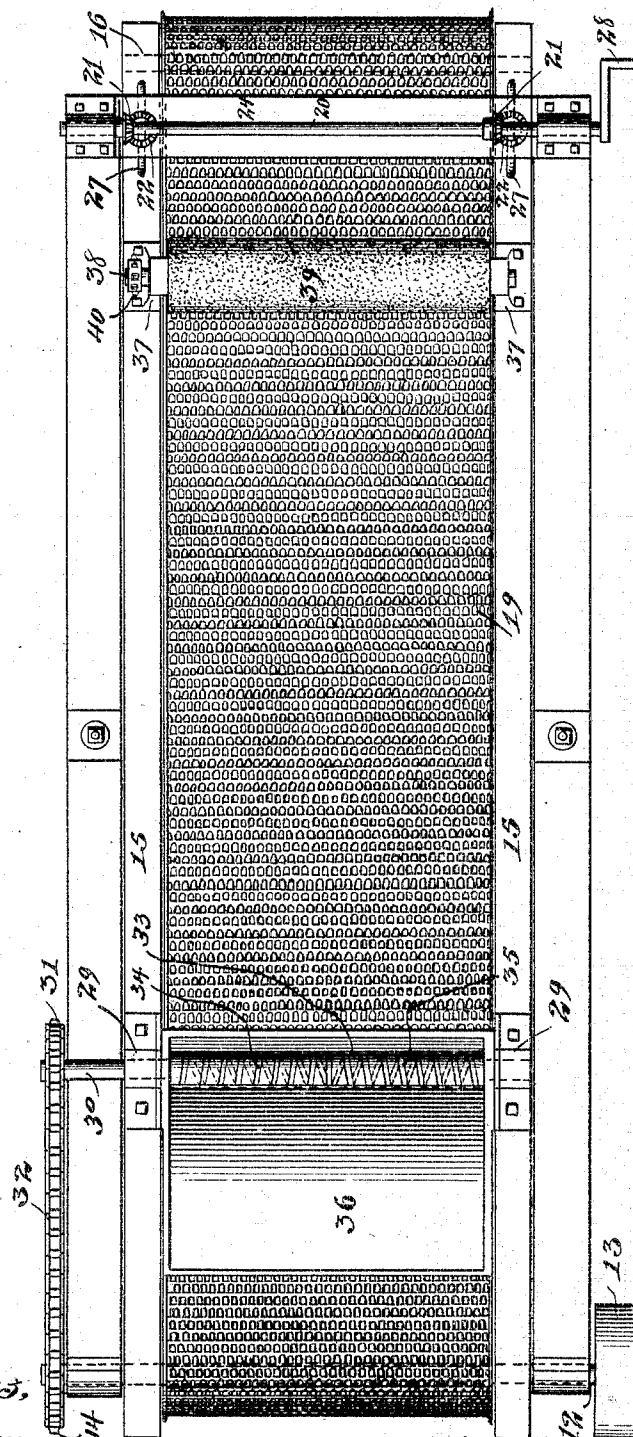


A. P. MACDONALD.
MACHINE FOR GRADING GRAIN.
APPLICATION FILED DEC. 18, 1901.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
J. Mamm.
S. N. Pond.

Inventor,
By Alexander P. MacDonald,
Offield, Dowle & Luthicum
Attys.

