

No. 741,335.

PATENTED OCT. 13, 1903.

H. D. HIBBARD.
GRINDING MACHINE.

APPLICATION FILED MAY 24, 1902.

NO MODEL.

6 SHEETS—SHEET 2.

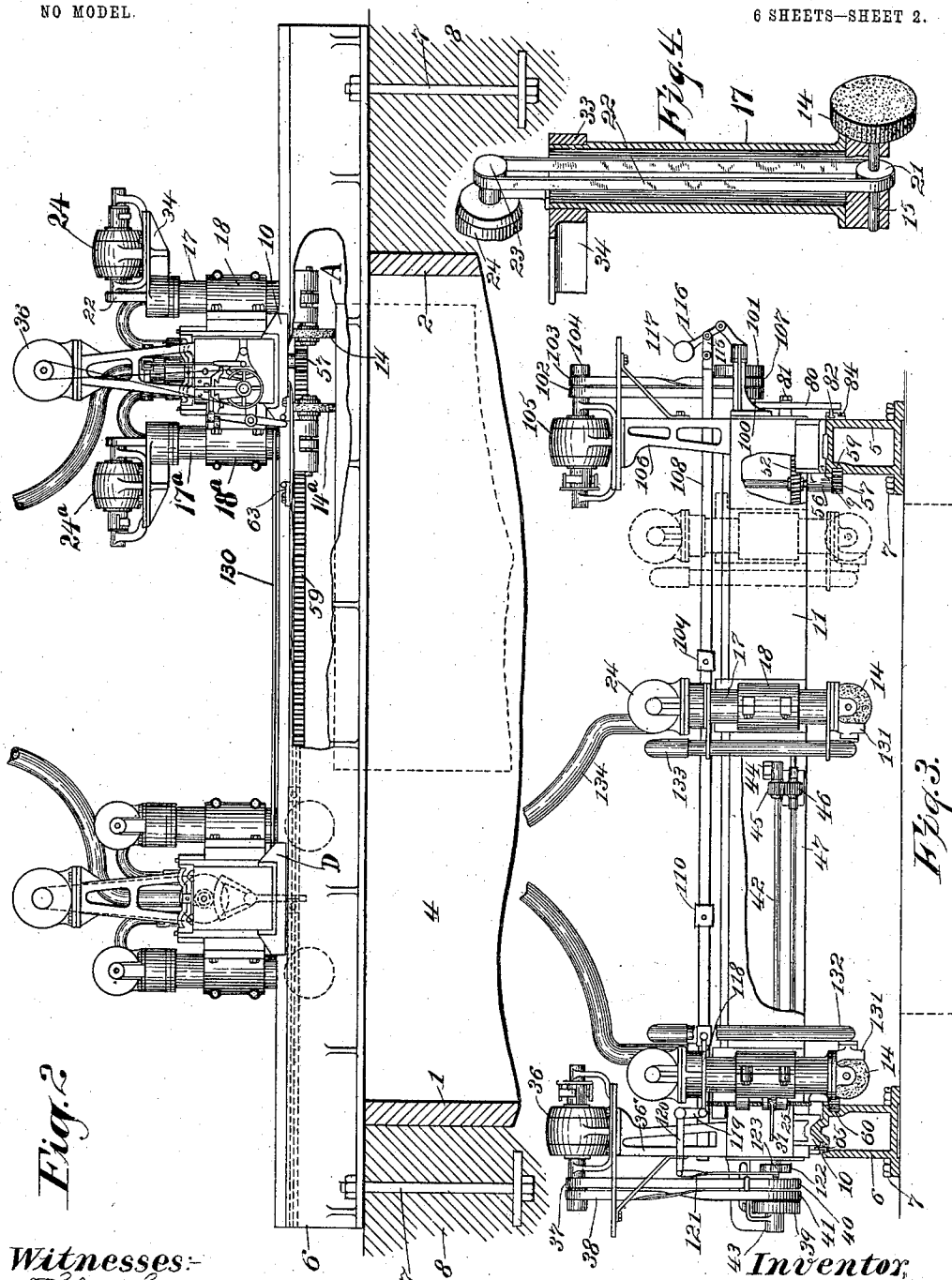


Fig. 2

Fig. 3

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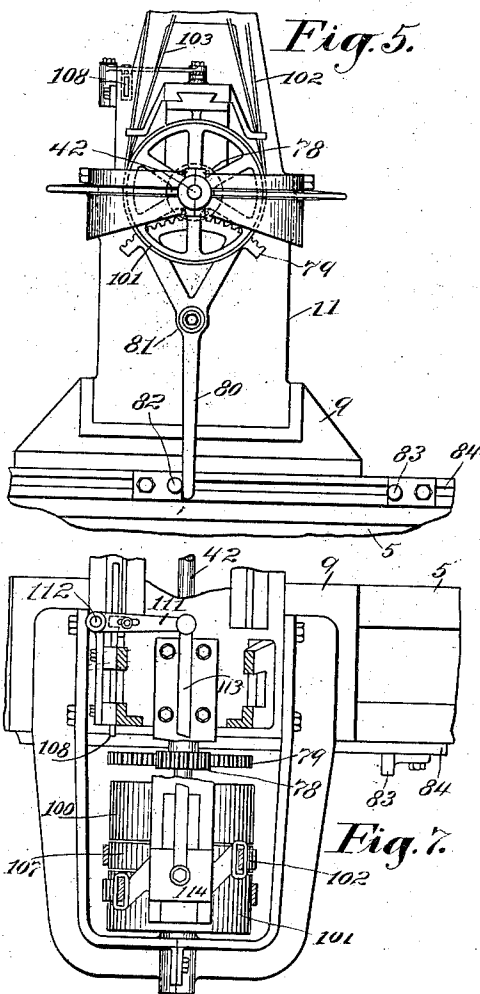
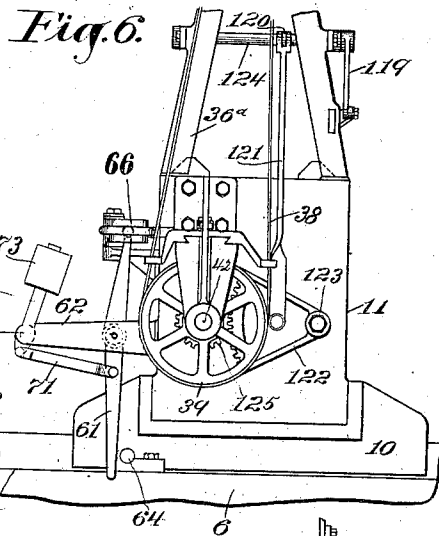
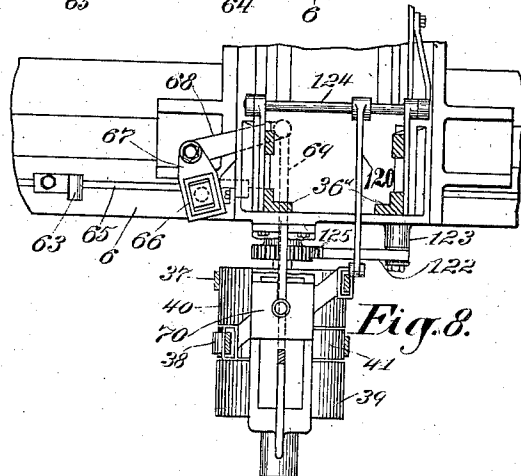
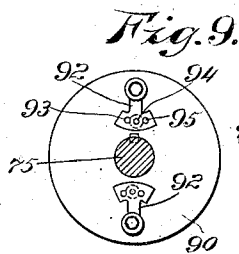
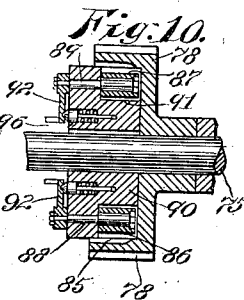
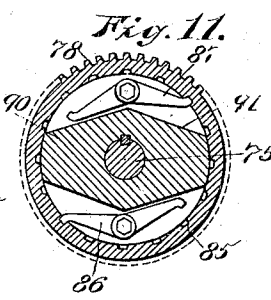
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6 SHEETS—SHEET 3.



