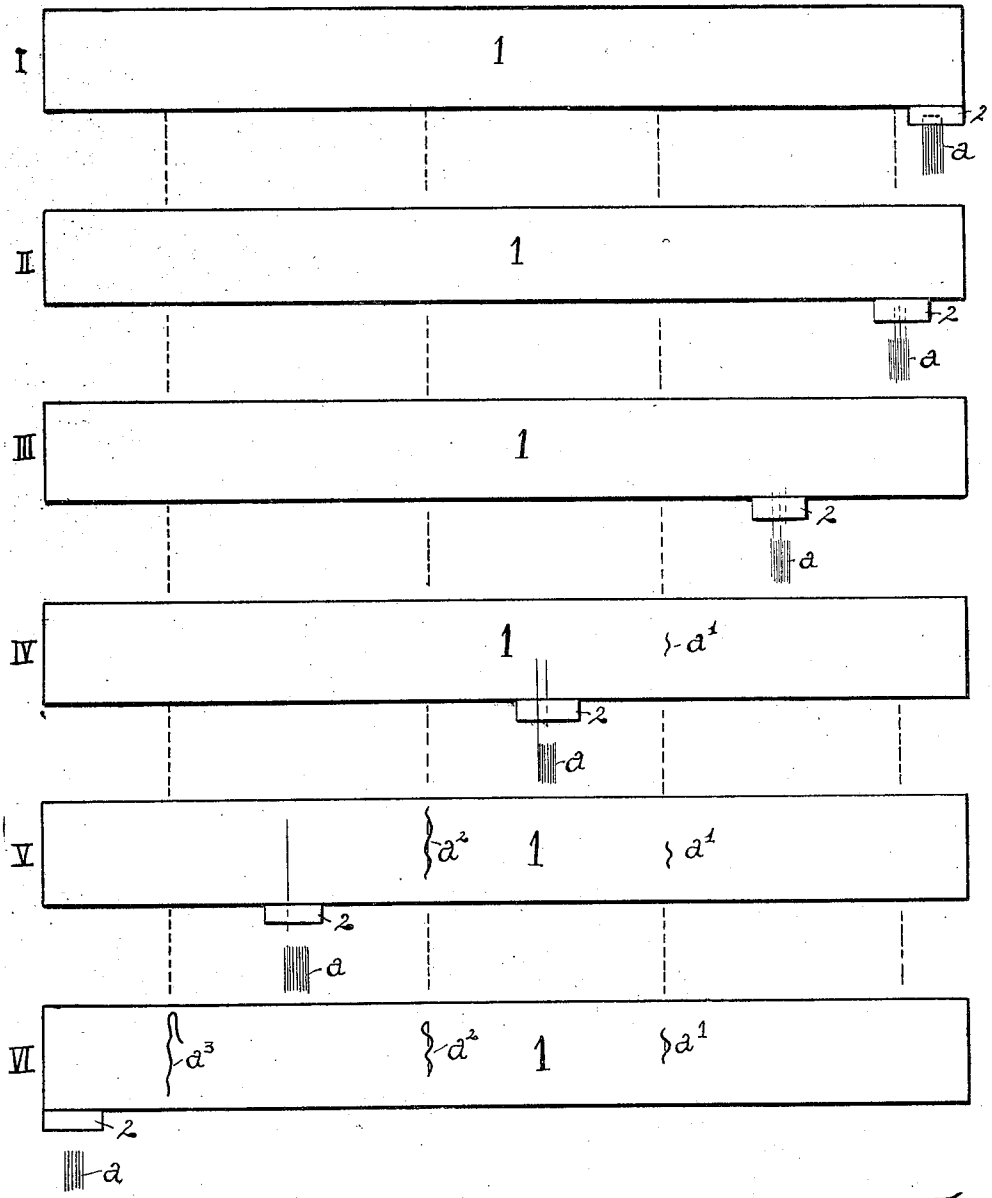
Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 1



