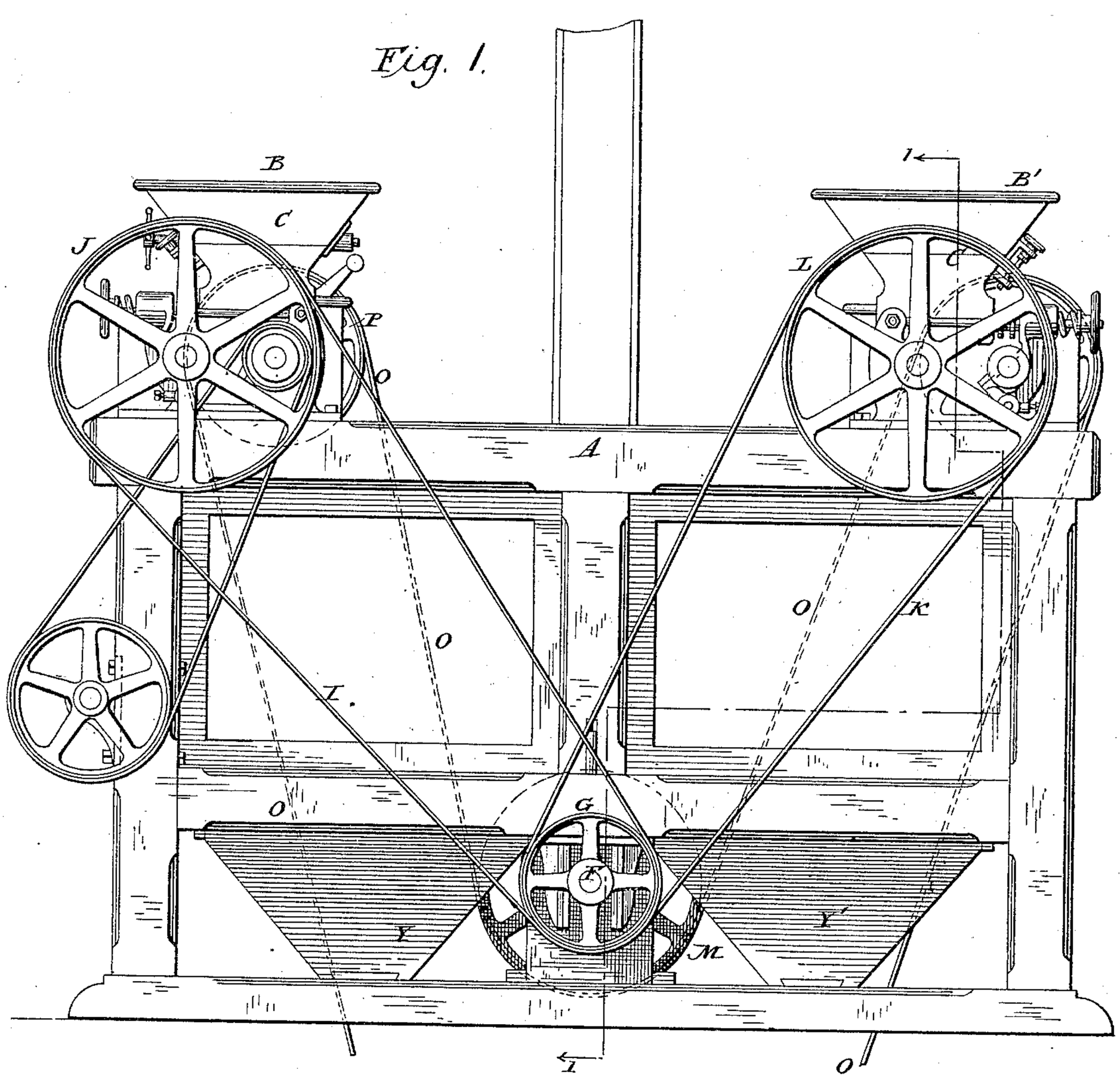
(No Model.) 5 Sheets—Sheet 1.

W. D. GRAY.

APPARATUS FOR THE GRADUAL REDUCTION OF GRAIN.

No. 271,331. Patented Jan. 30, 1883.

Fig. 1.



Attest.

Sidney P. Hollingsworth

Harry Shipley

Inventor.

William D. Gray.

