G. R. SHERWOOD.

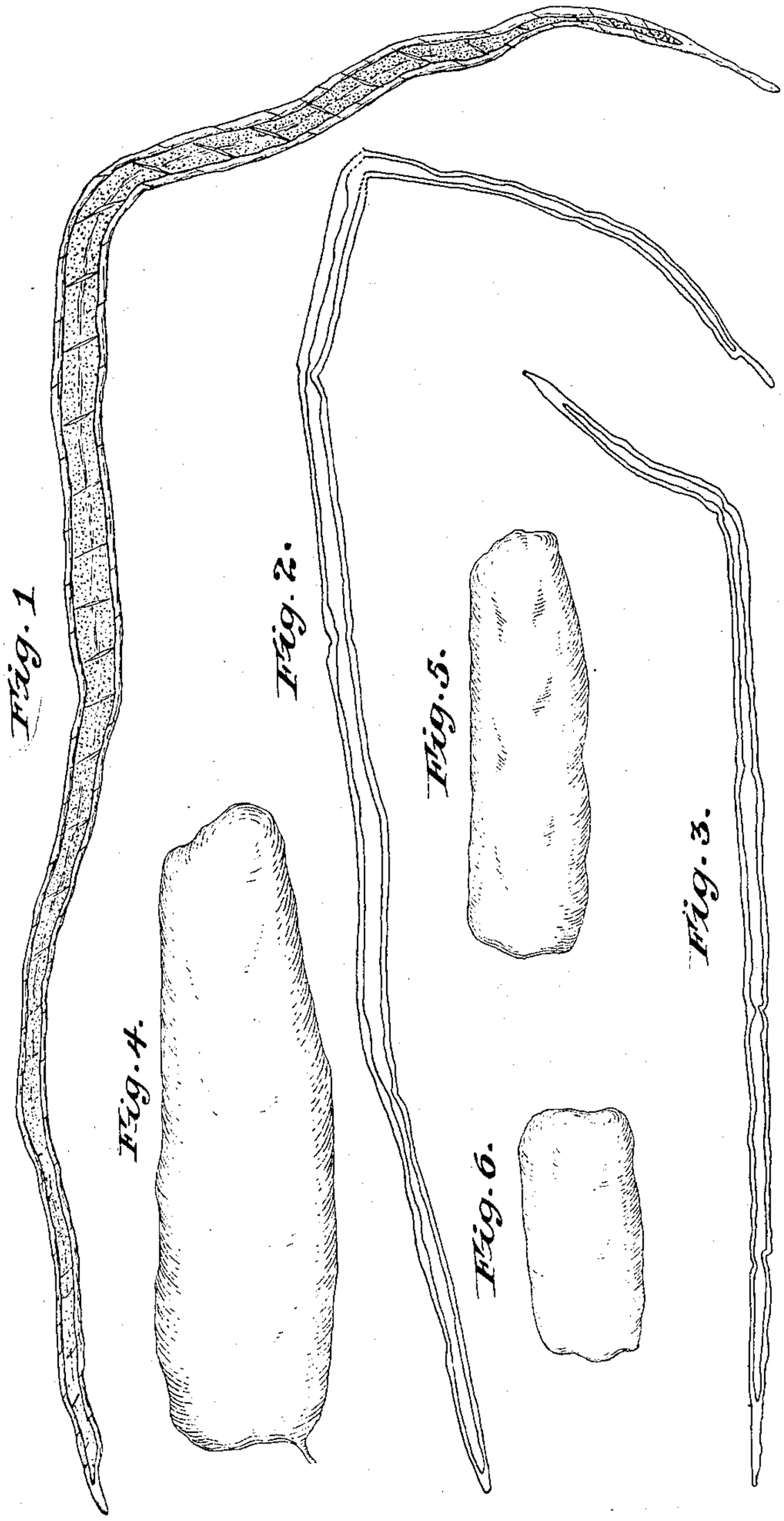
PROCESS OF PREPARING FIBER STOCK FROM CORNSTALKS AND ANALOGOUS PLANTS.

APPLICATION FILED JUNE 11, 1904.

905,374.

Patented Dec. 1, 1908.

3 SHEETS—SHEET 1.



Witnesses,
F. G. Mann,
A. D. Evans

Inventor;
George R. Sherwood,
By Offield Towle & Linthicum
Attys.

G. R. SHERWOOD.

PROCESS OF PREPARING FIBER STOCK FROM CORNSTALKS AND ANALOGOUS PLANTS.

APPLICATION FILED JUNE 11, 1904.

