G. CARLSON.

GRINDING MILL.

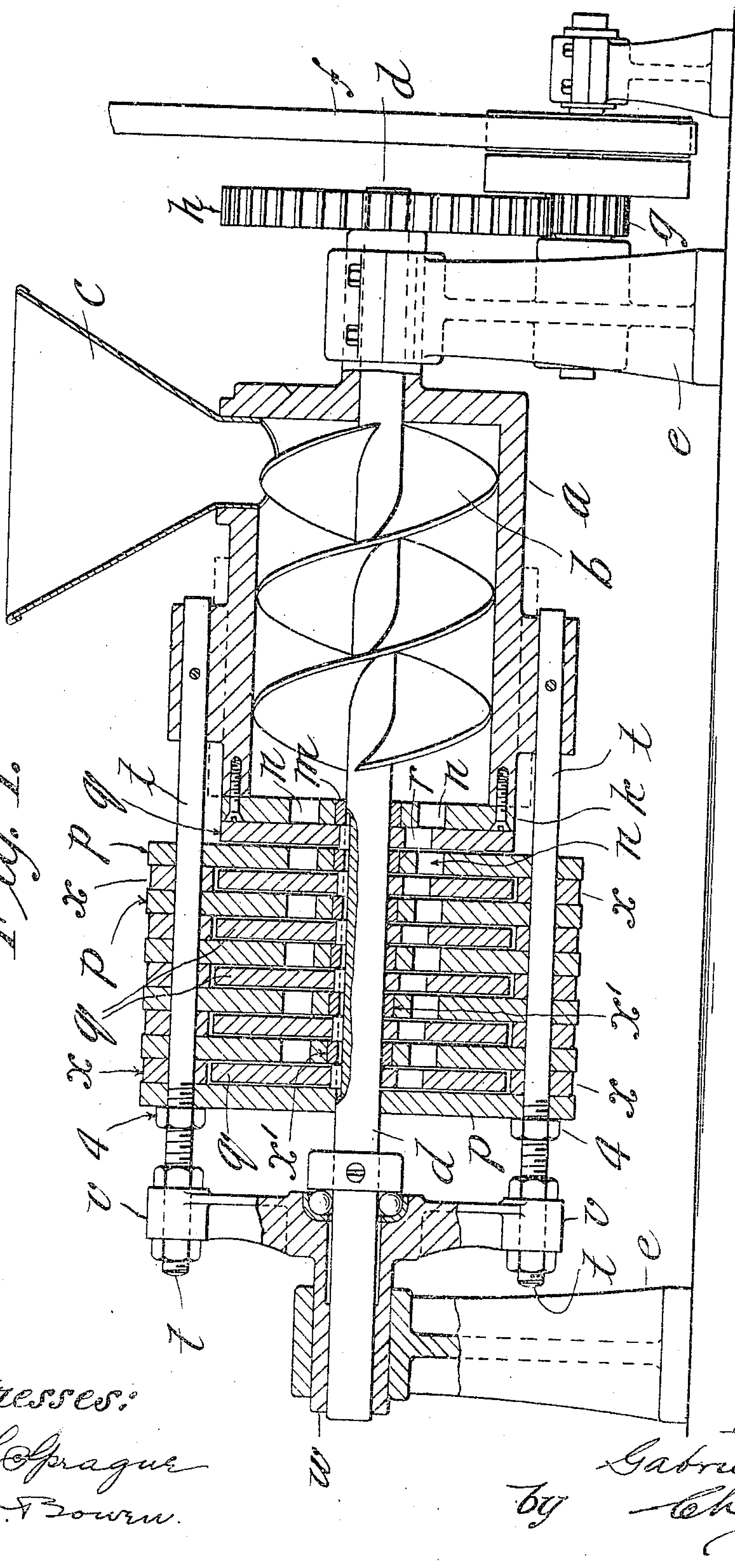
APPLICATION FILED MAY 8, 1908.

959,714.

Patented May 31, 1910.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

H. L. Sprague

H. W. Bowen.

Inventor,

Gabriel Carlson.

by Chapin & Co

Attorneys.

G. CARLSON.

GRINDING MILL.

APPLICATION FILED MAY 8, 1908.

959,714. Patented May 31, 1910.

3 SHEETS—SHEET 2.

Fig. 2.

