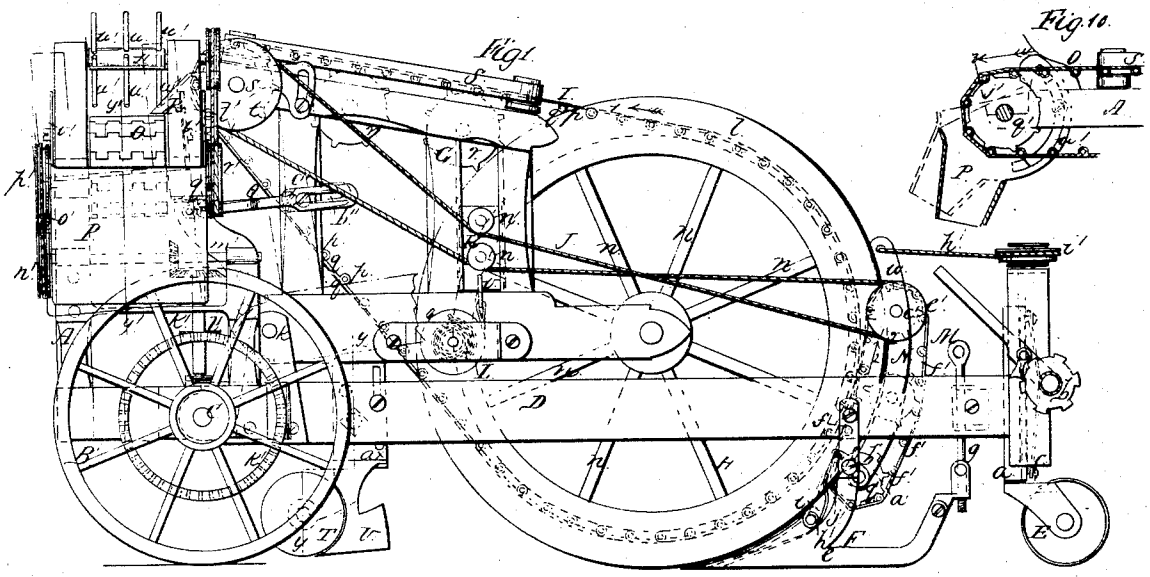
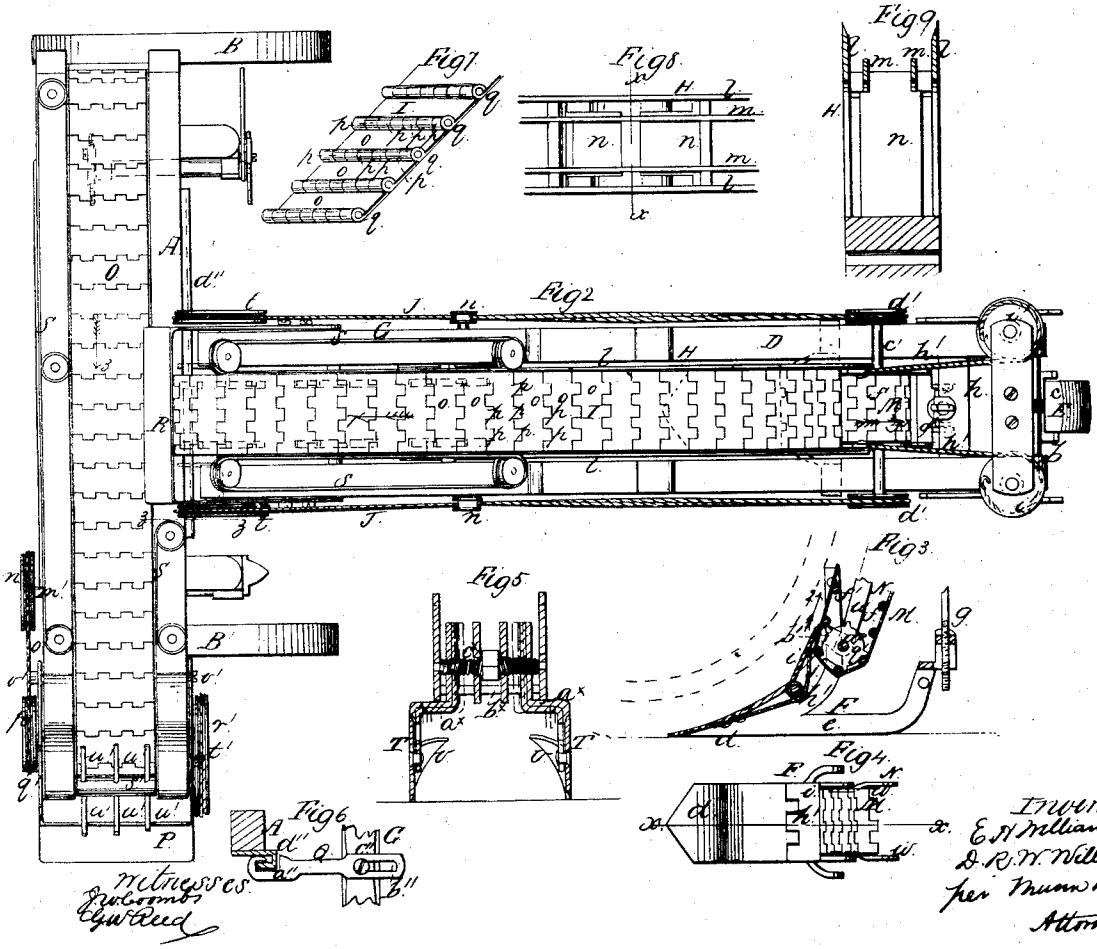
E. H. & D. R. W. Williams.