905,374. Patented Dec. 1, 1908.

3 SHEETS—SHEET 2.

Fig. 7.

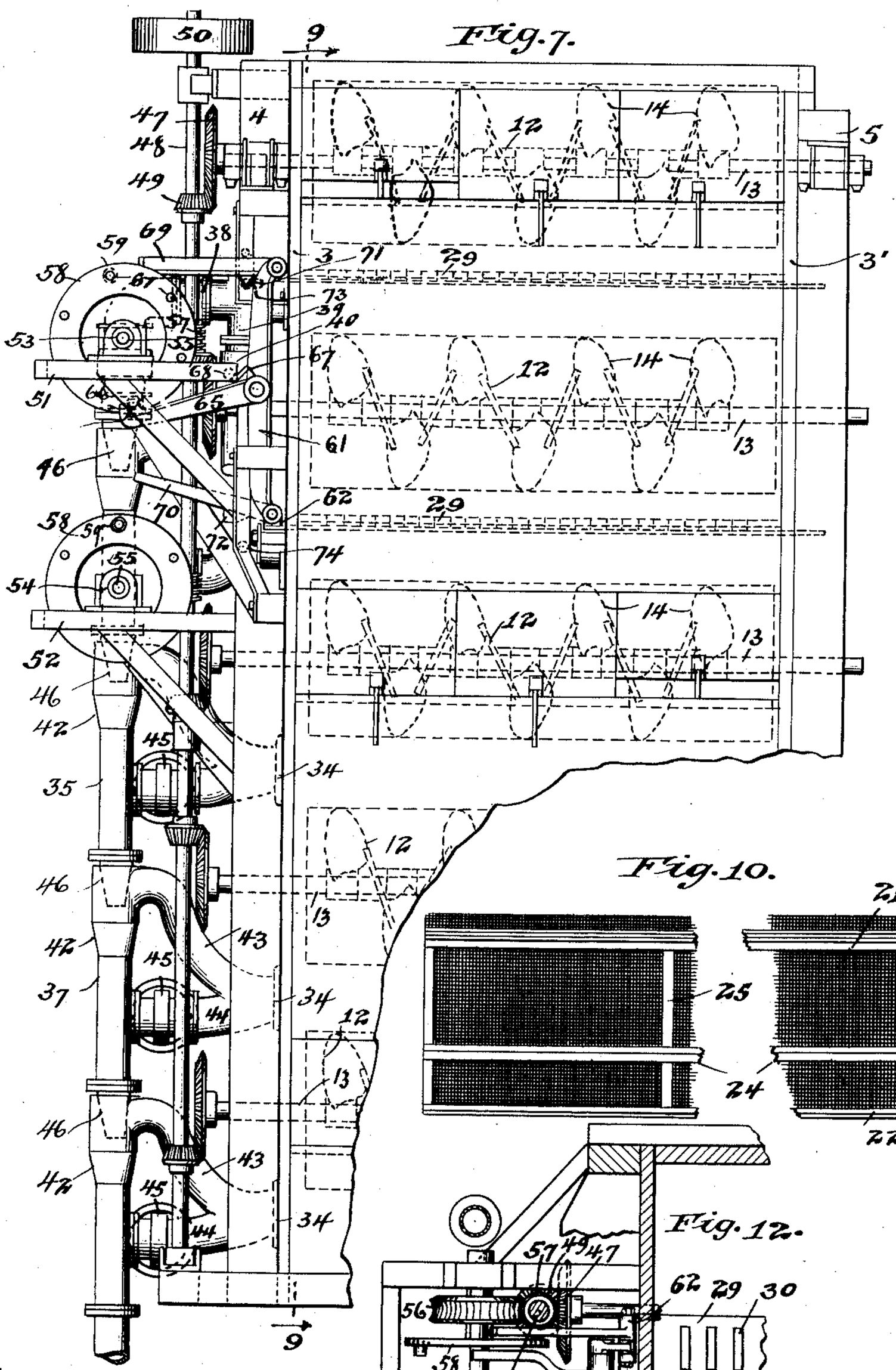


Fig. 10.

Fig. 12.

Witnesses,
F. D. Mann,
A. N. Graves.

Inventor,
George R. Sherwood
By Offield Towle & Linthicum,
Attys.

G. R. SHERWOOD.

PROCESS OF PREPARING FIBER STOCK FROM CORNSTALKS AND ANALOGOUS PLANTS.

APPLICATION FILED JUNE 11, 1904.

905,374.

Patented Dec. 1, 1908.

