J. Kingsland Jr.

Pulp Grinder.

No. 16,316. Patented Dec. 23, 1856.

Fig. 1.

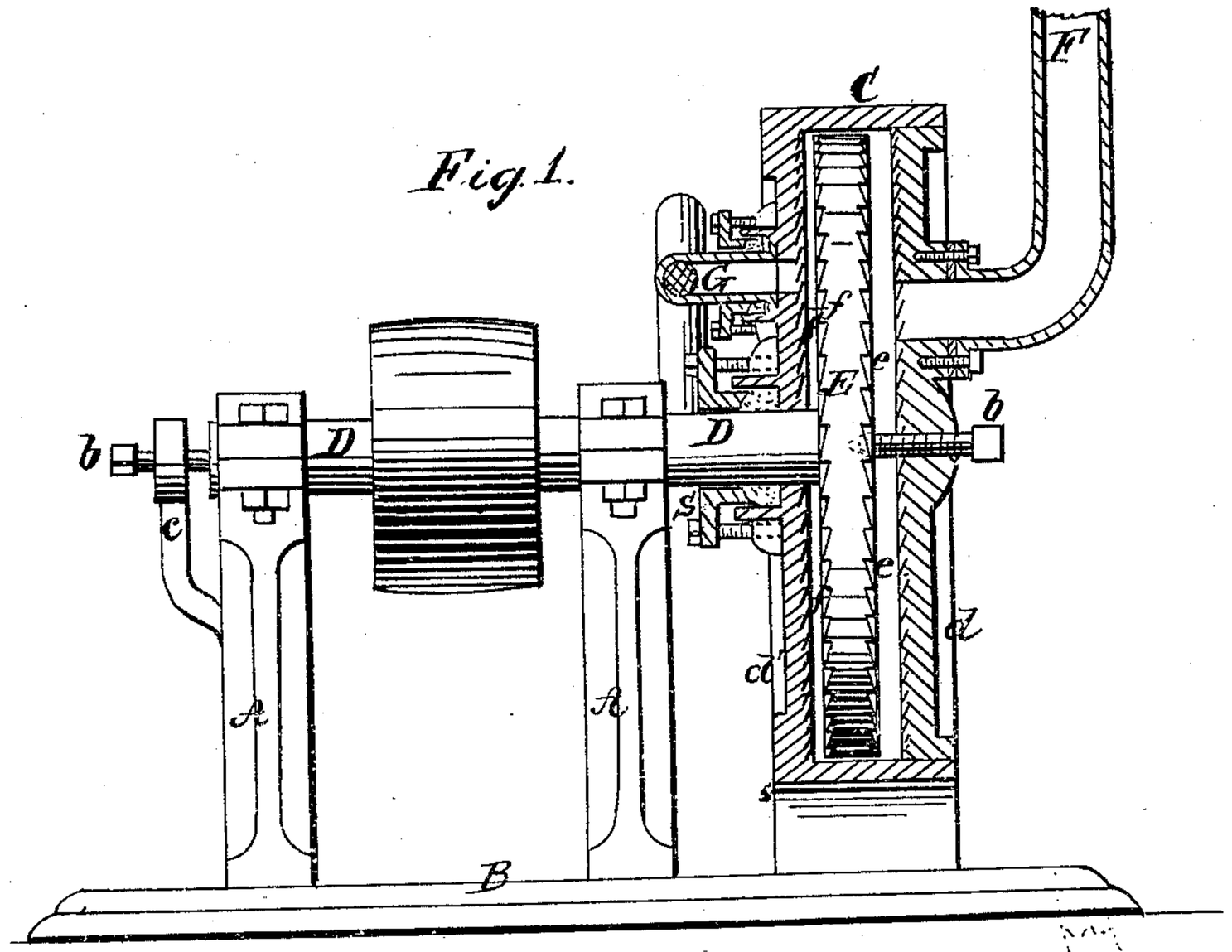


Fig. 2.