Excavator.

No. 35,005. Patented Apr. 15, 1862.





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UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN EXCAVATING, PLOWING, AND GRADING MACHINES.

Specification forming part of Letters Patent No. **35,005**, dated April 15, 1862.

To all whom it may concern:

Be it known that we, E. H. WILLIAMS, of Clermont, in the county of Fayette and State of Iowa, and D. R. W. WILLIAMS, of Werner, in the county of Juneau and State of Wisconsin, have invented a new and Improved Machine for Excavating, Grading, Plowing, Trenching, Ridging, &c.; and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, making a part of this specification, in which—

Figure 1 is a side elevation of our invention; Fig. 2, a plan or top view of the same; Fig. 3, a detached vertical section of a portion of the same, taken in the line *x x*, Fig. 4; Fig. 4, a plan or top view of Fig. 3; Fig. 5, a vertical section of a portion of the invention, taken in the line *y y*, Fig. 1; Fig. 6, a section of a portion of the same, taken in the line *z z*, Fig. 2; Fig. 7, a detached perspective view of a portion of a metallic belt pertaining to the same; Fig. 8, a portion of a top or plan view of a colter-wheel pertaining to the same; Fig. 9, a section of Fig. 8, taken in the line *x' x'*; Fig. 10, a vertical section of a portion of the invention, taken in the line *y' y'*, Fig. 1.

Similar letters of reference indicate corresponding parts in the several figures.

This invention consists, first, in the employment or use of an adjustable plow-frame and caster-wheel arranged in such a way and in such relation with each other that the plow is made to work with a steady motion or movement at any angle or degree of inclination, thereby enabling the machine to operate equally as well in deep cuts, where the plow has a considerable inclination, as in cuts near the surface, where the inclination is but slight.