3 SHEETS—SHEET 3.

Fig. 8.

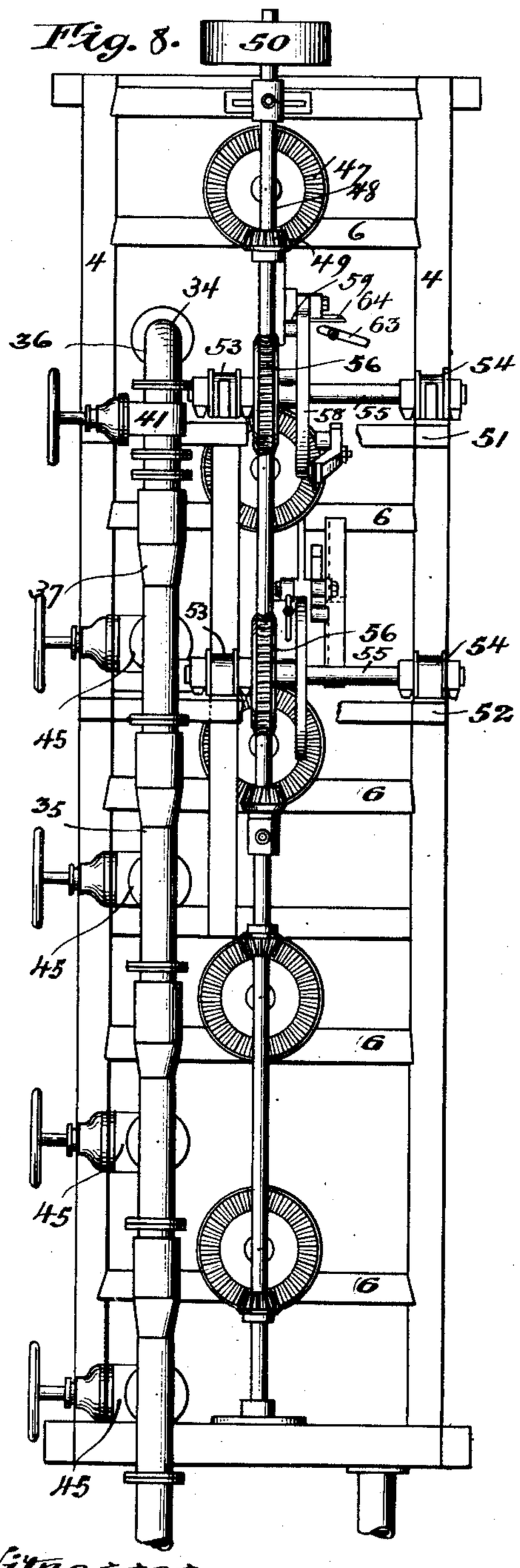


Fig. 9.

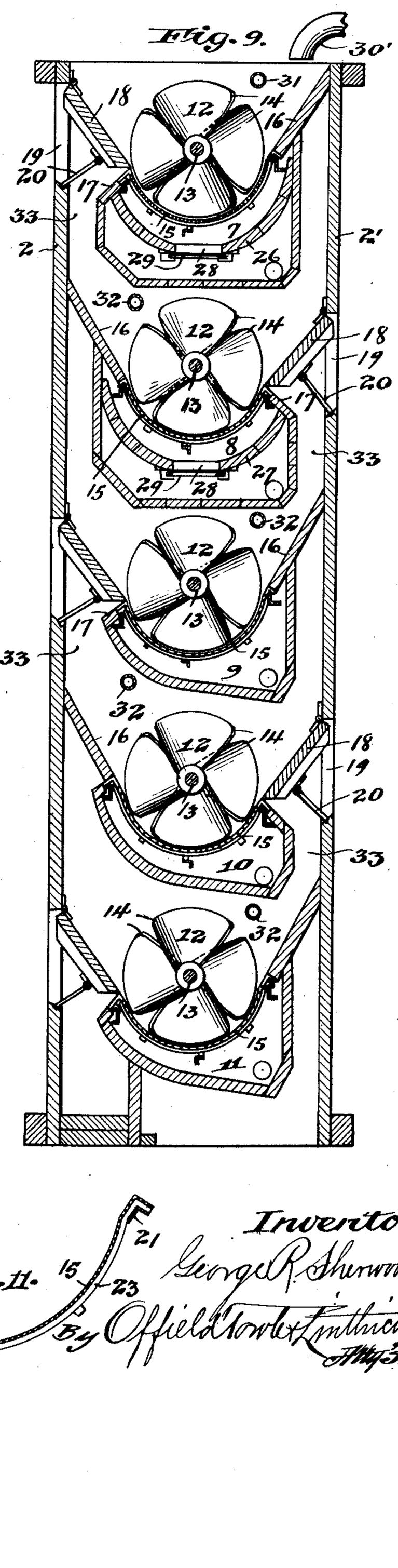
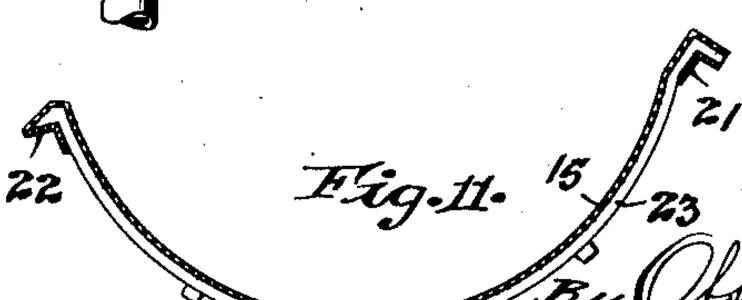


