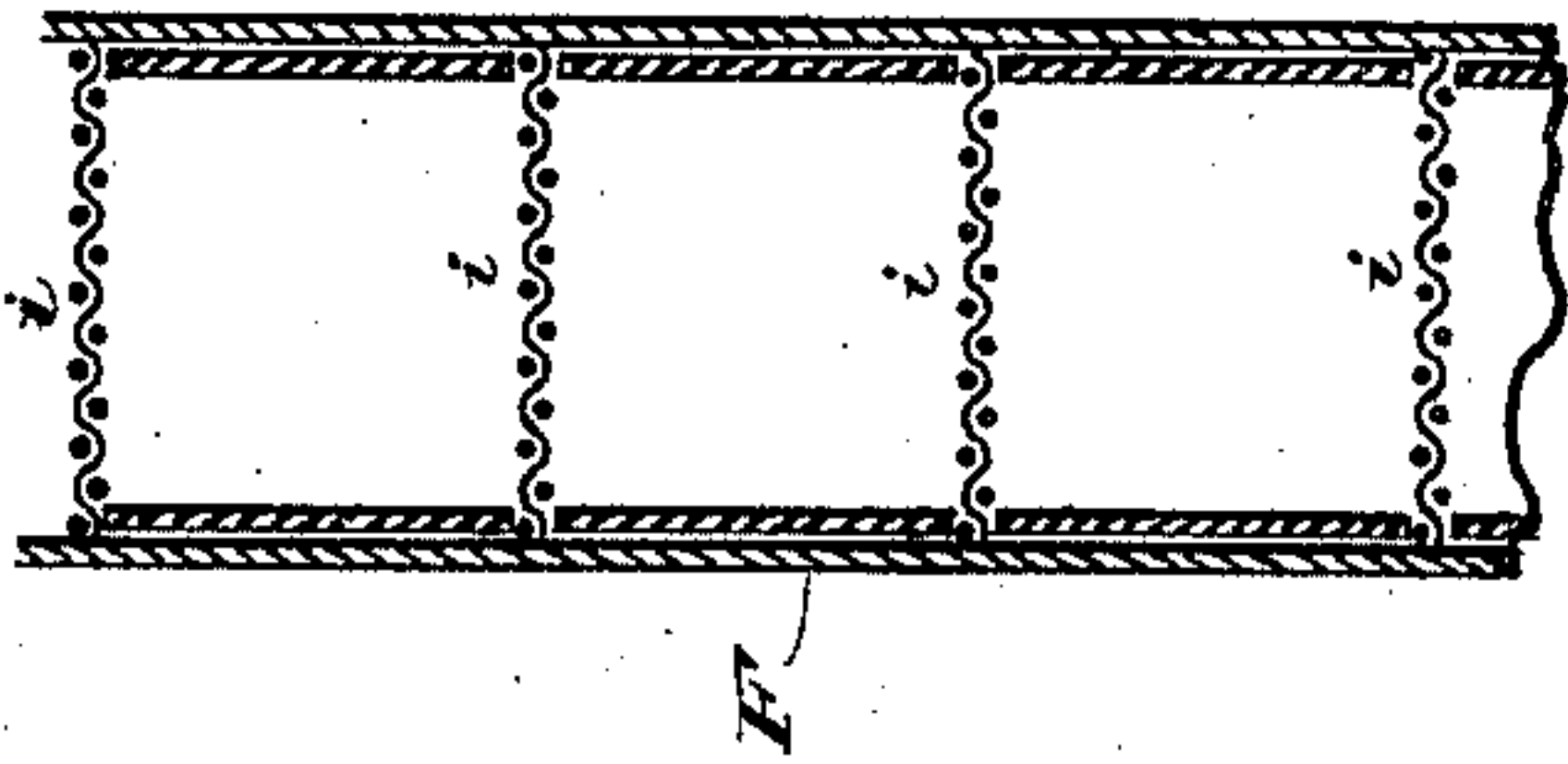


Fig. 8.