Witnesses Fig 1

C. A. Rowe

C. P. Kesler

Inventor

William L. Balls

by James L. Norris,

Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 2

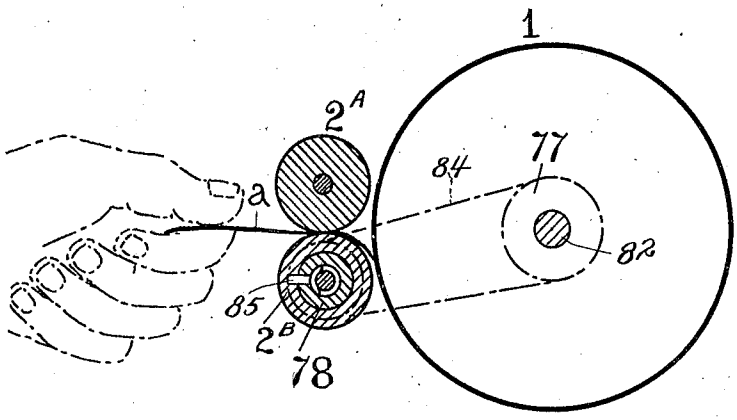


Fig.1a

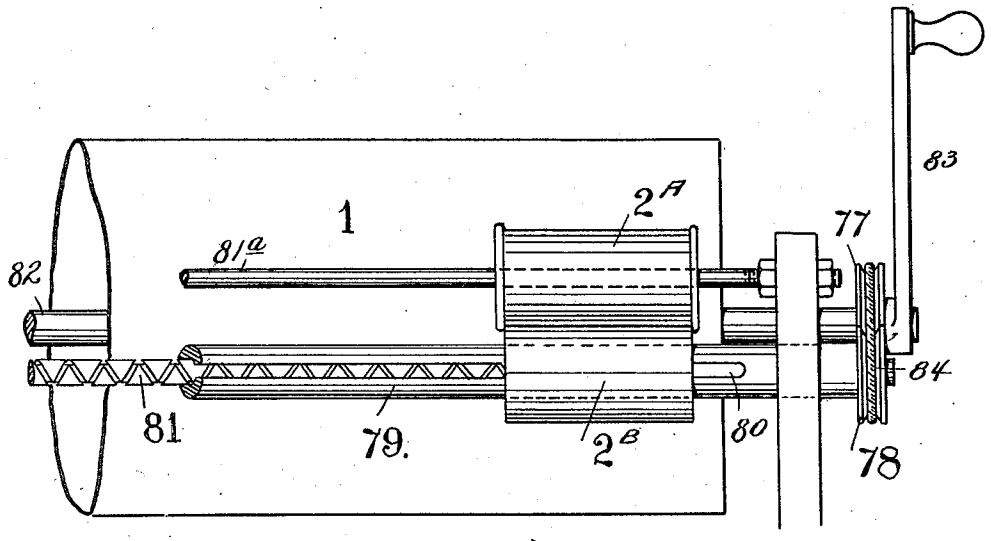


Fig.1b

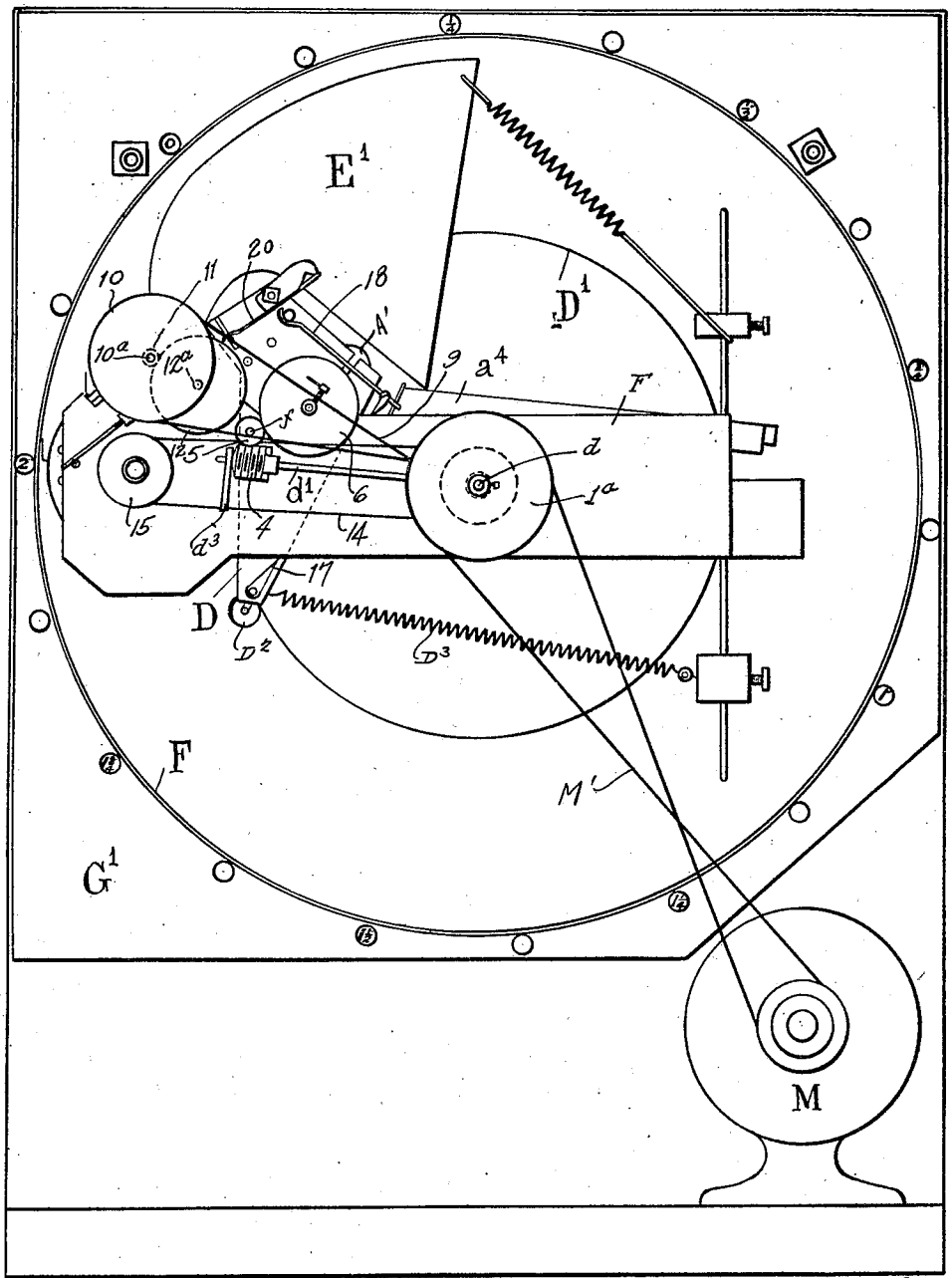
Inventor
William L. Balls
By James L. Norris
Attorney.

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 3



Witnesses:
C. A. Rowe

Fig. 2.

Inventor
William L. Balls
by James L. Norris
Attorney

Apr. 17, 1923. **1,452,352**

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 4

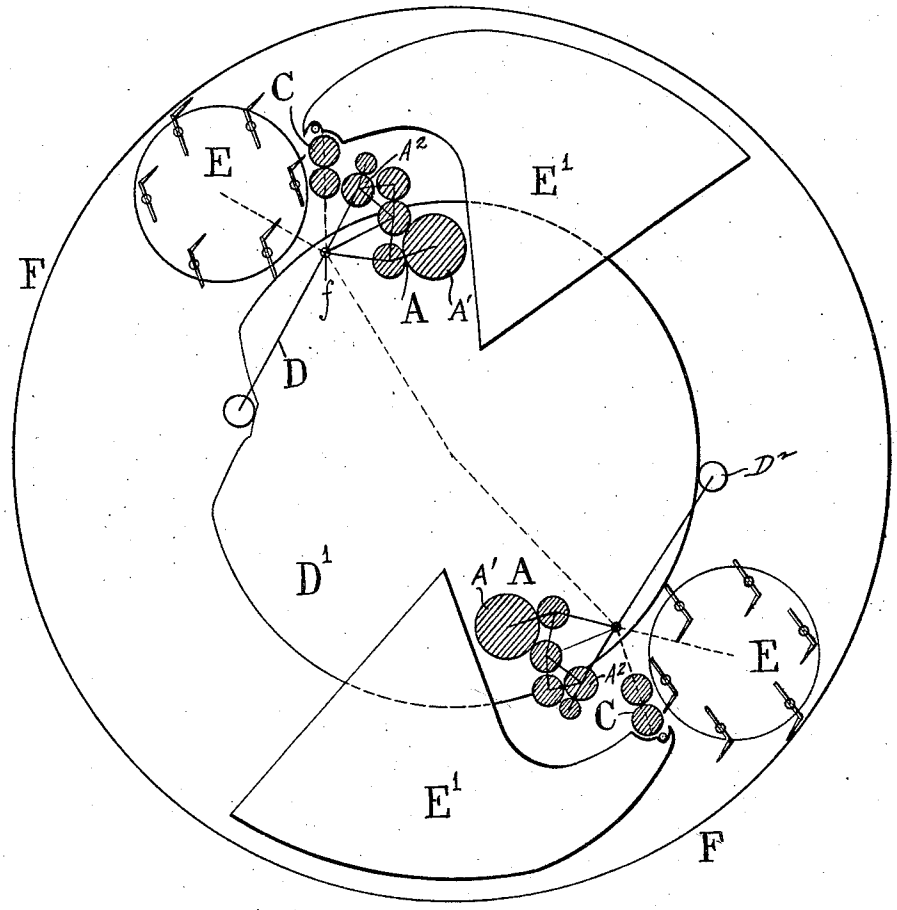


Fig.3.

Witnesses:
C. A. Rowe
C. L. Kesler

Inventor
William L. Balls
by James L. Norris
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27, 1918 14 sheets-sheet 5

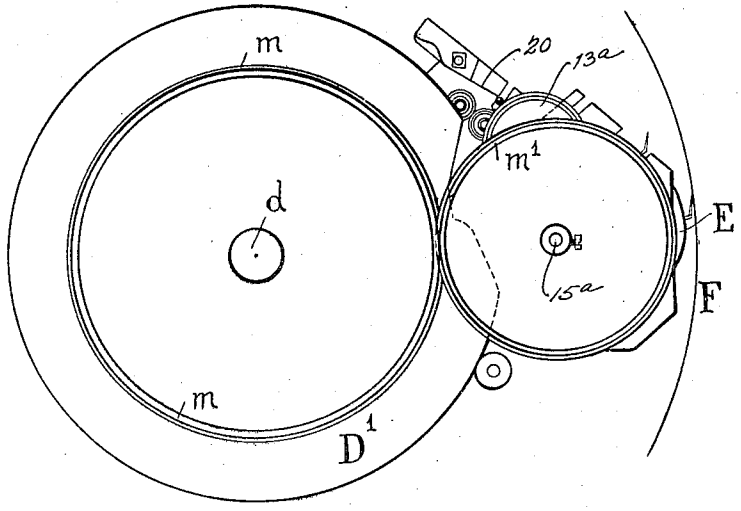


Fig. 4.

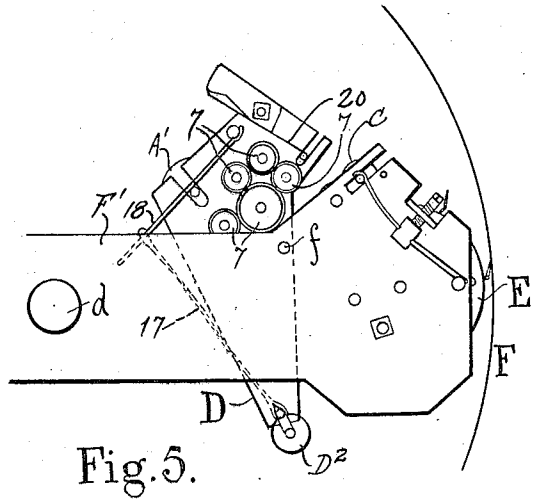


Fig. 5.