Fig. 11.



Witnesses,

T. D. Mann,

A. N. Graves

Inventor,

George R. Sherwood,

By Offield Towle & Linthicum

Attys.

UNITED STATES PATENT OFFICE.

GEORGE R. SHERWOOD, OF OAK PARK, ILLINOIS.

PROCESS OF PREPARING FIBER STOCK FROM CORNSTALKS AND ANALOGOUS PLANTS.

No. 905,374. Specification of Letters Patent. Patented Dec. 1, 1908.

Application filed June 11, 1904. Serial No. 212,223.

To all whom it may concern:

Be it known that I, GEORGE R. SHERWOOD, a citizen of the United States, residing at Oak Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Processes of Preparing Fiber Stock from Cornstalks and Analogous Plants, of which the following is a specification.

This invention relates to an improved process of making fiber stock from corn stalks and analogous plants, and it has for its salient objects, to provide a process whereby two kinds of characteristically different fiber may be practically and effectively separated; to provide a process which may be carried on continuously, by the use of comparatively simple and inexpensive apparatus, and without chemically or physically changing the character of the fiber; to provide a process which is characterized by the absence of mechanical injury to the fiber cells; and in general, to provide a simple and improved process of the character referred to.

To the above ends the invention consists in the matters hereinafter described and more particularly pointed out in the appended claims.

Corn stalks and analogous plants are composed chiefly of two kinds of fiber, differing radically in physical structure; the fiber cells of one kind being of elongated or filamentary character while the parenchymatous cells are relatively short and of more or less irregular ovoidal shape. I have discovered that these two kinds of fiber may be practically and effectually separated by first cooking the stalks in a reducing solution until the physical structure of the plant is broken down and the connective tissues disintegrated to such extent as to free the two fibers, and then subjecting the pulp thus produced to a screening operation in which the flowing action of a liquid is largely utilized for effecting the sorting out and separation of the two kinds of fiber. I have found that in passing the pulp over a screen of suitable mesh, the filamentary fibers have a propensity to cause the entire mass to mat together in such manner as to prevent the pulp from going through the screen, but that when sufficiently diluted and agitated in a proper manner the liquid sufficiently prevents such matting to free the ovoidal cells and permit the latter to flow out and escape through the screen while the filamentary cells pass over it. This separation cannot be effected at once, but must be accomplished by extending the screening treatment while maintaining the pulp in stirred or agitated condition, and also maintaining it in diluted condition. That is to say, if the pulp be maintained in diluted condition and stirred so as to prevent matting while it is being passed over a screen, the outflow of the liquid through the screen will separate out and carry with it the ovoidal cells while the shape of the filamentary cells will prevent the latter from escaping, and they may be carried over the screen indefinitely without passing through it. Notwithstanding, the filamentary character of the longer cells prevent them from passing through the screen, they tend to lodge in, and mat upon the screen, and thus prevent the escape of the ovoidal cells, and accordingly my process is most effectively and rapidly carried out when the flow through the screen is periodically arrested and reversed so as to dislodge such filamentary cells as have become matted thereon.

The process will be more clearly understood when described as carried out by the use of a suitable apparatus.