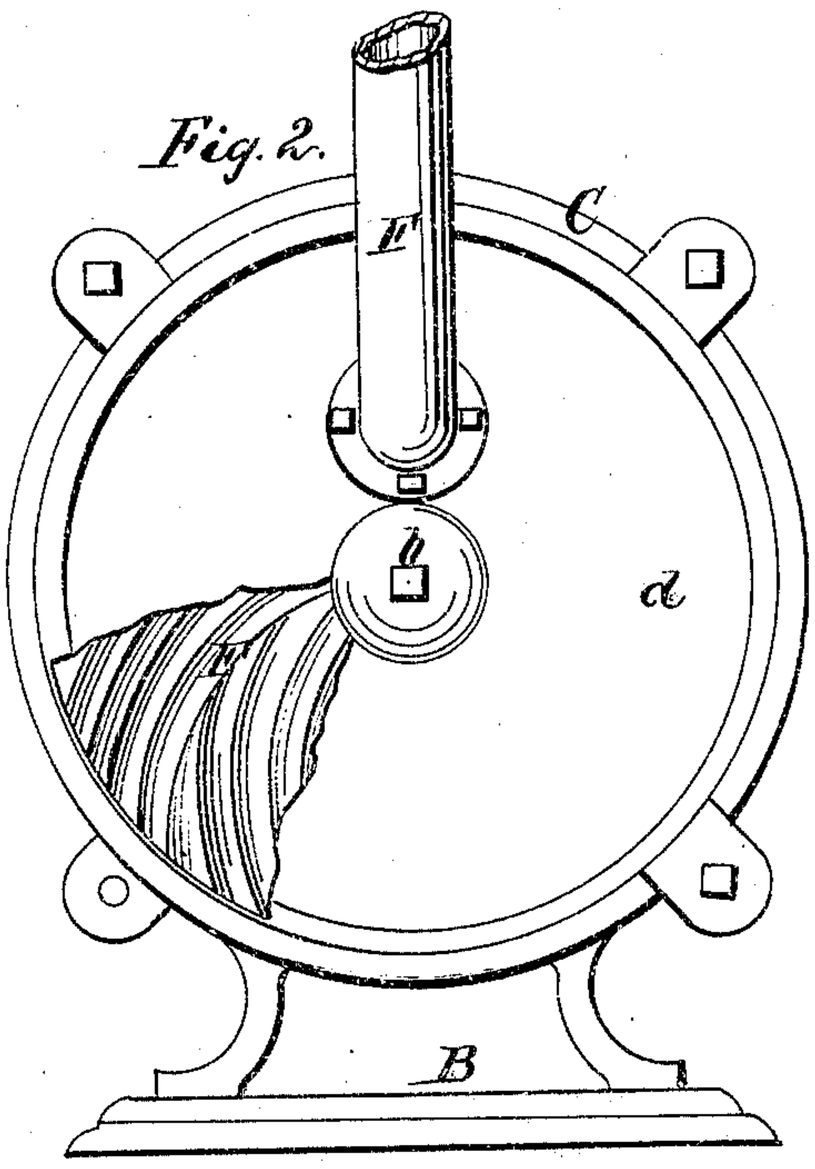