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6 SHEETS—SHEET 4.

Fig. 12.

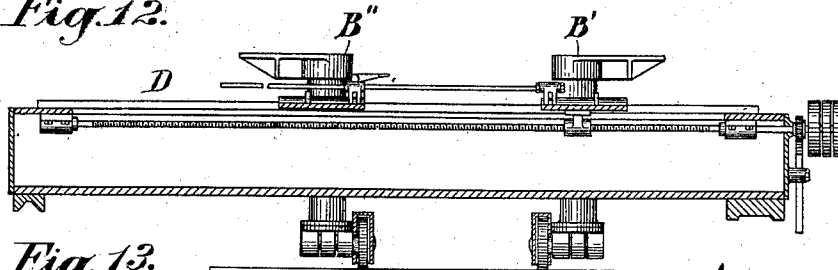


Fig. 13.

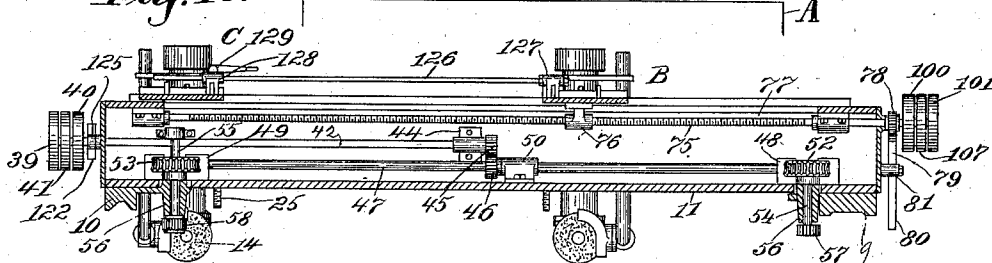
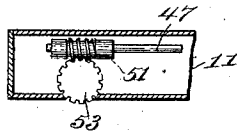


Fig. 14.

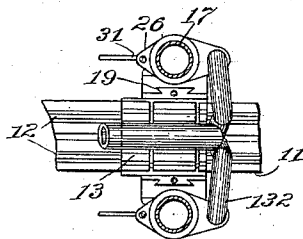


Fig. 15.

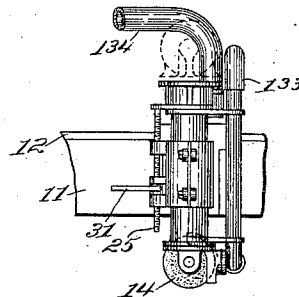


Fig. 16.

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6 SHEETS—SHEET 5.

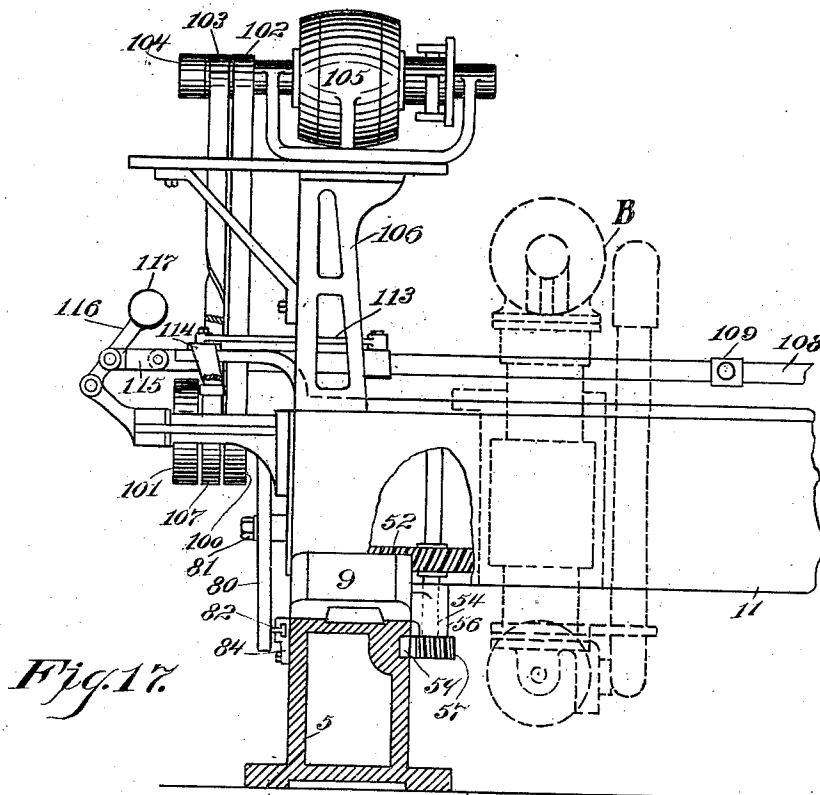


Fig. 17.