By his attorney

Philip T. Dodge

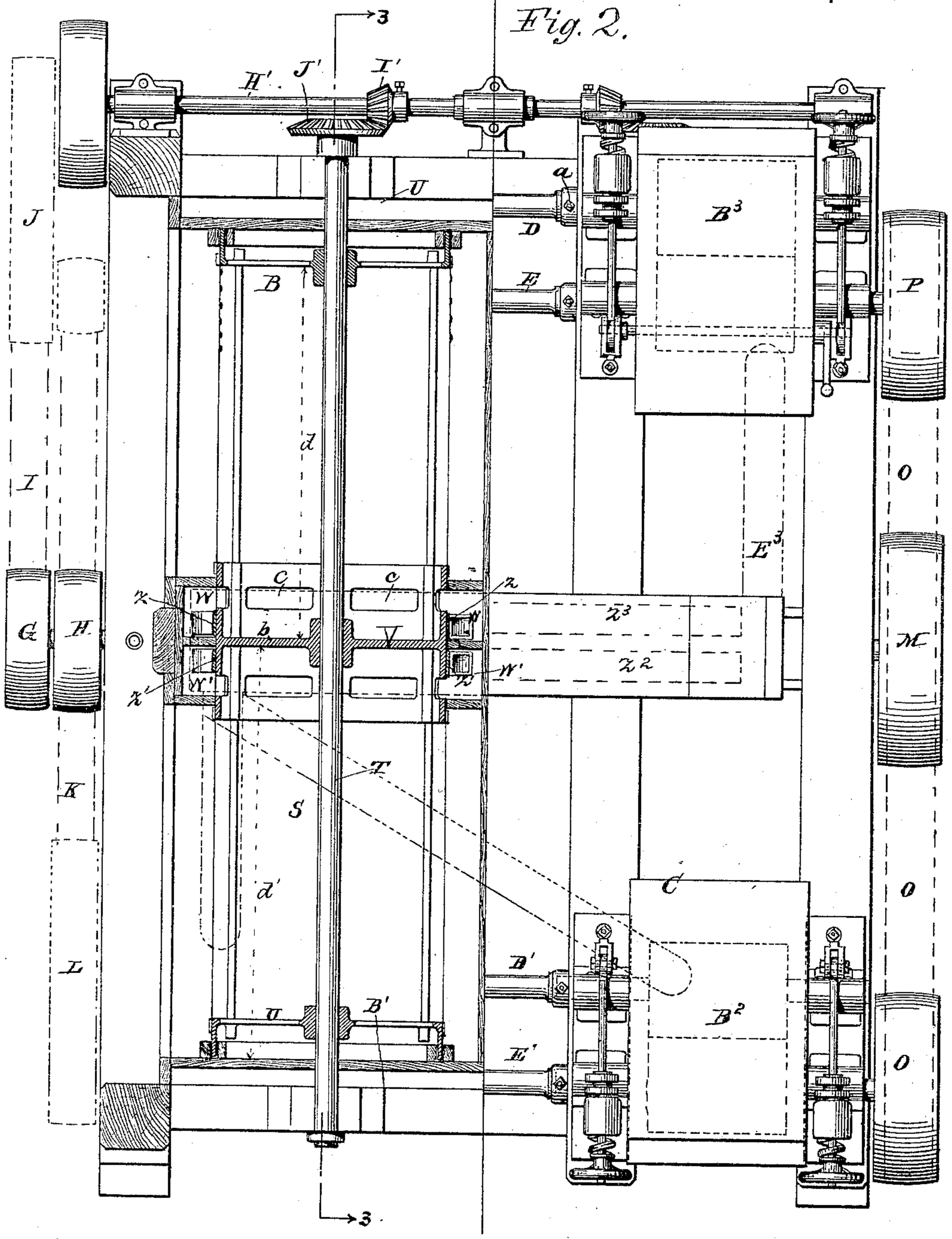
(No Model.) 5 Sheets—Sheet 2

W. D. GRAY.

APPARATUS FOR THE GRADUAL REDUCTION OF GRAIN.

No. 271,331. Patented Jan. 30, 1883.

Fig. 2.



Attest.

Sidney P. Hollingsworth

William H. Shipley

Inventor.