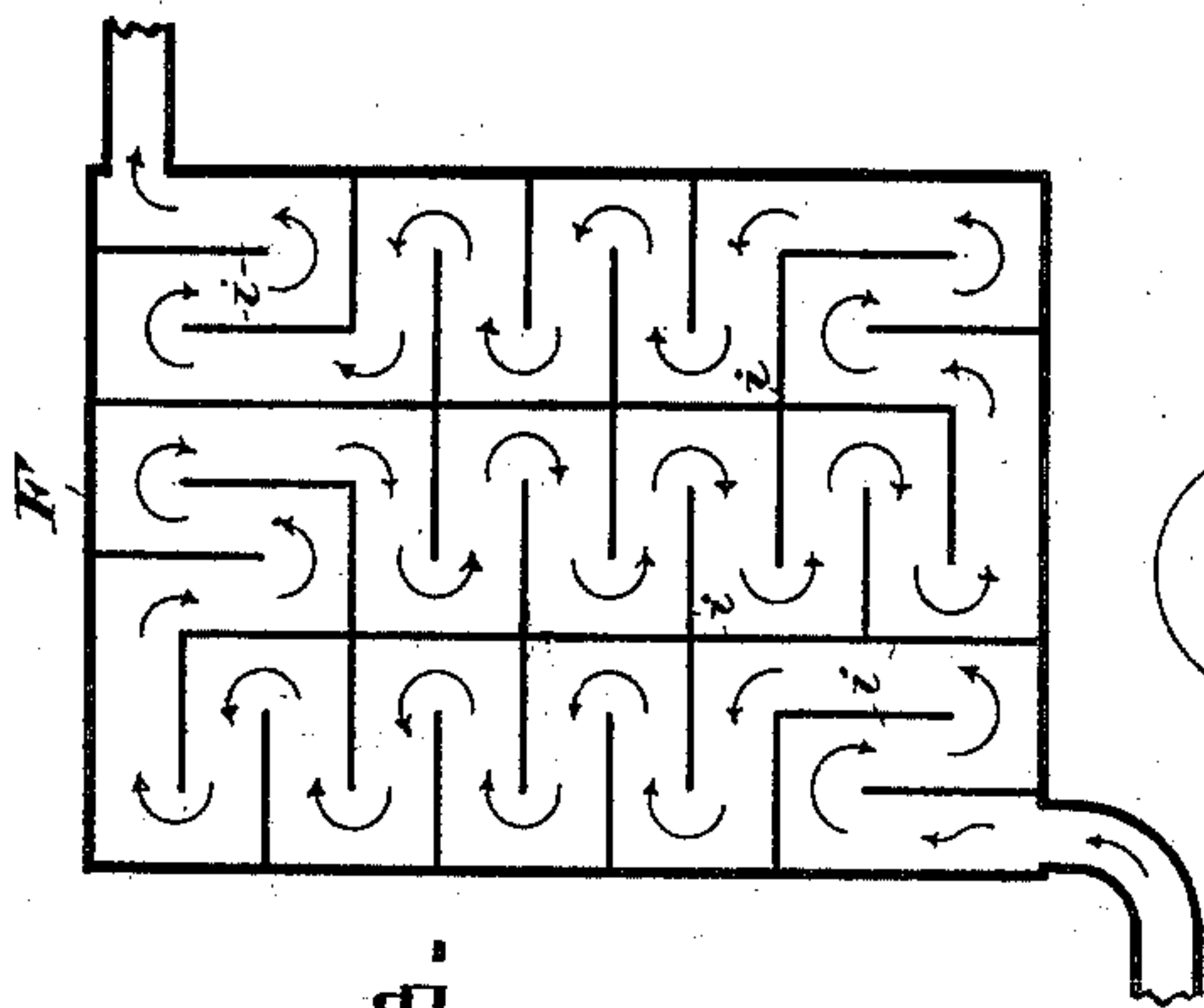
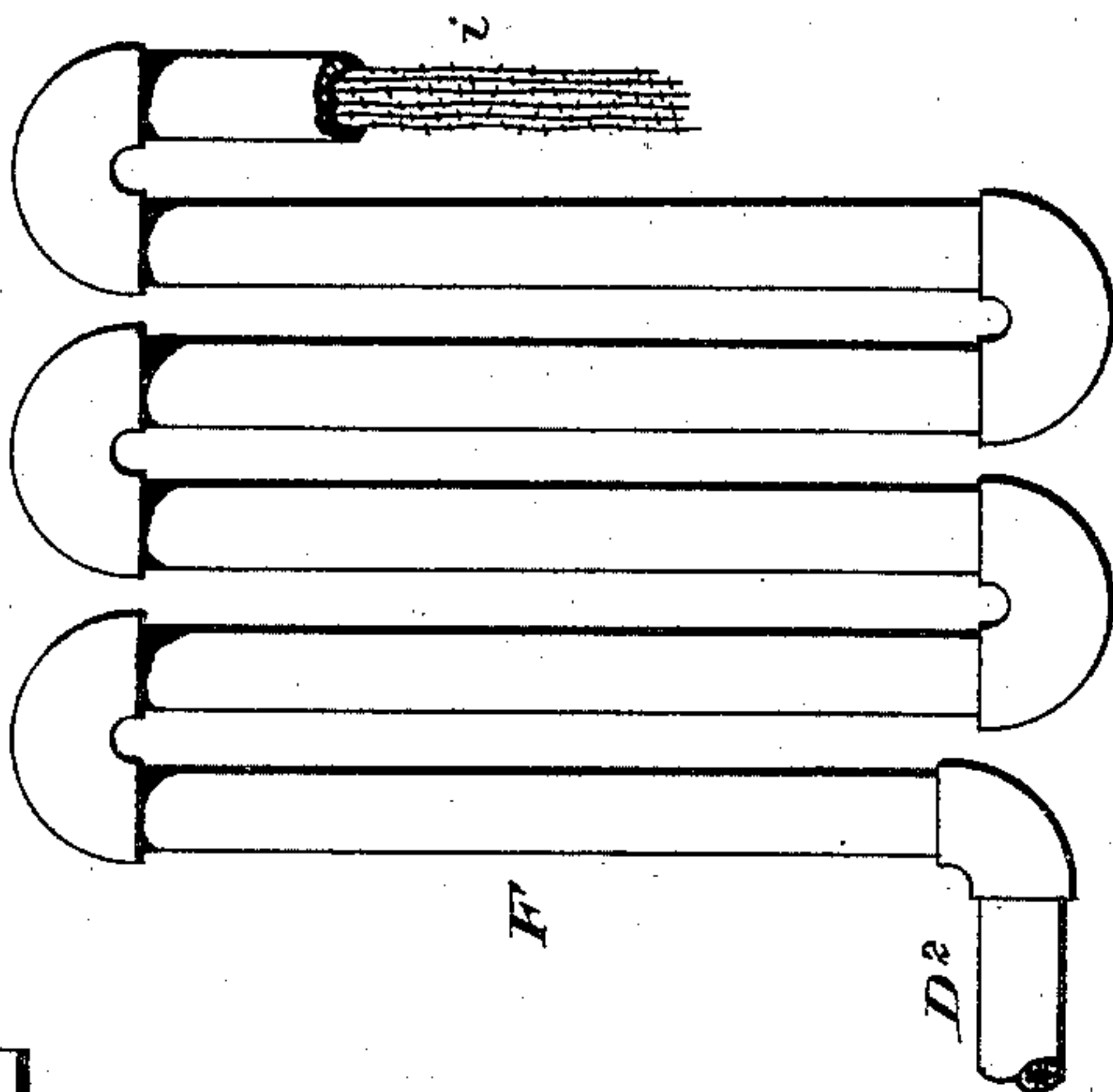


Fig. 6.