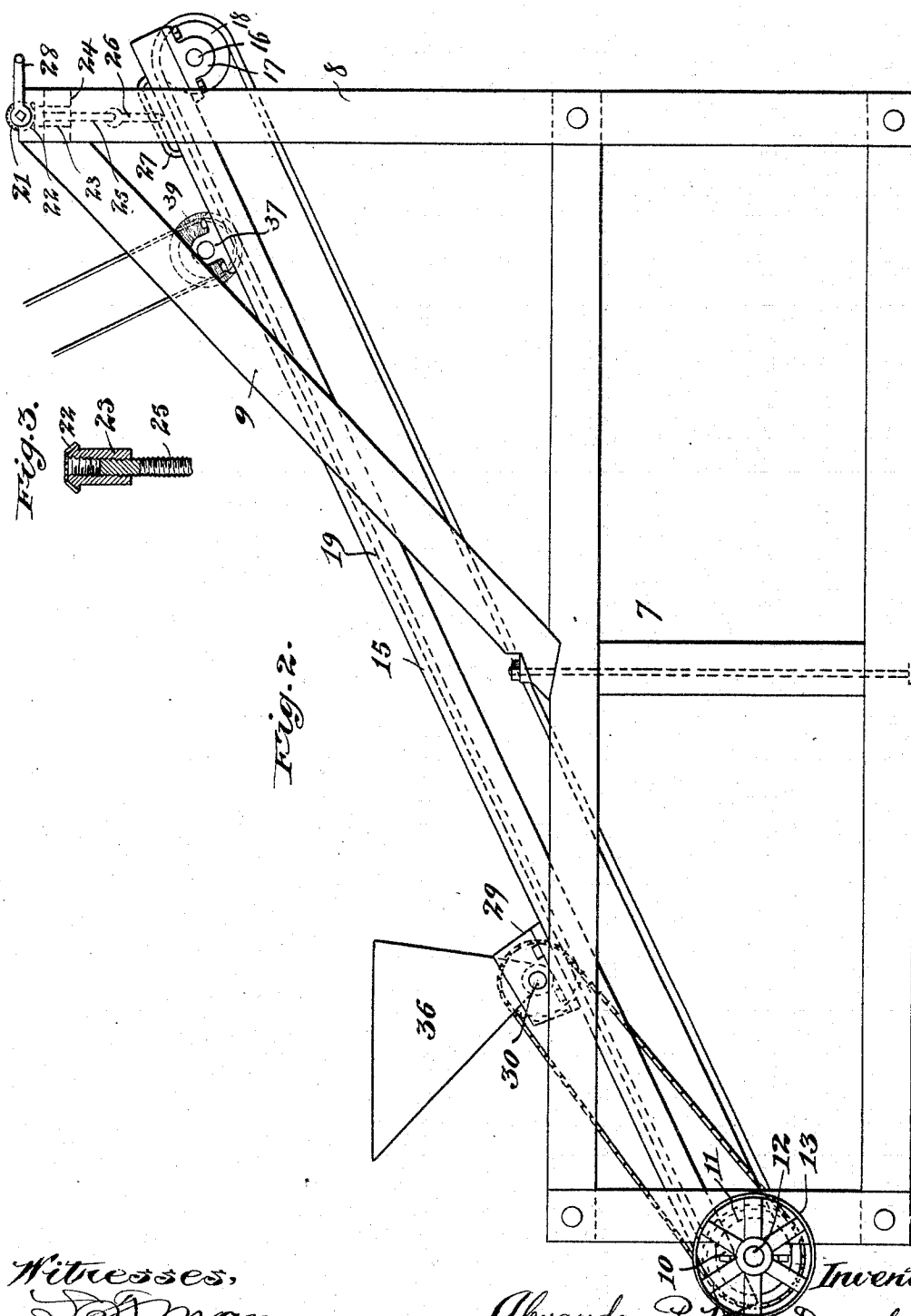
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PATENTED MAY 2, 1905.

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4 SHEETS—SHEET 2.