William D. Gray

By his attorney

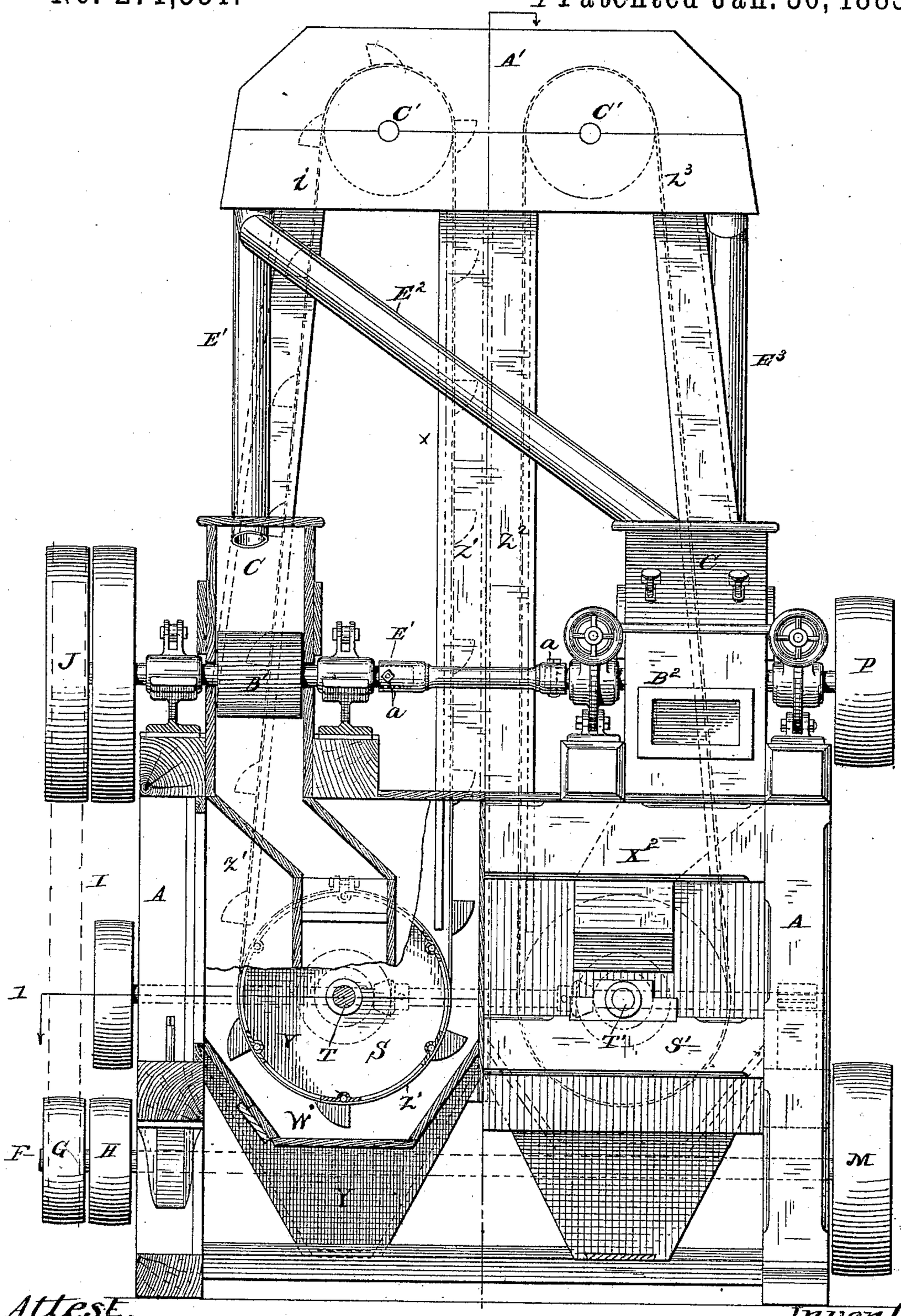
Philip T. Dodge.

(No Model.) 5 Sheets—Sheet 3.

W. D. GRAY.

APPARATUS FOR THE GRADUAL REDUCTION OF GRAIN.

No. 271,331. Patented Jan. 30, 1883.



Attest.

Sidney P. Hollingsworth

William H. Shipley

Inventor.

William D. Gray

By his attorney.

Philip F. Dodge.

