(No Model.) 3 Sheets—Sheet 1.

L. DOLOIRE & C. GOLAY.

MILL.

No. 462,372. Patented Nov. 3, 1891.

Fig. 1

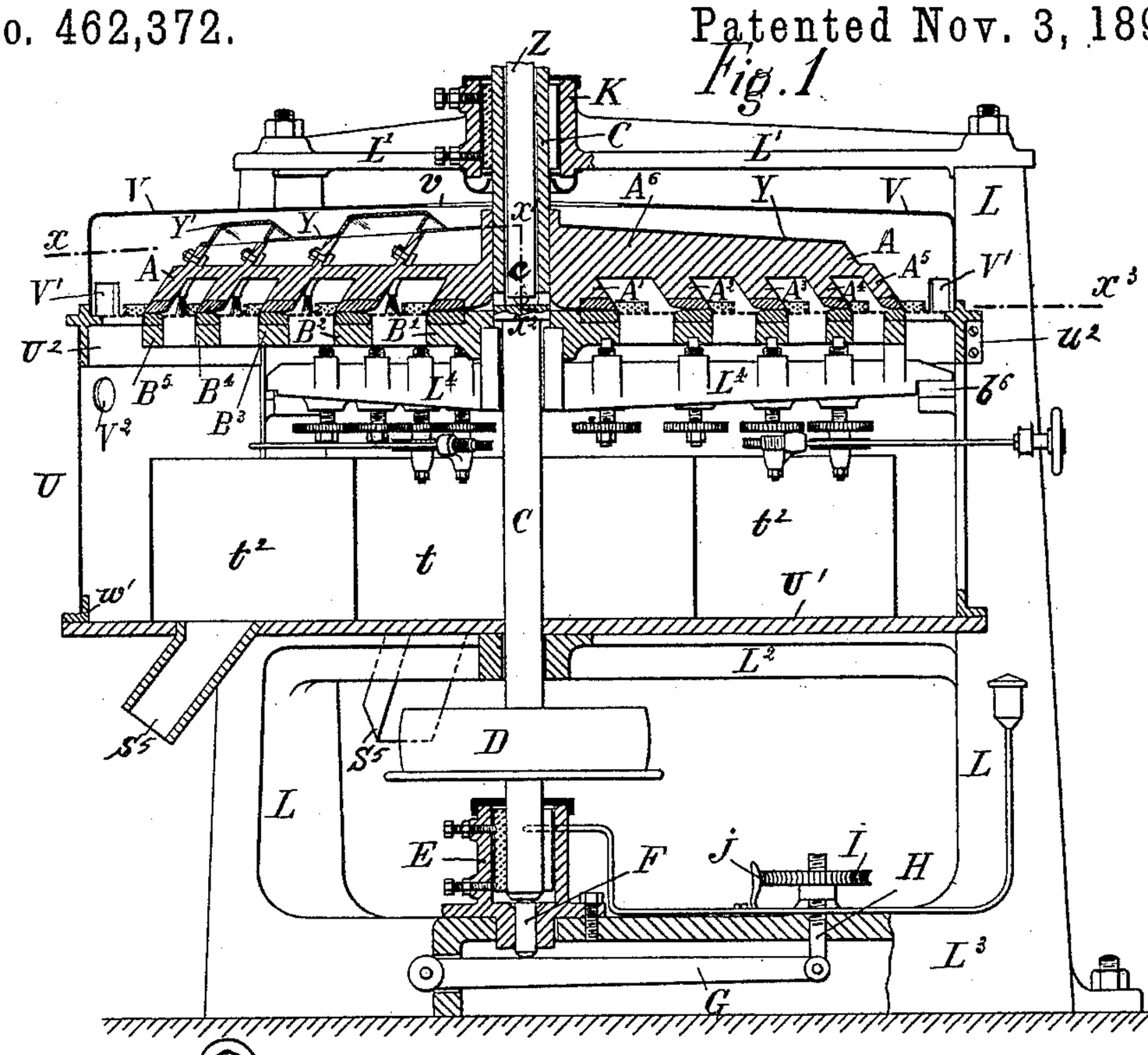
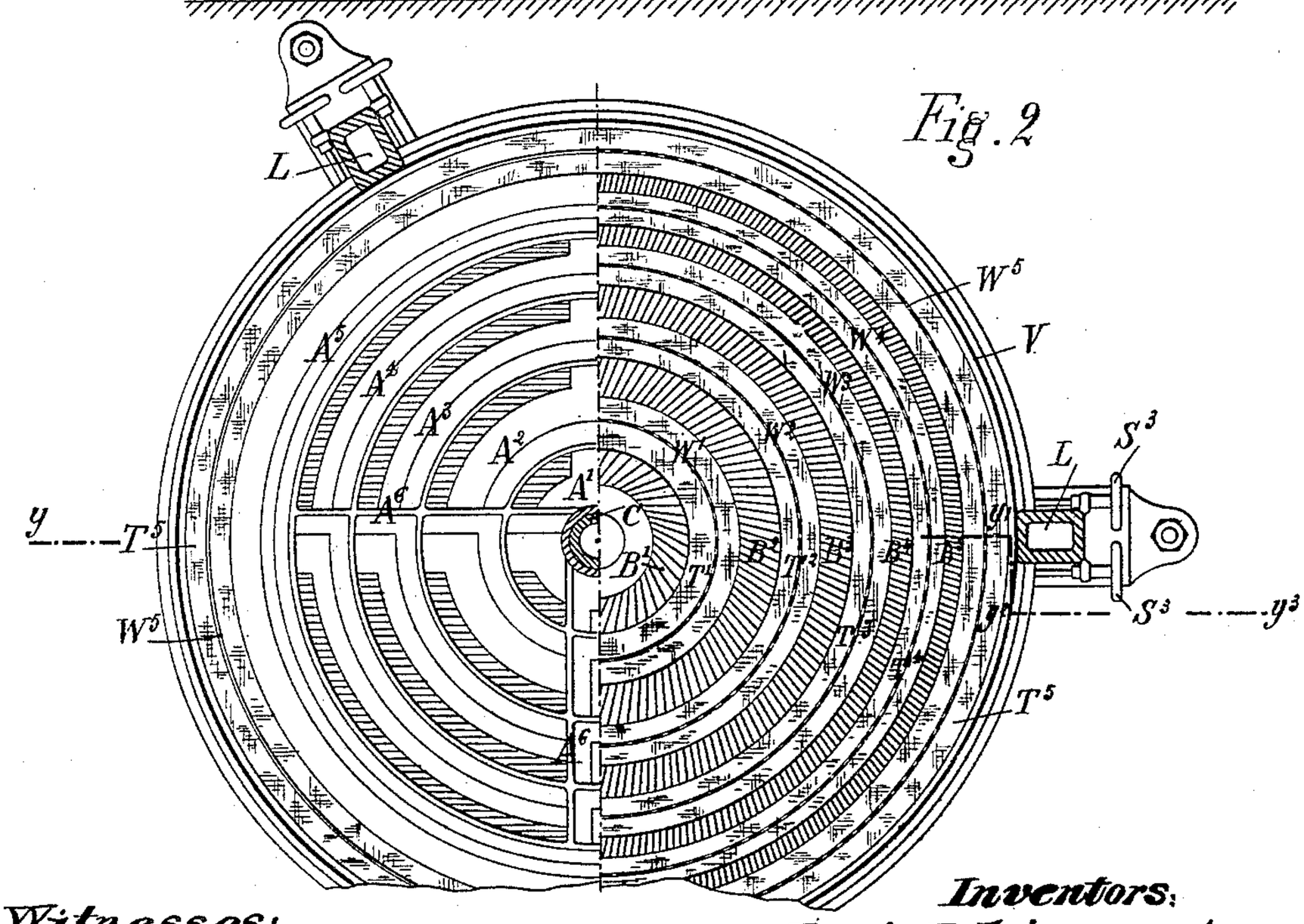