Witnesses:
C. A. Rowe
C. L. Kasler

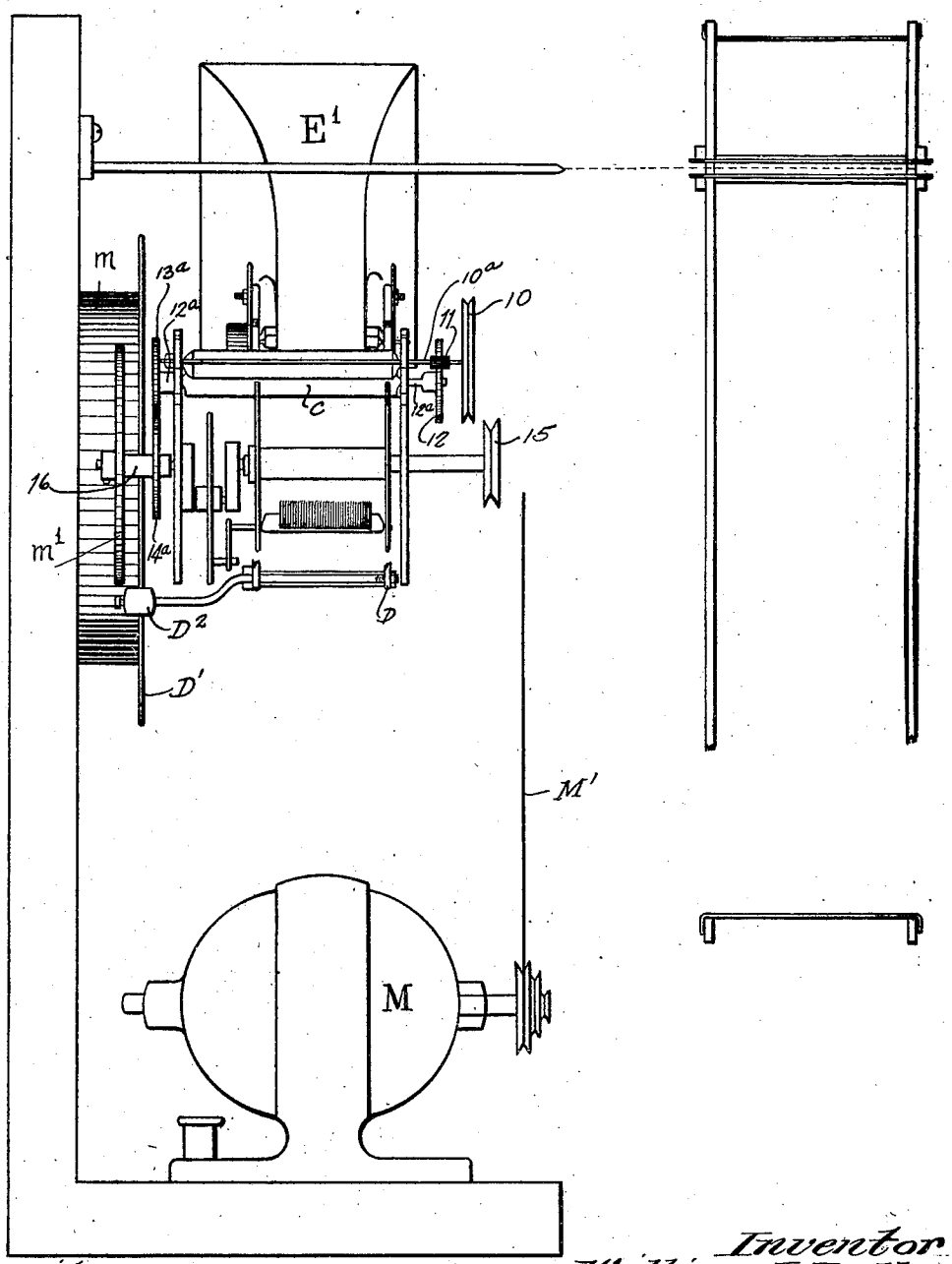
Inventor
William L. Balls
by James L. Davis
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27, 1918 14 sheets-sheet 6



Witnesses:
C. A. Rowe
C. L. Keller

Fig. 6.

Inventor
William L. Balls
by James L. Norris
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27, 1918 14 sheets-sheet 7

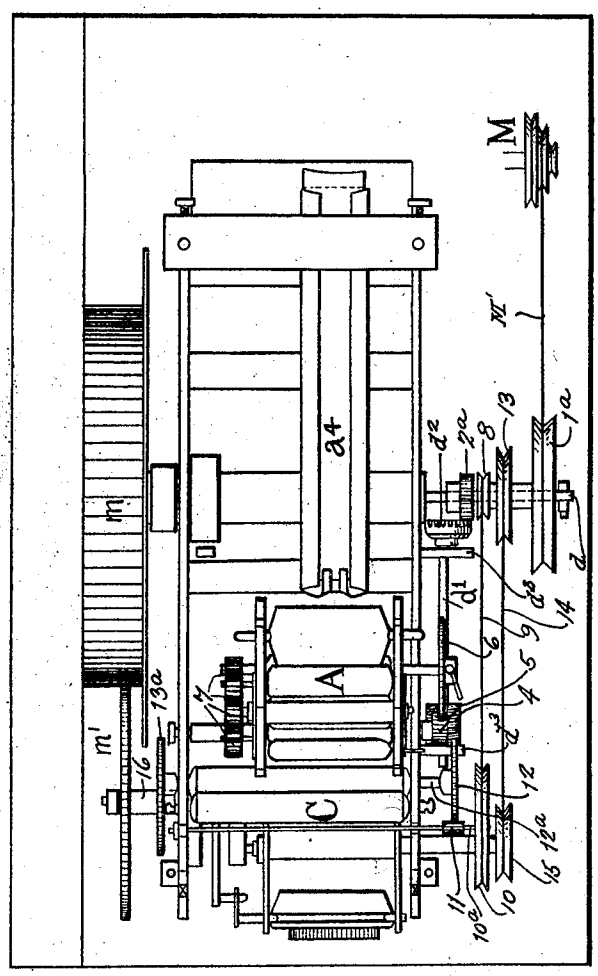


Fig. 7.

Witnesses:
C. A. Rowe
C. R. Kesler

Inventor
William L. Balls
by James L. Norris,
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 8

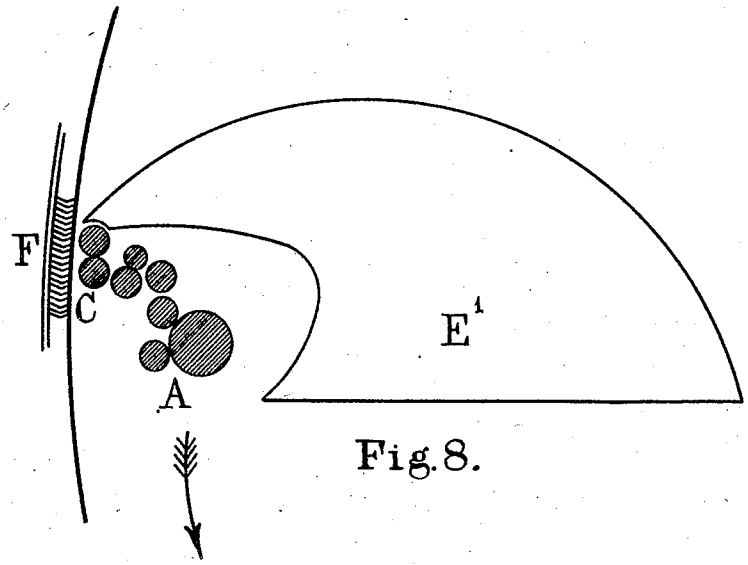


Fig. 8.

Witnesses:
C. A. Rowe

Inventor
William L. Balls
by James L. Norris
Attorney

Apr. 17, 1923. **1,452,352**

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 9

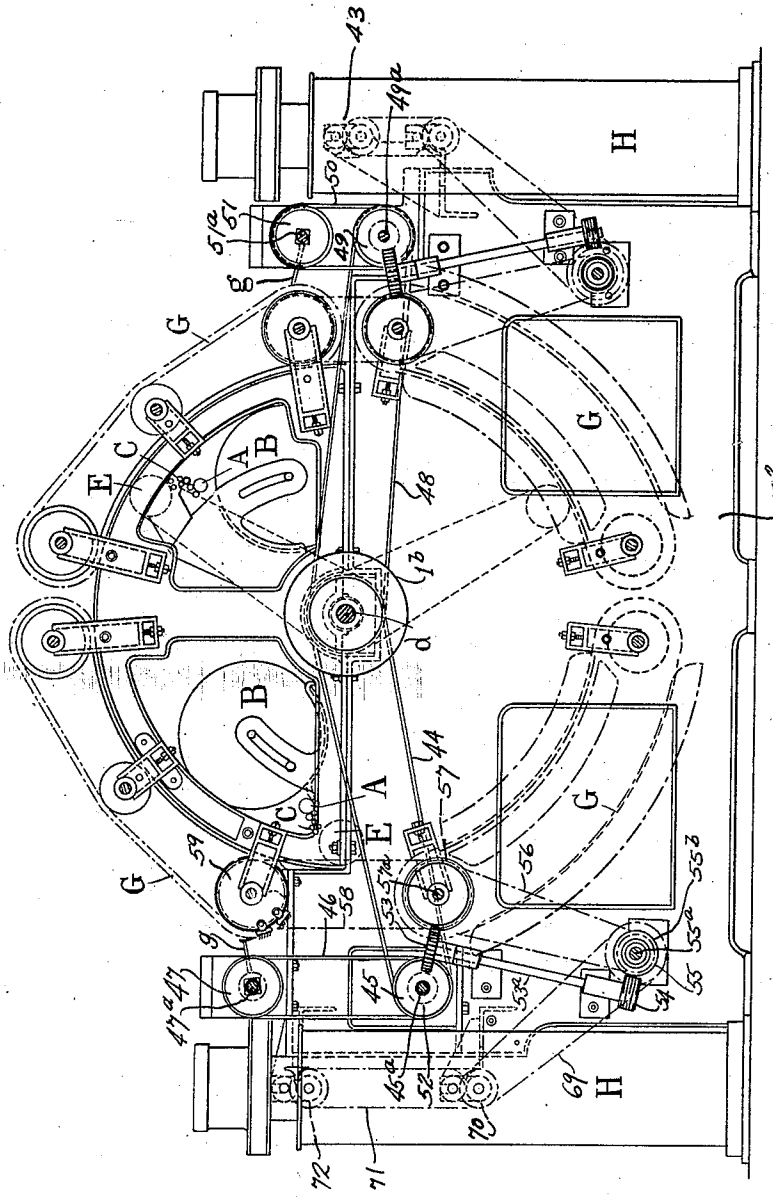


Fig.9.