The invention consists, second, in the employment or use of a colter-wheel constructed in skeleton form and placed in an adjustable frame, as hereinafter fully shown and described, and used in connection with an endless metallic carrying-belt, also peculiarly constructed, and also used in connection with a metallic pressure-belt, the above-named parts being so arranged and placed in such relation with each other and with the plow that the earth will be cut in a slice and carried up in a moving box and in an unbroken solid state to the top of the colter-wheel and on the metallic carrying-belt, the latter being operated solely by the colter-wheel in connection with the pressure of the carrying-belt itself, which forms the "tread" or periphery of the colter-wheel.

The invention consists, third, in the employment or use of an elastic mold-board arranged relatively with the share of the plow, supplemental pressure-belt, colter-wheel, and carrying-belt, as hereinafter described, so that the dimensions of the elevating or moving box above referred to may be expanded or contracted to conform to the bulk of its contents, and insure at all times a pressure upon the same sufficient to insure its elevation, all undue pressure at the same time being avoided.

The invention consists, fourth, in the novel arrangement of chains and springs, as hereinafter fully shown and described, for the purpose of driving or operating the pressure-belt and regulating the pressure thereof, the proper moving of the pressure-belt being always insured, and at the same time any undue pressure of the same on the ascending slice of earth prevented.

The invention consists, fifth, in the employment or use of adjustable colters and shares applied to the machine, and arranged, substantially as hereinafter described, for the purpose of widening ditches or trenches while being cut or formed, thereby obviating the friction which would otherwise be produced in consequence of the earth at each side of the ditch or trench being in contact with the sides of the machine.

The invention consists, sixth, in the employment or use of an adjustable discharging-spout and a rotary pulverizer constructed and arranged substantially as hereinafter shown and described, whereby the raised earth, just previous to its discharge from the machine, is pulverized and rendered capable of being discharged upon the ground in lines or ridges at varying points from the edge of the ditch or trench, as may be desired.

To enable those skilled in the art to fully understand and construct our invention, we will proceed to describe it.

A represents the front part of the frame of the machine. This part A may be of rect-

angular form, and it is mounted on two wheels B B′, one or both of which may be adjustable in a vertical direction. It is essential that one of them should be thus adjustable, in order to insure the vertical position of the machine when operating on an inclined surface. The draft-pole is attached to the front part of A, and to the back part of the same there is secured a fixed horizontal rod or axle C, on which the front end of the part D of the frame is fitted and allowed to slide laterally. The part D of the frame is of rectangular form and quite narrow in proportion to its length, the part D being at right angles to A, as shown in Fig. 2, and the back part of D is supported by a caster-wheel E, which is attached to a slide *a*, fitted in D, said slide being connected to a winch *b* by a chain *c*. By adjusting or turning the winch *b* the back part of D may be raised or lowered, as desired. (See Figs. 1 and 2.)

F represents a plow, the share *d* of which is of curved form in its transverse section. The share *d* is permanently attached to a frame *e*, which is connected to the part D of the frame of the machine by pivots *f*. Through the back part of the frame *e* a screw *g* passes, said screw also passing through a cross-bar *h* of D, or to a plate attached thereto. By adjusting or turning this screw *g* the point of the share *d* may be elevated or depressed—that is to say, inclined more or less upward or downward, as may be required. This will be fully understood by referring to Figs. 1 and 3.

To the upper end of the share *d* there is attached, by a hinge or joint *h*, a mold-board *i*, against the back of which a spring *j* bears, said spring being attached to the back of the share *d*, as shown in Figs. 1 and 3.

To the front part of D there is attached, by pivots *k k*, a frame G, and in the back part of this frame G, at its lower part, the axis of a wheel H is fitted. The wheel H is of metal, and its rim is formed of two circular side plates *l l*, which serve as cutters or colters, and two or more circular bars *m m*, which are between the plates *l l*, and to which the ends of the spokes *n* are attached. (See Figs. 8 and 9.) The plates *l l* have a sharp edge, so that they may readily penetrate the earth, and the plates *l l* project sufficiently far beyond the bars *m m* to cut into the earth a distance equivalent to the desired thickness of the slice to be cut.