Referring to the drawings—Figures 1, 2 and 3 represent three filamentary cells of the kind found in corn stalks, enlarged 260 diameters; Figs. 4, 5 and 6 represent three ovoidal cells of the kind found in corn stalks, and enlarged to the same scale as those shown in Figs. 1, 2 and 3; Fig. 7 is a side elevation of a machine well adapted for carrying out my improved process; Fig. 8 is an end elevation of the machine looking at that end upon which the main drive shaft is located; Fig. 9 is a transverse sectional view taken on line 9—9 of Fig. 7, and looking in the direction of the arrows; Fig. 10 is a plan view of one of the screens used in the machine; Fig. 11 is a cross sectional view of the same; and Fig. 12 is a view partly in plan and partly in horizontal section showing the relative arrangement of the

driving mechanism, and showing also a portion of one of the gates.

Referring to the drawings, 1 designates as a whole a suitable upright casing of oblong rectangular form and having substantially closed side and end walls 2, 3′ and 3, 3′ respectively. At each end the machine is provided with suitable frame standards designated 4 and 5, which serve to strengthen the casing and support the mechanism. Extending across the left-hand end of the machine, as seen in Fig. 8, is arranged a series of cross-frame members 6 which also constitute supports for the mechanism, as will hereinafter be described.

Within the casing, and arranged to extend transversely from end to end thereof, are a plurality of trough-like receptacles, designated 7, 8, 9, 10 and 11, respectively, these troughs being spaced apart at approximately equal intervals, and from top to bottom of the machine. The ends of the troughs abut against the end walls of the casing, and are supported thereby.

Above each trough, extending transversely of the machine, is arranged a conveyer 12; these conveyers being of a well-known type and comprising conveyer shafts 13 which extend through the machine from side to side and are journaled in suitable bearings outside of the casing and each being provided inside of the casing with a series of conveyer-blades 14 arranged in the form of a helical spiral.

Underneath each conveyer and arranged to extend concentrically with the lower periphery thereof is arranged a screen 15; the lateral margins of each screen being supported as to one side by means of a guide-board 16 connected with the side wall of the casing and extending obliquely downwardly and inwardly hopper-fashion towards the periphery of the conveyer, while at its opposite margin it is supported by an inturned extension 17 of the corresponding subjacent trough.

It will be noted that the construction and arrangement of the several troughs and guide-boards is reversed alternately from top to bottom of the machine, the guide-board 16 being arranged at the right hand side as viewed in Fig. 9, the guide-board 16 of the next subjacent mechanism at the left hand side and so on downwardly.

At the side of each conveyer opposite its corresponding guide-board are mounted a plurality of hinge sections 18 which may be swung inwardly into an inclined position corresponding substantially to the positions of the guide-boards, or may be dropped back into vertical positions to occupy openings 19 formed in the opposite side casing. In the normal operation of the machine all of these sections except that one at the delivery end of the conveyer will be secured in their inwardly inclined positions, conveniently by means of brace-bars 20. The last one of each series is, however, swung back into its vertical position to prevent the material from escaping from the end of the conveyer to the next succeeding lower section of the machine.

The screens 15 are so constructed as to fit closely around the peripheries of their several conveyers but are nevertheless supported out of actual contact with the latter.

The success of the process herein described depends upon the use of a screen of such character that the ovoidal cells will pass freely therethrough while the cells of filamentary character will not pass readily therethrough. Accordingly, it is necessary to employ a foraminous screen having openings the largest diameter or dimension of which is much less than the usual length of the filamentary cells, but greater than the largest diameter of the ovoidal cells. Screens formed either of sheet metal provided with round, or approximately round, perforations may be employed, or a woven wire screen of suitable mesh may be employed, but it is obviously impractical to utilize the screens ordinarily used in screening paper pulp, having long, narrow, slot-like perforations, since such form of screen would permit the filamentary cells to pass through almost as readily as the ovoidal cells. I have found in practice that a perforated sheet metal screen having round perforations of a diameter of approximately two to three-hundredths of an inch is best suited for carrying out my process, but the term "foraminous", as hereinbefore used and as employed in the claims is to be understood as meaning broadly a screen formed either of perforated sheet material or of woven material and as a term used to distinguish from a screen having long, narrow, slot-like openings. In order that they may retain their shape accurately each screen is preferably composed of marginal strips 21, 22 and 23, the cross-strips 24 and 25 of angle or strap-iron; these frame-pieces being secured to the exterior or under side of the screen. The uppermost screen will preferably be of much finer mesh than the succeeding screens and will serve chiefly as a drain to remove the water from the pump without permitting any considerable part of the fiber to go through.