Witnesses,
J. S. Mann,
S. N. Ford

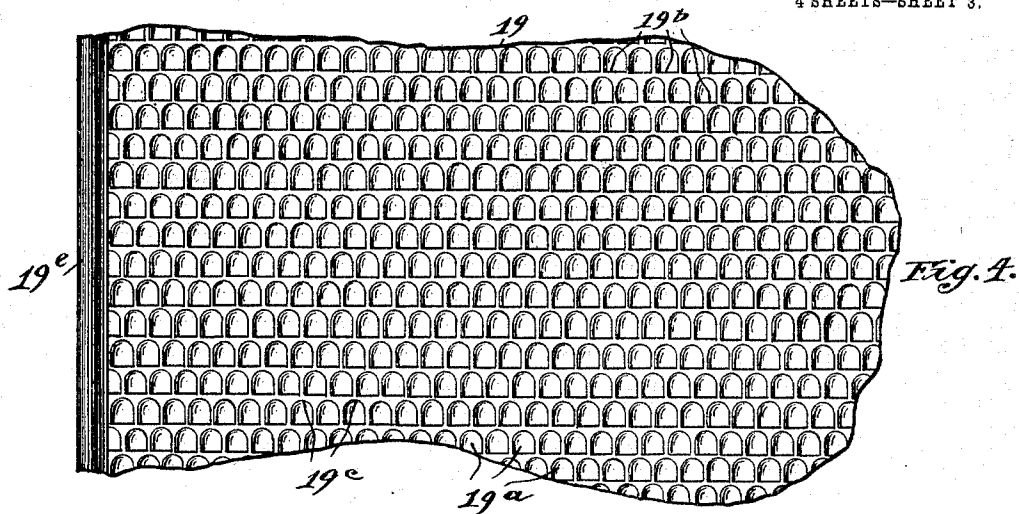
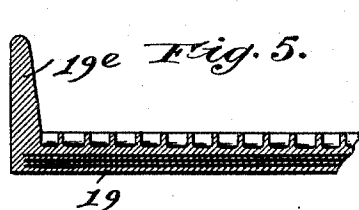
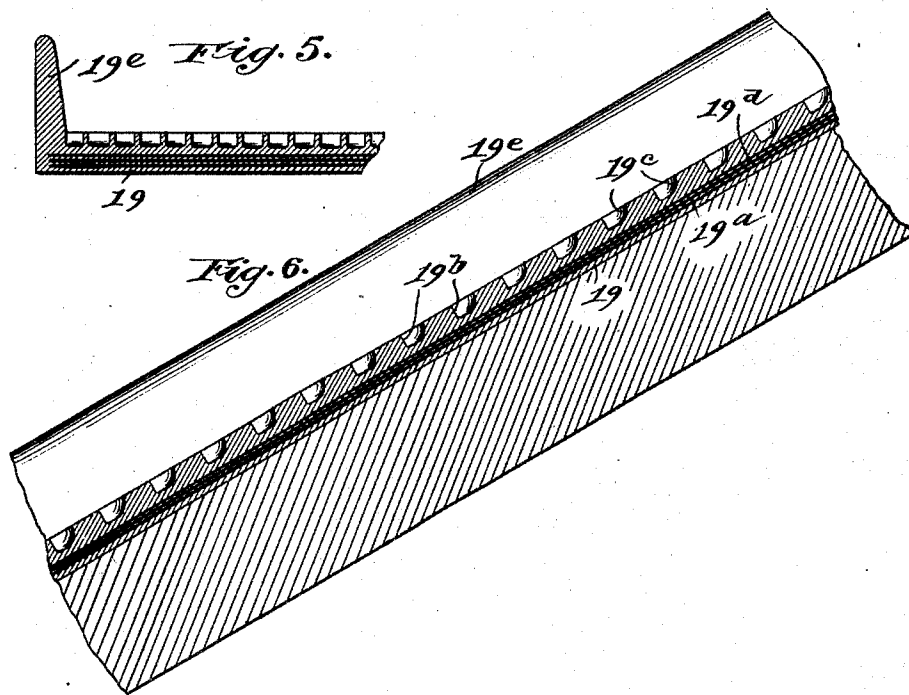
Inventor,
Alexander P. MacDonald,
By *Offield, Towle & Smith*
Attys.

No. 788,839.

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4 SHEETS—SHEET 3.



Witnesses,
J. D. Mann.
E. N. Ford.

Inventor,
Alexander F. MacDonald,
By *Offield, Fowler & Luthicum*
Attys.