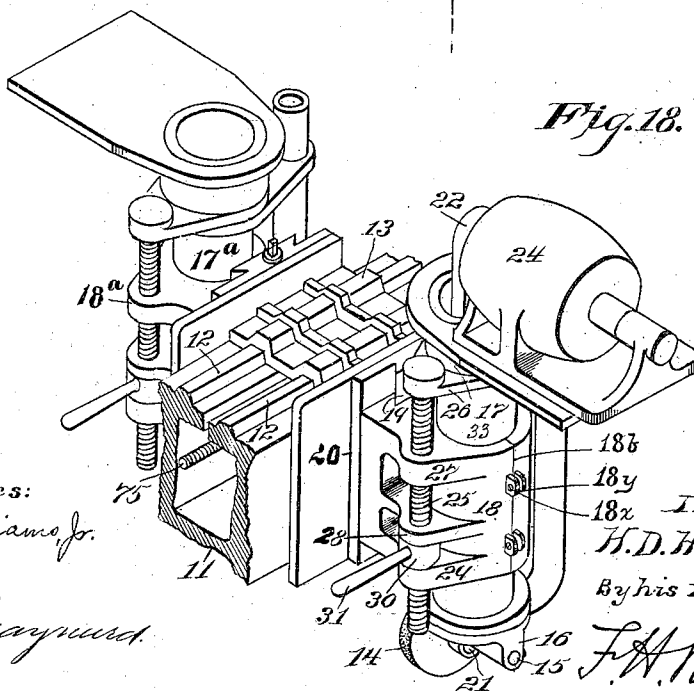


Fig. 18.

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APPLICATION FILED MAY 24, 1902.

NO MODEL.

6 SHEETS—SHEET 6.

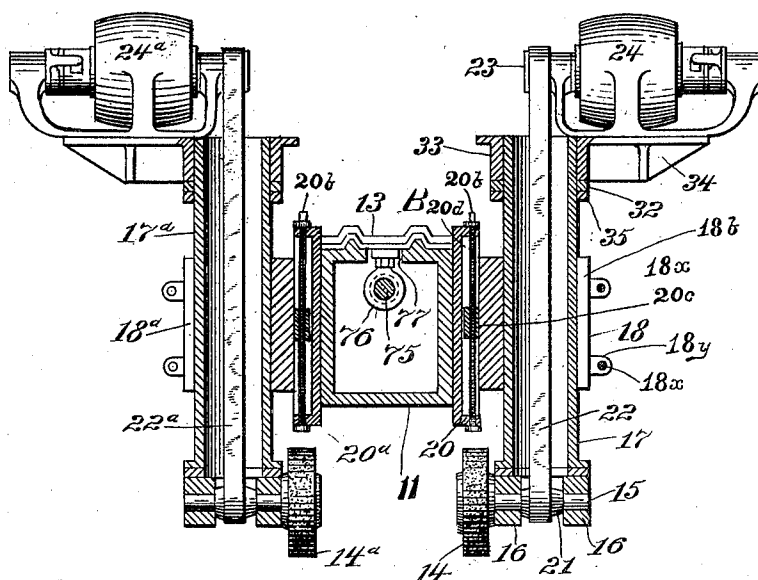


Fig. 19.

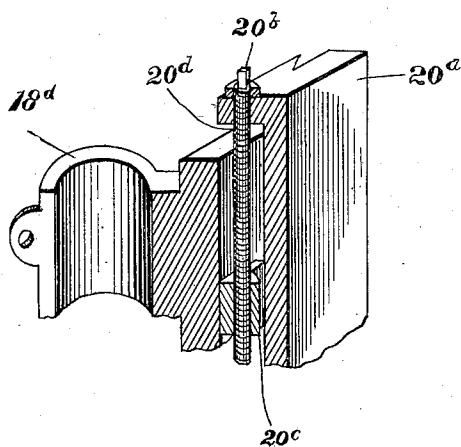


Fig. 20

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F. E. Maynard.

Inventor:

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H. D. Hubbard,
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UNITED STATES PATENT OFFICE.

HENRY DEMING HIBBARD, OF PLAINFIELD, NEW JERSEY, ASSIGNOR TO
MANGANESE STEEL SAFE COMPANY, OF NEW YORK, N. Y., A CORPO-
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GRINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 741,335, dated October 13, 1903.

Application filed May 24, 1902. Serial No. 108,764. (No model.)

To all whom it may concern:

Be it known that I, HENRY DEMING HIBBARD, a citizen of the United States, residing in Plainfield, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Grinding-Machines, of which the following is a specification.

This invention relates to machinery for surfacing or finishing plates, bodies, or castings, and especially those of a bulky character—as, for instance, safes or vault-sections; and its object is to produce a machine for rapidly and accurately finishing such surfaces.

In the accompanying drawings, Figure 1 is a plan of one form of grinding apparatus made in accordance with my improvements. Fig. 2 is an elevational view, partly broken away, of the right-hand side of Fig. 1, a portion of the foundation of the machine being shown in section. Fig. 3 is an end elevation of the apparatus looking at the same from the end shown near the top of the sheet in Fig. 1 and the main rails being shown in cross-section. Fig. 4 is a perspective showing a belt connection between an electric motor and a grinding-wheel. Fig. 5 is a fragmentary elevation upon a larger scale of a portion of the apparatus shown at the upper left-hand side of Fig. 1. Fig. 6 is a similar view of a portion of the upper right-hand side of Fig. 1. Fig. 7 is a plan of the part shown at Fig. 5. Fig. 8 is a plan of the part shown at Fig. 6. Figs. 9, 10, and 11 are details of a reversible pawl-and-ratchet device forming a part of each of several step-by-step feed mechanisms employed in the machine. Fig. 12 is a section illustrative of the construction of one traveling bed or carrier. Fig. 13 is a similar view of another traveling bed or carriage with its driving means. Fig. 14 is a detail plan of a detail of the carriage-driving means seen at Fig. 13. Fig. 15 is a plan, and Fig. 16 an elevation, of a saddle-like traversing-head, several of which are mounted upon the carriages seen at Figs. 12 and 13. Fig. 17 is an elevation of the apparatus seen at the right-hand side of Fig. 3. Fig. 18 is a perspective of a traversing grinding-head, also

showing a fragment of the traveling bed whereon it moves. Fig. 19 is a cross-section of a traveling bed and a grinding-head thereon. Fig. 20 is a perspective sectional view of certain parts shown at Fig. 19 and illustrates particularly the means for effecting fine vertical adjustments of a hollow trunk, within which is adjustably supported a grinding-wheel frame.

In the several views, which are drawn upon various scales, portions are broken away or omitted in order to disclose the invention more clearly, and similar parts are designated by similar characters of reference.