Witnesses.
C. A. Rowe
C. E. Keller

Inventor
William L. Balls
by James L. Norris
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27, 1918 14 sheets-sheet 10

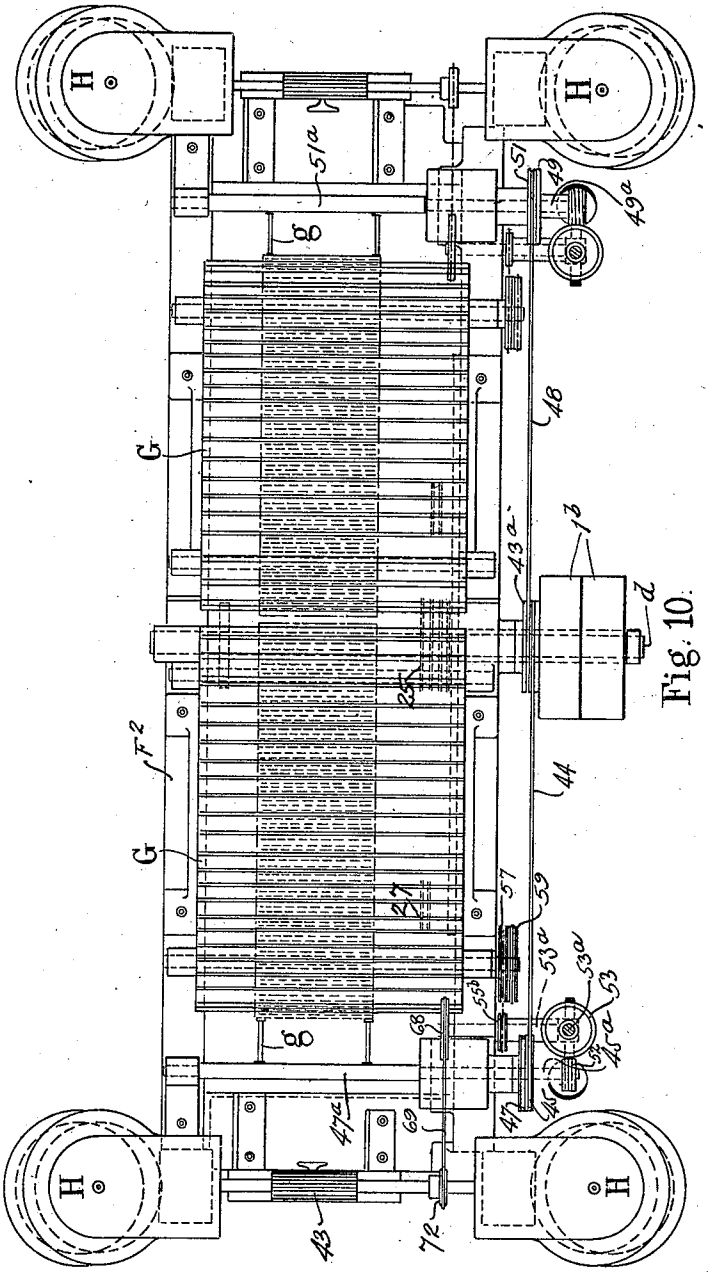


Fig. 10.

Witnesses
C. A. Rowe
G. R. Kasler

Inventor
William L. Balls
by James L. Norris,
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 11

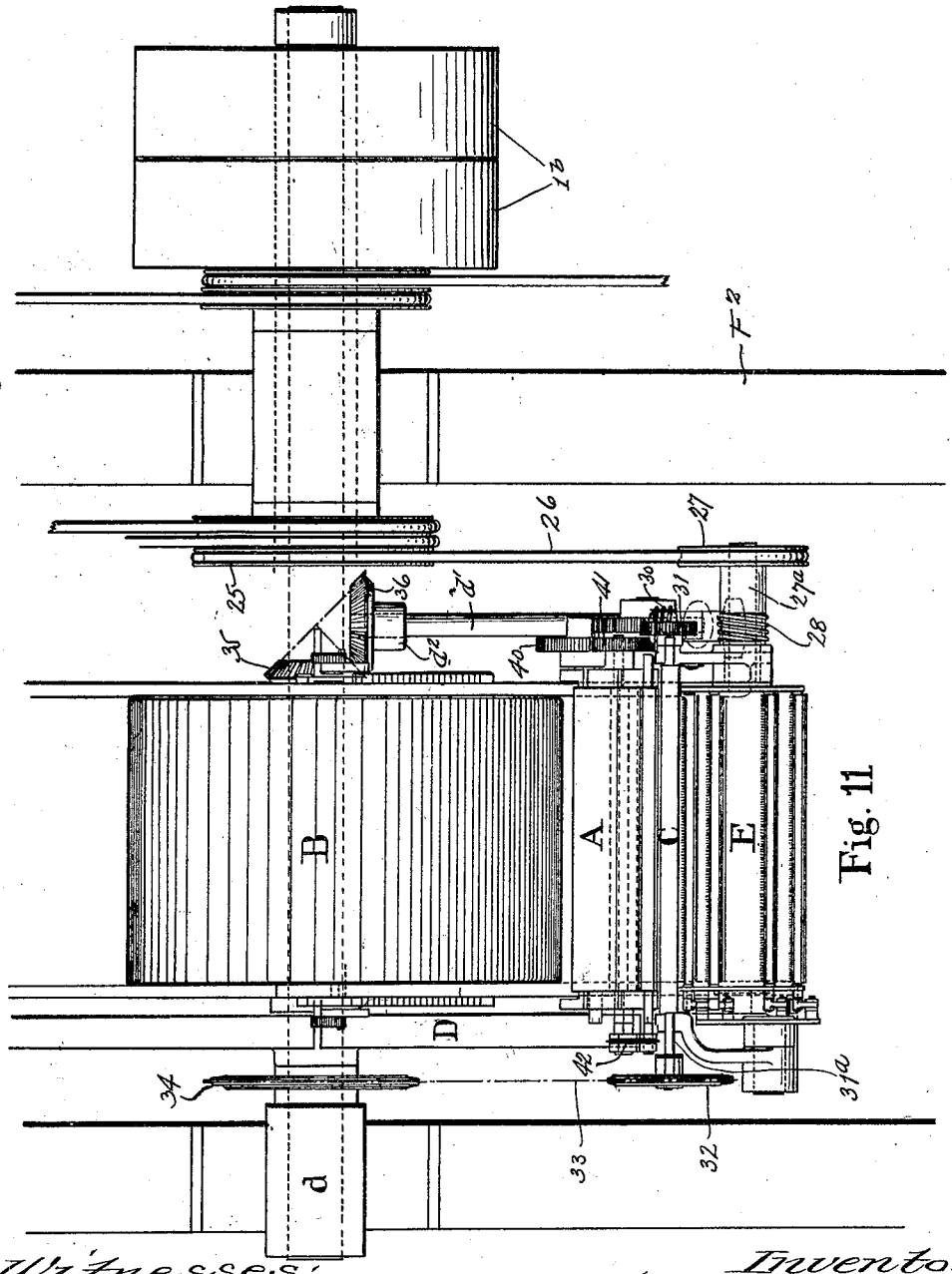


Fig. 11

Witnesses:
C. A. Rowe
C. D. Kesler

Inventor
William L. Balls
by James L. Norris
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27, 1918. 14 sheets-sheet 12

