938,923.

J. WALKER.

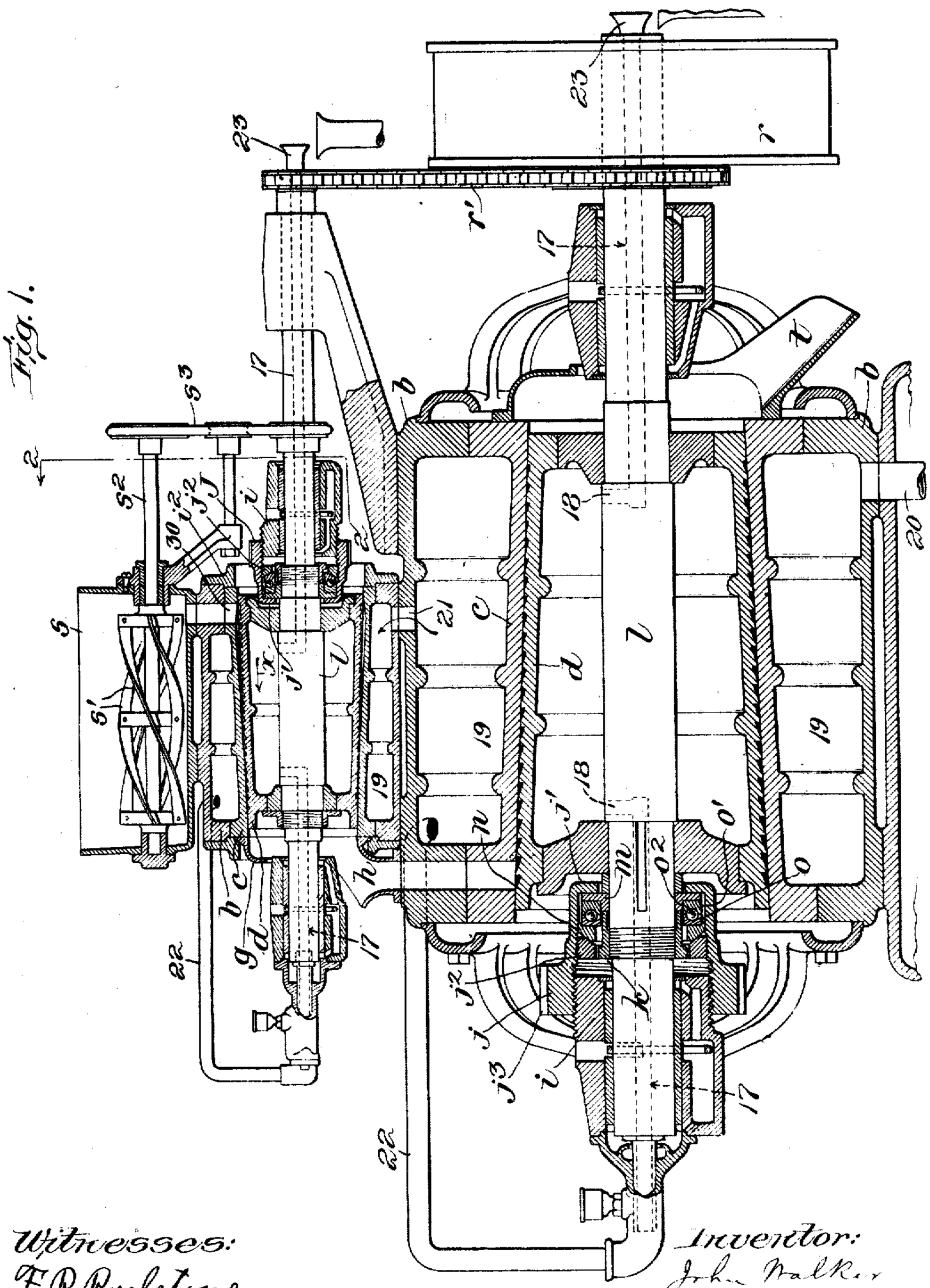
GRINDING MILL.

APPLICATION FILED OCT. 29, 1908.

Patented Nov. 2, 1909.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
F. R. Rowletine
P. H. Pizzetti

Inventor:
John Walker
by Wright Brown Quinby & May
Attys.

J. WALKER.

GRINDING MILL.

APPLICATION FILED OCT. 29, 1908.

938,923.

Patented Nov. 2, 1909.

4 SHEETS—SHEET 2.

Fig. 2.