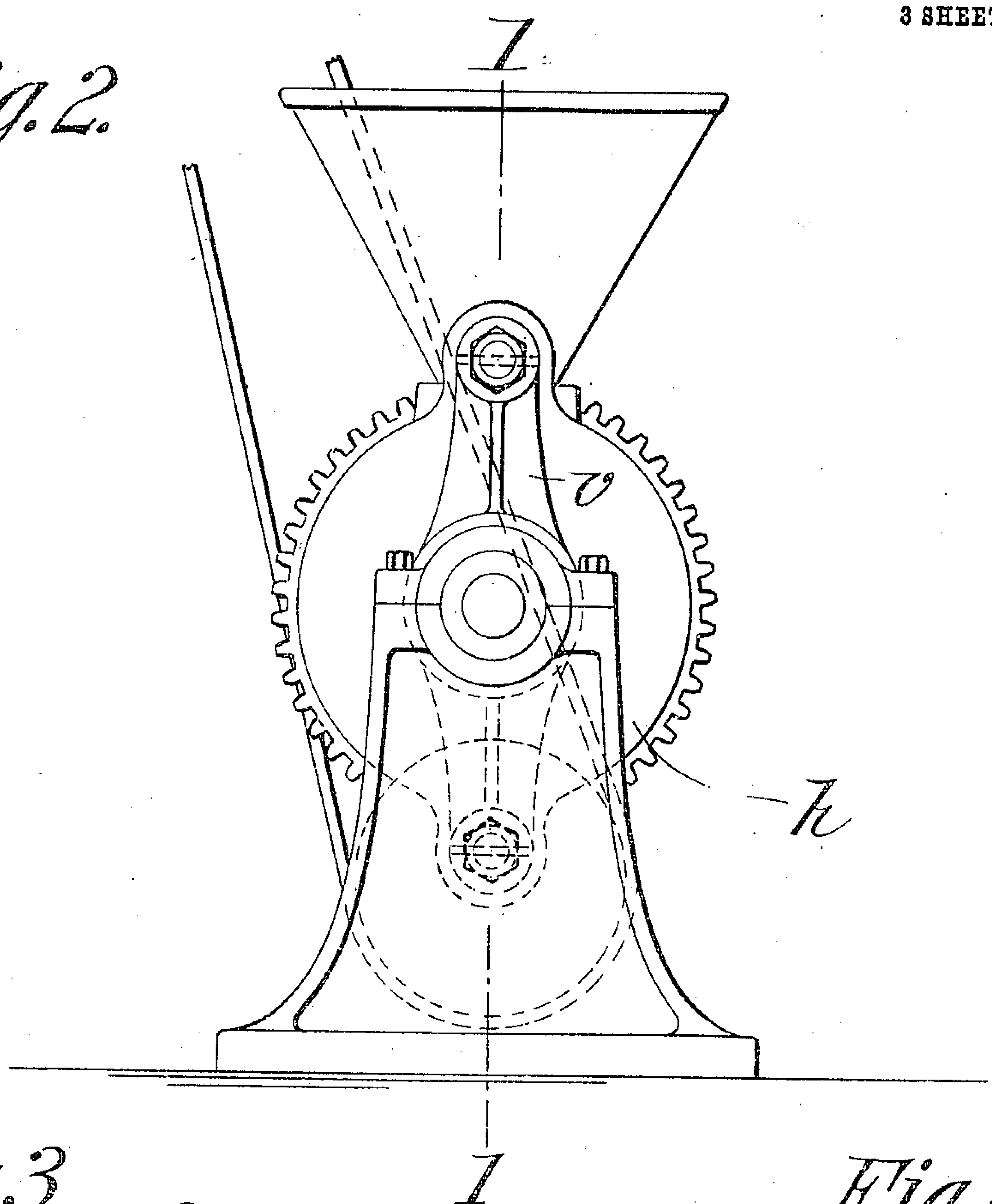


Fig. 3.