The work, as A, which may be a head or section of a vault or other article, is preferably placed in a pit, whose end walls are seen at 12 and side walls at 34, said pit being preferably oblong and of any required depth and enabling the upper surface of the work to be reached and treated without requiring undue elevation of the finishing machinery from the floor of the workshop. At the sides of the pit is arranged a pair of tracks or rails 56, bolted or anchored at 7 to concrete flooring 8, Fig. 2. Extending transversely of said rails and mounted thereon at its ends by means of shoes 9 and 10 is a traveling bed 11, whose function is to carry the grinding-heads over the work A in a direction parallel with the said tracks 5 and 6. The latter are preferably longer than the pit, so as to enable the operation of the grinders entirely over any article placed therein. Extending longitudinally upon the traveling bed and at right angles to the tracks 5 and 6 are ways 12, upon which slides to and fro a grinding-head, whereby all points of the work may be reached.

In Fig. 19 is shown a grinding-wheel 14, depending from the head 13 and projecting to a lower level than the traveling bed 11, said wheel being mounted by means of a spindle 15, journaled in ears 16, depending from the lower end of a vertical tubular trunk or housing 17, clamped or fastened in a split sleeve or support 18, which has a sliding engagement at 19 with a vertical plate 20, rigid with and forming one side of the traversing head 13 and preferably lying against the side of the traveling-bed 11. Said support 18 may

be adjusted vertically upon the plate 20, so as to throw the grinding-wheel into or out of use or to approximately adjust the same to different heights of the work. Between said ears 16 is mounted a pulley 21, which is connected by a belt 22, housed within the trunk 17, to a pulley 23, mounted upon the arbor of an electric motor, (indicated at 24.) The purpose of mounting a cylindrical trunk in a split sleeve is to enable the trunk to be turned, together with the motor and emery-wheel, so that the plane of rotation of the latter may be made parallel either with the tracks 5 and 6 or the transverse ways 12 on the traveling bed, according to the direction in which the grinding proceeds or, if desired, to enable said emery-wheel to be adjusted to any other desired angle. Vertical adjustments of the trunk may be secured by means of a vertical jack-screw 25, connected at its upper end to an ear 26 of the housing 18 so as to turn in said ear and control the position of the latter, and hence of the trunk. The screw is guided in ears 27, 28, and 29, formed upon the housing. An internal ratchet-nut 30 engages said screw between said ears 28 and 29, said ratchet having a handle 31 and being of well-known construction, whereby the nut may be rotated at will in either direction, so as to elevate or lower the trunk 17 and effect coarse adjustments of the grinding-wheel. It will be seen that the single device 17 carries both the motor 24 and the grinding-wheel 14, so that these two members are positively connected by the belt 22 at all adjustments. The ear 26 is formed upon a loose collar 32, the latter being placed between a boss 33, whereby the motor-platform 34 is secured to the head of the trunk 17, and a collar 35, which is fixed upon said trunk. After adjustment the trunk, which is split at 18^b, may be clamped by screws 18^x, working in ears 18^y in the trunk.

Fine adjustments of both the trunk 17 and the support 18 in which it is clamped may be effected by a screw 20^b, extending vertically through the plate or head 20 and working in a nut 20^c, provided upon the support 18, said nut working up and down in a cavity 20^d in the outer face of the plate 20.

Upon the opposite side of the traveling bed 11 is carried a second grinding-wheel 14^a, connected by a belt 22^a to a motor 24^a, the latter being mounted on a trunk 17^a, carried by a housing 18^a, which is vertically adjustable upon a bed 20^a, forming part of the saddle-like head 13, said second grinding-wheel and its motor being adjustable in the manner already described. By providing a single traversing head with two grinding-wheels the speed or capacity of the machine is doubled, while when desired either of the grinding-wheels may be operated without the other—as, for instance, when taking a very thin finishing cut which it is desirable to make perfectly true. Moreover, both grinding-wheels may be employed either when making a trav-

ersing cut, as at Fig. 19, or when making a traveling cut, the trunks in the latter case being swiveled at right angles to the Fig. 19 position. It will also be seen that whether traveling or traversing either of the grinding-wheels may occupy either of two positions to which it may be brought by rotating the trunk.

The broadside traveling movement of the bed or carrier 11 along the rails 5 and 6 is effected by means of an electric motor 36, Figs. 1, 2, and 3, which is connected by plain and cross-belts 37 and 38 to outer fast pulleys 39 and 40 and inner loose pulley 41, all mounted upon the end of a horizontal shaft 42, which is journaled at its outer end in a bracket 43, carried upon the end of the traveling bed 11 and at its inner end in a bracket 44, mounted about midway within said bed, as at Fig. 3. This shaft carries at its inner end a pinion 45, meshing with a pinion 46, mounted about midway of a horizontal bed-driving shaft 47, which is arranged, preferably, below the shaft 42, Figs. 3 and 13, and mounted at its inner end in a bracket 50, provided upon the bed 11. At its ends said bed-driving shaft 47 carries worms 51, Fig. 14, meshing with worm-wheels 52 and 53, mounted upon vertical shafts 54 and 55, which work in bosses 56, projecting below said bed, and carry at their lower ends pinions 57 and 58, the former meshing with a horizontal rack 59, extending along the upper inner edge of the rail 5 and a rack 60, similarly mounted on the rail 6. Movement is communicated through the belt 37 or 38 in one direction or the other to the shaft 42 and through the pinions 45 and 46 to the main bed-driving shaft 47, which by the worms 51 operate the worm-wheels 52 and 53 and the pinions 57 and 58, thereby driving the carriage along the tracks 5 and 6. Since the motive power is applied equally at each end of the bed, the latter is caused to run without liability of binding or cramping. By placing the pinions 45 and 46 about midway of the bed-driving shaft 47 in case the latter yields somewhat under the torsional stress the torsion will be distributed equally along the shaft on both sides of the pinion 46, and hence the worms 51 will be simultaneously affected and must act in unison under all circumstances. The bed 11 may thus be driven broadside at any rate of speed practicable in a grinding operation without liability of hitching or sticking of the bed or injury to the mechanism.

Preferably the shifting of the belts 37 and 38 and reversal of the movement of the bed is effected automatically while the motor is running, one way of accomplishing this object being illustrated at Figs. 6 and 8, in which it will be seen that a vertical tappet-lever 61 of the first order is mounted upon a bracket 62, projecting from the end of the carriage 11, and is adapted at its lower end to engage adjustable tappets 63 and 64, secured at suitable points along a rail 65,

mounted upon the rail 6, to determine the reversing-points of said bed. At its upper end said lever 61 has a universal connection 66 with a bell-crank lever consisting of arms 67 and 68, the latter being connected by a link 69 to a shipper 70, controlling the belts 37 and 38. Connected to the lever 61 by a link 71 is a double-acting weight or weighted arm 72, which completes the belt-shifting movement of the shipper 70 in either direction after the weight 73 has passed over the pivot 74 of the arm. Thus the bed 11 is driven by the motor 36 along the tracks 5 and 6 to and fro without cessation, the reverse of the movement being accomplished automatically at the termination of each movement of the bed, thus enabling one or both of the grinding-wheels 14 and 14^a to finish the surface of the work A upon a line or lines parallel with the said tracks 5 and 6, said wheels, however, being set so that the plane of revolution thereof may be parallel with the direction of the travel of the bed.