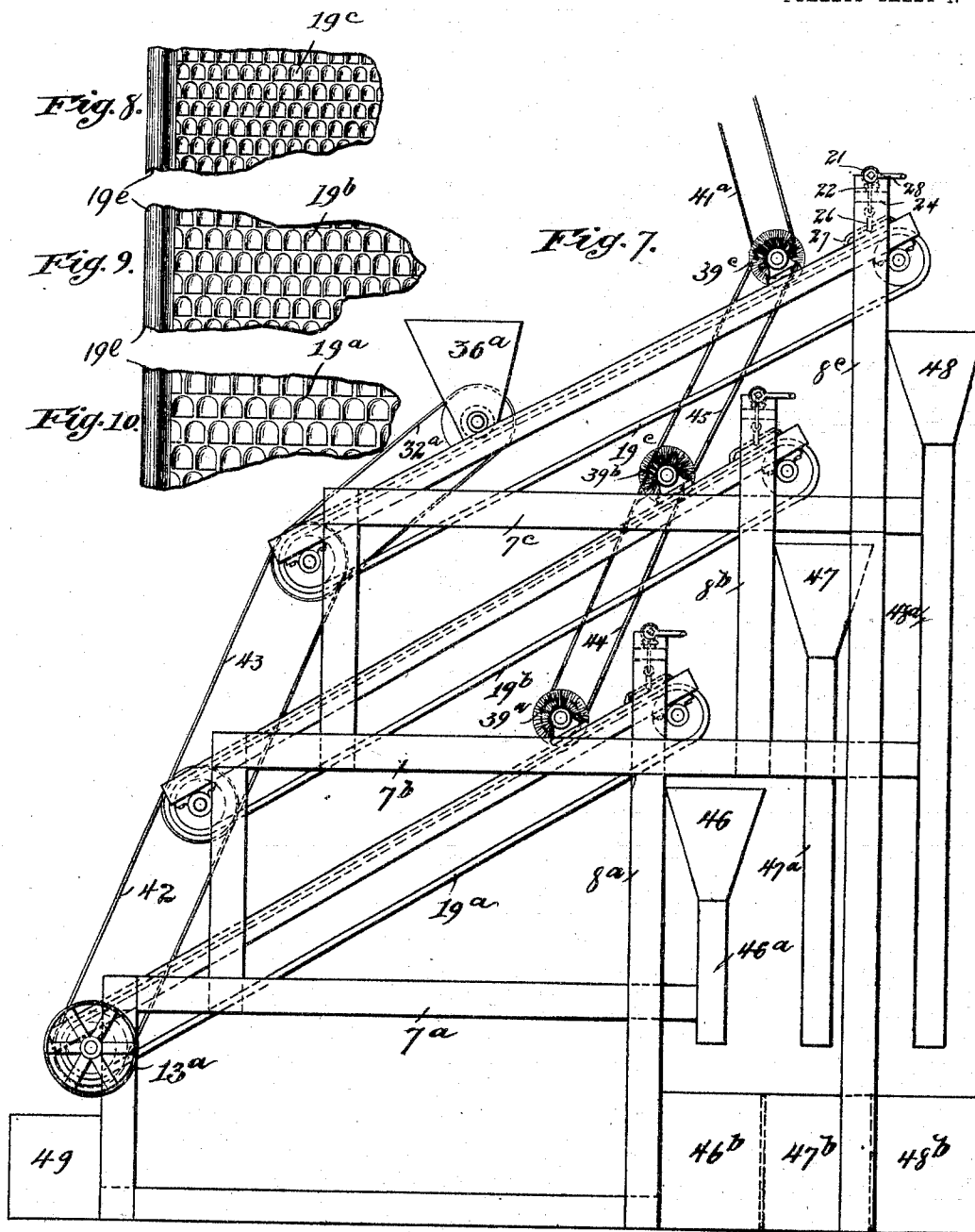
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4 SHEETS—SHEET 4.



Witnesses,
J. J. Mann,
S. N. Ford.

Inventor,
Alexander P. Macdonald,
By *Offield, Doble & Lintner*
Attys.

UNITED STATES PATENT OFFICE.

ALEXANDER P. MACDONALD, OF CHICAGO, ILLINOIS.

MACHINE FOR GRADING GRAIN.

SPECIFICATION forming part of Letters Patent No. 788,839, dated May 2, 1905.

Application filed December 18, 1901. Serial No. 86,428.

To all whom it may concern:

Be it known that I, ALEXANDER P. MACDONALD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Machines for Grading Grain, of which the following is a specification.

My invention relates to machines for grading grain, separating the same according to length of the individual kernels, the invention being designed primarily for use in the grading of oats, but being also capable of use in the grading of other kinds and classes of grain more or less closely allied to oats in respect to the physical structure of the kernels.

Other objects of the invention are the separating of wheat and other foreign grain from the oats, as well as the elimination of cockle-seed and other impurities.

To these and other ends my invention consists of an improved grading-machine having the peculiarities of structure and relative disposition of parts substantially as hereinafter described, and more particularly pointed out in the claims.

My invention, in a preferred embodiment thereof, is illustrated in the drawings accompanying this application, in which—

Figure 1 is a plan view of the machine in its simple form. Fig. 2 is a side elevation thereof. Fig. 3 is a sectional detail illustrating one means which may be employed for adjusting the pitch or inclination of the apron. Figs. 4, 5, and 6 are fragmentary details of the separator-apron in plan, transverse section, and longitudinal section, respectively. Fig. 7 is a side elevation of a machine embodying my invention in series form, showing three superposed separator-aprons in a single structure or frame having separate deliveries for their upper ends and at their lower ends delivering the material in series from the top apron to the bottom; and Figs. 8, 9, and 10 are fragmentary details in plan view of the three aprons illustrated in Fig. 7, showing the variation in the sizes of the cells or pockets.