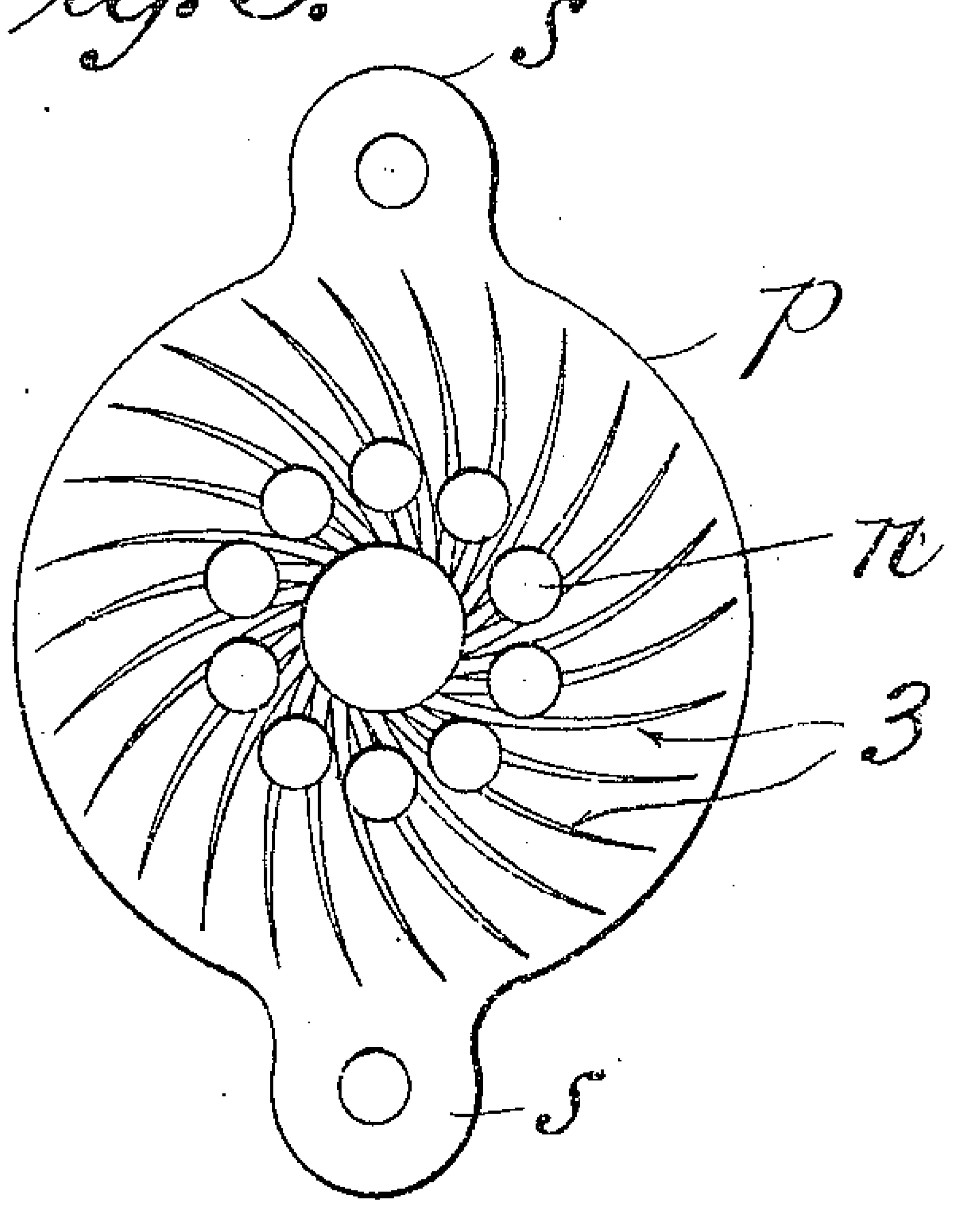
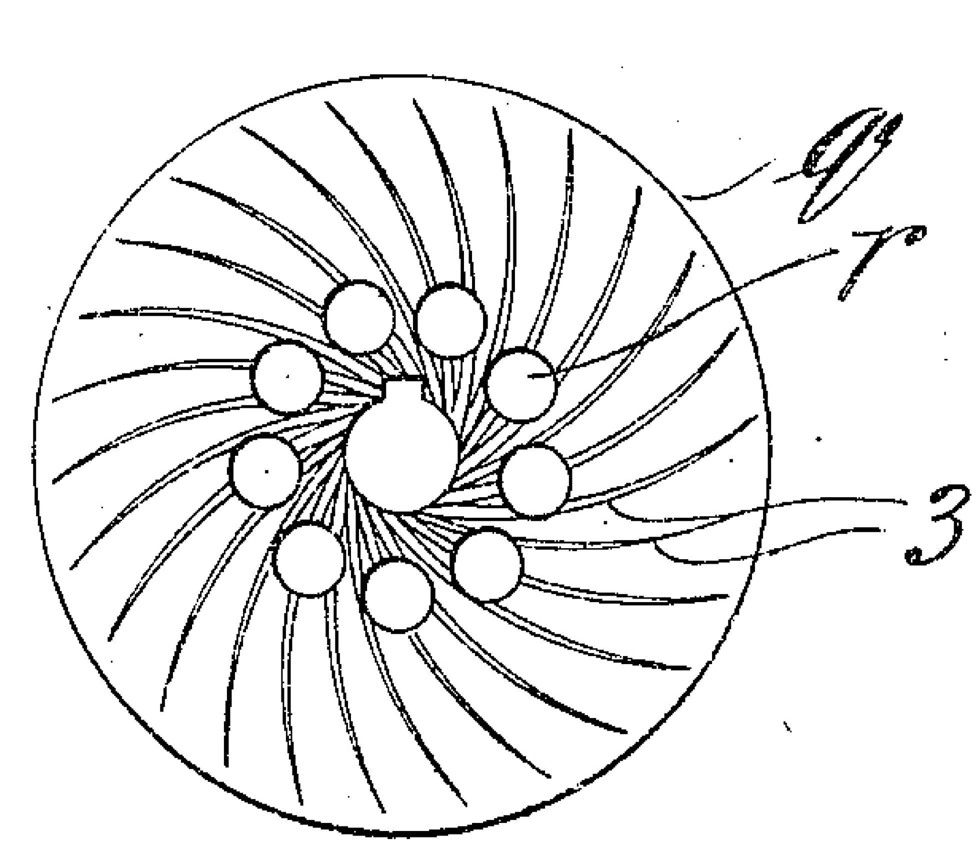