I represents a metallic endless belt, which is constructed of metal plates *o*, of a suitable width and of a length equal to the space between the colters *l l*. These plates are connected together by joints formed by slotting and swaging the edges of the plates to form eyes *p*, with spaces between them, the eyes of one plate fitting into the spaces between the eyes of its adjoining plates, and a pin *q* passed through the eyes. The eyes *p* are swaged or formed so as to be beneath the plates, the outer surfaces of the latter being flush with each other. (See Figs. 1, 2, and 7.) The plates *o*, it will be seen, are connected together precisely similar to the two leaves of a butt-hinge, and the eyes *p*, with the pins *q* inserted in them, form projections or cogs for the belt, which mesh into toothed rollers *r* in the upper part of the frame G. (See Fig. 1.)

The belt I is fitted on or passes around the wheel H, and is in contact with the annular bars *m m* of the wheel, and the front rollers *r*, around which the belt I passes, are at the front end of the frame G at its upper part. The axis *s* of these front rollers *r* projects through the frame G at both sides, and it has grooved pulleys *t t* upon it, around which chains J J pass, said chains also passing underneath two idle-pulleys *u u*, which are attached to slides K in frame G, one at each side of it. (See Fig. 1.) The slides K are connected by chains *v* with hollow wheels or drums L, having each a coil-spring within them and arranged precisely similar to a watch-spring, and said springs cause the pulleys *u u* to bear upon the chains J J and render them taut for the purpose of driving the part connected with them.

The chain J drives or operates a pressure-belt M, which is constructed precisely similar to belt I, but a trifle narrower, so that it, with the frame N, in which it is fitted, may pass between the colters *l l* of wheel H. This frame N is formed of two curved or segment bars *w w*, the lower ends of which are attached by pivots or a shaft *a′* to projections or lugs *b′* at the upper part of the elastic or yielding mold-board *i*, one at each side, and through the upper parts of the bars *w w* a shaft *c′* passes horizontally, said shaft having a grooved pulley *d′* at each end, around which the chains J J pass. On the shaft *c′*, between the bars *w w*, there are placed two toothed pulleys *e′*, into which the joints *f′* of the belt M mesh in the same way as the joints of belt I mesh into the pulleys *r*. Toothed pulleys *g′* are also placed in the lower part of the frame N for the belt M to pass around, the pulleys *g′* being so placed that the upper end of the mold-board *i* will bear against the lower part of belt M, as shown clearly in Fig. 3.

The upper ends of the bars *w w* of the frame N have each a chain *h′* attached to them, and these chains *h′ h′* are connected at their outer ends to hollow wheels *i′ i′*, having coil-springs within them and arranged precisely similar to those which act upon the slides K K at the sides of the frame G.

Having now described the principal parts of our machine, we will proceed to explain the operation. As the machine is drawn along, the colters *l l* of the wheel H penetrate the earth and cut the sides of the slice to be removed or taken up, while the share *d* cuts the bottom of the slice from the earth. The share *d*, it will be seen by referring to Fig. 1, is in close proximity to the lower part of the wheel H at a point nearly in line with its axis, as shown in Fig. 1. The belt I forms

the tread of the wheel H—that is to say, it rests or bears upon the ground on the top of the slice which is being cut—and the friction of the colters *l l*, in connection with the friction produced by the pressure of the belt I on the ground, insures the rotation or movement of the belt in the direction indicated by the arrows 1. The slice as it is cut is carried up in the wheel H between the colters *l l*, belt I, and the pressure-belt M, the latter being operated by the chains J J and moving in the direction indicated by the arrows 2. The slice, therefore, as it is cut is carried up by what may be termed a "moving box," the only stationary surface it passes over being the share *d* and yielding or elastic mold-board *i*, and as the latter, as well as the apron M, are allowed to yield or give it will be seen that said moving box will contract and expand to suit the varying thickness of the slice. The slice, therefore, will be carried up in a solid or unbroken state, whatever the character or nature of the soil may be, whether clayey or tenacious, or loose, sandy, and friable. This it must be understood is a very important feature of the invention, as it insures perfect operation in every instance. The are many machines for excavating, plowing, &c., which will work passably well in tenacious soils, but which are utterly inefficient in loose sandy soils, on account of the latter not adhering to the apron, the share merely scraping up the loose soil and carrying it along, like a road-scraper.