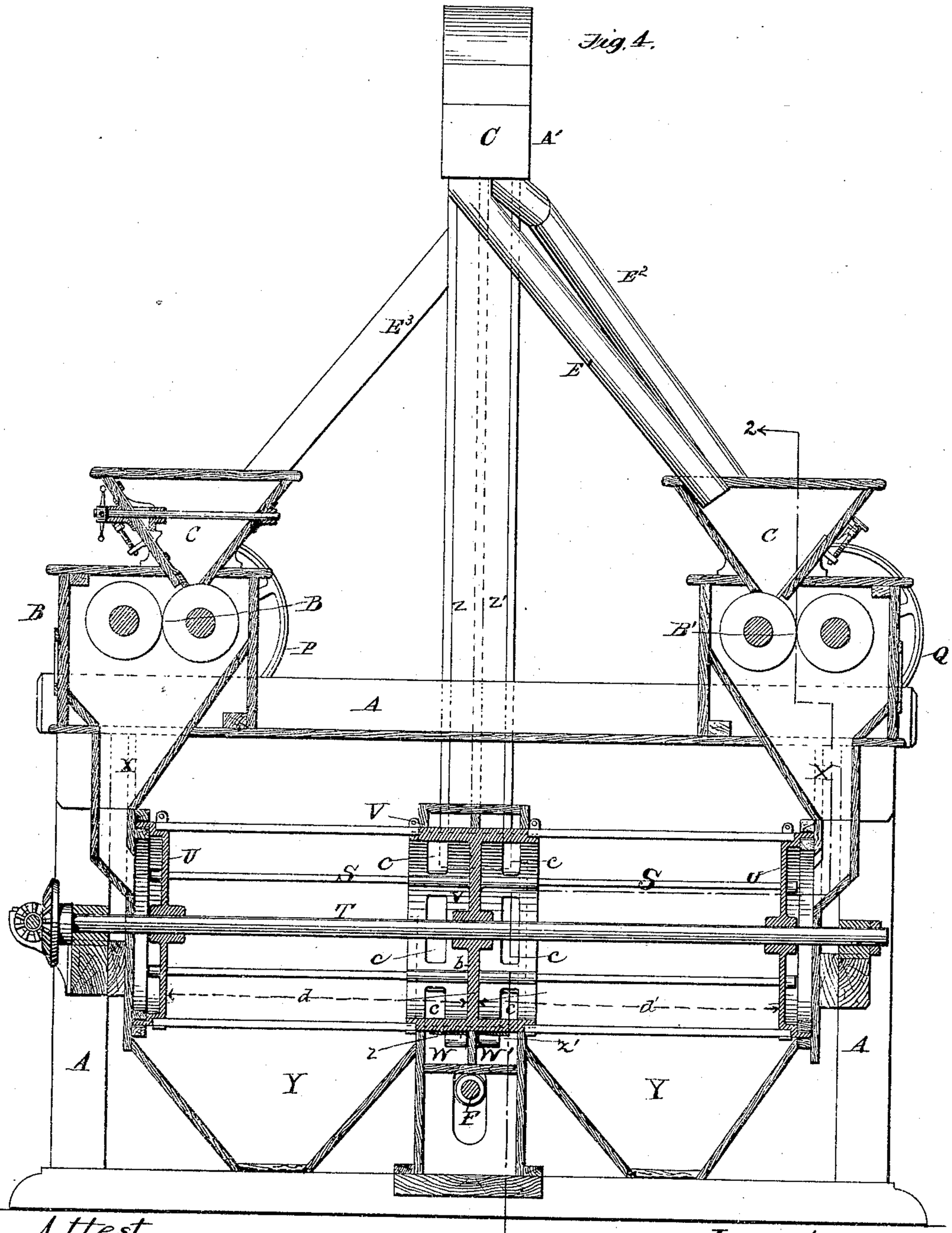
(No Model.) 5 Sheets—Sheet 4.

W. D. GRAY.

APPARATUS FOR THE GRADUAL REDUCTION OF GRAIN.

No. 271,331. Patented Jan. 30, 1883.

Fig. 4.



Attest

Sidney P. Hollingsworth

William H. Shipley

Inventor.

William D. Gray.

By his attorney

Philip T. Dodge.