Fig. 4.



Witnesses:
H. L. Sprague
H. W. Bowen

Inventor;
Gabriel Carlson
by Chapin & Co.
Attorneys.

G. CARLSON.

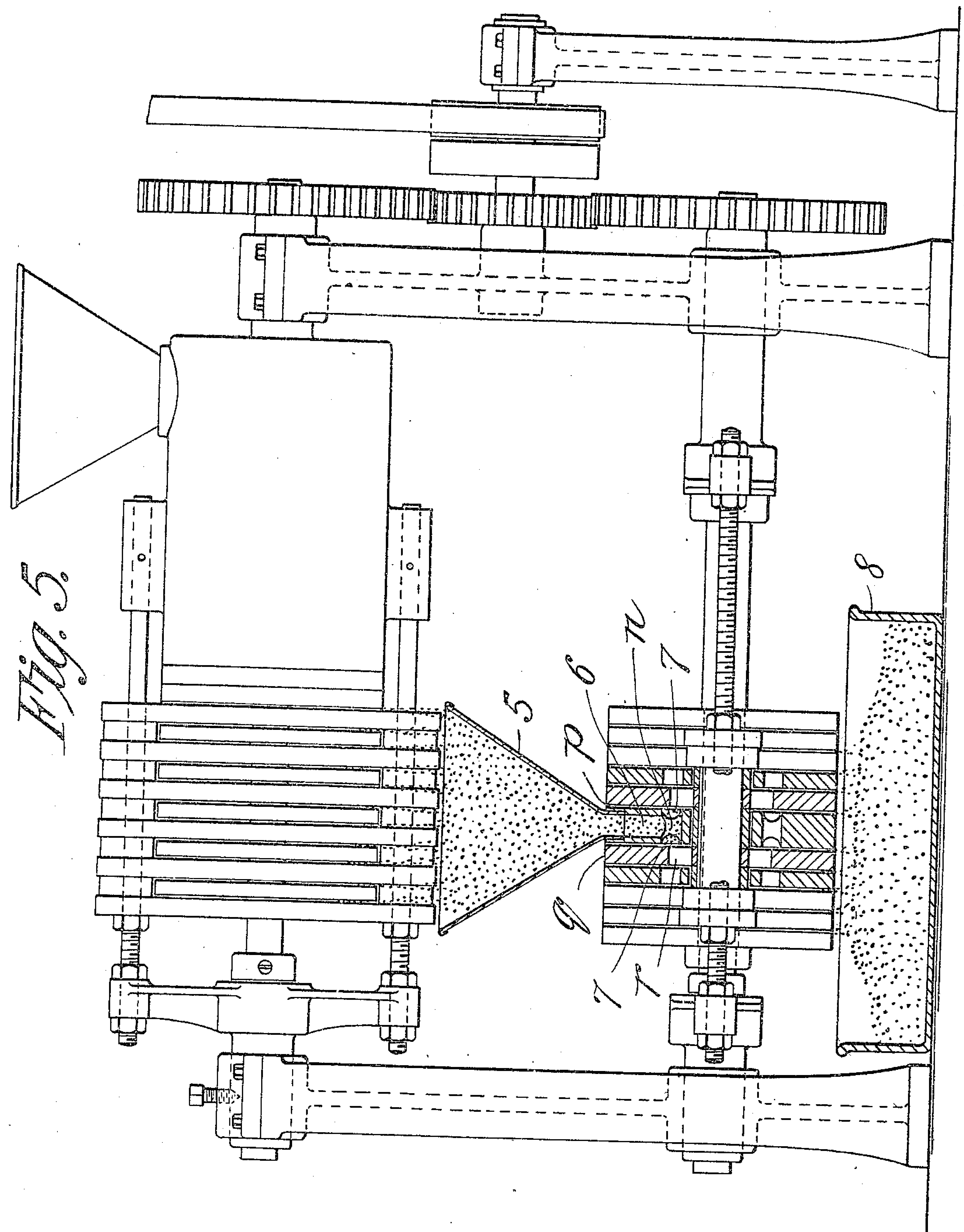
GRINDING MILL.