WITNESSES:

Arthur Wilton.

Chas B. Barber.

Fig. 12.

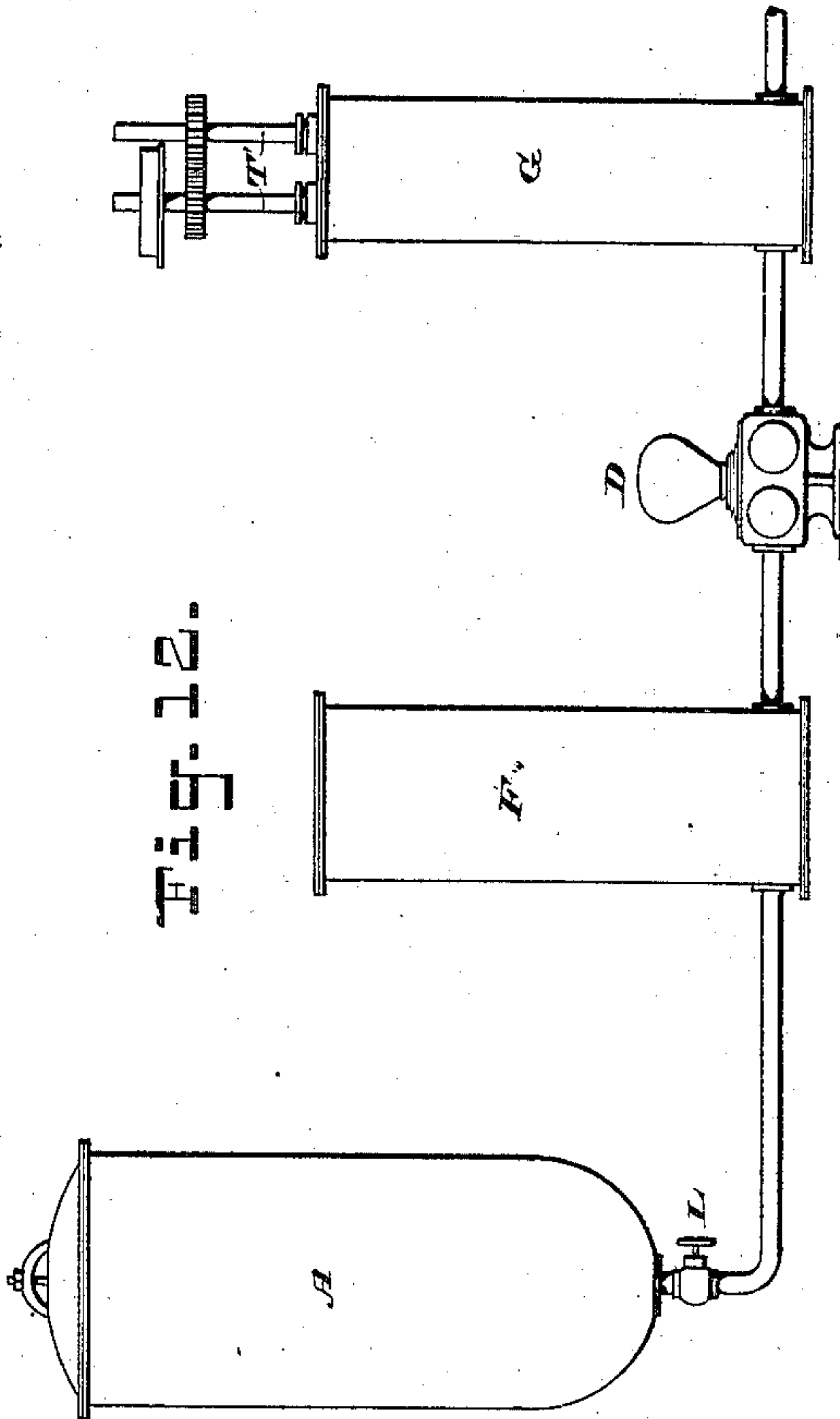
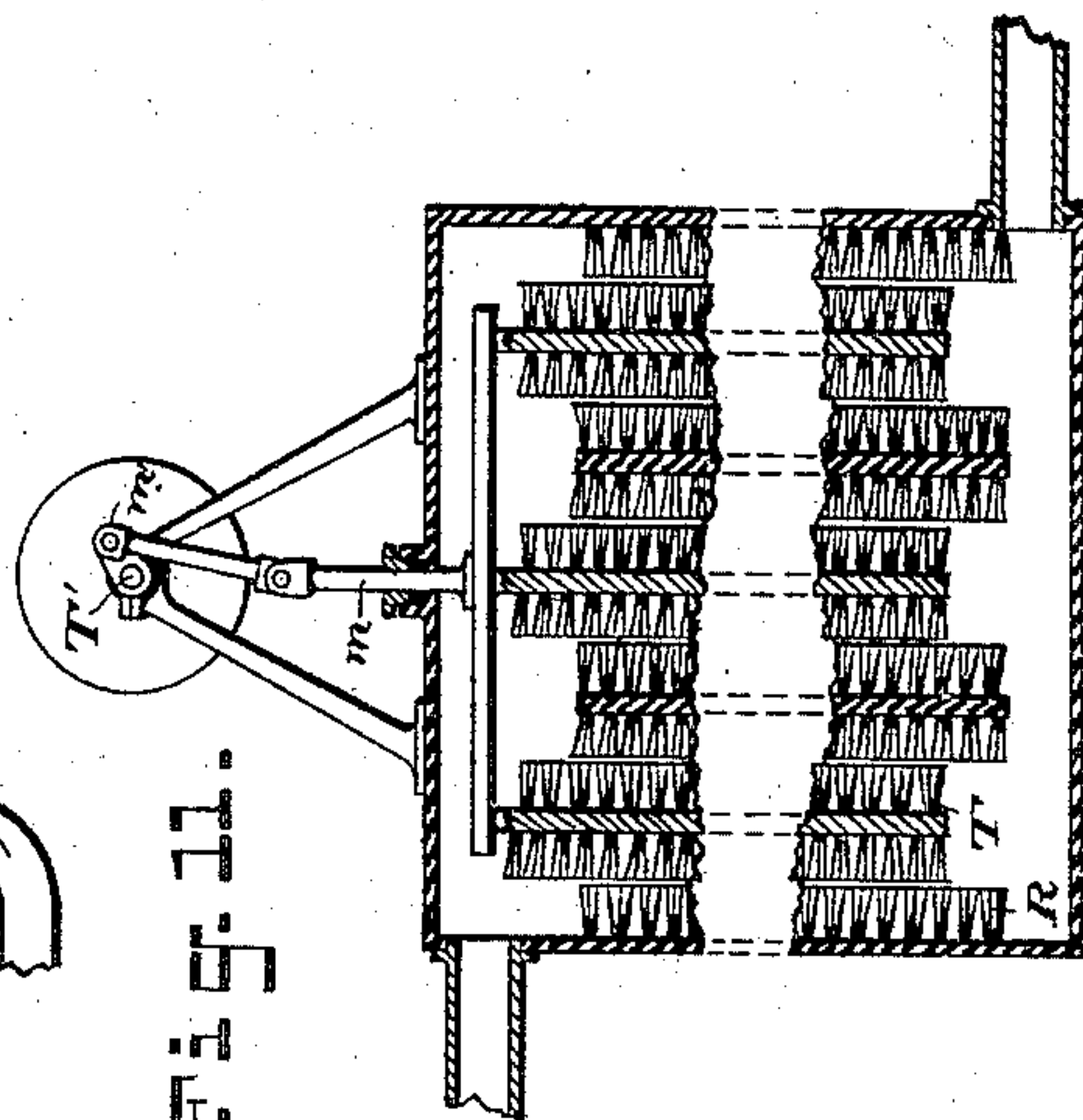