The chains J J, it will be remembered, operate the pressure-belt M, and in order to insure its perfect operation by having the chains J sufficiently taut the idle pulleys *u u* are made to bear upon the chains by coil-springs. This tightening of the chains J J would cause the belt M to press too hard upon the slice were the chains *h' h'* and coil-springs in the wheels *i' i'* not employed. These latter springs detract from the power of the springs which act upon the chains J, and hence the pressure of belt M upon or against the slice is equal to the power of the springs in the drums L less the power of the springs in the wheels *i' i'*. The chains J, therefore, are rendered sufficiently taut to operate belt M, while the latter is not allowed to bear or press unduly on the ascending slice.

The colters *l l* penetrate the earth by the gravity of the wheel H, chain I, and frame G. It is supposed that this weight will be sufficient for the purpose; but in case experience should prove otherwise the back part of the frame G may be connected to the part D of the frame of the machine by springs, so as to transmit a portion of the weight of D to G. This would be preferable to loading G with extraneous weight, as in the latter case the weight and draft of the machine would be proportionately increased.

As the ditch, furrow, or trench is cut it will be seen that the part D of the frame of the machine is inclined, the caster-wheel E running on the bottom of the ditch, furrow, or trench, and in deep ditching or trenching several cuts of course are made successively, and the part D of the frame, as well as the share *d*, becomes more and more inclined as the wheels B B' of the part A of the frame always run on the surface of the earth at each side of the cut. This inclination of the share, however, does not in the least interfere with its perfect operation, as the caster-wheel E serves as guide or bearing and prevents any lateral or unsteady motion in any direction. The reverse is the case in the operation of ordinary plows, when the share is tilted or inclined, as they have nothing to serve as a bearing at the heel, and consequently a very unsteady draft movement is the result.

In case any particles of earth should find their way between the belt I and the wheel H, they cannot be retained, but will pass down between the annular bars *m m*. This is an important feature in the construction of the wheel H, as it prevents wear and abrasion which would otherwise occur; and we would remark that if necessary the bars *w w* of the frame N of belt M may be provided with shields or guards of such width that they may cover the sides of apron M and prevent earth passing therein. These shields or guards may be constructed of thin metal plates riveted or otherwise secured to the bars *w w*.

There is a feature attending the arrangement and operation of the wheel H and belts I M which must not be overlooked, and that is that a slice or earth elevating device is obtained within a comparatively narrow compass. It is probably impracticable for earth to be elevated on an ordinary smooth endless apron having a greater inclination than forty-five degrees; hence excavators, as previously constructed, are cumbersome and unwieldy, as considerable length of frame is required to accommodate the apron and the machines are turned with considerable difficulty. Our invention obviates this, for it will be seen that the slice is elevated to a height equal to the diameter of the wheel H within a space equal in length to half of the diameter of the wheel.

On the upper surface of the part A of the frame of the machine there is placed an endless horizontal belt O, which is constructed precisely similar to I and works on toothed pulleys *j'*. This apron O is moved or operated in the direction indicated by the arrows 3, Fig. 2, from the wheel B' by bevel-gears *k' k'*, (see Fig. 1,) one of the gears *k'* being on a vertical shaft *l'*, the upper end of which is connected by bevel-gears with a horizontal shaft *m'*, on one end of which a grooved pulley *n'* is placed, said pulley having a chain *o'*, passing around it, which chain also passes around a pulley *p'* at the outer end of the shaft *q'*, which has two of the pulleys *j'* of the apron O upon it. On the inner end of the shaft *q'* there is placed a grooved pulley *r'*,

from which a shaft s' is driven or rotated by a chain t'. (See Figs. 1 and 2.)