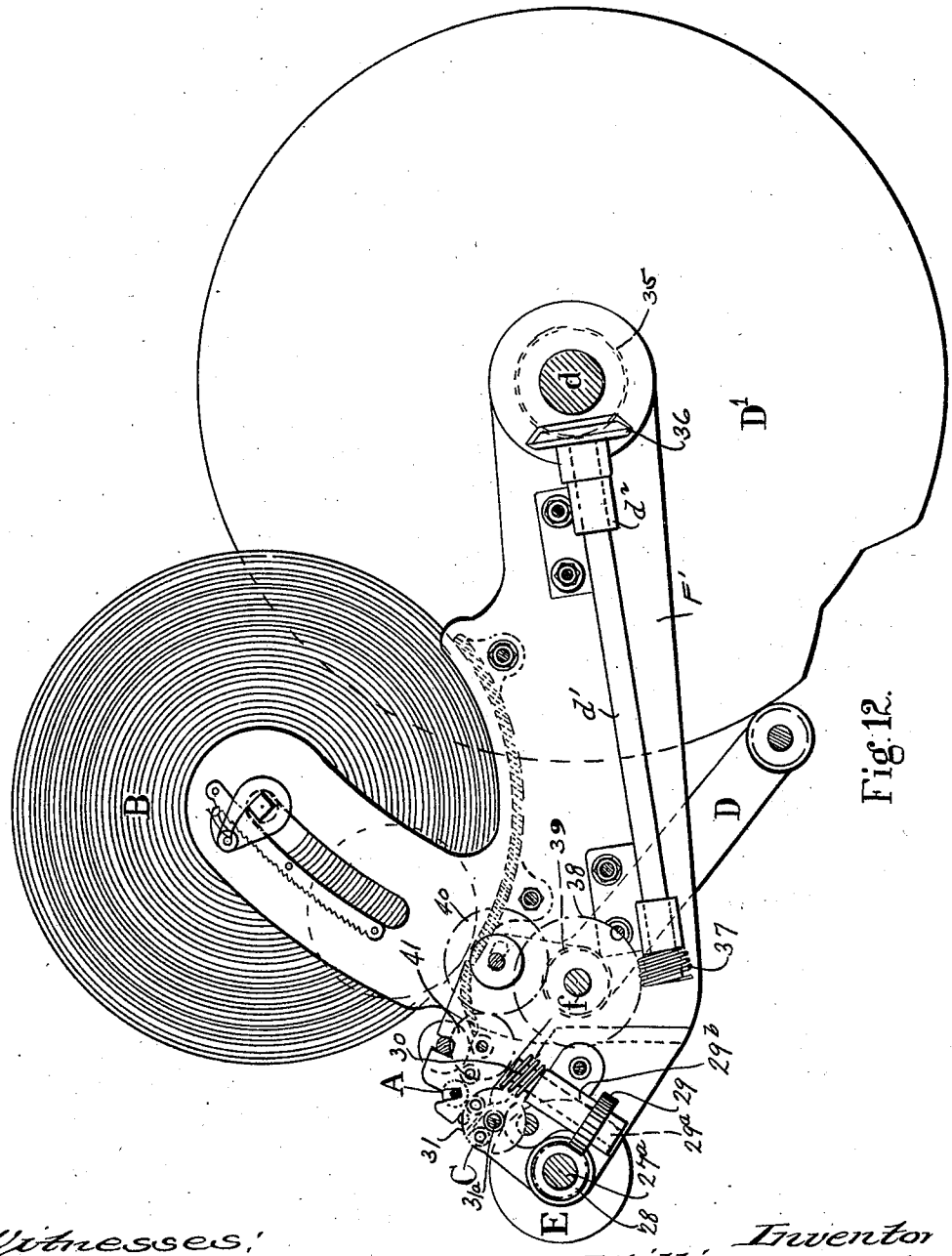


Fig. 12.

Witnesses:
C. A. Rowe
C. B. Keelan

Inventor
William L. Balls
by Wallace L. Norris
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 13

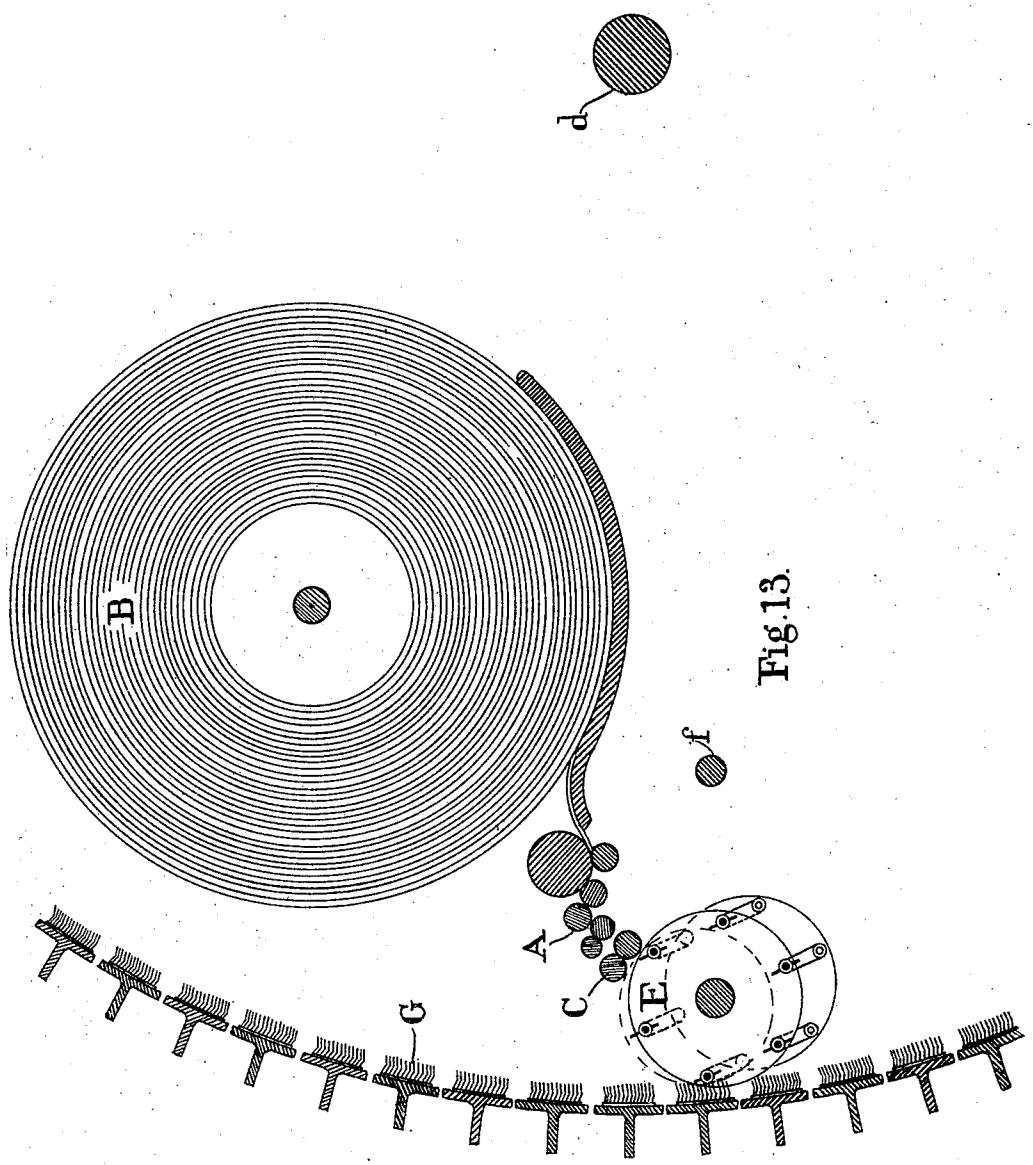


Fig.13.