Fig. 2



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3

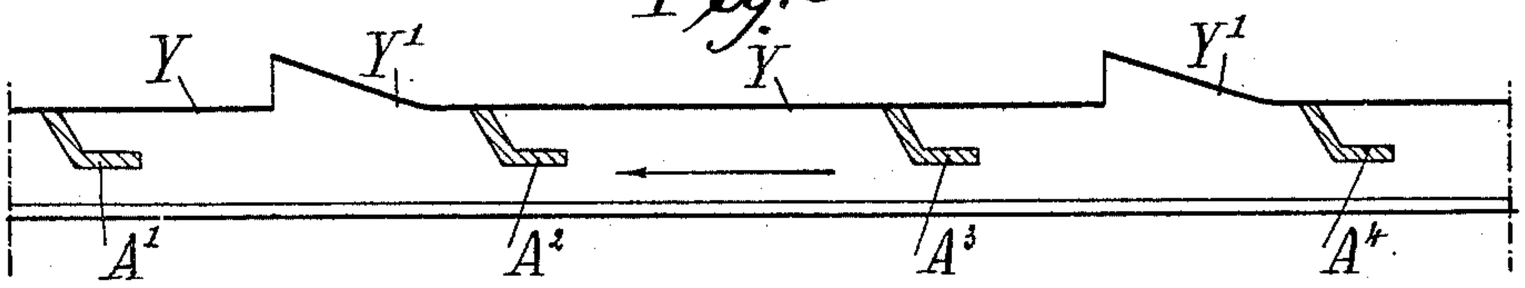

Fig. 4

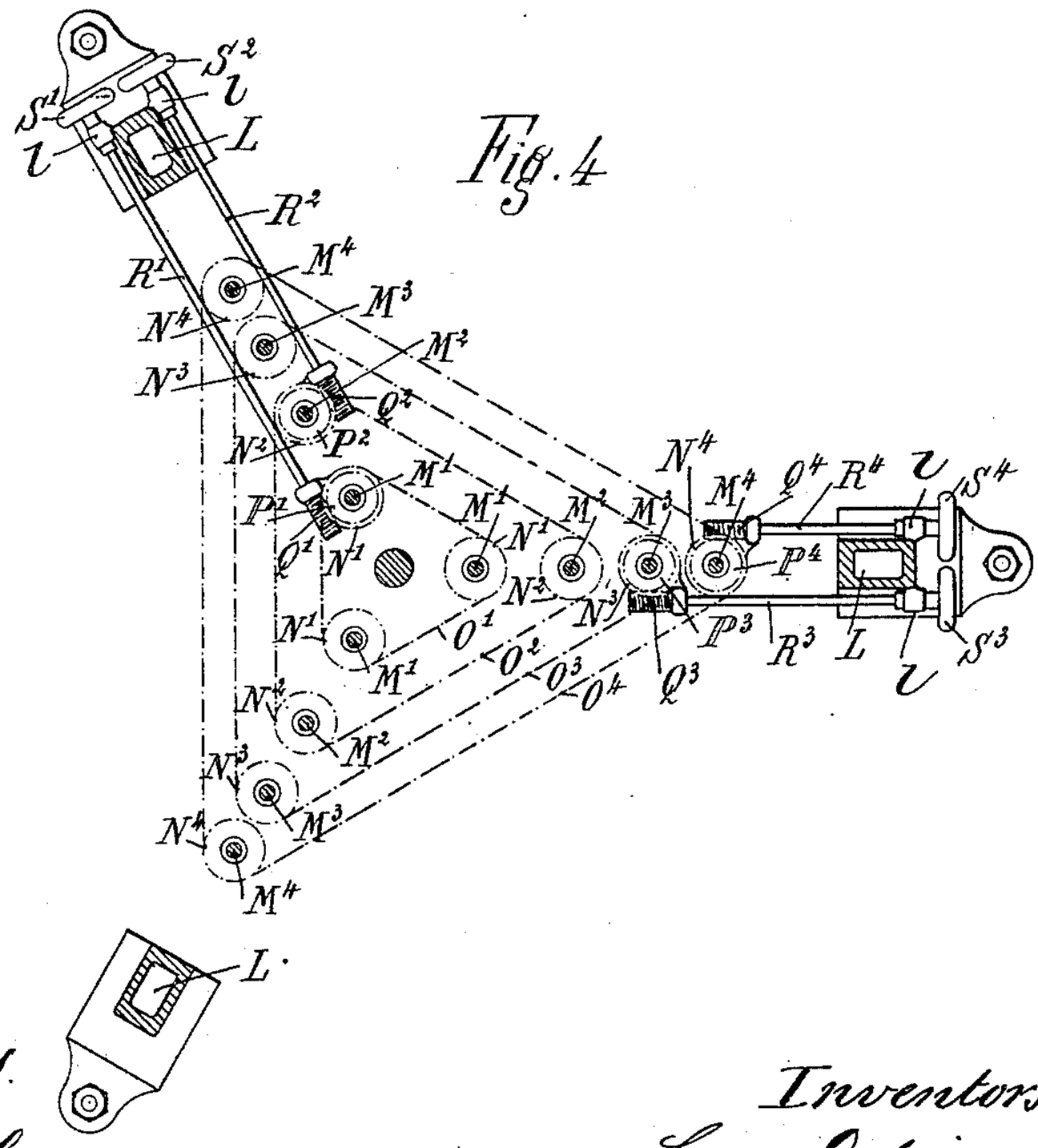

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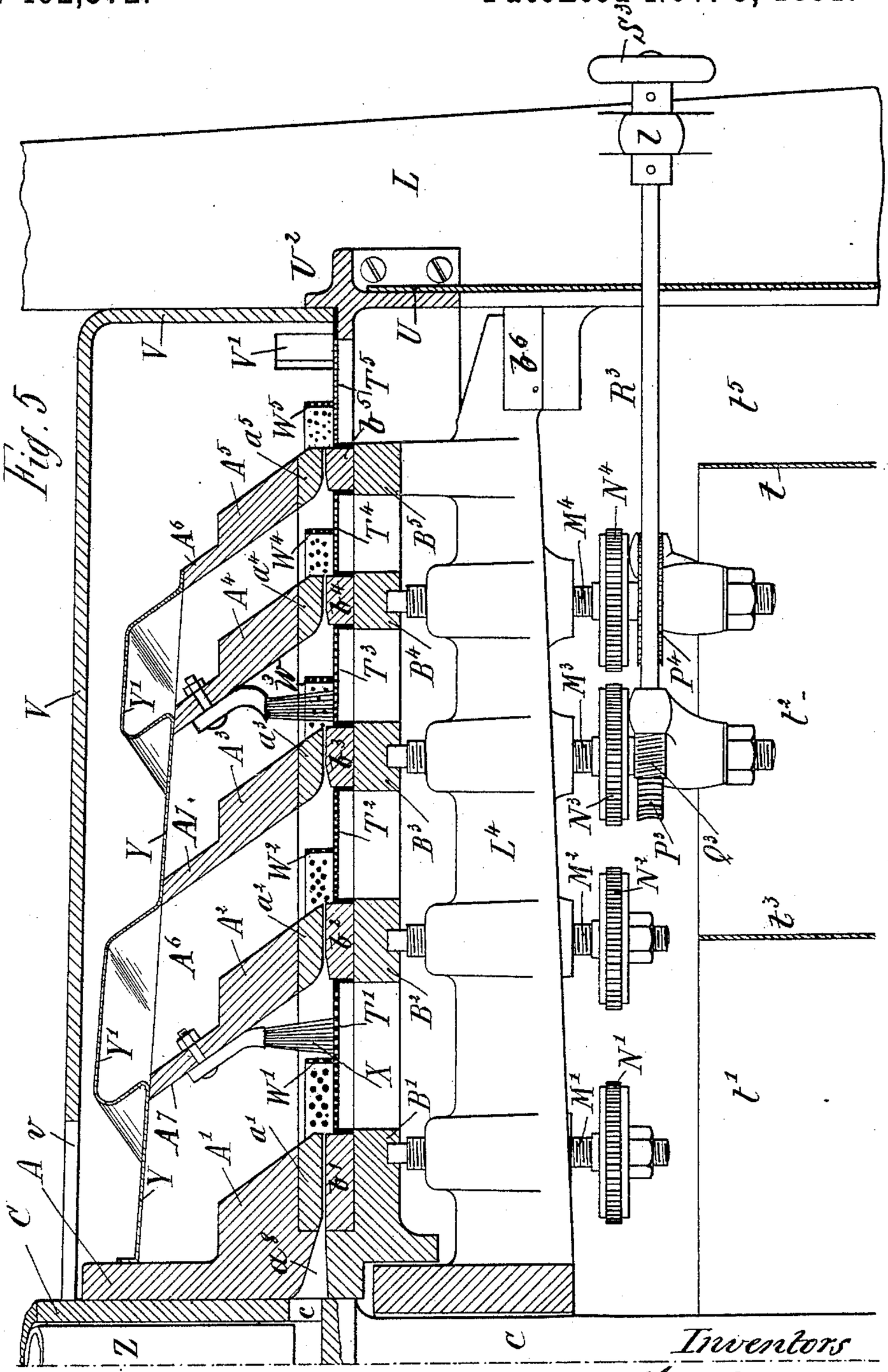
Fig. 5



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UNITED STATES PATENT OFFICE.

LOUIS DOLOIRE AND CHARLES GOLAY, OF PARIS, FRANCE.

MILL.

SPECIFICATION forming part of Letters Patent No. 462,372, dated November 3, 1891.

Application filed January 29, 1891. Serial No. 379,546. (No model.) Patented in France June 30, 1890, No. 206,702.

To all whom it may concern:

Be it known that we, LOUIS DOLOIRE, a citizen of the Republic of France, and CHARLES GOLAY, a citizen of the Republic of Switzerland, engineers, both residents of Paris, in the Republic of France, have invented certain new and useful Improvements in Mills, (for which we have obtained Letters Patent in France, No. 206,702, dated June 30, 1890;) and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

The invention relates to grinding-mills, and more especially to those mills designed for grinding cereals into flour or meal, and has for its object to simplify the construction of such mills by combining in one and the same machine a series of grinding and bolting or separating and purifying devices, so that at one operation cereals may be ground into flour of the desired degree of fineness and the resulting by-products separated and collected separately. In this manner we are enabled to dispense with a plurality of separate grinding-mills and separating or bolting and purifying devices. and with the means for transferring the flour to and from said separate grinding devices to and from the separating or bolting and purifying devices, and we are also enabled to effect a great saving in power as well as labor and expenditures in maintenance and repairs.

The invention consists in structural features and in combinations of elements, as will now be fully described, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical axial section on or about on line $y\ y'\ y^2\ y^3$ of a grinding-mill embodying our invention. Fig. 2 is a section thereof, taken on or about on line $x\ x'\ x^2\ x^3$ of Fig. 1. Fig. 3 is a projection of the cover for the revoluble grinding-disk. Fig. 4 is a diagrammatic plan view illustrating the means for independently adjusting each of the stationary grinding-disks relatively to their respective revoluble grinding-disks; and Fig. 5 is a vertical section, drawn to an enlarged scale, of one-half of the co-operating grinding-disks, illustrating a part of the devices for adjusting the stationary grinding-disks relatively to their respective revoluble co-operating grinding-disks.