After each back-and-forth movement of the carriage 11 a short transverse feed is effected of the double head B, mounted thereon by means of a screw-shaft 75, extending from side to side of the bed and journaled at its ends in suitable bearings upon the latter, the threaded length of said shaft passing longitudinally through a box-like or hollow traveling bed 11, Figs. 18 and 19, and engaging a threaded carrier or nut 76, depending from the yoke-like head B and passing through a slot 77, formed longitudinally in the top of said bed 11. Upon the end of said shaft 75 opposite from the motor 36 is carried a pinion 78, Figs. 1, 5, 10, 11, and 13, which meshes with a sector 79, carried at the upper end of a vertical lever 80, pivoted at 81 upon this end of the bed 11, the lower end of said lever being adapted to contact with tappets 82 and 83, adjustable along a rail 84, provided on the outer side of the track 5, said tappets being adjusted in harmony with the tappets 63 and 64 upon the other track 6, so that during the terminal portion of the travel of the carriage in either direction the arm or lever 80 may contact with the stationary tappets 82 and 83 and be vibrated thereby, thus through the sector 79 and pinion 78 effecting a slight rotation of the screw-shaft 75 and by means of the nut or carrier 76 causing a slight advance of feed of the double head B along the carriage 11 between the tracks 5 and 6, so that the entire surface of the work may be ground as desired. In Figs. 9 to 11, inclusive, it will be seen that the pinion 78, which is loosely mounted upon the shaft 75, is provided with an internal series of ratchet-teeth 85, engaged by ratchets or pawls 86 and 87, the latter being fixed upon spindles 88 and 89, mounted in a disk 90, which upon its inner side is suitably recessed at 91 for receiving the pawls. Upon the outer end of each of the spindles 88 and 89 is secured an adjustment-arm 92, having notches 93, 94, and 95

for receiving the point of a spring-pressed plunger 96, seated in said disk 90. When said arms 92 are adjusted to either extreme, so that the plunger or detent 96 engages either of the extreme holes 93 or 95, the double pawl 87 is caused to drive the shaft 75 in either one direction or the other, the driving movement of the traveling bed 11 and the movement of the shaft being effected during the stroke of the bed 11 in only one direction, and the movement of lever 80 and pinion 78 during the return stroke of the bed being idle, the point of the pawl slipping freely over the idle movement notches or teeth 85, and the spring-detent 96, by reason of its bevel-point, tending always to maintain a central engagement with the hole 93 or 95, and hence insuring the reengagement of the pawl with the ratchet-wheel 85 upon the next movement of the pinion in its active direction. It will be observed that since the arms 92 may be adjusted independently the pawls 86 and 87 may be caused to coöperate, or one may be set opposite to the other, so as to lock the pinion to the shaft 75, or said arms may be set in a midway position, as at Fig. 9, so that the detents engage the middle holes 94, both pawls thus being thrown out of use, whereby either the shaft or the pinion may be worked independently. Thus it will be seen that as the bed 11 travels up and down the ways 5 and 6 the double head B may feed automatically step by step along said bed in either direction, according to the adjustment of the clutch at Fig. 9, thus giving to each of the grinding-wheels 14 and 14^a a universal range of effective action.

The above-described operation is applicable when finishing either broad or narrow surfaces which extend longitudinally of the pit—as, for instance, side edges of safe or vault sections—the bed 11 moving rapidly back and forth from end to end of the work and the head B feeding across gradually, so that the grinding is uninterrupted. In order, however, to facilitate the finishing of surfaces which extend across the pit—as, for instance, the tops and bottoms of safe bodies or vaults—I provide means for driving the head B rapidly back and forth upon the bed 11 and also for feeding said bed step by step along the tracks 5 and 6 at the termination of the strokes of the head B. During this operation the motor 36, which drives the carriage 11 at speed, is idle, and the devices which shift the belts 37 and 38 are preferably disconnected or rendered inoperative, or, if desired, the tappets 63 and 64 may be slid to the extremes of the rail 65, so as to be ineffective, or they may be removed, and the tappets 82 and 83 may be also put out of use, if desired, while the clutch-controlling handles or levers 92 are each placed at the central inoperative position shown at Fig. 9, thereby throwing off the screw-driving pinion 78 and the sector-lever 80. The screw-shaft 75 may then be driven at speed by means of pulleys 101, fixed

upon the end of said shaft outside of the ratchet 78. Plain and crossed belts 102 and 103 transmit motion from the arbor 104 of a motor 105, carried upon a standard 106, mounted upon the other end of the bed 11. Either one or the other of said belts constantly runs upon a loose pulley 107, placed between the pulleys 100 and 101. By properly proportioning the pulleys and the speed of the motor the screw-shaft may be caused to turn at a rate to drive the double head across the work with the requisite speed.

Upon a horizontal rod 108, suitably mounted at its ends upon the bed or carriage 11 and extending longitudinally thereof, are adjusted tappets 109 and 110, which are adapted to be struck by a part of the traversing head B at the conclusion of the stroke thereof in either direction, thereby driving said rod 108 in one direction or the other, as the case may be, and through an arm 111, pivoted at 112 upon the carriage, and a link member 113, operating a belt-shipper 114, thereby reversing both the rotation of the screw-shaft 75 and the movement of the head B, whereby the latter is caused to reciprocate automatically across said carriage for a distance determined by the adjustment of said stops 109 and 110. I preferably connect to said rod 108 by means of a link 115, Fig. 17, a weighted arm 116 in such a manner that the weight 117 upon said arm may complete the throw of the rod 108 in each direction. The step-by-step or gradual feeding movement of the bed is also effected by means of the long tappet-rod 108, which for this purpose is connected through a link 118, bell-crank arms 119 and 120, and a vertical link 121 to a sector 122, the latter being pivoted at 123 to a vertical face of the same end of the bed 11 which carries the motor 36. Said bell-crank arms are preferably carried by a horizontal spindle 124, mounted in a standard 36^a, which carries the motor 36, said standard being mounted upon the bed 11. The sector 122 meshes with a pinion 125, mounted upon the projecting end of the shaft 42, said pinion being connected to said shaft in like manner and provided with the same appurtenances as the pinion 78, Figs. 9, 10, and 11, so that when said tappet-rod 108 is moved in one direction at the completion of one stroke of the head B said pinion is rotated and by means of the pawl-and-ratchet mechanism the shaft 42 is turned, the latter, through the hereinbefore-described mechanism, feeding the carriage 11 along the ways 5 and 6. Upon the return stroke of said tappet-rod 108 said sector 122 and pinion 125 move idly back, the feeding movement preferably taking place once for each complete excursion of the head B. It will be understood that when the motor 36 is driving the bed longitudinally of the machine the pinion 125 may be disconnected from the shaft 42, as at Fig. 9, and that either of the links 118 and 121 may be disconnected, if desired.