Fig. 11.



INVENTOR:

Henry Blackman.

By his Attorneys,

Arthur G. Brown & Co.

UNITED STATES PATENT OFFICE.

HENRY BLACKMAN, OF NEW YORK, N. Y.

PROCESS OF AND APPARATUS FOR MANUFACTURING PAPER-PULP.

SPECIFICATION forming part of Letters Patent No. 369,835, dated September 13, 1887.

Application filed September 4, 1886. Serial No. 212,736. (No model.)

To all whom it may concern:

Be it known that I, HENRY BLACKMAN, a citizen of the United States, residing in the city, county, and State of New York, have invented certain Improvements in Processes of and Apparatus for Manufacturing Paper-Pulp, of which the following is a specification.

This invention relates to the making of paper-pulp from straw, wood, and other fibrous substances. It pertains more particularly to the later stages of the manufacture of the pulp after the fibrous material has been disintegrated by any of the processes heretofore known, being designed to supersede the beater-engine heretofore used.

According to my present invention I take the fibrous matter after the fibers have been separated by other processes and pass it with water through what I call an "agitator," which consists, essentially, of an extended passage provided with obstructions, against which the current of water carries the fibrous matter, to such effect that on emerging therefrom the fibrous matter and water are reduced to a homogeneous pulp, the fibers of which no longer cling together in irregular masses, but are separated and diffused through the water in a condition of flocculence. I pass the fibers through one or more of such agitators. When more than one is used, I prefer to drain the water from the fibers after they leave the first and before passing them into the second agitator, and to wash them with fresh water or with water containing any suitable materials, by means of a rinsing and conveying apparatus consisting of a series of perforated buckets, in which the pulp is carried upward while water is sprinkled on it and runs through it. Before the fibers are passed through the second agitator they are mixed with a quantity of fresh water or other liquid. My agitating process greatly facilitates the bleaching of the pulp, which is readily accomplished by mixing the pulp with a bleaching-liquor before forcing it through the agitator. In addition to the mere agitation of the fibers by forcing them against obstructions in the agitator, I provide also, by preference, for their more forcible agitation in one or more of the agitators by means of a manipulation of the agitating obstructions, these being connected to a source of power and vibrated or rotated or

reciprocated or otherwise moved against the pulp in order to churn the fibers and beat them apart.

The preferred construction of agitator consists of a casing, with passages extending back and forth, and transversely-corrugated plates set into each of the passages, between which plates the liquid must flow, and the alternate plates connected together and reciprocated by appropriate mechanism in a longitudinal direction, while the intervening plates are either stationary or are reciprocated in a contrary direction. I further provide a means of mechanically drawing apart the fibers, in order to insure the separation of such fibers as adhere together too tenaciously to be separated by the gentler process of agitation. This apparatus, which I call the "scrubber," consists of two sets of brushes, one set being stationary and the other set moving over it, preferably by being mounted to revolve within the stationary brush, both being cylindrical. The pulp is caused to flow through the space between these brushes.