In the case of the two uppermost troughs 7 and 8 an intermediate trough 26 and 27, respectively, is arranged within the main trough and interspaced between the screen and the bottom of the main trough. The edges of these intermediate troughs are connected with and supported by the side margins of the main trough, and in the bottom of each is formed a longitudinally extending series of slot-like gate openings 28 con-

trolled by a slide gate 29 provided with corresponding openings 30 adapted to be shifted into or out of register with the openings 28.

30′ designates a supply pipe arranged to discharge into the upper section of the machine at the receiving end of the conveyer, and 31 designates a water-inlet pipe also arranged to communicate with the uppermost section. Similar water-supply pipes 32 are arranged to communicate with each of the several sections of the machine as indicated clearly in Fig. 3.

The relatively long filamentary fiber which is carried over the screens by the conveyers 12 is discharged downwardly through the passages 33 to the succeeding sections; the several conveyers being successively rotated in reverse directions so as to convey this fiber back and forth from end to end of the machine.

The relatively short ovoidal-shaped fiber which, in the case of a corn plant, is derived from the pith, passes through the screens and is delivered from the several troughs 7, 8, 9, etc., through outlets 34 communicating with the delivery ends of said troughs.

Referring more particularly to Figs. 7 and 8, 35 designates as a whole a stand-pipe composed of a plurality of sections 36 and 37 (see Fig. 8), there being a section for each section of the machine, and these sections being similar in construction, except as to the uppermost one 36. The section 36 connects with a horizontal eduction branch 38 which communicates with the outlet 34 of the uppermost trough. With the pipe 38 is arranged to communicate a waste-pipe 39 which is provided with a gate-valve 40 whereby it may be closed. A gate-valve 41 is also interposed in the stand-pipe section 36 as seen clearly in Fig. 8.

Each section 37 is so constructed that it may act as a siphon or as a gravity drain-pipe; being to this end provided with a vertical member 42 which forms the standpipe portion proper, an upper branch 43 and a lower branch 44; the two branches uniting at their receiving ends and being connected with the eduction outlet 34 of the corresponding section of the machine. Each lower branch 44 is provided with a gate-valve 45 and the inlet portion of the upper end of the vertical member 42 is made in the form of an injector nozzle 46, the inwardly tapered or contracting portion of which serves to induce siphoning action through the branch 43 when liquid is discharged from the section above.

Describing now the mechanism in actuating the conveyers and the slide gates of the two uppermost troughs, upon one end of each conveyer shaft 13 is mounted a beveled gear 47 and a main shaft 48 is arranged to extend vertically adjacent to the beveled gears 47 and is provided with pinions 49 engaging the respective gears 47. One end of the main shaft is conveniently provided with a belt pulley 50 whereby it may be driven, and it will be noted that the pinions 49 are so disposed as to alternately intermesh with the lower and upper peripheries of the gears 47 so as to drive the conveyer shafts in reverse directions.

At points laterally opposite the lower portions of the two uppermost sections of the machine are mounted two supporting brackets 51, 52 respectively, each of which carries a pair of journals 53, 54, and within these journals are mounted transverse shafts 55. Each shaft carries a worm-wheel 56 arranged to intermesh with a corresponding worm section 57 formed or mounted upon the main shaft 48. Upon each shaft 55 also is mounted a gate actuating wheel 58, which is connected to rotate with the worm wheel, and is provided near its periphery with two oppositely extending tappet studs 59 and 60 which are adjustable as to position. To this end the wheel 58 is provided with a plurality of sockets 61 arranged at intervals apart around its periphery, and in any one of which either of the tappet studs 59 or 60 may be mounted. If desirable, two or more tappet studs may be mounted upon each side of the gate-actuating wheel.

61 designates a vibratory lever which is mounted upon the same end of the machine which supports the main drive shaft (see Figs. 7 and 8). At its upper and lower ends the lever 61 is pivotally connected with the outer ends of the two gates 29; the latter being to this end provided with pivot eyes, as indicated at 62. Adjacent to each pivot-eye 62 is mounted a turn button 63 which may be turned to overhang a projection 64 carried by the eye of the gate and whereby the gate may be locked either at its innermost limit of movement or at its outermost limit of movement. The lever 61 is drawn outwardly by means of an actuating link 65 connected at one end of the central part of the lever extending outwardly and provided at its free end with an upturned hook 66 adapted to engage with the corresponding tappet stud 61 of the actuating wheel.

The link 65 is provided adjacent to its pivot end with a cam boss 67, which in the outward movement of the link encounters a fixed projection 68 on the bracket 51 and automatically disengages the link from the tappet-stud. It will be obvious from the foregoing that the lever 61 may be caused to reciprocate either gate 29 through the medium of the link and actuating wheel by simply fastening the other gate and connected end of the lever against movement by means of its turn button.