Thus it will be seen that the grinding-machine may be adjusted or set for finishing all parts of a large surface in an expeditious manner, the grinding-wheels being carried rapidly either longitudinally or transversely of the machine, according to the contour or arrangement of the surface of the work, and the frames which carry said wheels being swiveled, so that the latter may cut always in the direction of the rapid movement of the head, either longitudinally or crosswise of the machine as the case may be.

The direction of the rapid movement of the grinding-head may be changed at any time in going over a single piece of work, and the head may be swiveled accordingly, so that all parts of the work may be given a uniform cut and rendered perfectly smooth and plane. By means of the lever 31 and screw 20^b the depth of the cut may be regulated to a nicety, and by having two grinding-wheels upon the double head a rough cut may be taken with expedition, and a light finishing cut may be taken subsequently by a single wheel, the other one being elevated to a position of disuse.

The machine is thus particularly useful for finishing sections of safes or vaults which it is desired to make with liquid-tight joints.

Upon the bed 11 I also preferably mount a second double head C, carrying two grinding-wheels and similar to the head B, said head C being preferably without a driving-nut 76, but instead being connected by a draw-bar or coupler 126 to the head B, said bar being fixed in a bracket 127 upon the head B, Fig. 13, and at the other end running through an eye in a bracket 128, so as to permit adjustment of the head C relatively to the head B. A cam-lever 129 clamps the rod in the eye after adjustment of said head, as at Fig. 13. For some classes of work both the grinding-heads may be employed, thus practically doubling the speed of the machine, while for other work, and especially for finishing cuts, the head C may be disconnected and only the head B used.

By having long tracks 5 and 6 and the pit 1 of corresponding capacity two beds or carriages 11, each provided with one or more double grinding-heads, may be independently operated to advantage upon different portions of the same piece of work or independently upon different pieces of work, and to either or both of said beds may be connected a trailer D, Figs. 1 and 12, which need not be provided with a driving-motor 36 and its appurtenances, but may be adjustably connected to its associate bed 11 by draw-bars 130 and 131, Fig. 1, and driven thereby, thus increasing the capacity of the grinding-machine as a whole, the bed D being provided with one or more double grinding-heads B' and B'' illustrated.

Each grinding-wheel upon the machine is preferably provided with a hood 131, as seen at Fig. 3, which is connected to suitable exhaust-pipes 132 133 134 for drawing off the

dust produced by the grinding, thereby avoiding rapid wear to the various bearings of the machine, whose accuracy it is important to preserve. This feature, however, is made the subject-matter of my pending application filed December 4, 1902, Serial No. 133,808.

Variations may be resorted to within the scope of my invention, and portions of my improvements may be used without others.

It will be seen that each grinding frame or head is power-driven to and fro in transverse horizontal directions over the work, independently-operable power-driven means being provided for rotating the grinder during all of said movements of said head; that said head is driven automatically to and fro at speed in one direction and step by step in a transverse direction, the step-by-step movement being either forward or backward at the will of the attendant; that said head-frame may be moved either along the main tracks 5 and 6 or transversely thereto either at speed or step by step at will; that mechanism is provided for driving the grinder in one direction, mechanism for driving it in a transverse direction, and means for enabling either of said mechanisms to actuate the other thereof, each of said driving mechanisms being operable either at speed or gradually at will and movable gradually either forth or back at will; that said head is movable at speed by means of a motor, means independent of said motor being provided for moving said head step by step in the same direction; that when the head is driven to and fro at speed in either direction it is caused to move step by step in a transverse direction either forth or back at the will of the attendant; that means are common to the two motors 36 and 105 for driving said head at speed in either of two transverse directions and gradually in the other of said directions at will, and that motor-driven mechanism is provided for driving the head in one direction, independent motor-driven mechanism for driving said frame in a transverse direction, and means for enabling either of said mechanisms to actuate the other thereof either forth or back.

Having described my invention, I claim—

1. The combination with a frame or head having means for supporting a grinder, of power-driven means for moving said frame in one direction over the work, independently-operable power-driven means for moving said frame in a transverse direction over the work, and means operable independently of all of said moving means for revolving said grinder during the movement of said frame.

2. The combination with a frame adapted to carry a grinder of a fixed track along which said frame may move, electrically-operated means moving along said track with said frame, for driving said frame to and fro over the work in a direction transversely to said track, means for driving said frame to and

fro along said track, and an electric motor carried upon said frame and connected by a belt to said grinder.

3. The combination with a frame or head having means for supporting a grinder, of means for driving said frame at speed in one direction and step by step in a transverse direction over the work, and means for revolving said grinder during the movement of said frame.

4. The combination with a frame adapted to carry a grinder, of a motor upon said frame, a fixed rail along which said frame may move, a traveling motor for driving said frame at speed to and fro along said rail, means for driving the frame gradually transversely of said rail, and means for revolving said grinder while the frame is in motion.

5. The combination with a frame of means for driving said frame in transverse directions over the work, said means including an electric motor which travels in one direction together with said frame, a grinder upon said frame, and a motor connected to said grinder.

6. The combination with a grinder-supporting frame of a single electric motor traveling with said frame in one direction and operatively connected to means for driving said frame to and fro in transverse horizontal directions over the work, and an electric motor upon said frame for driving said grinder.

7. The combination with a frame adapted to support a grinding-wheel of a rail along which said frame may move over the work, an electric motor upon said frame for driving said grinding-wheel, and an electric motor traveling with said frame along said rail and operatively connected to means for driving said frame at speed along said rail and step by step transversely of said rail.

8. The combination of a frame having means for supporting and rotating a grinder, of a way or guide for said frame, and means for moving said frame upon or along said way or guide either at speed or step by step, at will.

9. The combination with a frame having means for carrying a grinder, of a way or guide for said frame, means for moving said frame to and fro upon or along said guide either at speed or step by step at will, and independently-operable means for revolving said grinder.