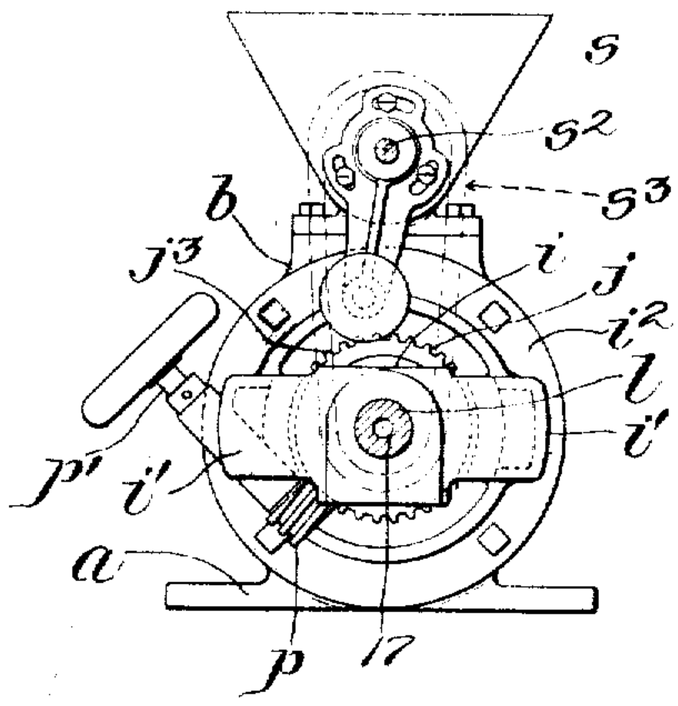
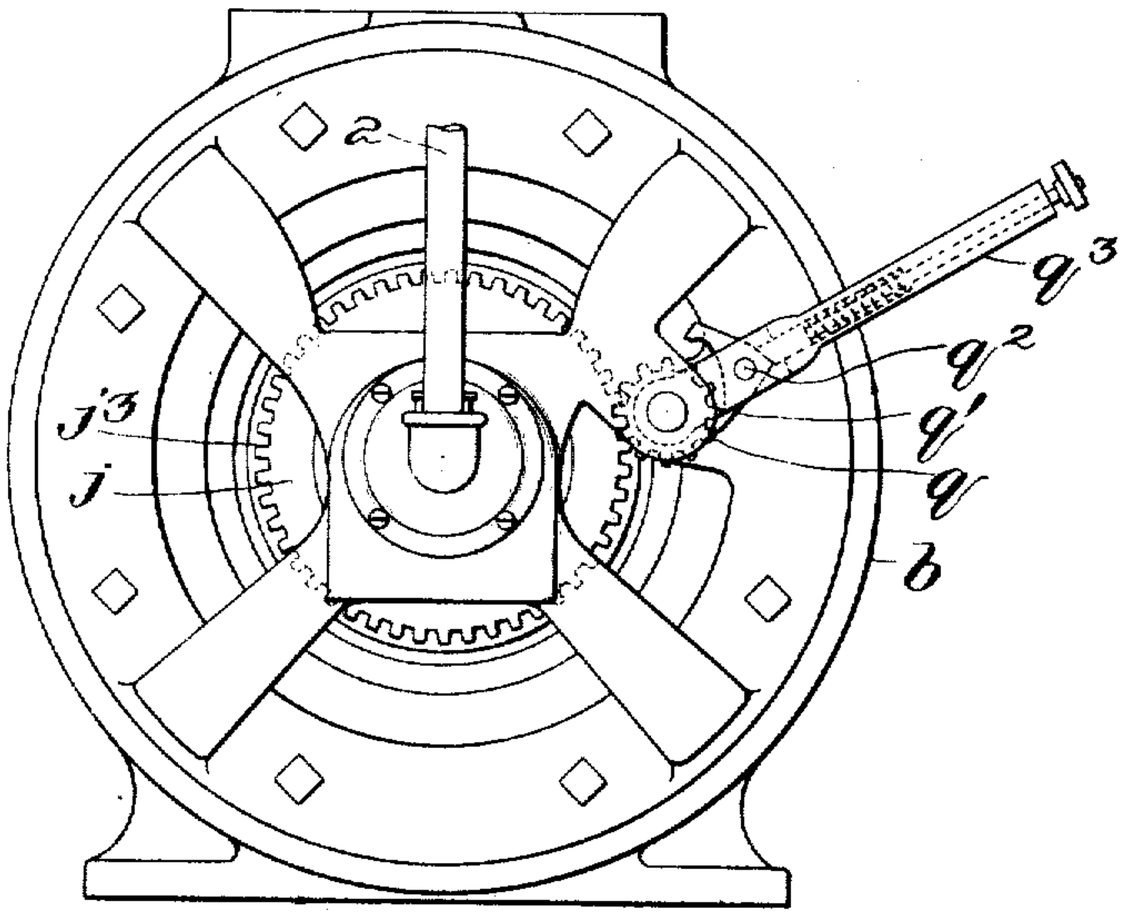


Fig. 3.



Witnesses:
P R Rouleteire.
P. H. Pezzetti

Inventor:
John Walker.
by Wright Brown Quinby & May
Attys.

J. WALKER.

GRINDING MILL.

APPLICATION FILED OCT. 29, 1908.

938,923.

Patented Nov. 2, 1909.