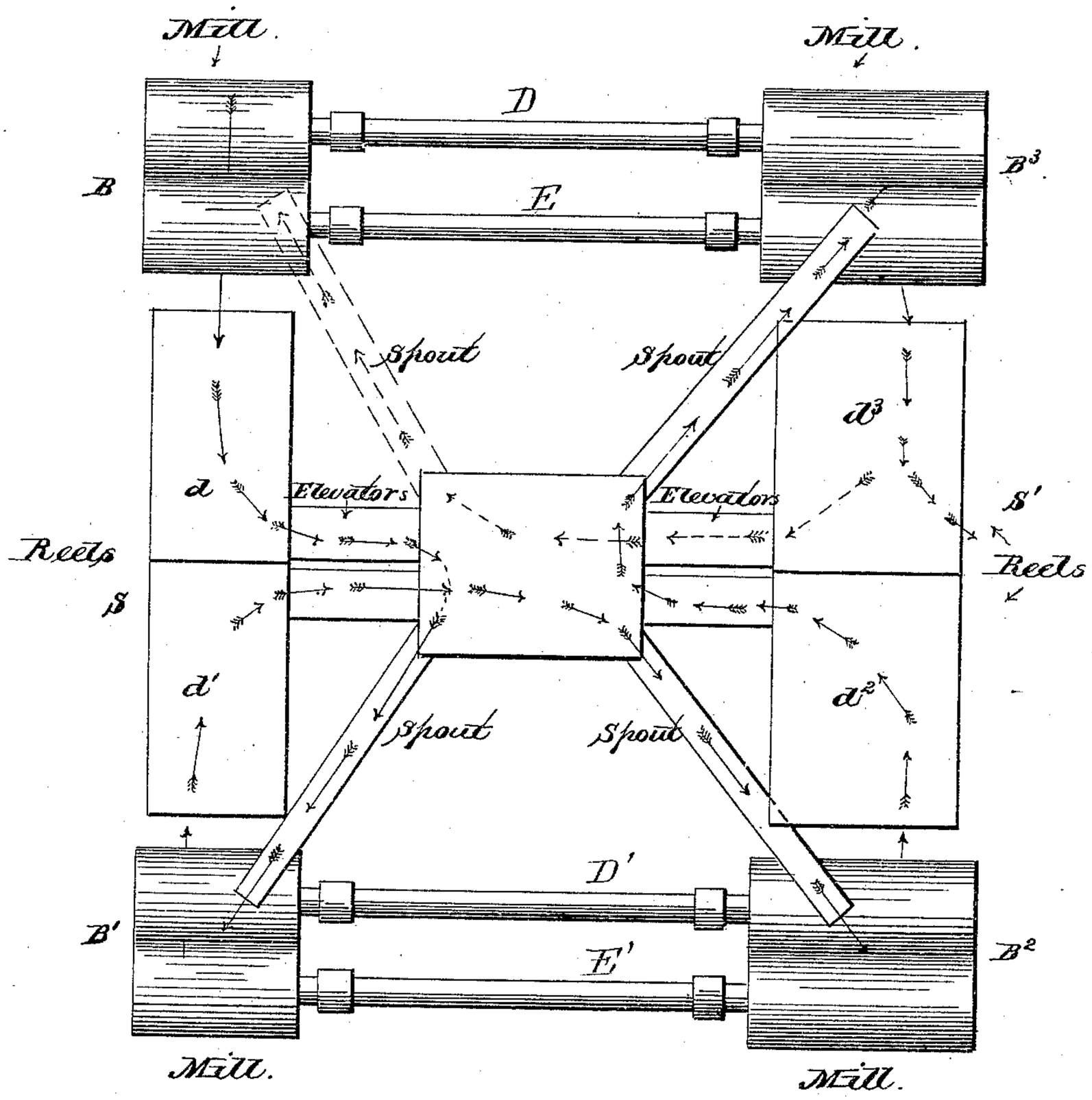
(No Model.) 5 Sheets—Sheet 5.

W. D. GRAY.

APPARATUS FOR THE GRADUAL REDUCTION OF GRAIN.

No. 271,331. Patented Jan. 30, 1883.

Fig. 5.



WITNESSES:

W. H. Knight

William H. Shipley

INVENTOR

William D. Gray

By Philip T. Dodge

Attorney

UNITED STATES PATENT OFFICE.

WILLIAM D. GRAY, OF MILWAUKEE, WISCONSIN.

APPARATUS FOR THE GRADUAL REDUCTION OF GRAIN.

SPECIFICATION forming part of Letters Patent No. 271,331, dated January 30, 1883.