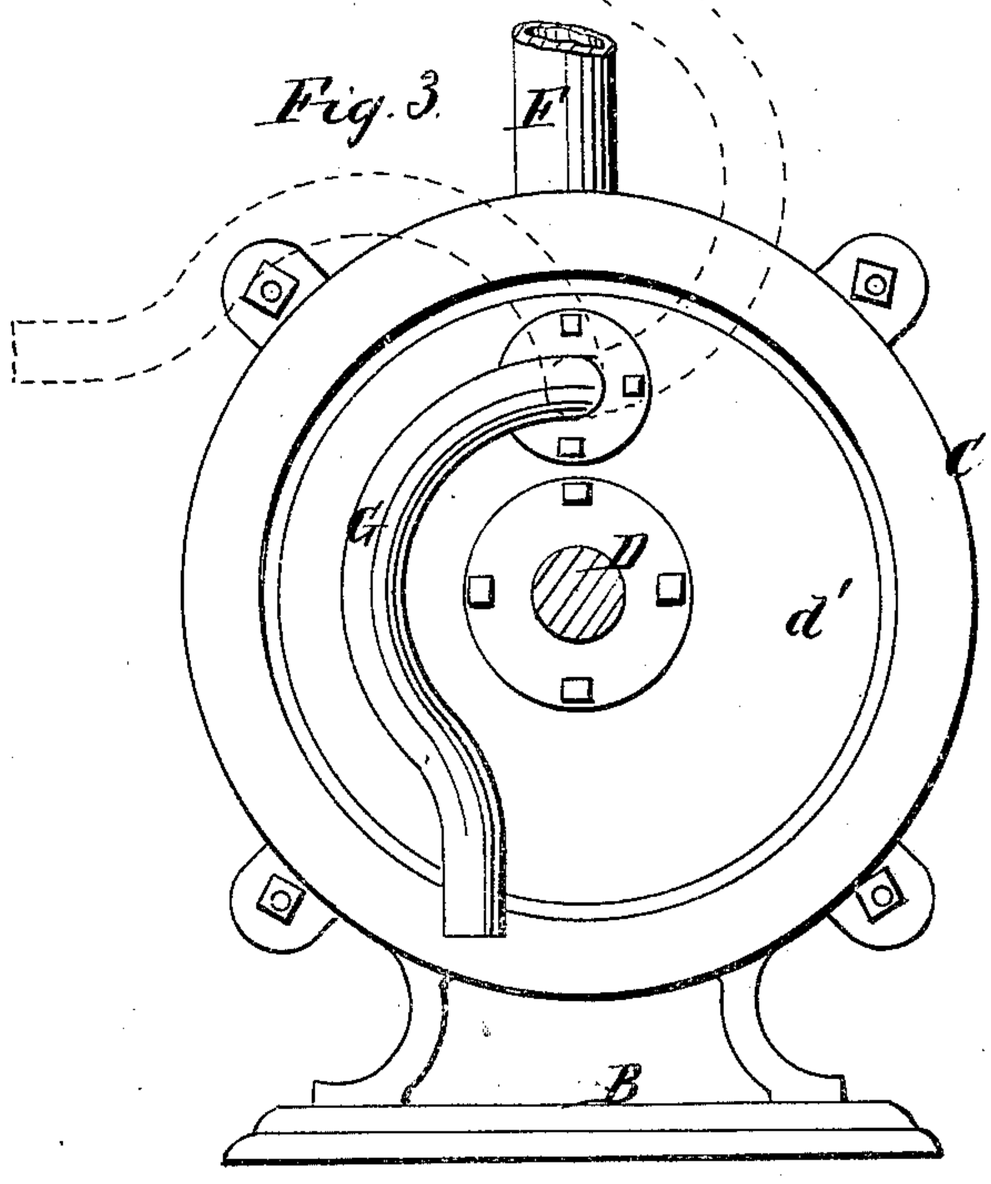