Witnesses:
C. A. Rowe
C. P. Hosler

Inventor
William L. Balls
by James L. Norris
Attorney

Apr. 17, 1923. 1,452,352

W. L. BALLS

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH

Filed Sept. 27. 1918 14 sheets-sheet 14

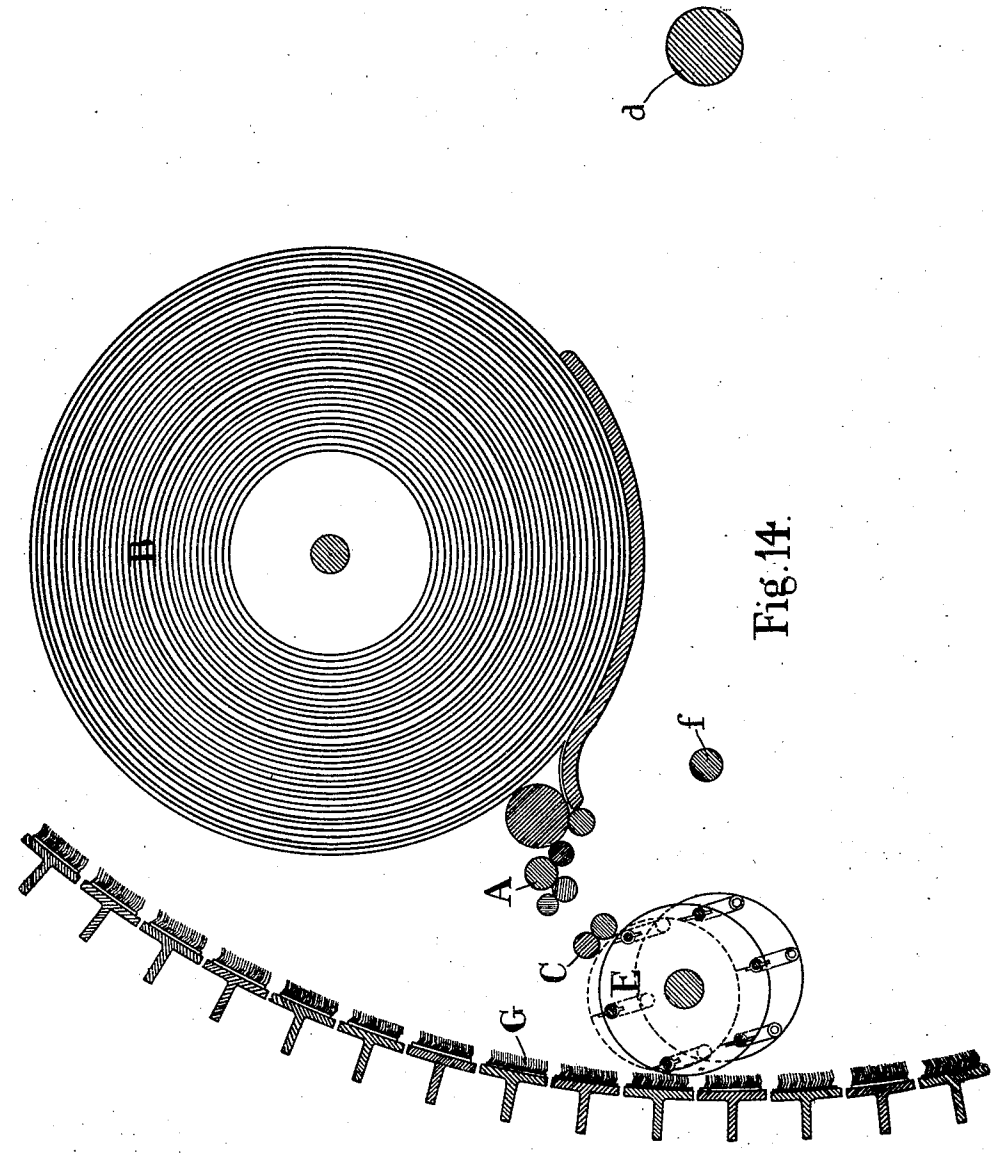


Fig. 14.

Witnesses:
C. A. Rowe
C. E. Fraser

Inventor
William L. Balls
by James L. Norris
Attorney

Patented Apr. 17, 1923. 1,452,352

UNITED STATES PATENT OFFICE.

WILLIAM LAWRENCE BALLS, OF MANCHESTER, ENGLAND.

APPARATUS FOR GRADING OR SEPARATING FIBERS ACCORDING TO THEIR LENGTH.

Application filed September 27, 1918. Serial No. 255,957.

To all whom it may concern:

Be it known that I, WILLIAM LAWRENCE BALLS, a British subject, residing at Manchester, in the county of Lancaster, England, have invented certain new and useful Improvements in Apparatus for Grading or Separating Fibers According to Their Length; and I do hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to apparatus for sorting or grading cotton, wool (or other fibers) for the purpose of ascertaining the length of the individual hairs or fibers of which the bulk or sample is composed and classifying it accordingly, or for the purpose of grading the material into slivers or roves having fibers of approximately equal length, or between certain desired limits of length.

The machine may be adapted for the use of cotton growers or others by which the various lengths of staple in a sample can be readily ascertained and classified; for use in the testing room or laboratory by which all the fibers or hairs of varying length can be divided out and their relative quantities or proportions ascertained, and also as a machine for forming slivers or roves the hairs or fibers of each of which will be of approximately equal length or of a length between certain desired limits, the dimensions of the machine and the degree of classification of the product depending on the particular object in view.

The apparatus comprises two main parts, a separator and a collector capable of being traversed relatively to one another, one part separating the hairs or fibers into lengths and delivering them forward and the other part collecting the separated or detached hairs graded according to their lengths.

The separating part of the apparatus may be built up in one or more units each unit preferably comprising—

(*a*) A carrier for the rove, sliver or lap fed to the machine.

(*b*) Feed rollers to receive the rove, sliver or lap and feed the material forward to the delivery rollers arranged in such a way as to obtain a secure hold upon the material but to allow the fibers to be drawn out without breaking and capable of being moved to and from the delivery rollers or of being reversed to detach or draw back the main body or bulk of the fibers after a length or bunch has been seized by the delivery rollers.

(*c*) Delivery rollers revolving continuously and delivering a fixed amount for each unit of relative motion of the two relatively moving parts of the apparatus.

(*d*) A doffing or delivery mechanism comprising combs, brushes or other device for taking the fibers from the delivery rollers and conveying them to the collecting apparatus.

The collecting part of the apparatus comprises a plush or card covered roller or annular collector in close proximity to the separating mechanism. A traversing movement is given to one part of the machine relatively to the other part, thus the separator may move and the collector be stationary or the collector may move and the separating mechanism remain stationary.

The invention will be fully described with reference to the accompanying drawings.

Fig. 1 is a diagram illustrating the principle of selecting and sorting the individual fibers upon which the invention is based.

Fig. 1^a is a sectional view of an elementary form of hand operated apparatus for carrying into effect the principle illustrated in Figure 1.

Fig. 1^b is a side elevation, partly broken away, of the apparatus shown in Fig. 1^a.

Fig. 2 is a front elevation of a machine applicable for laboratory or sampling purposes.

Fig. 3 is a section of the roller and cam showing two positions of the roller head.

Fig. 4 is an elevation of the stationary rack cam and roller head from the back or reverse side of the machine.

Fig. 5 is an elevation from the back of the roller carrying head or bracket.

Fig. 6 is an end elevation.

Fig. 7 is a plan.

Fig. 8 is a section of rollers showing a modification.

Fig. 9 is a side elevation of apparatus

designed for use on a large or commercial scale.

Fig. 10 is a plan of same.

Fig. 11 is a front elevation of one head of the machine.

Fig. 12 is a side elevation of one head of the apparatus.

Fig. 13 is a transverse section through one head of the apparatus.

Fig. 14 is a similar transverse section showing the parts in a different position.

Referring to the diagram Fig. 1 as illustrative of the invention, a collector 1 and separating rollers 2 are shown in six relatively different positions designated respectively by the numerals I to VI, inclusive, the collector being either stationary or rotating, and the separating rollers rotating and also traversing longitudinally of the collector. Thus, as shown in Figs. 1^a and 1^b, the collector 1 may comprise a roller having a plush covered or otherwise roughened surface and mounted upon a shaft 82 provided with a hand crank 83. As also shown in these figures, the separating rollers 2^A and 2^B are mounted for longitudinal movement upon fixed shafts 81 and 81^a arranged with their axes parallel to the axis of the shaft 82, said rollers being in frictional driving engagement and the roller 2^A being shown as provided with end flanges engaging the ends of the roller 2^B so as to cause said rollers to move longitudinally in unison. The shaft 82 may be provided with a pulley 77 connected by a belt 84 with a pulley 78 on a sleeve 79 rotatably mounted on the shaft 81 and having a slot 80 to receive a feather 85 projecting inwardly from the roller 2^B and engaging a thread formed on the shaft 81, whereby the rollers 2^A and 2^B are rotated in unison with the roller 1 and are at the same time caused to move longitudinally thereof.

In operation, a tuft of fibers a is presented to the rollers 2 which withdraw therefrom a number of fibers of different lengths, for the purpose of illustration say three. These fibers are passed forward by the rollers 2 as they rotate and each in succession as it leaves the nip of the rollers 2 is deposited on the collector 1, the shortest first and the longest last. Consequent upon the traverse of the rollers 2 the shortest fiber or hair a' (Fig. 1) is deposited upon a different section of the collector1 than the other two hairs or fibers a^2 and a^3, so that the fibers or hairs a', a^2, and a^3 of different lengths are successively deposited upon different sections of the collector. At each successive traverse of the separating rollers fibers or hairs of corresponding lengths will be deposited on the same sections of the collector. These fibers or hairs can afterwards be transferred from the collectors according to their relative lengths.

The machine shown in the drawings Figs. 2 to 7 is designed for laboratory or sampling purposes and illustrates a simple construction of machine which may be used for ascertaining the relative length of the individual fibers or hairs in a small sample of cotton or wool.