Application filed July 29, 1882. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. GRAY, of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain Improvements in Apparatus for the Gradual Reduction of Grain, of which the following is a specification.

This invention relates to an organization of mechanisms for automatically effecting the production of flour from grain by what is commonly known in the art as the system of "gradual reduction," which consists essentially in gradually reducing the grain by subjecting the same repeatedly to the action of grinding or crushing rolls with intermediate treatments to effect the removal of the fine flour between each reduction and the next. Various machines have, I am aware, been devised for this purpose.

The object of my invention is to produce a machine which shall be more simple and reliable in action than those which have preceded it, which shall occupy less space, and which shall admit of the reductions and separations being varied in number and arrangement, as circumstances may require.

To this end it consists in the combination of several pairs of grinding-rolls combined with intermediate screens, elevators, and conductors, as hereinafter described, and in many features and combinations, which will be hereinafter detailed.

My machine embraces in its construction, first, a rectangular main frame, upon the respective corners of which four roller-mills are located, the mills being coupled together in pairs, so that the motion imparted to two of them will be transmitted therefrom to the other two. In the base of the frame beneath the mills there are two longitudinal cylindrical screens or bolts divided transversely at the center, so that each constitutes in effect two independent bolts. In this manner four bolts are produced—one to receive the products from each of the roller-mills. From the bolts the material is delivered into receptacles from which endless elevators, driven preferably by the belts, convey the material from the respective screens into an elevator chamber or hopper, whence it is delivered through conductor-pipes to the respective rolls. The arrangement is such that the grain introduced into one mill is passed through the same and bolted to separate the fine material, after which the coarse material is elevated and delivered into the next mill, to be again bolted, and so on repeatedly throughout the series, the coarse material being subjected to the action of all the mills or rolls in succession with a removal of the fine material by the screen between each reduction and the next.

Referring to the accompanying drawings, Figure 1 is a side elevation of the machine. Fig. 2 is a top plan view of the same, one side being shown in horizontal section through the center of the reel on the line 1 1, Figs. 1 and 3. Fig. 3 is an end elevation of the machine, one side being shown in vertical section on the line 2 2, Fig. 4. Fig. 4 is a longitudinal vertical section through one side of the machine on the line 3 3, Fig. 2. Fig. 5 is a top plan view, illustrating the relative size and arrangement and the connections between the respective pairs of rolls, each pair being commonly denominated in the art as a "mill."

A represents a rigid rectangular base-frame, designed to sustain the various operative parts of the machine.

B B′ B^2 B^3 represent the four "roller-mills," located upon the respective corners of the main frame. These mills consist each of a pair of horizontal co-operating rolls mounted in suitable bearings and provided with adjusting devices and with a feed-hopper, C, for supplying the material thereto. The rolls and their supporting and adjusting devices may be of any ordinary or suitable construction. Either of the arrangements represented in the various patents hitherto granted to me for roller-mills will answer an excellent purpose.

The mills B and B′ upon one side of the frame are constructed with rolls of a length less than those of the other mills, it being preferred to make them usually of about two-thirds the length of the others. This is for the purpose of giving the last two mills a greater surface, in order to adapt them to act upon and dispose of all the reduced material without driving them at a higher speed than the others. As shown in the drawings, particularly in Fig. 5, the mills B and B^3 at one end of the frame are arranged with their axis in

line, having their rolls coupled together by means of transverse shafts D and E, the ends of which are connected to the journals of the rolls by universal joints, or joints of any suitable construction which will prevent the parts from cramping or binding in the event of the rolls being thrown slightly out of line. A simple connection for this purpose is that represented in the drawings, wherein connecting-shafts are each bored out at the ends to fit over the journals of the rolls and connected to each journal by a single transverse bolt, *a*, the bolt at one end being at right angles to that at the other. It will be seen that under this arrangement motion transmitted to either roll of one mill will be transmitted therefrom, through the connecting-shaft, to the corresponding rolls of the companion mill, being thus caused to drive them, and the two being caused to run at equal speeds. At the opposite end of the machine the mills B′ and B² are arranged in like relation to each other and coupled in like manner by shafts D′ and E′. Motion may be communicated to the mills thus coupled together by any suitable system of driving-belts or driving-gear; but I prefer to make use of the peculiar arrangement represented in the drawings, wherein a transverse counter-shaft, F, located in the base of the machine is provided at one end with two pulleys, G and H, connected, the former by a belt, I, to a driving-pulley, J, attached to one of the rolls of mill B, and the latter connected by a belt, K, to a driving-pulley, L, attached to one of the rolls of mill B′. In this manner motion is communicated from the counter-shaft to one roll of each of the four mills. Motion is communicated to the remaining rolls of the four mills from the counter-shaft on the opposite side of the machine by the arrangement represented in Figs. 1, 2, and 3, the counter-shaft being provided on that side with a pulley, M, from and beneath which a driving-belt, O, is extended upward around the pulleys P and Q, applied, the former to one of the rolls of mill B³ and the latter to one of the rolls of mill B².