In order to provide for the return movement of the lever and connected gate, said lever carries at each end a thrust link, as 69,

70, respectively, arranged to extend adjacent to the periphery of the corresponding actuating wheel and adapted to be engaged by the tappet studs 59 thereon. These thrust links, it will be understood, will be used in alternation, that one out of use being lifted up out of operative position and thus supported in any suitable manner. Each thrust link is provided with a cam boss as 71, 72, coöperating with subjacent cam studs 73 and 74 to throw the link out of engagement with the actuating wheel when the gate has reached the proper position in its inward movement.

The process as carried out by the use of the hereinbefore described apparatus, is substantially as follows:

My process is carried out most advantageously in preparing stock from the main trunk or body portions of corn stalks, separated from the relatively undeveloped top portions of the stalks and stripped of the leaves, husks and other forage portions. In a co-pending application filed by me, Serial No. 212,051, filed June 10, 1904, I have described a machine adapted for effecting such separation of the forage portions from the main stalk bodies and decapitating the same, but it will be obvious that the stalks may be suitably prepared by stripping and decapitating them manually, in a well understood manner. The material reduced to a suitable pulp by cooking in a suitable digester together with a suitable disintegrating chemical, such as caustic soda, in a manner well understood in this art, is fed gradually and continuously into the separating machine through the inlet 30, it being understood that the pulp will be in a semi-fluid condition and will usually contain more or less of the reducing liquor. It is desirable to wash out this reducing liquor before commencing the actual separation, and accordingly the relatively fine screen referred to is employed in the uppermost section. The pulp is by means of the conveyer 12 moved gradually through the length of the trough, being continuously stirred and constantly supplied with water let in through the supply pipe 31. Reaching the discharge end of the trough it passes downwardly through the passage 33 to the next subjacent section of the machine. During its progress through the first section, the reducing liquor, together with the wash water, is drawn off through the screen into the trough 26, and if preferred, the gate 29 may be left open so that this fluid will pass immediately into the lower trough 7. Ordinarily the waste pipe 39 which communicates with the outlet of the trough 7 will be left open so that this liquor will run to waste continuously.

The actual separation or sorting of the fiber is begun in the second section of the machine, the pulp being fed through the latter by its conveyer in the same manner as in the case of the first section. A fresh supply of water is fed in continuously through the inlet pipe 32, thus maintaining the pulp in a diluted condition notwithstanding the water is being drained therefrom constantly as it passes over the screen. The screen of this section is of such mesh as to let through the ovoidal and shorter cells derived from the pithy portions of the pulp, and consequently during the progress of the pulp over the screen a considerable portion of this ovoidal cell fiber will be screened out and pass into the trough 27. The filamentary character, or long and slender form of the fiber derived from the woody portion of the stalk causes this fiber to tend to mat together so that it is radially carried over the screens by the conveyers without passing through the latter. The fiber thus carried over the screen is again discharged through the next passage 33 into the next lower section, and again treated as before; a further quantity of the ovoidal cells being screened out in each successive section of the machine. The gate leading from the trough 27 downwardly will be alternately opened and closed, as will be hereinafter described. Accordingly, while the gate is closed the flow will be downwardly through the screen until the liquid reaches the level of the screen, whereupon the stirring action of the conveyer will cause the most of the water in the trough to circulate both above and below the screen and to flow upwardly from below, through the screen to a sufficient extent to dislodge the fiber accumulated in the openings of the screen. About the time the trough 27 has been filled and the screen fully flooded, the gate actuating mechanism opens the gate and allows the trough to empty rapidly into the lower trough and thence out into the standpipe, it being understood that the gate 45 controlling the branch pipe leading to the standpipe is left open as to this section. The rapid outflow of the liquid will obviously create a distinct suction action through the screen of this section which will result in washing out and drawing through the screen a considerable proportion of the ovoidal cell fiber, and the sudden discharge of this section will bring into siphoning operation all of the succeeding lower sections which will likewise empty rapidly, thus producing the same sucking action in each of the lower sections.

It will be understood that after the machine has been once fully brought into operation, all parts will be working together and the several troughs will gradually fill simultaneously in the manner hereinbefore described and will be simultaneously discharged, so that the pulp will be subjected

to an extended screening treatment during which it will be constantly agitated and constantly diluted and the filamentary portion thereof will be constantly moved across the screens by the conveyers. The operation of the machine will be so timed that about the time the troughs have been fully emptied the gate 29 will be closed, whereupon a new cycle of operation will be inaugurated.