APPLICATION FILED MAY 8, 1908.

959,714.

Patented May 31, 1910.

3 SHEETS—SHEET 3.



Witnesses:

H. L. Sprague

H. W. Bowen

Inventor;

Gabriel Carlson.

by Chapin & Co.

Attorneys.

UNITED STATES PATENT OFFICE.

GABRIEL CARLSON, OF SPRINGFIELD, MASSACHUSETTS.

GRINDING-MILL.

959,714. Specification of Letters Patent. Patented May 31, 1910.

Application filed May 8, 1908. Serial No. 431,568.

To all whom it may concern:

Be it known that I, Gabriel Carlson, a citizen of the United States of America, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented new and useful Improvements in Grinding-Mills, of which the following is a specification.

This invention relates to grinding machines and specifically to a grinding machine which may be employed singly to reduce material to a predetermined degree of fineness; or two or more machines may be employed together,—one feeding into the other,—whereby the material reduced in the first machine to a certain degree of fineness may, by subsequent treatment in another machine, be still further reduced.

The object of the invention is to provide a grinding mill whereby material may be reduced to a predetermined degree of fineness, and whereby a relatively low surface speed of the grinding elements may be maintained, and whereby the material to be ground may be fed uniformly to a plurality of rotating grinding elements mounted on a common axis; a further object of the invention being to provide a mill having a plurality of rotatable grinding elements on a common axis, and in means for utilizing each side of the grinding elements whereby the lateral thrust resulting from the presence of material on one side of said element will be counteracted by the presence of material on the opposite side of the element, means being provided to distribute the material to be ground to a number of these grinding elements grouped together, all as hereinafter described in a detailed manner, the invention being clearly illustrated in its preferred form in the drawings forming part of this application, in which,—

Figure 1 is a longitudinal sectional elevation of a machine embodying the invention and provided with mechanism to positively feed material to be ground to the grinding elements of the machine. Fig. 2 is an end elevation of the machine shown in Fig. 1 looked at from the left-hand end. Fig. 3 is a plan view of one of the stationary grinding disks. Fig. 4 is a plan view of one of the rotating grinding disks. Fig. 5 is a side elevation, partly in section, of two machines embodying this invention mounted in one frame, one of said machines being arranged to feed material to the other machine which has passed through the first.