10. The combination with a frame adapted to carry a grinder, of a rail along which said frame may move over the work; means for driving said frame to and fro along said rail either at speed or step by step at will, and also for moving said frame transversely of said rail; and means for rotating said grinder.

11. The combination with a frame adapted to carry a grinder, of a fixed rail along which said frame may move; a traveling prime motor for driving said frame to and fro at speed along said rail and also step by step transversely of said rail; a traveling prime motor

for driving said frame at speed transversely of said rail; and a prime motor also mounted upon said frame for driving said grinder.

12. The combination with a frame adapted to carry a grinder, of a rail along which said frame may move; a motor connected to means for effecting movement of said frame at speed along said rail and gradually in a direction transverse to said rail, said motor also traveling along said rail with said frame; a motor also traveling with said frame along said rail and connected to means for driving said frame at speed transversely of said rail; and a motor for driving said grinder.

13. The combination with a frame adapted to carry a grinder, of a rail along which said frame may move; a motor connected to means for driving said frame to and fro at speed along said rail and also step by step transversely of said rail; a motor connected to means for driving said frame at speed transversely of said rail and step by step along said rail; and a motor for rotating said grinder.

14. The combination with a frame adapted to carry a grinder, of a rail along which said frame may move; a motor connected to means for effecting a movement of said frame at speed along said rail, and gradually either forth or back at will in a direction transverse to said rail, said motor also traveling along said rail with said frame; a motor also traveling with said frame along said rail and connected to means for driving said frame at speed transversely of said rail and gradually either forth or back at will along said rail; and a motor for rotating said grinder.

15. The combination with a grinder-frame, of means for driving said frame at speed in either of two transverse directions and step by step either forth or back in the other of said directions, at will.

16. The combination with a frame, of a grinder and a grinder-driving motor thereon, and means including automatic reversing mechanism, for driving said frame at speed automatically to and fro in either of two transverse directions and automatically step by step in the other of said directions at will.

17. A grinding apparatus having a grinder-frame and means for driving the same in transverse directions; said driving means including a motor and means operable thereby for driving the frame to and fro at speed in the first direction and step by step in the second direction, and also including a motor and means operable thereby for driving the frame step by step in the first direction and at speed in the second direction; one of said motors being operable while the other is idle.

18. The combination with a grinder-frame and devices for effecting movement thereof in transverse directions, of a motor connectible to one of said devices for driving said frame in one direction; a motor connectible to the other of said devices for driving said frame in the other direction; and means op-

erable upon the completion of the movement of said frame effected by either of said motors, for causing the driving device associated with the other of said motors to advance said frame a step.

19. The combination with a grinder-frame, of mechanism for driving said frame in one direction; mechanism for driving said frame in a transverse direction, and means for enabling one of said driving mechanisms to actuate the other thereof.

20. The combination with a grinder-frame, of mechanism for driving said frame in one direction, mechanism for driving said frame in a transverse direction, and means for actuating either of said driving mechanisms either at speed or gradually at will.

21. The combination with a grinder-frame, of mechanism for driving said frame in one direction, mechanism for driving said frame in a transverse direction, means for actuating either of said driving mechanisms either at speed or gradually at will, and means for enabling either driving mechanism when operating at speed to effect gradual movements of the other driving mechanism.

22. The combination with a grinder-frame, of mechanism for driving said frame in one direction, mechanism for driving said frame in a transverse direction, means for actuating either of said driving mechanisms either at speed or gradually at will, means for enabling either driving mechanism when operating at speed to effect gradual movements of the other driving mechanism, and means operating automatically for reversing the direction of movement of said frame at the termination of its movement at speed in each direction.

23. The combination with a frame having means for supporting a grinder, of a guide for said frame, a motor for moving said frame upon or along said guide at speed, and means independent of said motor for moving said frame along said guide step by step.

24. The combination with a frame adapted to carry a grinder, of a fixed horizontal rail along which said frame may move over the work, means for driving said frame to and fro along said rail at speed, said driving means including a motor, belt connections and automatic belt-shifting mechanism, means for moving said frame transversely of said rail, and a motor upon said frame for driving said grinder.

25. The combination of a frame having means for supporting both a grinder and a motor, of means for driving said frame at speed to and fro in either of two transverse directions, and at the same time gradually in the other of said directions, at will.

26. The combination with a grinder-frame, of means, including an electric motor, belt connections and belt-shifting mechanism, for driving said frame at speed automatically to and fro in either of two transverse directions and automatically step by step in the other of said directions at will, said driv-

ing means traveling with said frame in one of said directions, and an electric motor for rotating the grinder.

27. The combination with a grinder-frame of motor-driven mechanism for driving said frame in one direction, motor-driven mechanism for driving said frame in a transverse direction, and means for enabling either of said driving mechanisms to actuate the other thereof either forth or back.

28. The combination with a grinder-frame of mechanism for driving said frame in one direction, mechanism for driving said frame in a transverse direction, and motor-driven means for actuating either of said driving mechanisms in opposite directions either at speed or gradually at will.

29. The combination with a grinder-frame of mechanism for driving said frame to and fro in one direction, mechanism for driving said frame to and fro in a transverse direction, means for actuating either of said driving mechanisms at speed, and means for enabling either driving mechanism when operating at speed to effect gradual movements either back or forth of the other driving mechanism.

30. The combination with a frame having means for supporting a grinder, of a bed whereon said frame is mounted, means for driving said frame along over the work in one direction, means for driving said bed in a transverse direction, and an electric motor upon said frame for rotating said grinder.

31. The combination with fixed tracks or rails between which the work may rest, of a bed moving upon said rails over the work; a grinder-frame mounted upon said bed; means for driving said frame at speed along said bed; means for driving said bed gradually along said rails; and means for rotating the grinder.

32. The combination with fixed rails between which the work may rest, of a bed moving upon said rails over the work; a grinder-frame mounted upon said bed; power-driven means operable at will for driving said bed at speed along said rails; independent power-driven means operable at will for driving said frame at speed along said bed; and independently-operable means for rotating the grinder.

33. The combination with fixed rails between which the work may rest, of a bed moving upon said rails over the work; a grinder-frame mounted upon said bed; means operable at will for driving said bed to and fro along said rails at speed and also driving said frame step by step along said bed; means operable at will for driving said frame at speed to and fro along said bed and also driving said bed step by step along said rails; and means for rotating the grinder.

34. The combination of tracks between which the work may rest of a bed extending from track to track, an electric motor mounted upon said bed and connected to means for driving said bed along said tracks, a grinder-

frame upon said bed, a second electric motor mounted upon said bed and connected to means for driving said grinder-frame along said bed, and means for rotating the grinder.