By the above system of belting on the two sides of the machine a positive motion is transmitted to the four sets of grinding-rolls.

It is obvious that the same system of belting may be applied entirely to one side of the machine by placing all the driving-pulleys on that side; but for various reasons, the principal one being that a smoother action is obtained, it is preferred to retain the arrangement represented.

Having thus described the arrangement and action of the mills, I will now pass to the bolting or separating mechanism and the means for elevating the tailings and effecting the delivering the coarse material from one mill to another.

Referring to Figs. 2, 3, and 4, it will be seen that there are located in the base of the machine on opposite sides two horizontal or substantially horizontal cylindrical reels, S and S′. These reels are each carried by longitudinal central shafts T and T′, one in each reel. Each reel has its outer end sustained and carried by a skeleton wheel or head, U, mounted upon the central shaft, as shown in Figs. 2 and 4. At the center each reel contains a large supporting pulley or drum, V, made with a broad face or rim and with a central web, *b*, which is made solid for the purpose of forming a division or partition, and thus dividing the reel transversely, so that its opposite ends *d* and *d′* will serve as separate and independent reels.

The central pulley has its rim or periphery provided with perforations *c*, near the outer edge, these perforations serving as outlets through which the tailings escape into the receiving-chambers W W′, &c., beneath, as clearly shown in Figs. 2, 3, and 4.

As regards their construction and arrangement, the two reels on opposite sides of the machine are duplicates of each other, the pair of divided reels constituting in effect four separate and independent reels—one for each mill.

It will be observed that the reels are so arranged with respect to the mills that the open end or head of one reel is located beneath each mill to receive the product therefrom. As shown in Figs. 2, 3, and 4, a spout or conducting-passage, X, extends from the mill B downward into one end of the reel S, while a corresponding passage extends from the mill B′ into the opposite end of said reel, and in like manner, on the opposite side of the machine, conducting-passages X² extend from the mills B² and B³ into opposite ends of the reel S′, the product from each mill being thus delivered into a screening-surface below, so as to have the fine material separated from the coarse, the fine material passing through the screening or bolting surfaces into the receiving chambers or hoppers Y Y′, &c., located thereunder, while the tailings or coarse material passes from the interior surface of the reel through the perforations *c* into the chambers W and W′. As shown in Figs. 1, 3, and 4, there are two of these tailings-chambers beneath each reel, the chambers being independent of each other to receive the material discharged from opposite ends of the reel. To effect the delivery of the coarse material from the hoppers W W′, &c., to the next succeeding mills for treatment, I employ on each side of the machine two elevator-belts, Z′ and Z² Z³. As shown in Figs. 2 and 3, these belts are arranged to pass around the circumference of and are driven by the central reel-pulley, V, one belt traveling in the chamber W, to receive the tailings from one end of the reel, while the other belt travels in the chamber W′, to receive material from the opposite end of the reel. From the reel the elevator-belts extend upward through spouts to an elevator-chamber, A′, as clearly shown in Figs. 2, 3, 4. In this chamber the four elevator-belts pass around supporting-pulleys C′, being so

disposed that they deliver the material into the upper ends of spouts or conductors E′ E² E³, leading to the hoppers of the respective mills. The arrangement of the spouts, as clearly represented in the drawings, is such that the material passing from the mill B, through the corresponding end of the reel S, is carried by the belt Z and delivered into the pipe E′, by which it is conducted into the mill B′ for the second reduction. After passing through the mill B′, the material passes into the right-hand end of the reel S, where a second separation of the fine material takes place, after which the remaining coarse material is delivered into the chamber W′, whence it is carried by the elevator Z′ to the top of the conductor-pipe E″, and thereby delivered into the mill B². Passing through the mill B², the material enters one end of the reel S′, and has the fine material removed, as before, after which the coarse product is taken up by the elevator Z², and delivered through the spout E³ into the third mill, B″, from which it passes into the second or opposite end of the reel S′, whereby a fourth separation of the fine material is effected. The coarse product resulting from this last screening operation may be removed from the machine for further treatment, or it may be permitted to ascend through the elevator Z³ preparatory to its being again passed through the machine.