In my application for patent for "improvements in disintegrating fibers and manufacturing paper-pulp," filed May 17, 1886, I have disclosed a novel method of disintegration by first digesting the fibers and then blowing the fibers with water out from the digesting-vessel under heavy pressure and at a high temperature into a vacuum-chamber, in which a sufficient rarefaction is continuously maintained by means of a pump or exhauster. The process described in that application is the one which I prefer to use in connection with my present invention.

I will now proceed to describe my invention more in detail, in connection with the accompanying drawings, wherein—

Figure 1 is a side elevation, partly in section, of a complete apparatus for manufacturing paper-pulp according to my said previous application and my present invention. Fig. 2 is an elevation and vertical mid-section of the portion of the apparatus to which my present invention pertains, on a larger scale. Fig. 3 is a vertical section of the agitator and scrubber, on a still larger scale; and Fig. 4 is a horizontal section thereof. Fig. 5 is a plan of the apparatus shown in Fig. 2, on the same scale as Fig. 1. Figs. 6 and 7 are diagrams. Figs. 8,

9, and 10 are fragmentary views illustrating modifications of the agitator.

Referring to Fig. 1, A is the digester. B is the vacuum-chamber. C is a grit-separator. D is a force-pump for drawing off the fibrous matter and water from the grit-separator and forcing it through the agitator. E is a suction-pump for maintaining the vacuum in the vacuum-chamber. F is the agitator. G is the scrubber, which is here constructed in the same casing with the agitator. H is the pulp-drainer or conveyer for draining and rinsing the pulp. I is a force-pump, and F' is a second agitator.

The digester A, vacuum-chamber B, and grit-separator C are by preference constructed according to another application executed by me this day, and the processes of digesting and blowing off are preferably practiced as detailed in that application. It is sufficient for the purposes of this application to state that the fibrous material is placed in the digester A and boiled under pressure or under vacuum, or both, to soften and separate the fibers and eliminate the impurities, and that, finally, the pressure is raised, an outlet-valve, L, is opened, and the fibrous matter and water are forced out through pipe L' and into the vacuum-chamber B, which they enter through a contracted nozzle, and on passing through said nozzle the steam and water in the interstices of the fibers, being relieved of pressure, suddenly expand, whereby the fibers are forcibly torn apart. The vacuum is maintained by operating the suction-pump E, and by showering water into the vacuum-chamber to condense the steam. By means of this water the fibrous matter is washed into the grit-separator C, where it passes through a succession of traps, in which the heavier particles of sand, grit, pieces of knots, &c., are precipitated, and the fibrous matter and liquid are drawn off to the force-pump D. This is the preferred method of disintegrating and otherwise treating the fibrous matter before subjecting it to the treatment contemplated by my present invention; but any other known or suitable method of disintegration may be used instead.

According to my present invention the fibrous or pulpy matter and water or other liquid are forced by the pump D through the agitator F and scrubber G, after which the pulp is drained, rinsed, and again forced, mixed with fresh liquid, through the second agitator, F'. I will proceed to describe these apparatus in their order.

The agitator F is constructed with an outer box or casing, *h*, in which are fixed alternate partitions *h'* *h'*, whereby is constituted a zig-zag or back-and-forth passage, Q, as clearly indicated in Fig. 3. In this passage Q are placed any kind of agitating obstructions, *i* *i*, adapted to impede the flow of the liquid pulp through the passage and cause a movement or circulation of the fibers relatively to one another. These obstructions may be fixed or movable. As here shown, they are partly mov-

able in the first four sections of the passage Q, and are fixed in the remaining sections thereof. The obstructions shown consist of sheets or plates of corrugated metal, with their corrugations arranged transversely to the direction of flow of liquid through the passage. These plates are set close together, so that the fibers in flowing between them will be caused to impinge against their convex or projecting corrugations. The plates in the first four sections of the passage Q are alternately stationary and movable. The stationary plates *i'* *i'* are fixed in place within the casing. The movable plates *i''* *i''* are arranged to slide in grooves at the sides of the casing, or otherwise mounted so that they may slide or move longitudinally in the spaces between the fixed plates. Their upper ends are connected to a cross frame or head, *j*. This head is mounted on a vertical rod, *j'*, which extends up through a stuffing-box, and is jointed at its upper end to a pitman, *k'*, which embraces a crank, *k*, on a rotary shaft, *l*. This shaft has two cranks oppositely placed, one being connected to the movable plates in the first and second sections of the passage Q, and the other to the movable plates in the third and fourth sections of the passage. As one set of plates moves up the other moves down, and vice versa. If more than four sections of the passage are fitted with movable plates, there will be one or more additional cranks, pitmen, and rods. Any other suitable mechanism may be used to reciprocate the movable plates. The intervening plates may also be made movable, reciprocating oppositely to the plates *i''* *i''*, in which case some mechanism such as that shown may be applied to move them.

In Fig. 3 I have shown an agitator having seven sections to its passage Q, four of which are fitted with movable plates and the remaining three with fixed plates. The latter have their plates arranged as shown in the diagram, Fig. 6, so that the liquid flows through in a sinuous sheet, moving from side to side, and impinging in its passage against the salient projections on alternately opposite sheets. The forcing of the pulp through these sinuous spaces effects a gentle agitation, causing the fibrous particles to move one upon another and gently working apart any fibers that may be clinging together. In the first four sections of the passage the respective plates have at one time the relative position shown in Fig. 6 and at another time that shown in Fig. 7; being continually shifting from one position to the other. The stroke of the movable plates should be equal to the combined widths of several corrugations, and they should be reciprocated at sufficient speed to effect a somewhat violent agitation of the liquid. The continual and rapid changes of shape of the passages between the plates, due to their reciprocation, acts to dash the liquid passing through them against the corrugations, to throw it from side to side, and to churn it and beat it until the fibers are separated

from one another and cleansed by their attrition against one another and by the rinsing of the liquid past them.