Referring to the drawings in detail and describing first the simple form of my invention illustrated in Figs. 1 to 6, inclusive, the numeral 7 designates as an entirety a gener-

ally rectangular horizontally-disposed framed structure supporting the operating parts of the machine. The vertical standards at one end of this frame are extended upwardly, as shown at 8, to a suitable height, and the upper ends thereof are connected by oblique braces 9 with the upper horizontal side members of the frame 7. In bearings 10, secured to the uprights at the opposite end of the machine-frame, is journaled a roller 11, the shaft 12 of this roller being provided at one end with a driving-pulley 13 and at its opposite end with a sprocket-wheel 14 for a purpose that will hereinafter appear. Pivotally supported on the shaft 12 at their lower ends and between the outer ends of the roller 11 and the opposite inner faces of the side members of the main frame, as shown in Fig. 1, are a pair of parallel inclined apron-supporting bars 15, which extend at their upper ends between and slightly beyond the upright extensions 8 and are transversely connected at their upper ends by a shaft 16, journaled in brackets 17, secured on the lower faces of the bars 15 and carrying a roller 18, similar to and preferably of like dimensions with the lower roller 11. For convenience I term the upper roller 18 the "head-roller," while the lower roller 11 may be appropriately designated as the "foot-roller." Passing over and between these rollers and filling the space between the side supporting-bars 15 is an endless apron or belt 19, the particular structure and formation of which constitutes an important feature of my present invention and will be hereinafter more particularly described.

In the operation of my machine, as hereinafter set forth, it is sometimes desirable to vary within comparatively narrow limits the pitch or angle of inclination of the apron. This may be done in a great variety of ways; but a simple and convenient mechanism which I have designed for this purpose consists of a transverse shaft 20, journaled in and between the upper ends of the uprights 8, this shaft carrying a pair of bevel-pinions 21, which latter engage, respectively, a pair of companion pinions 22, fast on the upper ends of a pair of internally-threaded sleeves 23. (See Fig. 3.) Each of these sleeves is rotatably

supported in a transverse strut 24, disposed between and connecting the upper ends of the uprights 8 at a point beneath the shaft 20 and above the elevated end of the apron-carrying frame and is entered from its lower end by a screw-threaded suspension-rod 25, the lower end of which latter is bent in hook form and engages the eye of a hook 26, on which latter is suspended, as by means of a staple 27, the side frame member 15. The shaft 20 is provided with a crank 28 or equivalent device for rotating the same. From the foregoing it will be evident that the simple turning of the shaft 20 by the crank 28 or other equivalent operating device will effect the simultaneous upward or downward feed of the pins 25 in and through the sleeves 23, according as the shaft is rotated in one direction or the other, thus raising or lowering the upper and free end of the apron-carrying frame, swinging the latter through a slight angle about its pivotal axis on the shaft of the foot-roller, and thereby adjusting the angular inclination of the apron within and between such extremes or limits of adjustment as are found to be desirable and practicable.

At a suitable point on the upper faces of the side rails 15 of the apron-carrying frame are secured a pair of journal brackets or supports 29, in and between which is journaled a transverse shaft 30, this latter having fixed on one overhanging end thereof a sprocket-wheel 31, which is operatively connected with the sprocket-wheel 14 by a sprocket-chain 32, whereby the shaft 30 is positively driven from the main driving-shaft 12. That portion of the shaft 30 lying between the journal-supports 29 has fixed thereon or formed integral therewith a roller 33, the peripheral surface of which is provided with right-hand and left-hand spiral grooves, (indicated at 34 and 35, respectively,) each spiral groove occupying one-half the surface of the roller and the two grooves meeting at their inner ends at or about the center of the roller. This roller thus formed rotates in or directly below the discharge-opening of a grain-hopper 36, supported by and between the brackets 29 and extending across and a slight distance above the upper surface of the apron 19. The purpose or function of the grooved roller 33 will appear later in the description of the operation of the machine. Also secured to the upper faces of the side rails 15, near the upper ends thereof, are a pair of journal-brackets 37, in which on a shaft or spindle 38 is mounted a rotary brush 39, so disposed relatively to the underlying apron as to just sweep over and contact the upper face of the latter in its rotation. One end of the spindle 38 is provided with means for rotating the same, that herein shown comprising a sprocket-pinion 40, engaged by a sprocket-chain 41, driven from any suitable source of movement, this driving means being preferred because per-

mitting slight adjustments of the apron-frame without necessitating any adjustment or take-up of the driving-chain 41.