It will be seen that by the above apparatus the coarse product may be caused to travel repeatedly through the machine, subject to continual reductions and separations for any desired length of time, or until it is reduced to the proper degree of fineness; or the material may be spouted out and removed after the first, second, or third reduction, as preferred.

Motion may be communicated to the reels in any suitable manner; but it is preferred, as shown in Figs. 2 and 4, to mount a transverse shaft, H′, across one end of the machine, and to provide the same with bevel-pinions I′, engaging into and driving corresponding wheels, J′, on the outer ends of the reel-shafts.

It will of course be understood that, if preferred, the various mills may be driven independently of each other, and that instead of driving the elevator-belts by means of the reels they may be otherwise driven without departing from the general scope of my invention. It is preferred, however, to retain the details of construction represented in the drawings.

It is also obvious that one or two of the mills and the corresponding reels and elevators may be omitted when a smaller number of reductions are to be effected.

By the expression "roller-mill," as employed in this specification, is meant a reduction apparatus or grinding-machine consisting of two or more coacting rolls, by and between which the material to be reduced is passed.

The present invention is restricted to those matters and things which are specifically claimed herein, and as to all features, devices, or combinations which may be shown and described but not claimed herein, the right is reserved to make the same the subject-matter of an independent patent.

Having thus described my invention, what I claim is—

1. In an automatic apparatus for the gradual reduction of grain, the combination, substantially as shown, of four roller-mills, two reels located thereunder, and provided each with a central division, and elevators operating in connection with the respective ends of each reel, said parts arranged substantially as described, to effect the delivery of the material through the successive mills and reels alternately.

2. In combination with the two roller-mills or reduction-machines, a cylindrical reel divided transversely, and arranged to receive the product from the respective mills at its opposite ends.

3. The rotary reel or screen provided with a central pulley, V, having the dividing web or disk to separate the two ends of the reel, and the perforations in the rim to permit the escape of the tailings.

4. The improved reel for gradual-reduction machines, consisting of the cylindrical screening-surface and the central shaft provided with the skeleton wheels or heads at opposite ends, and with a central pulley, V, having a perforated rim.

5. The transversely-divided reel having the outlets on opposite sides of its central division, in combination with the independent receiving-chambers W and W′, and the independent elevator-belts X and X′, as shown and described.

6. In a gradual-reduction machine, the combination of two pairs of crushing-rolls and intermediate couplings connecting the rolls of each pair with the corresponding rolls of the other pair, substantially as and for the purpose described.

7. In a reduction-machine, the roller-mills B and B³ and the intermediate couplings connecting the respective rolls, as described, in combination with the two driving-pulleys arranged on opposite sides of the machine, and connected, one with the forward roll of one mill and the other with the rear rolls of the other mill, as described, whereby motion is transmitted to the forward rolls of both mills from one pulley and to the rear rolls of both mills from the other pulley.

8. In a gradual-reduction machine, the combination of a rectangular sustaining-frame, four roller-mills mounted upon the respective corners of said frame, two transversely-divided reels mounted in the base of said frame, below the mills, to receive the meal or break by gravity therefrom, an elevator connected with each reel, and a series of spouts leading from the upper ends of the respective elevators to the respective mills, in the manner shown and described.

9. The combination, in a gradual-reduction machine, of the following members: four roller grinding-mills, universal couplings, as described, connecting said mills in pairs, two driving-pulleys applied in connection with each pair of mills on opposite sides of the machine, and a counter-shaft, F, extending transversely of the machine, and provided with driving-pulleys on its two ends, and three driving-belts extended, two from one end of the main shaft and one from the opposite side of said shaft to the respective rolls of the grinding-mills, as described and shown.

WILLIAM DICKSON GRAY.

Witnesses:
WM. W. ALLIS,
THEO. F. WAMBOLD.