Referring now to these drawings, particularly to Fig. 1, *a* is a cylindrical casing in which there is a feed-screw *b* to force material which is fed into said casing from a hopper *c* toward the grinding elements of the machine located at the left-hand end of said screw, said cylindrical casing and said grinding elements being supported on a shaft *d*, mounted in suitable standards *e*, which shaft is rotated, by means of the belt *f*, through the gears *g* and *h*, or in any other suitable way. This method of feeding is desirable when dry or relatively dry material is to be ground. The casing *a* is stationary, the screw *b* revolving within it, and the ends of the casing are closed. The delivery end of said casing is closed by a plate *k* through which is a central hole *m* of greater diameter than the shaft *d* and through which the latter extends, and surrounding this are a number of feed-holes *n* which are arranged in this plate in the same order and on the same axes as similar holes, also indicated by *n*, in the stationary disks *p*,—one of which is shown in Fig. 3,—these being alternately arranged on the shaft *d* with the rotating disks *q*, one of which is shown in plan view in Fig. 4. The rotatable disks *q* are provided also with concentrically disposed feed-holes *r* though their distance from the center of the shaft is not quite as great as that of the holes *n*, the purpose of this being to provide an acute shearing edge to these feed-holes that they may serve to cut any large particles passing from one disk to the other. It will be observed that the feed-holes *n* and *r* constitute practically conduits extending from the interior casing *a* through to the last one of the disks *p*, which is not perforated, these feed-holes *r* and *n* periodically coming into registration one with the other, as the disks *q* revolve carrying the holes therein past the holes in the stationary disks.

To hold the disks *p* stationary they have been constructed as shown herewith with oppositely arranged ears *s* perforated to receive the rods *t*, one end of each of which is secured in a suitable boss cast on the side of the casing *a*, the opposite ends of the rods being supported in a yoke *v* which is rigidly fixed in one of the standards *e*. In this case, the yoke *v* has been provided with a hub *w* through which the end of the shaft *d* extends and has a rotatable bearing therein, this hub being clamped in the upper end of the standard *e*, by means of a set-nut as shown. This manner of holding the disks *p* stationary is shown only as one method of holding the disks, and another way which would accomplish the same end may be substituted if desired.

As stated above one end of the casing *a* is closed by the plate *k*, and on the shaft *d* beyond this are located the grinding elements consisting of the alternately disposed disks *p* and *q*, the latter being keyed to the shaft to rotate with said shaft, and the disks *p* being non-rotatably supported in the manner described by the rods *t*. These disks are preferably made of steel of a suitable degree of hardness, with an abrasive surface on each side thereof. On each of the rods *t*, between adjoining disks *p*, are spacing washers *x*, these being located in the same plane as the rotating disks *q*, and fitted on the shaft between each of the last named disks are the washers x^1, these being located in the enlarged central apertures of the stationary disks *p*. It should be stated that the axial length of the keys which are employed to rigidly secure the rotatable grinding disks *q* to the shaft *d* are of such a length that they project an equal distance beyond the opposite faces of the disks *q*, and with their opposite ends engaging the washer x^1, as shown in Fig. 1, whereby the spaces between the rotatable and non-rotatable disks are at all times equal and therefore the ground cocoa or other material that escapes from these spaces is of uniform fineness. By making the washers *x* and x^1 of the same thickness and each thicker than either stationary or rotating disk, it follows that when the non-rotatable disks are clamped together each of the disks *q* will be separated from the stationary disk on each side thereof by spaces of equal width, and thus by the use of washers *x* and x^1 of any desired thickness, the grinding space between the disks may be determined with the utmost exactness. When as many of these grinding elements *p* and *q* have been assembled on the shaft as are deemed necessary for the work to be performed, a disk *p* (not provided with feed-holes) is applied, having only its inner surface made abrasive. This abrasive surface is made preferably by cutting the circularly disposed grooves or channels 3 therein which radiate from the central apertures of all of the disks (see Figs. 3 and 4) and all of these, whether stationary or rotatable, comprised between the two end disks, are provided on both sides thereof with these channels which, preferably, are arranged substantially in the manner and having the form of those shown in Figs. 3 and 4 of the drawing, although their form and arrangement do not constitute a part of this invention, except in so far as they indicate an abrasive surface. It will be noted that these channels preferably do not extend to the periphery of the disk on either side, thus leaving an annular plane surface around the edge of each disk to the end that the space between a rotating disk on either side thereof and the contiguous surface of one of the stationary disks close to the edges thereof, will be the measure of the largest particle of ground material which can escape from the space between two adjacent abrasive surfaces, and this space may be determined at will in the manner described, by means of the washers *x* and x^1. To hold the disks in their proper spaced relations, the outer ends of the rods *t* are screw-threaded to receive a nut 4 which serves to force all of the disks toward the feed end of the machine and into abutting relation to the end of the casing *a*; and, consequently, forcing and securing all the washers *x* and x^1 and the disks into close abutting relation. In this manner a predetermined spacing between the adjacent abrasive surfaces of the stationary and the rotating disks is provided, and this space is made of any desired width by substituting for the washers *x*, x^1 on the machine, washers having a greater or less thickness, and then screwing them up tightly by means of the nuts 4, as described.