Fig. 3.



UNITED STATES PATENT OFFICE.

JOSEPH KINGSLAND, JR., OF FRANKLIN, NEW JERSEY.

PROCESS OF GRINDING PAPER-PULP.

Specification forming part of Letters Patent No. 16,316, dated December 23, 1856; Reissued June 28, 1859, No. 744.

To all whom it may concern:

Be it known that I, JOSEPH KINGSLAND, Jr., of Franklin, in the county of Essex and State of New Jersey, have invented a new and useful Process of Grinding Fibrous Vegetable Matter, in Water, to Pulp in the Manufacture of Paper, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which make part of this specification, and in which—

Figure 1 represents a vertical section of a "beating" or "stuff-engine" suitable for carrying into effect my improved process. Fig. 2, represents an elevation of one end and Fig. 3, an elevation of the other end of the same.

The stock from which paper of fine quality is made, usually consists of rags varying in strength and fineness of fiber. These rags, in the process of manufacturing them into paper, are reduced, by grinding them in water, to a mass of pulp. The machines heretofore generally employed for this purpose, are two in number, similar in construction, and termed, respectively, the "washing-engine" and the "stuff-engine." The "washing-engine" is employed to cleanse and rough-grind the rags, which, after being subjected to this operation, are called "half-stuff;" the "stuff-engine" is employed to complete the grinding of the half-stuff into fine pulp. This stuff-engine consists of an annular trough or vat, in which a current of water, with the half-stuff to be ground floating therein, may be kept flowing around. This vat has a fixed grinding-bed placed across its bottom and a revolving grinding cylinder placed above this bed, leaving a narrow space between the two. The face both of the bed and of the cylinder is armed with blunt steel knives, those on the face of the cylinder working past those on the face of the grinding bed, in the manner of shear blades, but so as to bruise and tear rather than cut the half-stuff, as sharp knives working as shears would tend too much to granulate the fiber by cutting it into short lengths, instead of crushing it into pulp. This bed and revolving cylinder constitute the grinder of this engine, and they also form a partition across the trough or vat. The rotary motion of the cylinder dashes the water and rags from one side of the partition to the other, through the spaces between the knives, thus depressing the level of the water in the trough on that side of the partition whence the water flows, and raising it on the opposite side; the water thus disturbed seeks to regain its level, by flowing from that side of the partition at which it is highest, around the annular trough or vat, to the opposite side of the partition; this establishes a current around the vat, which continues while the cylinder is in motion, and keeps the whole mass of rags passing repeatedly through between the knives where they are repeatedly ground, until the fiber is reduced. It necessarily follows, from the manner in which this stuff-engine operates, that the fine and the coarse, the tender and the strong fibers are all subjected to an equal amount of grinding, and therefore, the coarse and strong fiber must be ground too little, or the fine and tender fiber too much, in either case producing a pulp of heterogeneous quality, which will impart a corresponding defect to the paper made from it. But as the quality of the paper is most injured by insufficient grinding of the fiber, the grinding is generally continued until the coarse fiber is well reduced, which grinds much of the more tender fiber to powder, a portion of which flows off with the waste-water and is lost; another portion of it is lost at a subsequent stage of the manufacture by draining off with the water from the screen that transfers the pulp from the vat to the Fourdrinier machine, for converting the pulp into sheets of paper. The loss from these two sources has been estimated as high as fifteen per cent. of the whole quantity of rags ground. Another objection to this engine is, that its speed is limited to a certain low rate from the fact that when the periphery of the cylinder of the grinder begins to run above twelve hundred feet a minute, it repels the rags and water in such manner as to retard their entrance between the grinding knives, and when the speed of the cylinder is greatly accelerated, the current will be almost arrested and the grinding stopped. This limit to the speed of the stuff-engine, it will be seen, is a very serious objection, when its great bulk and the large amount of floor space it occupies are taken into account, es-

pecially in manufactories doing an extensive business and requiring a large number of these engines.

It is one of the objects of my invention to remedy the before mentioned defects of the stuff-engine, and this I accomplish by providing in my improved engine for the withdrawal of the fiber from the action of the grinder, the moment it is sufficiently reduced, and leaving to be longer acted upon, that which requires more grinding, by which means, the whole of the fiber, whether strong or weak, is reduced to pulp of uniform fineness, each part of it being subjected to a degree of grinding proportioned to its strength. Further, by rendering the feed independent of the motion of the grinder, the engine can be run at any speed that its strength will sustain, and the work is thus done much more rapidly than in the old engine, as the grinder can be run very fast and the half-stuff thoroughly reduced by passing through it once, and lastly, by dispensing with the annular vat and feeding the half-stuff to the engine through a pipe and discharging the pulp therefrom by similar means, this engine is rendered very compact and requires less than one quarter of the space occupied by the engine heretofore in use.

By reference to the accompanying drawings, the construction and operation of the stuff engine to carry into effect my improved process, will more fully appear. It consists of a bed-plate (B) which supports two standards (A, A) and a hollow cylinder (C) whose diameter is equal to about four times its length. In a line with the axis of this cylinder, a shaft (D) is mounted in bearings in the heads of the standards (A, A). In a bracket (*c*) on the outer standard (A), and in a boss at the middle of the outer head (*d*) of the cylinder (C) set screws (*b*) are placed, in a line with the axis of the shaft (D), the object of these set-screws is to permit the shaft (D) to have a regulated amount of end-play in its bearings, for a purpose which will presently be described, or to adjust it for any special purpose, at any given point within the range of its end-play. This shaft passes through a stuffing-box on the inner head (*d'*) of the cylinder (C), and projects about two-thirds of the way across the space within the cylinder, toward its outer head (*d*). On this projecting end of the shaft (D) a disk (E) is secured at right angles with the shaft and concentric with it and the cylinder. This disk is somewhat less in diameter than, and in thickness about half the length of the interior of the cylinder, so as to leave between it and the heads and periphery of the cylinder, a free space for a current of water and rags, half-stuff, or paper pulp to flow through.