The shaft s' is directly above the discharge end of the apron O, and to it there are attached a series of curved arms or beaters u', which are of such a length that they will in rotating just clear the apron O.

To one end of the upper part of the part A of the frame of the machine there is attached an adjustable spout P, which may be constructed of sheet metal. This spout is at the discharge end of the apron O, and it is fitted loosely on the shaft q', so that it may be swung or adjusted in a more or less inclined position. The spout is retained or held at any desired point within the scope of its adjustment or movement by means of screws v', which pass through curved slots w' at the upper part of the spout at each side and into A. This will be understood by referring to Figs. 1, 2, and 10.

The upper part of the part A of the frame of the machine is attached to the upper part of G by means of slotted bars Q, provided with a hook a'' at their front ends. (See Fig. 6.) The slots b'' of these bars have each a screw c'' passing through them into G, and the hooks a'' catch under a ledge or plate d'', attached to the back part of A. This arrangement admits of the parts A D of the frame working independently of each other, so that they may conform perfectly to the inequalities of the surface of the ground over which they pass, and the plate d'' is sufficiently long to admit of the part D of the frame being shoved along on the rod or axle C to any desired point without detaching the bars Q from A. The upper part of A may be permanently attached to G at any time by merely screwing up the screws c''.

To the front and upper end of the frame G there is attached an adjustable apron R. This apron conducts the slice of earth from the belt I to O, and the upper edge of said apron serves as a scraper to clean the belt I and insure the discharge of the earth or slice therefrom upon the belt O. The slice or earth is discharged from the belt O into the spout P, by adjusting which the slice or earth may be deposited in lines or layers nearer to or farther from the sides of the ditch, furrow, or trench. This is also an important feature of the invention, as the layer or slice of earth of each cut may be kept separate and returned or replaced in the ditch or furrow or trench either in the same order as they were excavated or removed or in an inverse order, so that after the work is performed the original surface soil or the subsoil may be left at the surface, as may be desired. The shaft s' and beaters u' pulverize the earth as it is discharged from the belt O, and this pulverizer is important in plowing and trenching the earth for purposes of tillage. In excavating for ditching, draining, &c., it may be dispensed with.

In cases where the earth which is excavated is to be conveyed from the ditch, furrow, or trench it is necessary that the belt O be sufficiently elevated to allow the earth to be discharged into a wagon. The part A, therefore, of the frame must be sufficiently high to admit of this result; but in cases where the earth is to be deposited at the sides of the ditch, furrow, or trench both wheels B B' of A should be vertically adjustable to admit of A being lowered as much as possible, in order that the part D of the frame may not be unduly inclined, a contingency which might occur in deep cuts. In this latter arrangement the belt O must be driven from the wheel H, or from the pulleys t t on shaft s, or other pulleys placed on the same shaft.

Both belts I O may have vertical endless aprons S at each side of them to serve as guards or fenders to prevent the earth from passing laterally off from the belts.

The belt O may have the gearing by which it is driven so arranged as to be capable of being reversed and admit of the belt being moved in either direction. By this means the slices or earth may be discharged at either side of the machine, as circumstances may require, and the slices or earth taken up from either side of the ditch, furrow, or trench and deposited therein.

To the front part of the part D of the frame of the machine there are attached two rotary colters T T and two shares U U. These colters and shares are directly in front of the wheel H, and they perform an important function in widening the cuts, so as to prevent the sides of the same coming in contact with the sides of the wheel H and other parts of the machine. The colters T T and shares U U are attached to plates $a^{\times}$ $a^{\times}$, which are placed loosely on one or more horizontal guide-rods $b^{\times}$ in the part D of the frame of the machine.