The separation of the fibers by the agitation of their liquid vehicle is the object of this process, and this agitation may be effected in various ways, either by movable obstructions moving against the liquid, or by stationary obstructions against which the liquid is forced, or by the forcing of the liquid in a rapid stream through a passage having frequent abrupt angles. Fig. 8 illustrates a modified construction of agitator on the latter principle. Fig. 9 shows an agitator consisting of a coil of pipe, the pipe being filled with stationary obstructions. Barbed fence-wire is here used to form the obstructions. In my said application filed May 17, 1886, I have shown an agitator consisting of a coil of pipe containing wire helices. The pipe or passage may contain any irregular obstructions that are suited to the purpose—such as trimmings of sheet metal, bits of wire-gauze, and the like—provided only that they will not pack with the pressure of the current, nor form pockets in which the fibers will precipitate and choke the passage. Fig. 10 illustrates a good construction, consisting of diaphragms *i i*, of woven wire, inserted transversely of the passage at intervals. From the agitator the fibers pass to the scrubber G. (Shown in Figs. 2, 3, and 4.) The scrubber is here shown as constructed in the same casing as the agitator; but this is not essential. The agitator-passage Q terminates at the top of the casing, and from this the pulp flows across the top of two cylindrical passages, R R, down these passages to the bottom of the casing, and thence to the outlet G'. The passages R R are clothed with bristle brushes, and in each passage is set a revolving cylinder, T, which is clothed exteriorly with bristle brushes. The cylinders T T are mounted on shafts T' T', having bearings at top and bottom of the casing, extending out at the top of the casing through stuffing-boxes geared together, and connected by a belt or otherwise with a source of power, in order to be rotated. One of these shafts is also, by preference, geared to the shaft *l* of the agitator. The stationary brushes in the cylindrical passages R R and the moving brushes on the rotating cylinders T T are arranged to barely touch each other as the cylinders revolve. The pulp flowing down through the annular space between the two sets of brushes is acted upon thereby, any fibers which may be still clinging together being thus drawn apart.

The scrubber acts to complete the disintegration and separation of the fibers, doing all that is left undone by the agitator, and the pulp comes from it with its fibers reduced to a homogeneous flocculent condition. The scrubber might be used alone, without the agitator, or it might be arranged to act first upon the pulp, passing it then to the agitator; but I prefer the arrangement shown.

The scrubber may be modified in various

ways. All that is essential is, that the pulp shall be acted upon by moving brushes while it is held by stationary (or oppositely-moving) brushes or by other equivalent device. Wire brushes might be used, or one set of brushes might be of wire and the other set of bristles, or one set might consist of teeth similar to those on a curry-comb, while the other consists of bristle or other brushes. The movement might be reciprocating instead of rotary.

Fig. 11 illustrates a scrubber having three rectangular compartments, R R, clothed internally with bristle or other brushes, with three flat plungers, T T, working in them, and clothed externally with brushes, the three being connected by a cross-head to a rod, *m*, which passes out of the casing through a stuffing-box, and is connected by a pitman to a crank, *m'*, on a shaft, T'.

From the scrubber the pulp passes to the pulp drainer or elevator H, by which it is drained and rinsed. The outlet-pipe G' enters a box, H', and a conveyer, consisting of an endless belt carrying buckets *n n*, runs with its lower end in this box and with its upper end over a hopper, U. As the buckets pass under the lower roller, they scoop up a quantity of pulp and carry it up the incline until, in passing around the upper roller, they dump it into the hopper, as is customary in elevating-conveyers. The buckets are made with perforations, preferably on the side toward the belt, in order to act as strainers, the water being drained from the pulp and passing through the belt, where it is caught by a screen-plate, *p*, arranged inside the belt, and carried to a gutter, *p'*, whence it is conducted away at one side by a pipe, *p''*, Fig. 5. Thus the pulp is drained of the liquid which has carried it through the agitator and scrubber, and which by this time has become impure. In addition to this draining, the pulp is rinsed with fresh water, which is sprinkled into the buckets as they ascend from a perforated pipe, *q*, arranged in front of the ascending side of the conveyer. The water flows through the pulp in the buckets, and is drained out at the back thereof, escaping with the impure liquid by the gutter *p'* and pipe *p''*. By this rinsing the pulp is rendered quite clean, and is in condition for use by the paper-maker, if brown paper or wrapping-paper is to be made; but for finer papers it should pass through another treatment—namely, the forcing through another agitator, F', in connection with a bleaching-liquid.

A stream of water or bleaching-liquor is directed into the hopper U from a pipe, Y, and washes the pulp down the pipe *u* to the force-pump I, which forces it out by pipe *u'* and through the agitator F'. This agitator is designed more for effecting a thorough union of the fibers with the liquor than for separating the fibers, and hence has no moving obstructions, but consists simply of an extended passage containing corrugated plates or fence-wire, or twisted strips of metal, or any other

obstructions that are calculated to agitate the current of pulp and liquor as it is forced through them and cause a thorough circulation. By this treatment the pulp is bleached
 5 very thoroughly and rapidly. It is then delivered through pipe U' to a second drainer or conveyer, H², by which the bleaching-liquor is drained out and saved to be used over again.