4 SHEETS—SHEET 3.

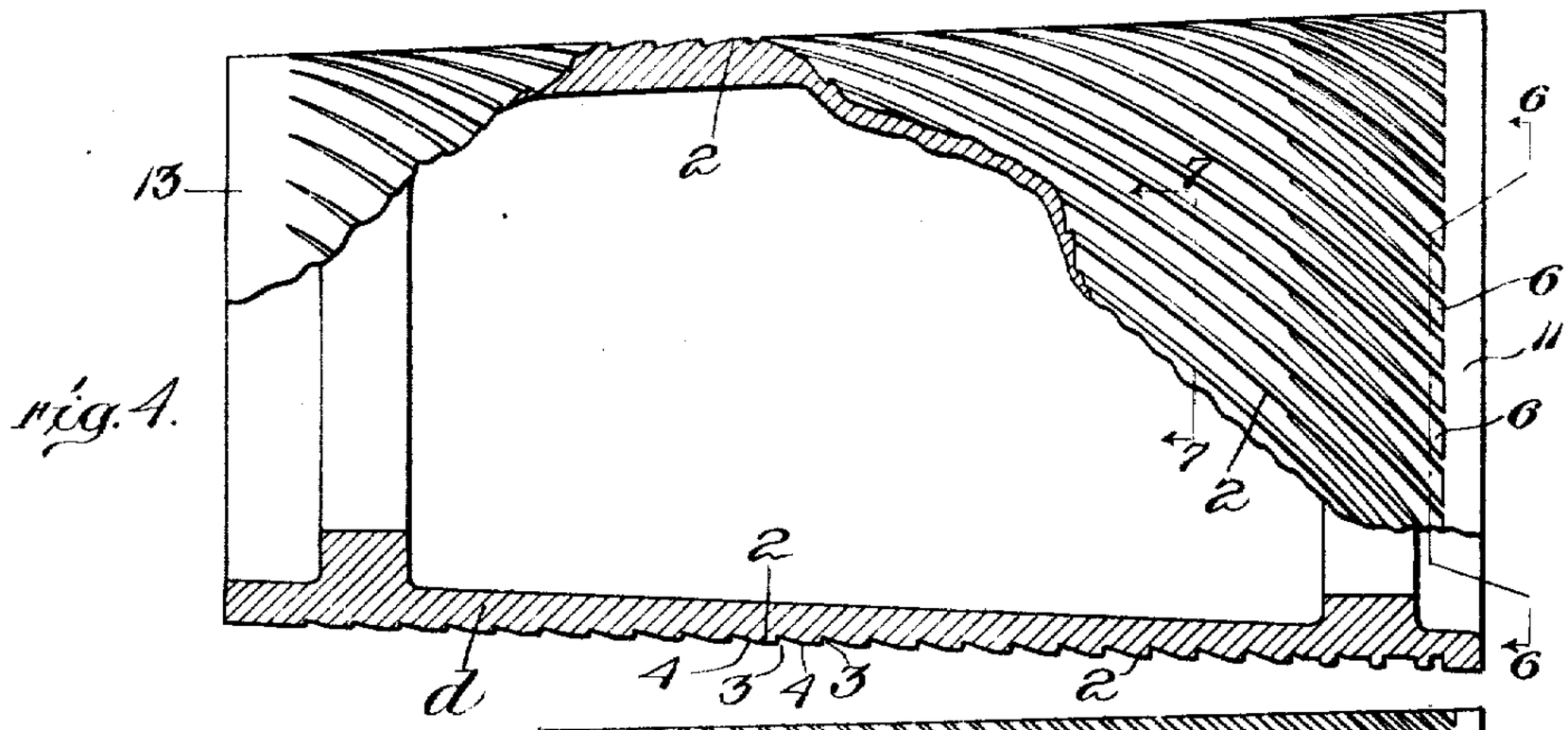


Fig. 4.

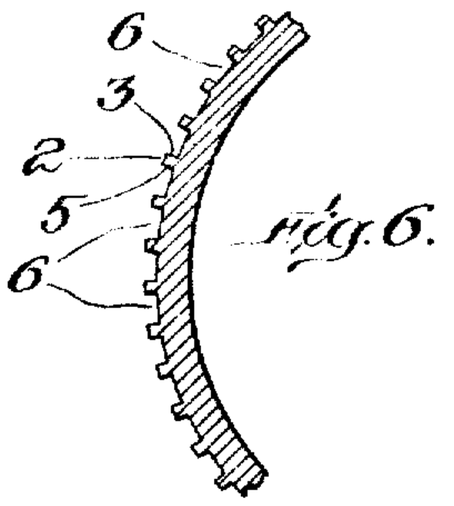


Fig. 6.

Fig. 5.

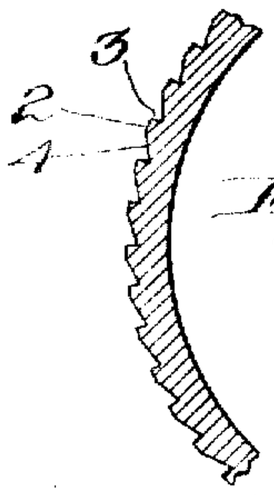
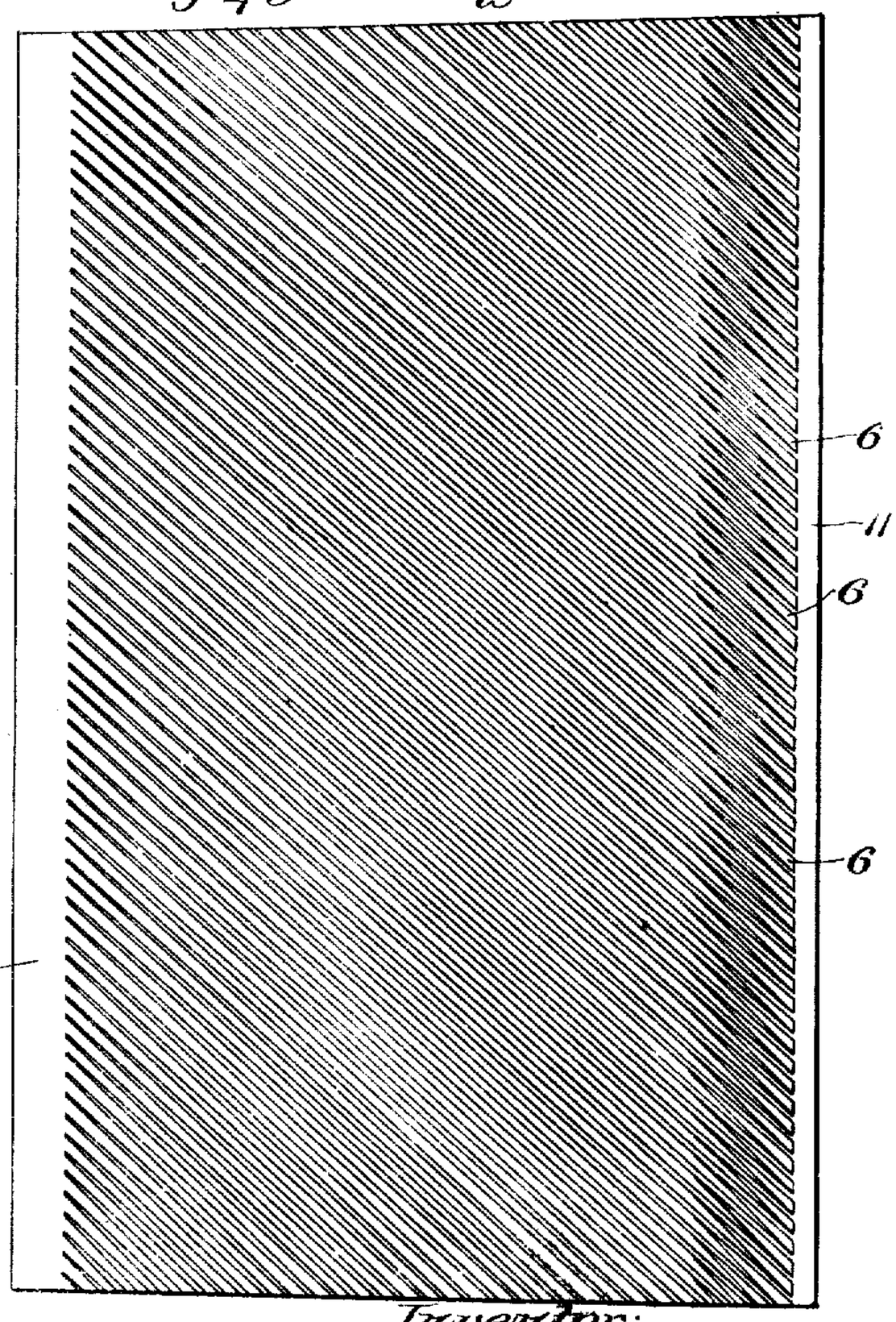