Turning now to the construction and formation of the grading and separating apron 19, which constitutes an important element of the machine for the successful performance of its intended function, it will be observed by reference to Figs. 4, 5, and 6, in which the details of said apron are fully shown, that the outer surface of this apron is formed with a multitudinous series of indentations in the nature of small pits, cells, or pockets, which are designated individually by 19^a, these pockets having a substantially straight and plane side wall disposed in a direction normal to the plane of the apron at their lower ends, as indicated at 19^b, and at their opposite or upper ends being dished or concaved and of gradually-increasing shallowness from the lower to the upper end of the cell, as indicated at 19^c, thus forming a cell which is D shape in plan view. As a result of this peculiar formation of the grain-engaging surface of the apron it will be seen that any and all particles of grain which are of a length and size sufficient to enable them to become lodged or fairly caught in the cells 19^a will travel upward therewith and be carried thereby, while such other particles of grain as are too long to become lodged in the cells or pockets will roll down the upper surface of the apron and be discharged from its lower end. The entire endless apron is preferably made of india-rubber, which may be suitably reinforced to increase its strength and durability by longitudinal strips or sheets of canvas or other tough fabric 19^d, embedded therein on or adjacent its inner surface. The outer surface of the apron in which the cells or pockets are formed is, however, made integral, and preferably of solid rubber, since this material possesses a friction-surface peculiarly adapted for coöperation with the character of the grain treated in a degree unequaled by any other material with which I am acquainted. The sides of the apron preferably have comparatively low integral walls 19^e of a height sufficient to prevent spilling and waste of the grain laterally of the apron. These walls by being made of a longitudinally-distensible material, such as rubber, do not interfere with the travel of the apron around the head and foot rollers.

Referring now more particularly to the operation of the machine as an entirety, the hopper 36 is filled or placed in free communication with a source of supply of oats or similar grain to be graded. Suppose, first, that this grain is in a somewhat impure state, containing a percentage of cockle-seed or other undesirable foreign matter. In this case the machine will be provided with an apron, the surface cells or pockets of which are too small to catch and retain the average minimum size of grain-kernels, but which will catch and re-

tain the smaller cockle and other impurities. This grain drops by gravity through the discharge-opening of the hopper and is at once received on the upper surface of the roller 33, the right and left grooves of which serve to distribute the grain therefrom uniformly and evenly over the underlying and upwardly-traveling surface of the separator-apron. The grain thus distributed to the apron travels upward therewith, being more or less agitated thereon, thus causing the foreign matter to easily and readily find lodgment in the pits or cells of the apron, by which it is carried over the head-roller and immediately drops from the apron by the action of gravity. In this operation the oats or other grain lying upon the surface of the apron is swept downwardly and prevented from being carried over the upper end thereof by the brush 39, which continuously rotates with its under surface traveling in a direction opposite to the movement of the apron. Where oats are being thus treated, this operation serves also to eliminate any grains of wheat that may be with the oats, owing to the fact that the wheat-kernel is much shorter than the oat-kernel, and the wheat will therefore lodge in the cells of an apron that would not contain the oats. The machine having thus freed the oats from cockle, wheat, and any other foreign substances possessing a physical structure shorter than the oat-kernel may then be equipped with another apron, or the grain may be transferred to another machine of the same nature possessing an apron formed with larger cells, of a size sufficient to retain grains of and under a predetermined length. Upon putting the grain through this machine in the manner already described a certain proportion of the grain will lodge in the cells of the apron and be carried over, while the remainder, being too large to find lodgment, will be swept back by the brush 39 and be discharged by gravity from the lower end of the apron. The grain thus rejected by this apron may be still again subjected to another machine or another apron having still larger cells and a given quantity of this residuum thus removed. In this way not only may the grain be readily freed from impurities, but it may be accurately graded and separated according to length.

An extension of the fundamental idea and mechanical principle underlying my invention is illustrated in Figs. 7 to 10, inclusive, of the drawings. The form of the machine shown is adapted to treat a given quantity of grain at a single operation, the machine serving to successively separate out cockle-seed, dirt, and relatively small or fine impurities, remove any percentage of wheat that may be mixed with the oats, and finally separate the resulting body of oats into grades according to length. Referring in detail to the construction and organization of this machine, it