The operating mechanism is supported from a suitable frame-work, which is preferably of cast-iron and consists of three pillars or standards L, projecting from the outer end of three arms L^3, that radiate from a central bearing forming a spider, which and the pillars L constitute the base and vertical supports of the mill. In the central bearing of the spider is fitted the contracted neck of the axle or bearing-box E for the lower end of the vertical spindle C, which latter is stepped on a cone pin F, that has bearing on a lever G. The lever is fulcrumed to one of the radial arms L^3, and to the free end of said lever is pivoted a screw-threaded adjusting-bolt H, that extends vertically through a bearing-sleeve *h* on one of the other radial arms of the spider and carries a hand-wheel I, the hub of which is screw-threaded interiorly. The wheel has a milled or toothed edge, into which takes a spring-pawl *j* for the purpose of locking the said wheel against accidental rotation. It is obvious that when the wheel I is rotated in one or the other direction the lever G is either depressed or elevated, thereby lowering or elevating the spindle C, for purposes presently to be explained. The spindle C is centered by means of centering-screws *s*, that have bearing upon a bearing-sleeve *s'*, and said spindle carries a belt-pulley D, belted to any suitable motor. Each pillar L has an arm L^2 radiating from a central bearing, through which the spindle passes, said arms L^2 serving as a support for an inclosing casing or housing and for the collectors.

The inclosing casing is constructed as follows: U' is the bottom or base plate, to which is secured a flanged ring *u'*, that serves as a seat for and to which is secured the foot or lower edge of the cylindrical sheet-metal housing U. The upper edge of the cylindrical sheet-metal housing is secured to a ring U^2, that in cross-section has the form of a cross, the upper vertical and inner horizontal arms of which serve as a seat for a removable sheet-metal cover V, said ring U^2 being provided with bolt-flanges u^2, by means of which

and suitable bolts it is firmly bolted to the pillars L, as shown on the right of the machine in Figs. 1 and 3.

In the cover V is formed a central aperture *v* of sufficient size to admit free ingress and egress of air for purposes presently explained. The sheet-metal inclosing cylinder is constructed in sections, two or more of which are detachably connected with their supporting-rings for the purpose of gaining access to the interior of the housing below the grinding devices and to the collectors, or the said sheet-metal inclosing wall may be provided with suitable man-holes or doors. The collectors *t' t²* are formed of concentric sheet-metal cylinders arranged below the grinding and bolting devices upon the bottom of the housing, and in said bottom are formed suitable discharge-spouts S^5, of which there is one for each collector, for the discharge of the contents thereof.

The upper end of the spindle C is hollow or tubular and of increased cross-sectional area and has its bearing in a box K, from which radiate three arms L', that are bolted to the upper ends of the pillars L, means for centering the spindle at its upper end, similar to those for centering its lower end, being provided, as shown in Fig. 1. At the lower end of the tubular portion of the spindle, Fig. 1, ports *c* are formed for conducting the grain to the grinding devices, said grain being fed into said tubular portion through the medium of a feed-duct Z.

The stationary grinding devices consist of a plurality of independent concentric grinding disks or rings, of which five are shown in the drawings, as at B', B^2, B^3, B^4, and B^5; but we do not desire to limit ourselves to this number. The central disk B' has an axial opening for the passage of the spindle C and for the reception of the hub of a spider having three radial arms L^4, that serve as supports for the independent concentric grinding-disks and the means for adjusting said disks independently, as will be hereinafter more fully described. These concentric grinding-disks B', &c., are of such relative diameters or dimensions as to leave a suitable space between each two disks and between the outer disk and the vertical wall of the housing, and they are armed with a steel grinding-face, (indicated in Fig. 3 by the corresponding lower-case letters *b'* to b^5, respectively.) These steel grinding-faces *b' b²*, &c., are detachably secured to the disk B' and rings B^2, &c., so that they may be readily removed when neccessary. The steel facings may have any desired or suitable dress, and, as shown, are of less diameter than the disk B' and rings B^2, &c., so that there is an annular seat formed around the steel facing of the central disk B' and a like seat on opposite sides of the steel facings of the rings B^2 B^3, &c., upon which seats are seated the separating or screening or bolting frames T', T^2, T^3, T^4, and T^5, the outer bolting-frame being seated on the ring B^5 and on the inner horizontal flange of the ring U^2 of the housing, in whose vertical wall is formed an aperture or apertures V', (see Figs. 1 and 5,) normally closed by a valve or gate, for the discharge of the tailings. As shown in Figs. 1 and 5, the screening or bolting frames are so arranged that their screening or bolting faces are on a level with or but slightly below the grinding-faces, so that the material will readily pass from one set of disks or rings to the other. The space between the grinding-disk and the rings B' B^2, &c., in which are arranged the separating or bolting screens T' T^2, &c., as shown more plainly in Fig. 5, is divided by an annular vertical perforated partition (indicated by W', W^2, W^3, W^4, and W^5, respectively) into two annular separating or bolting chambers. The size of the perforations in or the mesh of the annular partitions relatively to the perforations in or the mesh of the screens or bolts are such as to allow the coarser stuff that will not pass through the screens or bolts to pass freely through the meshes or perforations of the partitions which are employed to retard the passage of the coarser material from one pair of grinding-rings to the other, so that the material may be thoroughly screened or bolted before such passage from one pair of grinding-rings to the other. The dress of the grinding devices and the mesh of the screens or bolts is preferably such as to gradually increase in fineness from the inner to the outer sets of grinding devices, and, as shown in Fig. 6, for purposes well understood.