Fig. 7.



Witnesses:
F. P. Roulstone
P. A. Pezzetti

Inventor:
John Walker
By Wright Brown Quinby & May
Attys.

J. WALKER.

GRINDING MILL.

APPLICATION FILED OCT. 29, 1908.

938,923.

Patented Nov. 2, 1909.

4 SHEETS—SHEET 4.

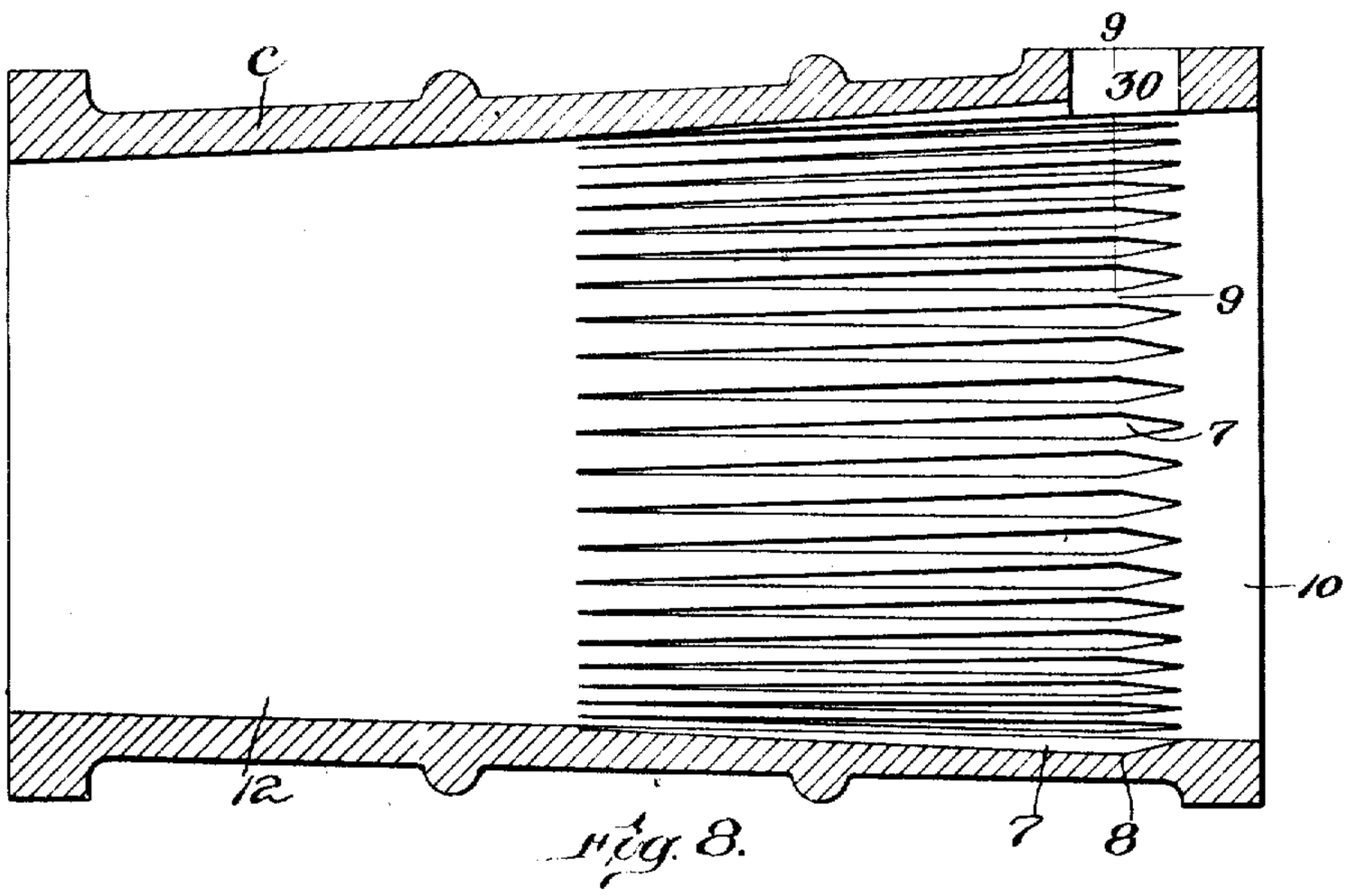


Fig. 8.