Where it is desired to reduce material to a degree of fineness which can not be attained by the passage thereof through one machine, two grinding mills may be mounted in one frame, as shown in Fig. 5—one above the other,—the machine shown at the top being that illustrated in Fig. 1, and the machine shown at the bottom being like that above in all respects as to the principles of operation but differing slightly from it in regard to the manner of introducing the material to be ground between the disks, which difference in construction will be described further on.

The grinding mill described herein is particularly adapted to the grinding of the cocoa bean which, preferably, is fed to the machine, shown in Fig. 1, in a roughly broken up condition. This material, as is well known, contains cocoa butter which is expressed therefrom, (or freed in the process of grinding,) in such quantity that the mass soon becomes pasty and eventually, when reduced to a very fine condition, becomes semi-fluid. This material has to be treated with considerable care in order to prevent raising the temperature thereof by friction to a too high degree; and to avoid this condition the grinding elements of this machine have been made of relatively small diameter in order to keep the surface speed at the peripheries thereof as low as possible, and at the same time to provide for an output which shall render the machines commercially successful, the grinding surfaces may be made sufficiently extensive by suitably multiplying the units in the form of the disks described above, and in the provision of suitable means to feed the material to be ground to both sides of each disk from the center thereof radially outward. In this manner it is possible to obtain an output which in quantity is sufficient to make the machine profitable, and at the same time to keep down the surface speed of the grinding elements and thus prevent over-heating and the glazing of the grinding surfaces by the adhesion thereto of the material being treated.

To insure the successful operation of the grinding elements disposed in the manner above set forth, provision has been made to carry the material by means of the feed-holes *m* and *r* to each side of each of the grinding elements, for as the screw *b* forces the material toward the plate *k*, which closes the forward end of the casing *a*, it will be seen that this material is being constantly packed into the feed-holes *m* in said plate *k* (which of course is stationary) and as the screw *b* revolves carrying with it the disks *q*, the feed-holes *r* in these latter disks constantly pass, one after the other, across the open ends of the holes *m* and thus constantly receive more or less of the material to be ground: and, of course, in a few moments, after starting the machine, all of the feed-holes will be packed with material which, by reason of the pressure behind them, when in a roughly broken state, and because of the form and arrangement of the radially disposed ears *s*, will be worked out between the disks and toward the periphery thereof; and as soon as it has attained a degree of fineness which will permit it to do so, it will escape from the spaces between the abrading surfaces and be deposited in a suitable receptacle, provided to receive it.

When the machine described herein is used for the reduction of the cocoa bean as described, it is not possible, or it is not practicable, to reduce it to as fine a state as is required for some purposes by passing it once through the grinding machine; and for treating such of this, or other like material as must be ground up rather finely, the machines may be used in series, as more fully shown in Fig. 5 and already referred to. When the cocoa issues from the space between the grinding elements of the first machine, as shown in Fig. 1, it is in a semi-liquid condition and therefore a hopper 5 on the second machine is located to permit the products of the first to run into it. The neck of this hopper entering one of the stationary disks *p* which is made wide enough to receive it, a channel 6 from the periphery of the disk extending into one of the feed-holes *m* and to provide for a uniform distribution, two shallow channels 7 are turned in the opposite sides of the aforesaid stationary disks intersecting the outer end of each of the feed-holes *m* whereby the said semi-liquid product of the first machine may, by gravity, flow through the feed-openings *n* and *r* of the adjacent disks, thus feeding all of the latter, said material finally being forced outwardly from the spaces between the abrasive surfaces of said disks to be received in a suitable receptacle 8. It is therefore clear that after the cocoa bean has been reduced to a semi-liquid state, the screw-feed, or any other forced feed, is not necessary. Of course the disks *p* and *q* of the second machine described herein as forming part of the device are adjusted with their adjacent surfaces as near together as is desirable to produce the required effect, but in all cases it should be borne in mind that the space between the peripheries of the revolving and the stationary disks is the measure of fineness of the material passing through the machine. In this way it makes it possible to determine precisely the degree of fineness of any material on which the machine may be used.