will be observed that it comprises substantially a number of the machines illustrated in Figs. 1 to 6, inclusive, superposed in vertical series and having their several rotating elements connected up in series with each other, so as to be driven from a single application of power. 7^a designates the lowermost supporting-frame, having the rear vertical extension 8^a and carrying the endless apron 19^a, driven from the power-pulley 13^a. Upon and carried by the frame 7^a 8^a is a similar supporting-frame 7^b 8^b, carrying an endless apron 19^b, which is driven from the main power-pulley 13^a by means of an ordinary belt connection 42 engaging the foot-roller of the apron 19^b. Superposed upon the frame 7^b 8^b and supported by the latter and the bottom frame 7^a 8^a is a third frame 7^c 8^c, supporting the topmost endless apron 19^c, the foot-roller of which may be driven from the corresponding roller of the apron 19^b by a belt connection 43. Mounted on the side bars of the apron 19^c is a feed-hopper 36^a and driving means therefor 32^a, corresponding in all respects to the similar elements described in connection with Figs. 1 and 2. The three aprons located and arranged as described are provided with rotary sweeps or brushes 39^a, 39^b, and 39^c, respectively, connected by driving cords or belts 44 and 45, the topmost brush 39^c being driven from any suitable source of power by a belt or chain 41^a. Beneath the upper overhanging end of the apron 19^a is located a funnel 46 and discharge-pipe 46^a above a receiving-bin 46^b. Beneath the corresponding end of the apron 19^b is located a similar funnel 47, discharge-pipe 47^a, and receiving-bin 47^b, and beneath the corresponding end of the apron 19^c is located a similar funnel 48, discharge-pipe 48^a, and receiving-bin 48^b. It will be observed that the lower or tail end of the topmost apron 19^c is so located relatively to the next underlying apron 19^b as to discharge onto the upwardly-traveling top surface of the latter, while a similar relation exists between the apron 19^b and the next underlying apron 19^a. It will also be observed by reference to Figs. 8, 9, and 10, which represent fragments of the aprons 19^c, 19^b, and 19^a, respectively, that the cells or pockets are of varying sizes between the topmost and lowermost aprons, the topmost apron having the smallest or finest cells and the lowermost apron having the largest or coarsest cells. The operation of this machine and its capability to effect the purification and several desired separations of the grain by a single continuous operation will be readily understood. The machine having been set in operation, the oats in varying sizes containing a certain percentage of wheat, cockle, dirt, and other foreign substances and impurities is fed continuously into the receiving-hopper 36^a. The topmost apron 19^c separates out the cockle and dirt, discharging the same into the funnel 48 and discharge-pipe

48^a into the receiving box or bin 48^b, the oats and wheat (which are too large to find lodgment in the cells of the apron 19^c) being discharged over the tail of the apron upon the next underlying apron 19^b. This apron will receive the wheat-kernels, which are comparatively short, but rejects all the oats, and the wheat is therefore discharged over the top of the apron through the funnel 47, discharge-pipe 47^a, into the receiving box or bin 47^b. The long and short oats are discharged over the tail of the apron 19^b onto the upwardly-traveling underlying top surface of the lowermost apron 19^a. This apron separates the oats according to length, the shorter kernels finding lodgment in the cells and being carried over the upper end of the apron, through funnel 46 and discharge-pipe 46^a into the receiving box or bin 46^b and the long oats being finally discharged over the tail of the apron into a receiving-bin 49.

It will thus be seen that a machine arranged and organized as hereinabove described performs successively a series of operations which in the case of the simple form of machine illustrated in Figs. 1 and 2 would require either a series of separate and complete machines or the application of aprons having different sizes of cells to the same machine for the performance of the successive operations, either of which would compare unfavorably in point of time and labor required with the compound or multiplex form of machine illustrated in Fig. 7.

Owing to the high degree of friction possessed by india-rubber I have found this to be the most perfect material as yet discovered by me for the purposes described. The frictional character of this material coöperates with and aids the cells or corrugations of the apron in retaining such particles as are to be separated out and carried over with the apron. Moreover, owing to its distensible character, it enables the body or base of the apron to be made integral with its side walls, thus avoiding the necessity of constructing the apron or the side walls of the latter in a number of short sections in order to make the apron travel readily over and around its supporting and guiding rollers. The use of rubber also affords a desirable vibratory quality to the apron, which is not obtainable with any other material not possessing its elasticity.