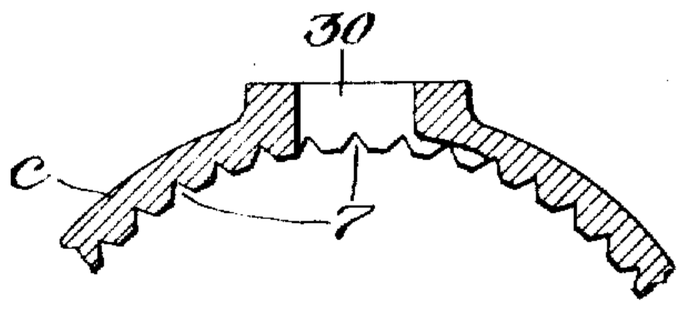


Fig. 9.

Witnesses:
H.R. Rouldone
P. H. Pezzetti

Inventor:
John Walker
by Wright Brown Quinby & May
Attys.

UNITED STATES PATENT OFFICE.

JOHN WALKER, OF BOSTON, MASSACHUSETTS.

GRINDING-MILL.

938,923. Specification of Letters Patent. Patented Nov. 2, 1909.

Application filed October 29, 1908. Serial No. 460,011.

To all whom it may concern:

Be it known that I, JOHN WALKER, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Grinding-Mills, of which the following is a specification.

This invention relates to machines for triturating, mixing and levigating granular material, especially of a more or less oily nature, and my invention particularly relates to apparatus of this nature designed for use in the manufacture of chocolate from the cocoa bean. Heretofore it has been customary to produce the chocolate especially when it is to be used for the manufacture of confections, by means of a series of machines. Of such machines, the first or stone grinder, commonly called a "triple mill", is employed for grinding the cocoa beans. Said machine is heavy and bulky, usually weighing about five tons, and it has been necessary to run such a machine at a very slow speed. Then it is customary to prepare the sugar in a mill. The vanilla beans, which are usually also employed, must be run through a "chopper" which breaks up or grinds the vanilla to relatively small particles. Then a fourth machine is used to levigate the three materials, said machine usually consisting of three or more cylinders or rolls revolving in peripheral contact with a differential speed, said rolls rubbing only at their point of contact. In addition to these machines, it has been usually necessary to employ a "chaser" which stirs or mixes the material thoroughly, this machine usually consisting of stones rolling in a pan.

The particular object of my present invention is to provide one single machine which will perform all of the functions of the above-mentioned four or five different machines.

With my machine, the different materials can be all ground and mixed together and during the latter part of a single pass of the combined materials, they are levigated between concentric cylindrical surfaces which preferably taper for the purpose of obtaining a fine adjustment.

With my improved machine, the chocolate and sugar are not only thoroughly levigated and mixed and the flavoring material such as vanilla when used, also thoroughly mixed with the chocolate and sugar, but there is no loss or change in the natural flavor of the chocolate. This is because the triturating, levigating and mixing are all performed between surfaces which are kept cool. The cooling, moreover, enables the machine to be run at a high speed.

Heretofore, so far as I am aware, the highest degree of subdivision and homogeneity of chocolate mixtures has been attained by the use of cylinder rolling mills. Then every kind of chocolate had to be passed through the rolling machine several times even when finely powdered sugar is included in the mixture. In this latter case, the effect of the rolling mill is rather that of thorough intermixing than of powdering or levigating. The best qualities of chocolate have been passed through such machines six or eight times or even more. In the last of such operations, the material is often fed into the machine in the state of blocks. The rolls were made of granite of a nature possessing a hardness between that of porphyry and ordinary granite and is known by the name of diorite. Obviously, granite could not be practically cooled by water circulation, nor could it be made practically into the form of two cones, one fitting within the other.

In carrying out my invention, I am able to make the triturating and levigating surfaces of steel. The outer cone or shell is made absolutely smooth in its interior excepting for a rather short feed or supply groove or channel, while the inner rotary member or runner is formed with grinding or triturating spiral ribs for a portion of its length, a considerable portion of the entire surface at the discharge end being absolutely smooth. Both of the members taper, whereby the levigating surfaces can be given absolutely accurate relative positions by shifting or adjusting one member longitudinally relatively to the other. And both the stationary and revolving members are kept cool by suitable means, such as hereinafter described. With this machine, I am therefore enabled to produce refined chocolate rapidly and without losing or affecting the flavor of the chocolate or of the vanilla or other flavoring material that may be incorporated with the mixture of chocolate and sugar.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a longitudinal section of a machine embodying my invention. Fig. 2 represents a section on line 2—2 of Fig. 1, and an end

elevation of the mechanism at the left of said line. Fig. 3 represents an end elevation of the portion of the machine below the line 2—2. Fig. 4 represents a partial side elevation and a partial longitudinal section of one of the runners shown in Fig. 1. Fig. 5 represents the periphery of the runner shown in Fig. 4 developed as a plain surface. Fig. 6 represents a section on line 6—6 of Fig. 4. Fig. 7 represents a section on line 7—7 of Fig. 4. Fig. 8 represents a longitudinal section of the shell which coöperates with the upper runner shown in Fig. 1. Fig. 9 represents a section on line 9—9 of Fig. 8.

The same reference characters indicate the same parts in all the figures.