The colters T T are simply circular steel plates having sharp edges, and the shares U U are placed directly back of the colters, and are so curved as to throw the earth inward. (See Fig. 5.) The plates $a^{\times}$ $a^{\times}$ have a right and left screw $c^{\times}$ passing through them, by turning which the plates $a^{\times}$ $a^{\times}$, and, consequently, the colters T T and shares U U may be adjusted nearer together or farther apart, as may be desired. These colters and shares, it will be understood, share or cut the sides of the cut previously made by the machine, or, in other words, they always operate in the cut immediately above the one being made by the share F, and the cuts of the colters and shares T U are gradually narrowed from the upper to the lower surface of the ditch or trench, so that a transverse section of the latter when finished will, as the colters or shares cut vertically, be of taper form or have inclined sides formed by a series of step-like projections.

The machine, although in the aggregate composed of quite a number of parts, forms as a whole a simple and efficient device for

the different kinds of work it is designed to perform, and there are no parts liable to get out of repair nor become deranged by use. The machine may be made to cut several furrows side by side parallel with each other, without changing the path of the draft-animals, by simply shoving the part D of the frame along on the rod or axle C of A, and by the same means different layers or cuts deposited at the sides of a ditch, furrow, or trench may be returned or replaced therein, either in the same or in an inverse order to that in which they were removed or excavated.

We would remark that in certain cases—as in stony ground, for instance—it may be desirable to dispense with the colters *l l* on wheel H. In this event the wheel H may be used, having a plain periphery with side guards or fenders at each side of its upper part and attached to the part D of the frame to retain the slice or earth on the belt I.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. Constructing the endless belts I M O, of a series of metallic plates *o*, connected together by joints formed of eyes *p*, which interlock into each other and are so swaged or formed as to receive their pins *q* at the inner sides of the belt, whereby the outer surfaces of the plates will be flush with each other, and projections formed at the inner side of the belts to mesh into toothed pulleys or wheels which are driven by the belts or by which the belts are driven, substantially as herein shown and described.

2. The combination of the adjustable part D of the frame of the machine with the adjustable caster-wheel E and adjustable plow F, all arranged, substantially as shown and described, for the purpose of insuring a steady movement of the plow at any angle or degree of inclination in which it may work.

3. The wheel H, provided with two annular colters *l l*, and two or more annular bars *m m* in connection with the endless belt I, and endless pressure-belt M, arranged in relation with each other and the plow F, to operate as and for the purpose specified.

4. Providing the plow F with a yielding or elastic mold-board *i*, attached to the upper end of the share *d* and arranged, in relation with the belts I M, to operate as and for the purpose set forth.

5. The combination of the chains J J *h' h'*, connected to springs and arranged, substantially as shown, for the purpose of driving or operating the pressure-belt M from the belt I, and preventing the belt M from being subjected to any undue pressure against the ascending slice of earth while the chains J J are kept sufficiently taut to insure the perfect operation of the belt M.

6. The employment of the laterally-adjustable rotating colters T and shares U, arranged and applied to the part D of the frame of the machine and used in connection with the wheel H, belts I M, and plow F, as and for the purpose herein set forth.

7. The adjustable discharging-spout P, attached to the upper part of the part A of the frame of the machine and in relation with the discharge end of the bolt O, as and for the purpose herein described.

8. The rotary beater formed of the rotating shaft *s'*, and beaters *u'*, arranged in relation with the belt O, to operate as and for the purpose set forth.

9. The combination of two endless belts I M, when arranged relatively with each other, a wheel H without the colters *l l*, and a plow F, so as to serve as elevators to carry up the slice of earth as it is cut by the plow.

10. The employment or use of a wheel H, provided with annular colters *l l*, when so arranged as to perform the double function of a rotary colter, and a driving-wheel for operating the endless belt or belts and other working parts of an excavating-machine.

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