This drainer is constructed the same as the
 10 drainer H, except that its outlet-pipe (lettered Y') for conveying away the liquor drained from the pulp extends to a circulating-pump, Y'', which delivers the bleaching-liquor back through the pipe Y to the hopper U. The
 15 bleaching-liquor is thus used repeatedly. Some fresh water is mixed with it in the drainer H² while rinsing out the bleach from the pulp. The bleaching-liquor may be strengthened from time to time by introducing fresh chemicals through a pipe, r, Fig. 2. After being
 20 thus bleached, drained, and rinsed the pulp is mixed with fresh water from a pipe, t, Fig. 1, and is washed down a pipe, v, to a pump, J, which forces it through a third agitator, F'',
 25 Fig. 1, the purpose of which is to dissolve out of the fibers every vestige of bleaching chemical. It is finally delivered through pipe V' to a receiving-trough, V, by which it is supplied through any one of several outlets, Fig. 5, to
 30 one or more "wet machines," X.

The wet machine is well understood in the paper-maker's art, and I have not thought it necessary to illustrate it in detail, nor to explain it further than to say that it is used to
 35 form the pulp into a continuous web or "felt," draining it of its liquor. The felt is carried away to be dried and sold, or is conducted to a paper-machine to be immediately made into paper. Any other device for finally working
 40 up the pulp into felts or otherwise may be used in place of a wet machine.

It will be observed that by my present invention the disintegrated fibrous matter is beaten and worked into a clean homogeneous
 45 flocculent pulp without once exposing it to the air until it is drained and rinsed, and by a rapid, continuous, and progressive process. This I consider a marked improvement upon the pulping by means of the beater-engine,
 50 wherein the pulp is exposed to the air and its impurities are liable to oxidize in the fibers, and foreign particles are liable to get into the pulp. My process avoids such discoloring of the pulp, saves bleaching, and produces a
 55 pulp with longer fiber, since there is no cutting of the fiber, as in the beater-engine.

The vacuum-chamber B and grit-separator C may be omitted in practicing my present invention, and instead of forcing the liquid
 60 through the agitators and scrubbers it may be drawn through by suction.

Fig. 12 shows an apparatus wherein the digester connects directly with the agitator F, and a pump, D, is connected between the agi-
 65 tator and the scrubber G.

I am well aware that fibrous matters have been agitated in the digester and during the

boiling or other disintegrating or softening process by means of mechanical agitating or stirring devices therein. My invention has
 70 no reference to this stage of the process, but applies only to the pulping of fibers already disintegrated, or nearly so, by suspending them in a liquid vehicle and agitating the liquid.
 75

I claim as my invention—

1. The improvement in the art of making paper-pulp, which consists in first disintegrating fibrous material, and subsequently pulping the disintegrated fibers by suspending
 80 them in a liquid vehicle, and agitating the liquid by forcing it through a passage containing obstructions or deflections, thereby causing a relative movement of the fibers, whereby the latter are gently worked apart and reduced to
 85 a condition of pulpiness.

2. The improvement in the art of making paper-pulp, which consists in first disintegrating fibrous material by boiling with a solvent, separating the disintegrated fibers from the
 90 solvent, and subsequently pulping them by suspending them in a liquid vehicle, and agitating the liquid by forcing it through a passage containing obstructions, thereby causing a relative movement of the fibers, whereby the
 95 latter are gently worked apart and reduced to a condition of pulpiness.

3. The improvement in the art of making paper-pulp, which consists in passing disintegrated fibers with liquid through an extended passage containing corrugated plates,
 100 whereby it is subdivided into sinuous spaces, through which the liquid flows, carrying the fibers against the projecting corrugations.

4. The improvement in the art of making
 105 paper-pulp, which consists in first disintegrating fibrous material and subsequently pulping the disintegrated fibers by suspending them in a liquid vehicle, passing the fibers and liquid through a closed chamber, and agi-
 110 tating the liquid therein by agitating devices driven by power, thereby causing a relative movement of the fibers, whereby the latter are gently worked apart.

5. The improvement in the art of making
 115 paper-pulp, which consists in forcing disintegrated fibers with liquid through a closed chamber and agitating them therein by reciprocating corrugated plates driven by power, between which plates the liquid is
 120 forced to flow.

6. The improvement in the art of making paper-pulp, which consists in forcing the fibers with liquid through an extended passage, wherein they are first forcibly agitated by
 125 means of moving agitating devices driven by power and subsequently gently agitated by passing stationary obstructions contained in said passage.

7. The improvement in the art of making
 130 paper-pulp, which consists in forcing the fibers with liquid through a passage or chamber and over moving brushes, which act to scrub the fibers.

8. The improvement in the art of making paper-pulp, which consists in forcing the fibers with liquid through a passage or chamber and between opposite brushes, which are moved relatively to one another and act to scrub the fibers.

9. The improvement in the art of making paper-pulp, which consists in forcing the fibers with liquid through a passage clothed internally with brushes and scrubbing them in their passage therethrough by brushes filling said passage and driven by power.

10. The improvement in the art of making paper-pulp, which consists in forcing the fibers with liquid through a passage wherein they are forcibly agitated by agitating devices driven by power, and then through a passage wherein they are scrubbed by moving brushes.

11. The improvement in the art of making paper-pulp, which consists in forcing the fibers with liquid through a passage wherein they are scrubbed by moving brushes, and subsequently forcing them through an agitating-passage, wherein they are gently agitated by contact with obstructions.