In the drawings, which represent an embodiment of my invention which I have shown for the purposes of illustration, *b* represents a rigidly supported housing having a circular orifice, in which is fitted a shell *c* which constitutes the outer fixed or non-rotary member of a grinding and levigating couple. The internal face of the shell, which is circular in cross section, cooperates with an external face formed by the periphery of a runner *d*, which is located within the shell, the external face of the runner conforming closely to the internal face of the shell. Each of the said faces is tapered, as shown in Fig. 1, for purposes of adjustment, as presently described. The two members of the couple are so related as to leave between their opposing surfaces an annular conical working space extending from end to end of the shell and runner, the material to be treated being fed to one end of said annular space, and ejected from the opposite end after passing horizontally through the entire length of the space between the opposing faces of the couple. The portion of the periphery of the runner, which constitutes the inner side of the receiving end of the working space, is provided with screw threads 2 of a steep pitch, one side 3 of the threads at any given point (excepting at the larger end portion of the runner), being substantially at right angles to the axis of the runner, while the opposite side 4 is inclined to said axis, as shown clearly in Figs. 4 and 7.

The portions of the threads which coincide with the supply inlet 30, hereinafter described, have the rectangular form in cross section shown in Fig. 6, each thread having a rear side 5 as well as a front side 3 arranged substantially at right angles to the axis of the runner. These rectangular portions of the threads are therefore separated by spaces 6 which are of gradually decreasing width, as shown in Figs. 4 and 5. Said spaces receive the material fed through the inlet 30 and facilitate its movement to the succeeding portions of the thread which are separated by spaces the bottoms of which are formed by the inclined sides 4. When the runner is rotated, the recesses of the screw threads 2 coact with the interior face of the shell *c* to exert a feeding pressure on the material fed into the working space, the feeding pressure being in the direction indicated by the arrow *x* in Fig. 1, while the ridges formed between the sides 3 and 4 bite into and grind or triturate the material. The inner surface of the shell, corresponding or opposed to the portion of the runner occupied by the screw threads 2, has longitudinal V-shaped grooves 7 in its larger end portion, said grooves having relatively deep portions 8 arranged to coincide with the inlet 30 and tapered abruptly from said deep portions toward the larger end of the shell and gradually toward the smaller end thereof. The abruptly tapered portions terminate a short distance from the larger end of the shell which has a short smooth internal surface 10 closely fitting a corresponding smooth surface 11 on the larger end of the runner, said surfaces preventing the material from exuding at the larger ends of the shell and runner. The grooves 7 terminate at about the longitudinal center of the shell and the inner surface 12 of the shell between its smaller end and the ends of the grooves 7 is absolutely smooth. The entire inner surface of the shell and external surface of the runner have an endwise taper.

The material to be treated is admitted to the receiving portion of the working space through the inlet 30, into which the material may be delivered by a mixing trough or by any other suitable means. The opposite end portion of the runner is provided with a smooth peripheral portion 13. The corresponding or opposed part of the shell is provided with a smooth internal portion 12, the said smooth portions 12 and 13 being practically in rubbing contact with each other at all parts, so that they exert a rubbing pressure on the material passing through the working space, and reduce to impalpable form by levigation all particles which reach them through the other portions of said space. The material issues from the delivering portion of said space into a hood or deflector *g*, which communicates with an outlet spout or passage *h*.

The tapering grooves 7 in the shell arranged in the portions to receive the entering material, and the spaces 6 between the threads 2 at the portion of the runner which coincides with the inlet 30, facilitate the entrance of the material into the working space between the shell and runner, the angles formed by the grooves 7 coöperating with the angles formed by the threads of the runner in reducing the material before it reaches the portion of the working space which is formed by the contacting portions of the surfaces 12 and 13.

The runner *d* is longitudinally adjustable in the shell *c*, this longitudinal adjustability in connection with the tapering form of the reducing surfaces, enabling the width of the working space to be adjusted to any extent desired and with the utmost nicety. The means for adjusting the runner *d* and for holding it at any position to which it is capable of being adjusted, as here shown, comprise an external screw threaded bearing *i* which is one of the bearings in which the shaft *l* which carries the runner *d* is journaled, and is rigidly secured by ears *i'* (Fig. 2) to a ring i^2 bolted to one end of the housing *b*, and an internally threaded collar or nut *j* which is engaged with the runner shaft *l* in such manner that when the machine is in operation, the nut *j* remains stationary while the shaft rotates. The nut *j* has at its inner end an inwardly projecting flange *j'* and is provided internally with an inwardly projecting abutment j^2. The shaft *l* is provided between the flange *j'* and abutment j^2 with a sleeve *k* which has a rigid screw thread connection with the shaft and with a collar *m* which bears against one end of the sleeve *k*, and against the inner side of the flange *j'*, said collar being also rigidly engaged with the shaft.

n represents a ring which bears against the inner side of the abutment j^2. Between the ring *n* and collar *m* are interposed two rings *o*, *o'*, the inner sides of which are grooved to form a ball race retaining a series of anti-friction balls o^2. Means are provided for rotating the nut *j* upon the screw threaded bearing *i*, such rotation giving the nut a longitudinal movement. When this movement is in one direction the flange *j'* on the nut is caused to act upon the collar *m* on the shaft and move the shaft endwise in one direction. An opposite movement of the nut causes the abutment j^2 to press against the ring *n*, this pressure being transmitted through the ball race to the collar *m*, and causing an endwise movement of the shaft in the same direction.

The nut *j* may be rotated by engagement with teeth j^3 formed on its periphery, of a suitable actuating device which may be a worm *p* affixed to a shaft *p'*, as shown in Fig. 2, or a pinion *q* meshing with said teeth and rotatable step by step by a double ratchet *q'* pivoted at q^2 to a lever q^3 adapted to oscillate upon the axis of the pinion *q*. The double ratchet *q'* is reversible so that it may rotate the pinion *q* and the nut *j* in either direction.