The disk or ring B' and the rings B^2 B^3 B^4 B^5 are provided in their under face with sockets for the reception of the unthreaded upper ends of adjusting-screws M', M^2, M^3, and M^4, that work in interiorly-threaded bearings formed in the three radial arms L^4 of the spider, hereinbefore referred to, so that each of said rings is supported by three adjusting-screws, except the outer ring B^5, which is supported directly from the arms L^4, whose outer ends have bearing on a bracket b^6, projecting from each of the pillars L, thus providing a firm bearing for said arms and a like support for the stationary grinding-rings. These rings, as heretofore stated, with the exception of the outer ring B^5, are adjustable vertically by means of the sets of four screws M', M^2, M^3, and M^4 in the following manner, and as more plainly shown in Fig. 4: To each of the screws is keyed a sprocket-wheel, (indicated by N', N^2, N^3, and N^4,) and the sprocket-wheels of a set of three screws supporting a grinding-ring are connected by an endless chain, (indicated by O', O^2, O^3, and O^4, respectively.) Furthermore, one screw of each set of three screws has keyed thereto below its sprocket-wheel a worm-wheel, (indicated by P' P^2 P^3 P^4.) On opposite sides of two of the pillars L is formed a bearing *l* for an actuating-rod, the set of four rods being indicated by R', R^2, R^3, and R^4, each of which rods has an endless screw-thread, (indicated, respectively, by Q' Q^2

Q^3 Q^4,) that meshes with its respective worm-wheel P′, P^2, P^3, and P^4. By means of the described arrangement of the adjusting mechanism the attendant has the same well under his control, as he can manipulate the actuating-rods for two of the grinding-rings separately or simultaneously, each of said rods carrying a hand-wheel, (indicated by S′, S^2, S^3, and S^4, respectively.) It is evident that if, for instance, the hand-wheels S′ S^2 are revolved in the proper direction, thereby revolving the rods R′ and R^2, and through the same the worm-wheels P′ and P^2, the three screws M′, that support the grinding disk or ring B′, and the three screws M^2, that support the grinding-disk B^2, will be simultaneously revolved, inasmuch as they are connected together by means of their sprocket-wheels N′ and chain O′ and the sprocket-wheels N^2 and chain O^2, respectively, so that said rings will either be lowered or elevated, according to the direction of rotation of the hand-wheels S′ and S^2. In a similar manner the rings B^3 and B^4 may be adjusted by manipulation of the hand-wheels S^3 and S^4. The outer ring B^5 is not adjustable vertically, its position relatively to its co-operative revoluble ring being effected by adjusting the spindle D by means of the hand-wheel I and screw H, as hereinabove described, the revoluble grinding-rings being keyed to said spindle, as will now be described.

The revoluble grinding devices consist of a disk A, that has concentric outwardly-inclined annular ribs A′, A^2, A^3, A^4, and A^5, each faced with a steel grinding-ring a', a^2, a^3, a^4, and a^5, respectively, that co-operate with the like stationary steel rings b', b^2, b^3, b^4, and b^5, respectively, (see Fig. 5,) and, as more plainly shown in said Fig. 5, the said annular outwardly-inclined ribs are of gradually-increasing height from the outer to the inner one, thus forming a cone that imparts great strength to said disk. As shown at A^7, Fig. 5, a portion of the annular ribs A′ A^2, &c., from their upper edge downward is of reduced thickness for the purpose of reducing the weight of the disk A, and are interrupted by radial webs A^6, which are of about the same thickness as the reduced upper portion of the annular ribs. (See Fig. 2.) The radial webs A^6 divide the spaces between the annular ribs into segmental open-ended chambers of a width equal to the space between the concentric stationary grinding-rings B′ b' B^2 b^2, &c., thus providing a series of air-chambers for each set of grinding devices to prevent overheating and for the purpose of supplying air to the separators or bolts to prevent the ground material from becoming heated. The disk A has a suitable hub, that is keyed to the upper enlarged or feed end of the spindle D and has its lower inner edge beveled off to form with the lower stationary grinding disk or ring B′ a substantially wedge-shaped feed-passage d^8, in register with the ports c in the tubular portion of the spindle. In order to facilitate the passage of the ground material from the several screens to and between the grinding-rings the inner edges of both sets of rings are slightly beveled or rounded to form a wedge-shaped passage, as more plainly shown in Fig. 5, and the revoluble grinding-rings, like the stationary rings, have their grinding-faces suitably dressed and are detachably secured to the annular ribs for obvious purposes.