The separating part of the machine is constructed with a series of feed-rollers A to which the cotton or wool or other fibers are presented from a bunch or tuft placed in a tray or shoot a^4 behind them and delivery rollers C by which the fibers or hairs are successively drawn out from the feed rollers A. The feed rollers A are arranged in series of pairs, the rear rollers A′ having a strong nip to hold the fibers and the forward rollers A^2 a comparatively loose nip so as to allow the individual fibers to be drawn out or separated without breaking them. The roller A′ is given its relatively strong nip by means of an elastic cord 17 (Figs. 2 and 5) which draws upon a spring arm 18 bearing on the end of the roller shaft, while the roller A^2 is given its relatively weak nip by means of a light leaf spring 20 which engages the end of the shaft of the latter roller. The feed rollers A are mounted in bearings in a rocking arm or bracket D pivoted at f to a roller carrying head or frame F′, and to which an intermittent motion is imparted by a suitably shaped cam D′, which cooperates with a roller D^2 carried by the arm D and held in engagement with said cam by a spring D^3. The arrangement is such that the feed rollers A are caused to advance to the delivery rollers C, presenting the end of the bunch or tuft of cotton or wool thereto, remain there while the delivery rollers take up a length equal to the length fed up since last nip and recede leaving in the grip of the delivery rollers C a bunch or tuft of the fibres of varying length the forward ends of the fibers of which are all level. The feed rollers A are geared together and are driven by a shaft d' as hereinafter more fully described.

The delivery rollers C are mounted in fixed bearings and driven (as hereinafter more fully described) with a constant speed of rotation and in direct relation to the collecting part of the apparatus. The fibers may be taken from the rollers C by doffing or delivery mechanism such as by rotary combs E or the fibers may be delivered from the rollers direct on to the collector F as in Fig. 8, the comb or collector in taking the hairs from the rollers C, grips said hairs loosely. In this manner it will be understood that the shorter hairs will be drawn out of the tuft first and as progressively fed according to their length until finally the longest hairs are drawn away from the delivery rollers C. The rotary combs E

rotate in close proximity to the delivery rollers and are preferably mounted with a feathering movement and so centred as to collect or take up the detached hairs or fibers as they pass the delivery rollers and to yield up their cotton as they pass the collector F.

The collecting mechanism is constructed of an annular frame G′ internally covered with plush or card clothing to receive the fibers from the delivery rollers C and combs E and may revolve around the separating mechanism or the separating mechanism may revolve within the annular collector G′ so as to cause fibers delivered at different times by the delivery rollers to be deposited upon different parts of the collector; in the present instance upon different parts of its interior annular surface circumferentially of the latter. It is preferred to revolve the separating roller head F′ within the collector G′ as shown and as the roller head revolves the fibers are laid successively within the collector G′ from the different sections of which they can be taken. In the latter event, the cam D′ will, of course, be held stationary with the frame G′. An air trunk E′ is mounted on the revolving head to induce a current of air to blow the fibers on to the combs E or collector G′. The fibers are removed from the sections of the collector G′ by hand or by a brush in the hand of the operator when a sufficient quantity has been collected to give the result of the test.

The parts above described are preferably driven from an electric or other motor M, four drives being required, namely, (1) a drive for the feed rollers A, (2) a drive for the delivery rollers C, (3) a drive for the doffing combs E, and (4) a drive for the roller head F′.

(1) A pulley on the shaft of the motor M is connected by a belt M′ with a pulley 1^a fast on a shaft d which is suitably journalled in the machine frame and upon which the roller head F′ is rotatably mounted. The shaft d carries a pinion 2^a (Fig. 7) which meshes with a crown gear d^2 on a shaft d' journalled in suitable bearings d^3 on the roller head F′. The shaft d' carries a worm 4 which meshes with a pinion 5 rotatably mounted on the pivot f of the rocking frame D which carries the feed rollers. The pinion 5 meshes with a gear 6 on the shaft of one of the feed rollers A which are all interconnected by gears 7 (Figs. 5 and 7).

(2) Fast on the shaft d is a second pulley 8 connected by a belt 9 with a pulley 10 fast on a shaft 10^a journalled in the roller head F′. The shaft 10^a also carries a pinion 11 which meshes with a gear 12 on the shaft 12^a of one of the delivery rollers C.

(3) Fast on the shaft d is a third pulley 13 connected by a belt 14 with a pulley 15 on the shaft of the rotary carrier for the doffing combs E.

(4) The delivery roller shaft 12^a which carries the gear 12 is provided at its opposite end with a second gear 13^a which meshes with a gear 14^a (Fig. 6) on one end of a shaft 15^a (Fig. 4) journalled in a fixed bearing 16 on the frame. Said shaft 15^a is provided at its opposite end with a second gear m' which meshes with a fixed gear m supported by the frame and disposed concentric with the shaft d, whereby rotation of the gear m' causes said gear to travel around the periphery of the gear m, carrying with it the roller head F′ which is thereby caused to rotate about the axis of the shaft d.

The collector may if preferred consist of a roller 1 such as shown in Figs. 1, 1^a and 1^b covered with plush or card clothing placed adjacent to the delivery rollers which are both rotated and moved longitudinally of the roller 1.

The machine shown in the drawings Figs. 9 to 14 is designed for commercial purposes for forming a number of slivers or roves the fibers of each of which will be within certain fixed limits of length.

The separating part of the machine is constructed with one or more rotary heads F′ each provided with a series of feed rollers A, to which the cotton is presented from a lap B, and delivery rollers C by which the fibers or hairs are successively drawn out from the feed rollers. The feed rollers A are arranged in two, three, or more pairs, the rear rollers having a strong nip to hold the fibers and the forward rollers a comparatively loose nip so as to allow the individual fibers to be drawn out or separated without breaking them, as in the form of the invention last described. The feed rollers A are mounted in bearings in a rocking arm or bracket D pivoted at f and to which an intermittent motion is imparted by a suitably shaped cam D′, said feed rollers being thereby caused to advance to the delivery rollers C, presenting the end of the lap sliver or roving of cotton or wool thereto, remain there while the delivery rollers take up a length equal to the length fed up since last nip and recede leaving in the grip of the delivery rollers C a bunch of the fibers of varying length the forward ends of the fibers of which are all level upon delivery of the tuft of fiber to the delivery rollers C, said rollers will first grip the tuft by the forward end and when so gripped the rollers A^2 which grip the tuft loosely will move rearwardly removing all the fibers not gripped between the rollers C.

Instead of moving the feed rollers A to and from the delivery rollers C for the purpose of separating or detaching a bunch of fibers from the main bulk they may be re-

versed and the fibers be alternately fed forward a given distance and then drawn back a less distance.

The delivery rollers C are mounted in fixed bearings and driven with a constant speed of rotation and in direct relation to the collecting part of the apparatus. They deliver the fibers or hairs onto the collector G through doffing or delivery mechanism such as rotary combs E. Rotary combs E rotate in close proximity to the delivery rollers and are preferably mounted with a feathering movement and so centred as to collect or take up the detached hairs or fibers as they pass the delivery rollers and to yield up their cotton as they pass the collector G.

The collecting part of the apparatus is constructed with a number (herein four) of sets of wire covered flats G which travel forward as the roller heads revolve upon which the fibers are collected, and from which said fibers are stripped by a doffer comb g and delivered to coilers H which are of any ordinary or well known construction. This apparatus may be applied for separating or grading the fibers in bulk or on a commercial scale, each of the four sets of collecting flats G and sliver cans H collecting fibers of a different length.

The general organization of the machine constituting this form of the invention is similar to that shown in Figs. 2 to 7. The machine frame F^2 supports the collector mechanisms G as well as the fixed cam D′ and also provides bearings for the shaft d upon which the roller head or heads F′ are rotatably mounted. The shaft d is provided with one or more belt pulleys 1^b to receive power from any suitable source and also carries a pulley 25 (Figs. 10 and 11) connected by a belt 26 with a pulley 27 on the shaft 27^a of the rotary doffing frame which carries the combs E, whereby said frame is rotated. The shaft 27^a carries a worm 28 which meshes with a worm wheel 29 (Fig. 12) on one end of a shaft 29^a journalled in a bearing 29^b carried by the head F′, said shaft 29^a having at its opposite end a worm 30 which meshes with a worm wheel 31 on the shaft 31^a of one of the delivery rollers C, whereby said rollers are rotated. The shaft 31^a also carries a sprocket 32 (Fig. 11) connected by a chain 33 with a stationary sprocket 34 fast to one of the bearings of the shaft d, whereby the head F′ is rotated about the axis of said shaft d. A bevel gear 35 on the shaft d meshes with a bevel gear 36 on the shaft d' journalled in bearings d^2 on the head F′, said shaft d' having a worm 37 (Fig. 12) meshing with a worm gear 38 on the pivot shaft f of the rocking frame D. Connected with the worm gear 38 for rotation therewith is a pinion 39 meshing with a gear 40 which in turn meshes with a pinion 41 on the shaft of one of the feed rollers A. The shafts of the several feed rollers are connected by chain and sprocket or other gearing 42 (Fig. 11), whereby said rollers are rotated in unison from the gear 40.