In Fig. 1 I have shown a machine which includes two grinding and levigating couples, each comprising an externally threaded runner and a fixed sleeve inclosing the same, and each having substantially the characteristics above described. The members of the lower couple as here shown are larger than the upper couple, the larger ends of the shell and runner of the lower couple being arranged to receive the material discharged from the members of the upper couple, said material passing to the lower couple through the discharge spout or passage *h*, which is continued through the housing *b* and one end of the shell *c* of the lower couple. Since the material delivered to the lower couple has been considerably reduced, I do not consider it necessary to provide the shell of the lower couple with the longitudinal grooves 7, and I may omit from the runner of the lower couple the rectangular form given to the threads at the larger end of the runner of the upper couple. With these exceptions, the construction of the lower couple, as here shown, is identical with that of the upper couple, the mechanism for adjusting the runner being the same in both couples excepting that the mechanism for adjusting the nut *j* on the shaft of the lower couple is preferably as shown in Fig. 3, while the mechanism for adjusting the nut *j* on the shaft of the upper couple is preferably as shown in Fig. 2.

The runner-carrying shafts may be driven by means of a driving pulley *r* affixed to the shaft of the lower runner, and a sprocket chain *r'* connecting the sprocket wheels affixed respectively to the lower and upper shafts, as shown in Fig. 1.

s represents a mixing trough which is mounted upon the housing of the upper couple, and is provided with a series of helical mixing blades *s'* attached to a shaft s^2 which is journaled in the ends of the trough, and is driven by a belt s^3 from the shaft of the upper runner *d*. The trough *s* discharges into the inlet 30 of the upper couple. Completely reduced and levigated material delivered by the lower couple passes from the machine through a discharge spout *t*.

For the purpose of keeping the shells and the runners cool, I provide means for circulating a cooling medium, such as water, in contact with said parts. To this end the runner supporting shaft is made tubular, its interior constituting a duct or passage 17 which communicates through openings 18 with the interior of the runner, while each housing has a chamber 19, the inner wall of which is formed by the shell *c*.

20 represents a supply pipe through which water may be pumped or forced in any suitable way into the chamber 19 of the lower housing. 21 represents a passage connecting the chambers of the lower and upper housings so that water forced into the chamber of the lower housing will circulate through the same and enter into the chamber of the upper housing. Each of said chambers is connected by a pipe 22 with one end of the corresponding runner shaft.

It will be seen from the foregoing that the liquid forced through the supply pipe 20 circulates through the housing chambers 19 and passes through the pipe 22 and portions of the runner shafts to the interior of the runners through which the liquid circulates, and then escapes through waste outlets 23, shown in Fig. 1 at the right hand ends of the runner shafts.

It will now be understood that, when the cocoa is supplied to the trough *s*, it will pass down through the feed passage or inlet 30 and will be bitten into and first crushed by ridges formed between the sides of the rectangular portions of the screw threads 2 of the inner member or runner, and then by the succeeding portions of said threads, and will be gradually worked around and advanced toward the smaller or exit end of the coöperating members or couple, reaching the absolutely smooth portions and there be rubbed and reduced and refined or levigated until the material finally changes into the condition of chocolate. Owing to the tapered form of the two members of the couple and the adjustment provided for, as described, the material can be readily made to issue in complete refined or levigated condition. And when granulated sugar is introduced with the cocoa, it will at the same time be thoroughly levigated. Any flavoring material that may be employed will also be mixed in.

The longitudinal adjustability of the runner enables the same grinding couple to be used to reduce the material by successive operations with the same couple, the material being passed through with the runner at a given adjustment, and then again passed through with the runner adjusted to effect a finer reduction. The employment of two grinding couples, as shown in Fig. 1, however, obviates the necessity of passing the same material twice through the same grinding couple, the adjustment o fthe runner of the lower couple being such that it increases the reduction of the material that has been passed through the first couple.

It will be understood that the essential features of my invention are that the material or materials are absolutely rubbed while being mixed, the extent of the rubbing surfaces being such as to finish and thoroughly refine the chocolate.

The material passes directly from the ridges of the inner member to the coöperating levigating surfaces, which latter thoroughly triturate and mix or more completely levigate the materials. And all overheating which would affect the sugar and chocolate is prevented by provisions for keeping both surfaces cool. Cooling is especially advantageous when the coacting surfaces are smooth to levigate the material, so that the high speed, which is desirable, may be maintained in use without injury to the chocolate.

It is to be understood that the object of the provisions for cooling the inner and outer members of the mill is not with reference to the mill itself, but to the maintenance of the materials being operated upon in such physical condition that they are amenable to grinding and mixing during their entire passage along the annular conical space between the outer member or shell and the inner member or runner. The said provisions for cooling enable the mill to grind and intimately combine cocoa, sugar and vanilla to produce sweet chocolate at a single operation because, although the close and continuous rubbing would ordinarily have a tendency to unduly heat the materials, the said materials are in fact kept at a sufficiently low temperature so that the flavor is not injured. At the same time the materials as ground and mixed have no opportunity to harden during passage along the annular interspace, the mill feeding along not by gravity but being crowded along the crevices by mutual attrition. This crowding of the materials along the crevices causes it to work over the tops of the space between the groove which tops are smooth and rub the materials against the coacting smooth opposing surfaces so that each of the members has throughout its entire length, smooth attrition surfaces which are in close proximity to coacting smooth attrition surfaces of the other member. And it is to be noted that the annular space referred to is of a slow taper of closely approaching parallel grinding surfaces, the large end being the feed end, thereby, in connection with the grooves of the runner, the walls of which are obtuse, causing the material to be crowded along toward the smaller end of the taper.

When two grinding couples are employed the shell and runner of the second or lower couple should be of greater diameter than the shell and runner of the first or upper couple, in order that the material partly reduced and delivered by the first couple may pass through the more restricted interspace of the second couple practically as fast as it passed through the interspace of the first couple, the runner of the second couple being adjusted to make the interspace narrower than the interspace of the first couple.