I claim as my invention:

1. The art of sorting fiber stock produced from corn stalks and analogous plants, which consists in taking the pulp reduced to a mass in which the connective tissue is broken down and the several varieties of ultimate fiber set free, and sorting the ovoidal cell fiber from the filamentary cell fiber by adding liquid to maintain the pulp in relatively diluted condition while subjecting it to a combined screening and straining treatment accompanied by agitation by passing the pulp over a foraminous screen, whereby the ovoidal cells are washed out and pass through the screen while the filamentary cells pass over the screen.

2. The art of making fiber stock from corn stalks and analogous plants, which consists in treating the stalks in a reducing solution until reduced to a mass of pulp in which the connective tissue is broken down and the several varieties of ultimate fiber set free, then sorting the ovoidal cell fiber from the filamentary cell fiber by adding liquid to maintain the pulp in relatively dilute condition while subjecting it to an extended screening treatment by passing the pulp over an extended length of foraminous screen, accompanied by agitation, whereby the ovoidal cells are washed out and pass through the screen while the filamentary cells pass over the screen.

3. The art of making fiber stock from corn stalks and analogous plants, which consists in cooking the stalks in a reducing solution until reduced to a mass of pulp in which the connective tissue is broken down and the several varieties of ultimate fiber freed from each other, then sorting the ovoidal cell fiber from the filamentary cell fiber by maintaining the pulp in relatively dilute condition while subjecting it to an extended screening treatment by passing the pulp over an extended length of foraminous screen, accompanied by agitation and progressive movement across the screen, whereby the ovoidal cells are washed out and pass through the screen while the filamentary cells are retained and impelled over the screen.

4. The art of making fiber stock from corn stalks and analogous plants, which consists in cooking the stalks in a reducing solution until reduced to a mass of pulp in which the connective tissue is broken down and the several varieties of ultimate fiber freed from each other, then sorting the ovoidal cell fiber from the filamentary cell fiber by maintaining the pulp in relatively dilute condition by the substantially constant addition of liquid while subjecting it to an extended screening treatment by passing the pulp over an extended length of foraminous screen, accompanied by agitation, progressive movement across the screen and intermittent increase and decrease of flow pressure through the screen.

5. The art of making fiber stock from corn stalks and analogous plants, which consists in cooking the stalks in a reducing solution until reduced to a mass of pulp in which the connective tissue is broken down and the ovoidal cell fiber and filamentary cell fiber freed, then sorting the ovoidal cell fiber from the filamentary cell fiber by maintaining the pulp in relatively dilute condition by the addition of liquid while subjecting it to an extended screening treatment with a foraminous screen of suitable mesh, accompanied by progressive movement across the screen and intermittent reversal of direction of flow through the screen, whereby the ovoidal cell fiber is washed out and passes through the screen, while the filamentary cells are retained and carried over the screen.

6. The art of making fiber stock from corn stalks, which consists in denuding the stalk bodies and decapitating the same down to a point where the fiber is of substantially uniform character throughout the remaining length of the trunk, then cooking the stalks in a reducing solution until reduced to a mass of pulp in which the connective tissue is broken down and the several varieties of ultimate fiber freed from each other, then sorting the ovoidal cell fiber from the filamentary cell fiber by maintaining the pulp in relatively dilute condition while subjecting it to an extended screening treatment by passing the pulp over a foraminous screen of suitable mesh, accompanied by agitation, whereby the ovoidal cells are washed out and pass through the screen while the filamentary cells pass over the screen.

7. The art of making fiber stock from corn stalks and analogous plants, which consists in cooking the stalks in a reducing solution until reduced to a mass of pulp in which the connective tissue is broken down and the several varieties of ultimate fiber freed from each other, then sorting the ovoidal cell fiber from the filamentary cell fiber by maintaining the pulp in relatively dilute condition by the substantially continuous addition thereto of liquid while causing the pulp to traverse an extended area of foraminous screen and agitating it, and intermittently increasing the flow pressure through the screen by abruptly withdrawing the pulp from below the screen.

8. The art of treating vegetable pulp containing free cell fiber of ovoidal form and cell fiber of filamentary form, which consists in adding liquid to maintain the pulp in relatively diluted condition while subjecting it to a combined screening and straining treatment accompanied by agitation, whereby the ovoidal cells are washed out and pass through the screen while the filamentary cells pass over the screen.

GEORGE R. SHERWOOD.

Witnesses:

ALBERT H. GRAVES,

FREDERICK C. GOODWIN.