The disk A is closed at top by a sheet-metal cover Y, which is provided with inclined air-ducts Y′, and there is one such duct for each radial chamber, the opening or air-intake of said ducts being in the direction of rotation of the disk A, as more plainly shown in the projection, Fig. 3. As shown, the air-ducts incline in the direction opposite to the direction of rotation of the disk A, thereby directing the air taken in downwardly into the screening or bolting chambers and through the bolts, effectually cooling the grinding devices and the ground material.

As heretofore stated, the cover V for the housing has a comparatively large central opening, and as the disk A revolves the air is drawn in through the opening v by the centrifugal action of the disk, said air rushing into the raised inclined air-ducts, and thence into the radial chambers to the grinding-rings, and thence to and through the screens and through an opening or openings V^2, Fig. 1, in the housing U, a circulation of air being thus established that will keep both grinding devices and the ground material perfectly cool, which is of great importance in machines of this class.

In Figs. 1 and 5 we have shown three concentric collectors formed by the vertical walls U of the housing and by the concentric partitions t t^3, thus providing three collectors—the one t' for the coarser or black flour from the screen T′, the collector t^2 for the middlings or flour from the screens T^2 and T^3, and the collector for the flour from screen T^5; but, if desired, a separate collector may be provided for each screen T^2 T^3, as will be readily understood.

We have hereinbefore stated that by preference the dress of the stationary grinding-rings increases in fineness from the inner to the outer ring. When this is the case, the dress of the revoluble rings is made to correspond with that of the said stationary rings. The perforations or the mesh of the screens or bolts and that of the vertical partitions also increase in fineness from the inner to the outer ones; but, as stated, the perforations or mesh of said vertical partitions are coarser than the perforations or mesh of the screen to which it is connected. By providing a central feed, arranged as described, the grain is not subjected to centrifugal action and forcibly carried to the grinding devices, but said grain is fed to the inner pair of grinding-rings by gravity only, thereby preventing an overfeed of grain. Under the in-

fluence of the centrifugal action the motion of the partially-ground as well as the ground material increases as said materials pass outwardly from one pair of grinding-rings to another, which motion, if unchecked, would not only result in an overfeed, but would materially interfere with the screening or bolting; but this is effectually avoided by the use of the vertical foraminous partitions W′ to W⁵.

The separating, screening, or bolting of the material may be accelerated by the use of a brush X, whose holder is secured to the annular ribs A′, &c., said brush being arranged to trail over the screens T′ to T⁴ in one or more of the annular compartments thereof, as shown in Fig. 5, and one or more of such brushes may be used for each of said compartments.

Although the means we have devised for independently adjusting the stationary grinding-rings B′ B² B³ B⁴ relatively to their co-operating revoluble grinding-rings are very simple and effective, we do not desire to limit ourselves thereto, as other means well known to mechanics may be employed for this purpose; and although we have described our invention as applied to mills for grinding cereals, we do not desire to limit ourselves to this application, as it is apparent that other materials may be reduced or ground and screened or bolted.

Having thus described our invention, what we claim is—

1. In a grinding-mill, the combination, with a number of stationary concentric grinding-rings, a corresponding number of co-operating revoluble grinding-rings, and screens interposed between each two sets of such rings on or about on a level with the grinding-faces of the lower rings, of circular foraminous partitions dividing each of the spaces between two compartments, for the purpose set forth.

2. In a grinding-mill, the combination, with a number of concentric revoluble grinding-rings, a corresponding number of like stationary grinding-rings of such relative diameter as to leave a space between each pair of such, and means for allowing the material to move across said space from one pair of rings to the other, of an adjusting mechanism for separately adjusting all of the stationary rings, excepting one, relatively to their co-operating revoluble rings, and an adjusting mechanism for simultaneously adjusting the revoluble rings relatively to said stationary rings, for the purpose set forth.

3. In a grinding-mill, the combination, with the lower grinder composed of a series of independent concentric grinding-rings constructed of metal and of such relative diameter as to leave an unbroken annular space between each two rings and an annular screen in each of said spaces on a level with the grinding-surfaces, of a metallic revoluble grinding-disk having a corresponding number of concentric circular grinding-ribs adapted to co-operate with said stationary rings and having radial webs connecting the circular ribs and dividing the interspaces into segmental passages or chambers, a cover for said disk, provided with an air-duct for each of the segmental chambers, said air-ducts having their intake in the direction of rotation of the grinding-disk, and an inclosing casing provided with an air-inlet in its roof, for the purpose set forth.