It is obvious that the machine may be employed for grinding or reducing any other materials besides those here specified, which require to be kept cool while being reduced.

I claim:

1. A mill for grinding and intimately combining cocoa, sugar and vanilla to produce sweet chocolate at a single operation, said mill comprising a fixed outer member

and a rotatable inner member, said members having coacting, smooth, tapering attrition surfaces in close proximity substantially throughout their operative length, and means for keeping said members cool and the materials being treated in a physical condition amenable to grinding and mixing.

2. A mill for grinding and intimately combining cocoa, sugar and vanilla to produce sweet chocolate at a single operation, said mill comprising a fixed outer member and a rotatable inner member, said members having coacting, smooth, tapering attrition surfaces in close proximity substantially throughout their operative length, one of said members being adjustable longitudinally relatively to the other, and means for keeping said members cool and the materials being treated in a physical condition amenable to grinding and mixing.

3. A mill for grinding and intimately combining cocoa, sugar and vanilla to produce sweet chocolate at a single operation, said mill comprising a fixed outer member provided with an inlet at the receiving end portion for the supply of material, the inner surface of said member being smooth at the exit end portion, and an inner member having a portion of its periphery provided with triturating ridges and having a smooth surface at the exit end for the material, and means for keeping said members cool and the materials being treated in a physical condition amenable to grinding and mixing.

4. A mill for grinding and intimately combining cocoa, sugar and vanilla to produce sweet chocolate at a single operation, said mill comprising a fixed outer member provided with an inlet at the receiving end portion, and longitudinal grooves located between the receiving and delivering end portions, and terminating at a distance from the latter, the inner surface of said member being smooth between said grooves and the exit end, and an inner member having a portion of its periphery provided with triturating ridges and having a smooth surface at the exit end, and means for keeping said members cool, and the materials being treated in a physical condition amenable to grinding and mixing.

5. A mill for grinding and intimately combining cocoa, sugar and vanilla to produce sweet chocolate at a single operation, said mill comprising a fixed outer member provided with an inlet at the receiving end portion for the supply of material, the inner surface of said member being smooth at the exit end portion, and an inner member having a portion of its periphery provided with triturating ridges and having a smooth surface at the exit end for the material, the end portions of said ridges at the receiving end of the mill being substantially rectangular in cross section, while the remaining portions have inclined back faces, and means for keeping said members cool and the materials being treated in a physical condition amenable to grinding and mixing.

6. A mill for grinding and intimately combining cocoa, sugar and vanilla to produce sweet chocolate at a single operation, said mill comprising a fixed outer member provided with an inlet at its receiving end portion for the supply of material, the inner surface of said member being smooth at the exit end portion, and an inner member having a portion of its periphery provided with triturating ridges and having a smooth surface at the exit end for the material, and means for keeping said members cool and the materials being treated in a physical condition amenable to grinding and mixing, one of said members being adjustable longitudinally relatively to the other.

7. A mill for grinding and intimately combining the ingredients of sweet chocolate, said mill comprising a fixed shell having an internal smooth rubbing face, a rotary runner having an external face conforming to the internal face of the shell, a tubular shaft carrying said runner, a chambered housing supporting the shell, and means for circulating a cooling medium through the shaft and housing to cool the shell and runner.

8. A mill for grinding and intimately combining the ingredients of sweet chocolate, said mill comprising a fixed shell having an internal smooth rubbing face, a rotary runner having an external face conforming to the internal face of the shell, a tubular shaft carrying said runner, a chambered housing supporting the shell, a conduit connecting the shaft and the housing, and means for forcing a cooling medium through the said shaft, conduit and housing.

9. A mill for grinding and intimately combining cocoa, sugar and vanilla to produce sweet chocolate at a single operation, said mill comprising a fixed outer member and a rotatable inner member said members having coacting, smooth tapering attrition surfaces in close proximity substantially throughout their operative length, one or both of the members having feeding grooves, and means for keeping said members cool and the materials being treated in a physical condition amenable to grinding and mixing.

10. A mill for grinding and intimately combining cocoa, sugar and vanilla to produce sweet chocolate at a single operation, said mill comprising an upper and a lower grinding couple each including a fixed outer member and a rotatable inner member, said members having coacting, smooth tapering attrition surfaces in close proximity substantially throughout their operative length, one or both of the members having feeding grooves, means for conducting material from one couple to the other, and means for keep-

ing said members cool and the materials being treated in a physical condition amenable to grinding and mixing.

11. A grinding mill comprising a fixed tapered shell, a rotary tapered runner within the shell, a shaft supporting the runner, a fixed externally threaded bearing surrounding said shaft, a nut rotatively mounted on said bearing, and connections between the nut and shaft whereby rotation of the nut is caused to adjust the shaft and runner endwise.

12. A grinding mill comprising a fixed tapered shell, a rotary tapered runner within the shell, a shaft supporting the runner, a fixed externally threaded bearing surrounding said shaft, a nut rotatively mounted on said bearing, connections between the nut and shaft whereby rotation of the nut is caused to adjust the shaft and runner endwise, the nut having a toothed periphery, and means adapted to coöperate with said periphery in rotating the nut.

13. A grinding mill comprising a fixed tapered shell, a rotary tapered runner within the shell, a shaft supporting the runner, a fixed externally threaded bearing surrounding said shaft, a nut rotatively mounted on said bearing and provided with an internal flange and an internal abutment, and a ball race engaged with the shaft and interposed between said flange and abutment.

In testimony whereof I have affixed my signature, in presence of two witnesses.

JOHN WALKER.

Witnesses:
C. F. Brown,
P. W. Pezzetti.