The inner surface of the heads of the cylinder and the sides of the disk, are grooved in the usual manner of metallic grinders, or they may be armed with teeth or knives of any suitable kind. An orifice is made in each head of the cylinder, as near the center as possible. The orifice in the outer head (*d*) is connected by a pipe (F) with a tank above containing half-stuff mingled with water and ready to be ground into pulp. With the orifice in the inner head (*d'*) a pipe (G) is connected, which conducts off to a proper receptacle, the pulp discharged from the machine.

The operation of the engine is as follows. Rotary motion is communicated to the shaft (D) through the pulley near its middle, and the set-screws (*b*) are so adjusted as to allow the shaft to play enough to permit the disk (E) to run freely from end to end of the cylinder (C) to grind close at either end or open at both, as may be required, or if it should so happen that the fiber is of uniform strength, and the half-stuff homogeneous, the disk (E) may be fixed in one position by the set-screws (*b*) as represented in Fig. 1 of the drawings. The mixed half-stuff and water may now be let into the feed-pipe (F) from the tank above, and the hydraulic pressure will force it into the cylinder through the space (*e*) between the disk and the outer head (*d*), around the periphery of the disk and through the space (*f*) to the orifice of the discharge pipe (G), where it will leave the cylinder, and entering the discharge pipe, will pass through the same into any suitable receptacle.

The centrifugal motion of the disk will coöperate with the hydraulic pressure to pass the half stuff from the feed orifice near the center, where the motion of the disk is slow and but little grinding takes place, toward the periphery, where the motion is greater and the grinding energetic, but when the current of water and fiber turns the periphery of the disk, and enters the space (*f*) on the opposite side, its passage to the discharge orifice is retarded by the centrifugal action of the disk. This retarding force acts with the greatest effect upon the largest fibers. Moreover, the current carries the fibers through the grinder at a speed inversely proportioned to their size, the more reduced fibers having an area of surface for the current to act upon, relatively far greater than that of the larger fibers. In this way the reduced fibers are withdrawn from the action of the grinder, while the coarser fibers are left for further reduction. This separation of the finer from the coarser fibers, during the process of grinding, is facilitated by the increased mobility which they acquire by reduction.

The fineness of the grinding, it will be seen depends upon the hydraulic pressure

on the feed and the speed with which the disk of the grinder runs, while the rate of feeding depends upon the pressure alone.

In case a knot or lump of fiber should be fed into the grinder, the disk would, yield, moving toward the side opposite the knot, to allow the knot to pass freely toward the periphery, where it will be quickly reduced by the energetic action of that part of the grinder. While this reduction of the knot or lump is going on at the feed-side of the grinder, both the feeding and discharge are diminished, by the crowding over, by the knot of the revolving disk, against the discharge aperture; by this yielding of the disk, all danger of clogging is avoided, and at the same time, the flow of unground fiber through the grinder, is prevented. Further, if the fiber is tender and easily reduced, it will flow freely through the grinder, and occupy but little more space on the feeding than on the discharge side of the disk, but, if the fiber is tough and grinds slowly, it will accumulate on the feed side and crowd the disk over to the discharge side, retarding the discharge, the strong fiber being in this way subjected to, as it requires, more grinding action than the weaker fiber.

This machine is one I have devised for carrying my process into effect, but it will be obvious to those skilled in the art of manufacturing paper, that the modifications of machinery which might be constructed to operate upon this principle would be very numerous indeed, and it would be impossible even to enumerate them within the proper limits of a specification. I will, however, mention one or two by way of example.

The cylinder and rotating disk might be elongated in the direction of their axes, so that instead of their diameters being greater than their lengths, their lengths might be greater than their diameters, and the periphery of each might be armed with a grinding surface, leaving the ends of both, unarmed. Again, the diameters of the ends of the revolving and hollow cylinders might be reduced in such manner as to give to them the proportions of the middle section of a spindle, or of two frustra of cones, united base to base. Or, instead of being of a conical or spindle form, these parts may be made spherical.

What I claim as my invention and desire to secure by Letters Patent is—

The process of reducing fibrous matter, in water, to pulp by grinding it under hydraulic pressure, which creates a current that feeds the fiber into the grinder, and removes it therefrom as fast as it is sufficiently reduced and renders the feeding independent of the grinding, substantially as herein set forth.

In testimony whereof, I have hereunto subscribed my name.

JOSEPH KINGSLAND, Jr.

In presence of—
EDWARD MURPHY,
L. C. STUART.

[First printed 1912.]