4. In a grinding-mill, the combination, with the lower stationary grinder consisting of a series of independent metallic concentric grinding-rings of such relative diameter as to leave an unbroken annular space between each two disks or rings and an annular screen arranged in each of said spaces on a level with the grinding-surfaces, of a revoluble grinding-disk having a corresponding number of concentric circular grinding-ribs adapted to co-operate with said stationary grinding-rings, radial webs connecting the ribs and dividing the interspaces into segmental passages or chambers, a cover secured to said disk and provided with an air-duct for each of said segmental chambers, said air-ducts having their intake in the direction of rotation of the disk and inclining downwardly in a reverse direction, and an inclosing casing provided with an air-inlet in its roof, for the purpose set forth.

5. In a grinding-mill, the combination, with the upper revoluble and lower stationary grinders, each composed of a series of circular concentric grinding-rings of such relative diameter as to have an unbroken annular space between each pair of rings, a screen between each two stationary rings on or about on a level with the grinding-surfaces, and a like screen encompassing the outer lower grinding-ring, of a housing for the grinders, provided with an opening or openings for the discharge of the material too coarse to pass through the outermost screen, and concentric chambers arranged in the housing below the screens for the reception of the screened material, for the purpose set forth.

6. In a grinding-mill, the combination, with the upper revoluble and lower stationary grinders, each composed of a series of concentrically-arranged grinding-rings having an unbroken grinding-surface, an unbroken annular screen arranged between each two rings, and a like screen encompassing the outer one of said rings, said screens being arranged on or about on a level with the grinding-surfaces, of a housing encompassing the grinders and provided with peripheral discharge-ports leading to the outer screen, concentrically-arranged collectors within the housing below the screens, and a central feed for feeding the material to the inner set of grinding-rings, for the purpose set forth.

7. In a grinding-mill, the combination, with a series of concentric co-operating sets of grinding devices, the dress of which gradually increases in fineness from the inner to

the outer set, and a central feed for feeding the material to the inner set, of a screen interposed between each two sets of grinding devices, the mesh of which screens increases in fineness from the inner to the outer one, for the purpose set forth.

8. In a grinding-mill, the combination, with a series of concentric co-operating sets of grinding devices, the dress of which gradually increases in fineness from the inner to the outer set, and a central feed for feeding the material to the inner set, of a screen interposed between each two sets of grinding devices, the mesh of which screens increases in fineness from the inner to the outer one, and concentric collectors arranged below the grinding devices for collecting the screened material, for the purpose set forth.

9. In a grinding-mill, the combination, with a number of concentric co-operating sets of grinding devices and a screen or bolt interposed between each two sets of such devices, of circular foraminous partitions dividing each of the spaces between said sets of grinding devices above the screens or bolts into two compartments, and a traveling brush for and trailing upon the screen or bolt for each of said compartments, for the purpose set forth.

10. In a grinding-mill, the combination, with a series of concentric co-operating sets of grinding devices, the dress of which gradually increases in fineness from the inner to the outer set, and a central feed for feeding the material to the inner set, of a screen interposed between each two sets of grinding devices, the mesh of said screens increasing in fineness from the inner to the outer one, and a foraminous partition dividing the space between the several sets of grinding devices above the screens into two compartments, the mesh of said partitions increasing in fineness from the inner to the outer one, but being coarser than the mesh of their respective screens, for the purpose set forth.

11. In a grinding-mill, the combination, with a number of sets of concentric co-operating grinding devices and a screen or bolt interposed between each two sets, of vertical foraminous partitions dividing each of the spaces between said sets of grinding devices above the screens or bolts into two compartments, said partitions having a coarser mesh than their respective screens or bolts, for the purpose set forth.

12. In a grinding-mill, the combination, with independent stationary concentric grinding disks or rings, each of which is provided with a number of sockets in the under side, of a spider having a corresponding number of radial arms provided with interiorly-threaded bearings, adjusting-screws extending into said sockets and working in said bearings, a sprocket-wheel on each of said screws, an endless chain connecting the sprocket-wheels of the screws of each grinding disk or ring into a series, a worm-wheel on one of the screws of each series, and a worm-spindle for revolving said worm, for the purpose set forth.

13. In a grinding-mill, the combination, with a set of concentric grinding disks or rings composed of an outer stationary disk or ring and a plurality of independent vertically-adjustable concentric disks or rings, of a revoluble and vertically-adjustable grinding-disk provided with concentric grinding-faces adapted to co-operate with said stationary and independent vertically-adjustable disks or rings, for the purpose set forth.

14. In a grinding-mill, the combination, with a set of concentric grinding disks or rings composed of an outer stationary disk or ring and a plurality of independent vertically-adjustable concentric disks or rings, of a vertically-adjustable spindle and centering devices for centering said spindle, and a disk rigidly secured to the spindle and provided with concentric grinding-faces adapted to co-operate with said stationary and independent grinding disks or rings, for the purpose set forth.

In witness whereof we have hereunto set our hands in the presence of two subscribing witnesses.

LOUIS DOLOIRE.
CHARLES GOLAY.

Witnesses:
LUCIEN DURIEUX,
VITAL DEROUARD.