If desired the distance between the two machines shown in Fig. 5 may be increased to provide any required pressure or head which may be necessary to properly distribute the material through the feed conduits of the grinding mill which receives it.

A feature of the process of grinding described herein which is of special advantage resides in the fact heretofore referred to that by the distribution of the material in substantially equal quantities to both sides of the grinding elements, the latter are balanced as it were, and all end thrust taken off the shaft *d*.

What I claim, is:—

1. A grinding mill comprising a shaft, grinding disks thereon to rotate with the shaft, spacing washers between the disks and located on the shaft, non-rotatable disks fitted over said washers between the rotatable disks; other spacing washers located between the peripheries of the stationary disks of the same thickness as the spacing washers on the shaft, and means to secure the disks in close contact with the spacing washers to provide a uniform spacing of the disks on the shaft, together with means to feed material to the disks, substantially axially thereof.

2. A grinding mill comprising a shaft and a plurality of suitably spaced rotatable and non-rotatable disks alternately disposed on the shaft, means for securing the rotatable disks to the shaft and spacing said disks from the non-rotatable disks, both sides of both the stationary and the rotatable disks constituting a grinding surface, together

with one or more feeding conduits transversely disposed relative to the disks to convey material to be ground into the spaces between the disks, the feeding conduits being arranged so as to intermittently register with each other to permit the material to axially pass from one disk to the other.

3. In a grinding mill, a rotatable shaft, a disk mounted thereon for rotation with the shaft, a stationary disk on each side of the rotatable disk and spaced therefrom, and means to feed material to the space between said rotatable and stationary disks, the contiguous surfaces of both disks being grinding surfaces, and washers for definitely determining the axial space between each disk.

4. In a grinding mill, a shaft, a rotatable disk mounted thereon, a stationary disk on each side of the rotatable disk and spaced therefrom, and means to feed material to the space between said rotatable and stationary disks, the contiguous surfaces of both disks being grinding surfaces, and means to adjust the rotatable disks on the shaft to vary the spacing apart of the disks, means including a series of washers located respectively at the center and peripheral portions of the fixed disks for determining their relation to each other.

5. In a grinding mill, a shaft, a plurality of suitably spaced rotatable and non-rotatable disks alternately disposed on the shaft, the spaces between the disks constituting the grinding surfaces, feed-holes extending transversely through both the rotatable and non-rotatable disks, the feed-holes in the non-rotatable disks being located at a greater distance from the axis of the shaft than the feed-holes in the rotatable disks, so disposed that when in substantial registration they will constitute feed conduits intersecting the spaces between the disks, and means to supply material to be ground to said conduits, said feeding means including a screw member carried by the shaft, said shaft being located in a chamber having outlet openings in registration with feed-holes of the non-rotatable disks.

6. A grinding mill having in combination with a rotatable shaft, a hopper, a casing provided with outlet openings, a feed screw mounted therein, a series of rotatable and non-rotatable grinding disks arranged on the feed-screw shaft and provided with openings therethrough, spacing elements for separating the disks, the outlet openings in the casing being arranged in axial alinement with the openings in the stationary disks whereby when the screw is operated material will be fed from the casing to and between the disks, and means to operate the disks, said spacing elements including a series of washers located between the disks at the center and peripheral portions thereof.

GABRIEL CARLSON.

Witnesses:
K. I. Clemons,
H. W. Bowen.

Correction in Letters Patent No. 959,714.

It is hereby certified that Letters Patent No. 959,714, granted May 31, 1910, upon the application of Gabriel Carlson, of Springfield, Massachusetts, for an improvement in "Grinding-Mills," were erroneously issued to said Carlson, whereas the said Letters Patent should have been issued to *Henry H. Bowman, administrator of estate of said Gabriel Carlson, deceased;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of June, A. D., 1910.

[SEAL.]

F. A. TENNANT,

Acting Commissioner of Patents.