The mechanism for actuating the collectors G, doffing combs g, and coilers 43 is shown in Figs. 9 and 10. Pulleys 43^a on the shaft d are connected by belts 44 and 48 with pulleys 45 and 49 on the shafts 45^a and 49^a of two of the four doffing combs g, while said pulleys 45 and 49 are connected by belts 46 and 50 with pulleys 47 and 51 on the shafts 47^a and 51^a of the other two doffing combs g. The shaft 45^a is provided with a worm 52 which meshes with a worm gear 53 on a shaft 53^a journalled in the machine frame F^2 and provided with a worm 54 meshing with a worm wheel 55 on a shaft 55^a also journalled in the frame F^2. The shaft 55^a carries a pulley 55^b connected by a belt 56 with a pulley 57 on the actuating shaft 57^a of one of the collectors G. Said shaft 57^a carries a second pulley which is connected by a belt 58 with a pulley 59 on the actuating shaft of a second collector G at the same side of the machine. The two collectors G at the opposite side of the machine are similarly driven from the shaft 49^a, as will be obvious without further description. The shaft 55^a (as also the corresponding shaft at the opposite side of the machine) is provided with a second pulley 68 which is connected by a belt 69 with a pulley 70 on the actuating shaft of one of the coilers 43 on the corresponding side of the machine, said pulley 70 being connected by a belt 71 with a pulley 72 on the actuating of the other coiler at the same side of the machine.

The operation of the machine is as follows, during the course of a single sorting action:—

The feed rollers A having fed forward a length say about one tenth of an inch of sliver, lap or roving since the last sorting action, the said silver, lap, or roving is then pushed forward approximately half an inch quickly in the rocking movement given to the roller frame by the cam D′ until it touches one or other of the delivery rollers C; it may then be moved more slowly so that the said roller surface is moving the faster and thereby brushes the end of the sliver smooth; finally it is pushed quickly into the actual nip of the delivery rollers C and held there until they have taken up a length equal to the length fed forward since the last sorting traverse. The rocking gear comprising the bracket D and cam D′ then withdraws the feed rollers and the sliver as quickly as is conveniently possible, leaving the tuft of fibers or hairs which the delivery rollers C have gripped by their front ends held securely between them.

The rocking gear remains at rest during the remainder of the traverse while the

feed rollers A continuously or intermittently feed forward a fresh length of sliver.

The partially detached tuft of fibers or hairs held by the delivery rollers C is passed forward by the rotation of the latter and as the front ends of the hairs emerge on the other side of the roller nip they come within the action of the doffing combs E, being drawn into the same by air current produced by the rotation of the combs. Each hair as it is set free from the front of the delivery rollers C is carried away by the combs or other doffing mechanism. The short hairs are necessarily the first to be set free, and the longest ones last, intermediate lengths being set free at intermediate stages.

Since each comb as it reaches the face of the collector immediately gives up the hairs, it may have removed, to the collector until it touches, and since the combs are traversed on the same unit as the delivery rollers, and since the traverse of the delivery rollers is positively geared to their revolution on their own axles, and further since the movements of the rocking gear always take place at the same part of the traverse, it follows:—

That successive units of the collecting part of the machine such as the flats G receive successively longer and longer hairs, to a degree of minuteness in classification which is limited only by the number of collecting units employed, and hence by the length of each traverse.

It will be obvious that various modifications may be made in the construction of the machine in which a traversing movement is given to one part of the machine relative to the other part, that is the traverse may be given to the unit or units comprising the separating head which is preferred or the traverse may be given to the collector.

In the very simplest form of the machine for testing samples the feed rollers may be dispensed with and the cotton be fed to the delivery rollers a small bunch or tuft at a time by hand as illustrated in Figs. 1, 1^a and 1^b.

For a simple form of machine to be used by cotton growers or others for grading samples a vertical reciprocating rectilinear traverse may be employed with a gravity drive or a horizontal reciprocating rectilinear traverse with a pinion rotating in a rack first in one direction and then in the reverse with a change at each end of the traverse and a rotary plush covered roller to collect the fibers as they are delivered from the rollers.

Where additional precision is required, the sorting traverse may alternate with a traverse in which the end of the sliver is pushed nearly but not quite into the nip of the delivery rollers. The latter will then grip only such fibers or hairs as may have been displaced from their original position during the dragging out of the tuft previously removed and sorted. These displaced fibers or hairs will be removed and sorted or merely collected during the supplementary traverse, leaving the end of the sliver, lap or roving square and uniform in readiness for the next sorting traverse. The percentage of fibers or hairs thus displaced to any given distance may thus be measured if so desired, in addition to the primary effect of the machine.

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

1. Apparatus for sorting and grading fibers according to length, comprising members for firmly gripping therebetween fibers and separating them from a tuft of fibers, means movable relative to said members for loosely engaging the fibers as they are delivered and a collector for receiving said fibers from said means.

2. Apparatus for separating and sorting textile fibers according to length comprising, rollers adapted to firmly grip and separate fibers from a tuft of fibers, receiving mechanism having a movement relative to said rollers and means associated with said receiving mechanism adapted to loosely engage the ends of the fibers presented by said rollers.

3. Apparatus for separating and sorting textile fibers according to length comprising, rollers adapted to firmly grip and separate fibers from a tuft of fiber, receiving mechanism having a movement relative to said rollers and adapted to loosely grip the fibers delivered by said rollers, and a collector for receiving the graded fibers.

4. Apparatus for separating and sorting fibers according to length comprising, separator mechanism and collector mechanism having relative movement therebetween, said separating mechanism consisting of a lap carrier, delivery rollers and feed rollers therebetween, a doffer between said feed rolls and the collecting mechanism, said delivery rollers being adapted to grip the fiber firmly therebetween, while feeding the same to the doffer, the doffer being movable relative to said delivery rollers and adapted to loosely grip the fibers presented thereto by the delivery rollers.

5. Apparatus for separating and sorting fibers according to length, comprising a receiving and separating mechanism having a movement one relative to the other; the separator mechanism comprising a carrier for a lap of fiber, feed rollers and delivery rollers, said delivery rollers being adapted to rotate relative to each other and to firmly grip a tuft of fiber therebetween, a doffer between the collector and delivery rolls adapted to loosely grip the fiber held by said delivery rolls, whereby the fibers are sepa-

rated seriatim according to their length; said receiver comprising a plurality of movable endless belts, and means for bringing the separator mechanism opposite the various belts one after another.

6. Apparatus for separating and grading fibers according to length comprising a collector and separator having relative movement therebetween, said collector comprising a plurality of revolvable endless belts, and said separator comprising a lap holder, feed rollers, delivery rollers and a doffer between said delivery rollers and collector in position to transfer fibers from the rollers to the collector, said feed rollers and doffer being adapted to grip the fiber loosely and the delivery rollers being adapted to grip the fibers firmly when the apparatus is in operation.

7. Apparatus for separating and grading fibers according to length comprising a collector and separator having relative movement, said separator comprising a pair of delivery rollers adapted to firmly grip and progressively deliver fiber to said collector, feed mechanism movable relatively to said delivery rollers adapted to periodically move forward and then retract to feed fiber to said delivery rollers, means associated with the collector for removing the fiber from the delivery rollers; said means and said feed mechanism adapted to grip the fibers loosely when receiving and feeding the fiber respectively.

8. Apparatus for separating and grading fibers according to length comprising a collector and separator mechanism having a movement relative thereto; said separator mechanism consisting of a carrier for a lap of fiber, delivery rollers, feed rollers between said carrier and delivery rollers; said feed rollers having periodic movement to and from said delivery rollers to present the end of the lap thereto, said feed rollers loosely gripping the lap of fiber and presenting the same to the delivery rollers, and means associated with said collector to loosely grip the fiber to remove the same from said delivery rollers.

9. Apparatus for separating, sorting and grading fibers according to length comprising means for loosely holding and progressively feeding a tuft of fibers, means for intermittently seizing the ends of the fibers so held, firmly gripping, separating and delivering the same, and means having movement relative thereto to successively collect the separated fibers as they are delivered.

10. Apparatus for separating, sorting and grading fibers according to their length comprising members for loosely holding and feeding forward a bunch of fibers in the form of sliver, delivery rollers to seize and firmly grip the ends of the fibers presented to them, and separate them from the bunch, means to intermittently rock the holding members to present the fibers to and withdraw them from the delivery rollers, and means with a relative movement to receive and collect the fibers successively as they emerge from between the delivery rollers.

Signed at Manchester, in the county of Lancaster, England, this 6th day of September 1918.

WILLIAM LAWRENCE BALLS.

Witnesses:

J. OWDEN O'BRIEN,

HARRY BARNFATHER.