12. The improvement in the art of making paper-pulp, which consists in forcing disintegrated fibers mixed with a liquid vehicle through an agitating passage or chamber, whereby the fibers are cleansed, then draining the liquid from the fibers, adding clean liquid, and forcing again through an agitating passage or chamber.

13. The improvement in the art of making paper-pulp, which consists in cleansing the fibers by forcing them with liquid through a scrubber, draining off the liquid, supplying fresh liquid, and forcing through an agitating-passage.

14. The improvement in the art of making paper-pulp, which consists in cleansing the fibers by mechanical agitation with liquid and by scrubbing, then draining off the liquid, supplying fresh liquid, and forcing through an agitating-passage.

15. The improvement in the art of making paper-pulp, which consists in mixing disintegrated fibers with a bleaching-liquor, forcing the fibers and liquid through a passage containing agitating obstructions, whereby the liquor is brought into intimate contact with the fibers, then draining off the bleaching-liquor, adding fresh water, and forcing the fibers and water through a second agitating-passage, whereby the fibers are rinsed and freed from the residue of bleaching-liquor.

16. The improved apparatus for manufacturing paper-pulp, consisting of the combination of a digesting-vessel, a pump, an agitator consisting of a passage or chamber containing agitating obstructions or deflections, and pipes connecting the respective parts, whereby the fibers disintegrated in said digester may be forced by said pump through said agitator.

17. The improved apparatus for manufacturing paper-pulp, consisting of the combination of a digesting-vessel, a pump, a pipe for

conducting the contents of the digester to said pump, a water-pipe communicating therewith, whereby the fibers discharged from the digester may be mixed with water and washed to said pump, and an agitator in communication with said pump and consisting of an extended passage containing agitating obstructions or deflections, whereby the fibers and water may be forced by said pump through said agitator.

18. A pulp-agitator consisting of the combination of a casing with alternate partitions therein forming a back-and-forth passage for the pulp, and with agitating obstructions in said passage adapted to cause an eddying of a stream of liquid forced therethrough.

19. A pulp-agitator consisting of the combination of a casing with alternate partitions therein forming a deflected passage for the pulp, and with agitating obstructions consisting of corrugated plates arranged in said passage and subdividing it into sinuous spaces.

20. A pulp-agitator consisting of the combination of a casing forming a passage for the pulp, corrugated plates in said casing, the alternate plates being movable relatively to the others, and mechanism for imparting motion to said alternate plates.

21. A pulp-agitator consisting of the combination of a casing forming a passage for the pulp, corrugated plates fixed longitudinally in said passage, with their corrugations extending transversely thereof, movable corrugated plates alternated with the fixed plates, a reciprocating frame connected to said movable plates and extending outside the casing, and a rotary shaft having a crank connected to and reciprocating said frame.

22. The improved apparatus for manufacturing paper-pulp, consisting of the combination of a pump and a scrubber, the latter consisting of a casing with a passage through it for the pulp, and a moving brush in said casing adapted to scrub the pulp in its passage through said casing.

23. A pulp-scrubber consisting of the combination of a casing forming a passage for the pulp, stationary brushes clothing said passage, and a movable brush arranged in said passage, whereby the pulp in flowing through passes between said stationary and movable brushes.

24. A pulp-scrubber consisting of the combination of a casing, a cylindrical passage through said casing, brushes lining said passage, and a cylindrical brush arranged to rotate in said passage.

25. The improved apparatus for manufacturing paper-pulp, consisting of the combination of a pump, an agitator, and a scrubber, connected together, substantially as set forth.

26. The improved apparatus for manufacturing paper-pulp, consisting of the combination of a pump, an agitator connected to said pump, and a draining device connected with the outlet of the agitator and adapted to free the pulp issuing therefrom of its liquid vehicle.

27. The improved apparatus for manufac-

turing paper-pulp, consisting of the combination of a pump, a scrubber, and an elevator having draining-buckets adapted to drain the pulp of liquid.

5 28. The improved pulp-drainer consisting of an endless belt with perforated elevating-buckets and a gutter within the belt adapted to catch the liquid from the buckets and discharge it laterally, combined substantially as
10 set forth.

29. The improved pulp drainer and rinser consisting of an endless belt with perforated elevating-buckets, a gutter within the belt adapted to catch the liquid from the buckets
15 and discharge it laterally, and a sprinkler arranged in front of the ascending buckets and adapted to throw jets of water into them, combined substantially as set forth.

30. The combination, with a pulp-drainer,
20 of a hopper for receiving the drained pulp, a pipe discharging liquid into said hopper, a pump, and a pipe leading from said hopper to said pump.

31. The combination, with a pulp-drainer,
25 of a hopper for receiving the drained pulp, a pipe discharging liquid into said hopper, a pipe leading from said hopper, a pump, and an agitating-passage.

32. The combination, with a pulp-drainer and its hopper, of a bleaching-agitator, a pump
30 for circulating bleaching-liquor from said agitator to said hopper, and a pump for forcing said liquor and pulp through said agitator.

33. The combination of a pulp-drainer and its hopper, a bleaching-agitator, a second pulp-drainer for draining the bleaching-liquor from
35 the pulp as it comes from said agitator, a pump for circulating the bleaching-liquor from said pulp-drainer to the said hopper, and a force-pump for forcing said liquor and pulp through
40 said agitator.

34. The combination, with a bleaching-agitator, of a pulp-drainer for draining the bleaching-liquor from the pulp as it comes from said
45 agitator, a rinsing-agitator through which the pulp is passed with fresh water, and a pump for forcing it through said rinsing-agitator.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

HENRY BLACKMAN.

Witnesses:

ARTHUR C. FRASER,
GEORGE H. FRASER.