In practice the apron is given such a degree of inclination as will cause the rejected portion of the grain to fall down thereover during the upward travel of the upper surface of the apron on which it rests or when positively contacted by the brush. In view of the fact that the frictional quality or characteristic of different grains varies somewhat or even of the same grain under different conditions the provision of means for effecting a fine angular adjustment of the apron is an important consideration. The means herein shown and de-

scribed for this purpose constitutes only one out of many which would readily suggest themselves to the skilled mechanic for effecting this result upon becoming acquainted with my invention. An advantage possessed by the adjusting means I have shown resides in the fact that it is self-locking, the pitch of the screw-threads of the sleeve 23 and pin 25 being so slight as to render impossible the actuation of the adjusting devices by the mere weight of the apron and its frame. Again, while a rubber apron or an apron having a rubber grain-engaging surface affords the best surface for the purposes described of all materials with which I am acquainted, yet it will be evident that the results described might be accomplished in a less perfect degree with aprons of other materials possessing a lower degree of friction than rubber.

Although my invention has been designed particularly with reference to its operation in the manner and for the purposes described upon oats and affords the best results in connection with that grain, yet I do not desire to limit myself to its use exclusively with oats, since it might obviously be employed with advantage and perhaps with slight modifications of the character and pitch of the apron in the separation and grading of other cereals more or less closely resembling oats in physical structure.

I do not wish to limit my invention and the scope of the protection sought to be secured thereon to the precise and exact structure and arrangement of the machine and its coöperating arrangements, as herein shown and described, since numerous modifications and equivalents will readily suggest themselves to the mind of a skilled mechanic upon being made acquainted with my invention as herein typically presented.

I claim—

1. In a grain-grading machine, the combination with a supporting-frame, of a stationary foot-roller rotatably mounted at one end of the frame, a pair of longitudinally-inclined side bars pivotally mounted at their lower ends on the shaft of said roller, a head-roller rotatably mounted in and between the upper ends of said side bars, an endless apron running over said rollers and having an indented outer friction-surface, a feed-hopper mounted upon the side bars above and transversely of the apron, a rotary brush also mounted on the side bars transversely of the apron and above the hopper, and means for vertically adjusting the upper ends of the side bars and thus varying the inclination of the apron, substantially as described.

2. In a grain-grading machine, a supporting-frame, a stationary foot-roller rotatably mounted at one end of the frame, a pair of longitudinally-inclined side bars pivotally mounted at their lower ends on the shaft of said roller, a head-roller rotatably mounted in

and between the upper ends of said side bars, an endless grain-separating apron having an indented friction-surface running over said rollers, a feed-hopper mounted upon the side bars above and transversely of the apron, a grooved feed-roller rotatably mounted in the discharge-mouth of the hopper, driving connections between said feed-roller and the shaft of the foot-roller, a rotary brush mounted on the side bars transversely of the apron and above the hopper, means for vertically adjusting the upper ends of the side bars and thus varying the inclination of the apron, and a power-receiving device on the shaft of the foot-roller, said parts being combined and operating substantially as and in the manner set forth.

3. In a grain-grading machine, the combination with a supporting-frame, of a series of superposed endless grain-separating aprons disposed therein in longitudinally-offset relation, said aprons being provided with pockets or cells in their grain-receiving surfaces of gradually-increasing size or capacity from the top of the series to the bottom, substantially as described.

4. In a grain-grading machine, the combination with a supporting-frame, of a series of superposed endless grain-separating aprons disposed therein in longitudinally-offset relation, said aprons being provided with pockets or cells in their grain-receiving surfaces of gradually-increasing size or capacity from the top of the series to the bottom, and a corresponding series of grain-guides and receptacles disposed beneath the upper discharging ends of the respective aprons, substantially as described.

5. In a grain-grading machine, the combination with a supporting-frame, of a series of superposed endless angularly-adjustable grain-separating aprons disposed therein in longitudinally-offset relation, said aprons being provided with pockets or cells in their grain-receiving surfaces of gradually-increasing size or capacity from the top of the series to the bottom, a corresponding series of grain guides and receptacles disposed beneath the upper discharging ends of the respective aprons, and a feed-hopper disposed transversely above the topmost apron of the series, substantially as described.

6. In a grain-grading machine, the combination with a supporting-frame, of a series of superposed endless angularly-adjustable grain-separating aprons disposed therein in longitudinally-offset relation, said aprons being provided with pockets or cells in their grain-receiving surfaces of gradually-increasing size or capacity from the top of the series to the bottom, a corresponding series of grain guides and receptacles disposed beneath the upper discharging ends of the respective aprons, a feed-hopper disposed transversely above the topmost apron of the series, a series of brushes located respectively transversely above the aprons near their upper discharging ends, and driving connections between the brushes of the series, and between the aprons of the series, whereby they are all operated simultaneously, substantially as described.

ALEXANDER P. MACDONALD.

Witnesses:

SAMUEL N. POND,
FREDERICK C. GOODWIN.