35. The combination with fixed ways, of a bed thereon, an electric motor mounted upon said bed and connected to means for driving the latter at speed along said ways, a grinder-frame mounted upon said bed, means also operated by said motor for advancing said frame gradually along said bed, and means for rotating the grinder.

36. The combination with fixed tracks between which the work may rest, of a bed moving upon said tracks over the work, a grinder-frame mounted upon said bed, an electric motor connected to means for driving said frame at speed along said bed, means called into action by the movement of said frame for driving said bed gradually along said rails, and means for rotating the grinder.

37. The combination with fixed tracks between which the work may rest, of a bed moving upon said tracks over the work, a frame mounted upon said bed, a grinder swiveled upon said frame, an electric motor mounted upon one end of said bed and connected to means for driving the latter to and fro along said tracks at speed and also driving said frame step by step along said bed; an electric motor mounted upon the other end of said bed and connected to means for driving said frame at speed to and fro along said bed and also driving said bed step by step along said tracks; and an electric motor upon said frame for rotating the grinder.

38. The combination with a frame or head having means for supporting a grinding-wheel, of power-driven means for moving said frame over the work, means for revolving said grinding-wheel during the movement of said frame, and means for enabling the plane of rotation of said grinding-wheel to be changed to suit the direction in which the cut is being made.

39. The combination with a frame or head having means for carrying a grinder, of means for driving said frame to and fro in transverse horizontal directions over the work, means for revolving said grinder during the movements of said frame, and means for enabling said grinder to swivel.

40. The combination with a frame or head of a fixed track along which said frame may move, means for driving said frame over the work in a direction at right angles to said track, and a device swiveled on said frame and carrying both a grinder and means for rotating said grinder.

41. The combination with a frame of a device thereon adapted to carry a grinding-wheel; a fixed horizontal track along which said frame may move; a motor upon said frame; a belt connecting said motor to said grinding-wheel; means for setting said device in different positions upon said frame so as to change the plane of rotation of said

grinding-wheel; and means for driving said frame over the work in a direction transverse to said track.

42. The combination with a frame adapted to carry a grinder, of a fixed track along which said frame may move; electrically-operated means moving along said track with said frame for driving the latter to and fro over the work in a direction transverse to said track; means for driving said frame to and fro along said track; an electric motor carried upon said frame and connected by a belt to said grinder; and means for enabling the adjustment of said electric motor and grinder upon said frame into parallelism with the direction of the movement of the frame either along said track or transversely thereto.

43. The combination with a frame adapted to carry a grinder, of a rail along which said frame may move over the work; means for driving said frame to and fro along said rail either at speed or step by step at will, and also for moving said frame transversely of said rail; and means for rotating said grinder in different planes.

44. The combination with a frame adapted to carry a grinder, of a fixed rail along which said frame may move; a motor for driving said frame to and fro at speed along said rail and also step by step transversely of said rail; a motor for driving said frame at speed transversely of said rail; a motor for driving said grinder; and adjustable means for enabling said grinder to rotate in planes vertical to the work but parallel with the direction in which said frame is driven at speed.

45. The combination with a frame of a device swiveled thereon and adapted to carry a grinding-wheel, of a fixed rail along which said frame may move; a motor; means connected to said motor for effecting movement of said frame at speed along said rail and gradually in a direction transverse to said rail; said motor also traveling along said rail with said frame; a motor also traveling with said frame along said rail and connected to means for driving said frame at speed transversely of said rail; and a motor upon said swiveled device for driving said grinding-wheel.

46. The combination with a device adapted to carry a grinder which rotates in planes vertical to the work, of a fixed rail along which said device may move; means for setting said device to different positions so as to enable said grinder to rotate in different planes; a motor effecting a movement of said device at speed along said rail and gradually in a direction transverse to said rail, said motor also traveling along said rail with said device; a motor also traveling with said device along said rail and connected to means for driving said device at speed along said rail and step by step in a direction transversely thereto; and a motor also mounted upon said grinder-carrying device for rotating said grinder.

47. The combination with a support for a

grinding-wheel of means upon said support for rotating said wheel; means for setting said support so that said wheel may rotate in different planes; and means for driving said support in either of two transverse directions either at speed or gradually at will.

48. The combination with a grinder-frame of means for driving the same in transverse directions, said driving means including a motor which drives the frame to and fro at speed in the first direction and step by step in the second direction, and also including a motor which drives the frame step by step in the first direction and at speed in the second direction, one of said motors being effective while the other is idle; and means for rotating said grinder in a plane parallel with the direction in which it is driven at speed.

49. The combination with a grinder-frame of mechanism for driving said frame to and fro in one direction; mechanism for driving said frame to and fro in a transverse direction; means for actuating either of said driving mechanisms at speed; means for cooperating with either driving mechanism when operating at speed to effect gradual movements either back or forth of the other driving mechanism; independent means upon said frame for rotating said grinder; and means for setting said grinder in different planes.

50. The combination with a horizontal track of a bed mounted thereon, means for moving said bed along said track, a grinder-frame upon said bed, means for moving said frame along said bed, a device swiveled upon said frame, a grinder upon said swiveled device, and means upon said device for rotating the grinder.

51. The combination with a frame adapted to carry a grinder, of ways along which said frame may move over the work, means for driving said frame transversely of its movement along said ways, means for revolving said grinder during the movements of said frame, means for effecting coarse adjustments of said grinder toward and from the surface of the work, and means for effecting fine adjustments of said grinder toward and from the surface of the work.

52. The combination with a frame, of means for driving said frame in transverse directions over the work, a motor upon said frame, a grinder upon said frame connected to said motor, and means for adjusting said grinder together with said motor toward and from the surface of the work.

53. The combination with a frame adapted to carry a grinding-wheel of a fixed horizontal track along which said frame may move; a motor upon said frame; a belt connecting said motor to said grinding-wheel; means for driving said frame over the work in a direction transverse to said track; and means for effecting simultaneous adjustment of both said motor and said grinder toward and from the surface of the work.

54. The combination with a frame adapted to carry a grinder, of a fixed track along which said frame may move, means for driving said frame over the work in a direction transverse to said track, means for driving said frame along said track, an electric motor mounted upon said frame for operating said grinder, and means, including a screw, for effecting fine adjustments of said grinder toward and from the surface of the work.

55. The combination of a frame carrying at its lower portion a grinding-wheel, an electric motor mounted upon said frame above said grinding-wheel, means for enabling said motor to drive said grinding-wheel, a track along which said frame may move, means for driving said frame to and fro along said track, means for driving said frame to and fro over the work in a direction transverse to said track, means for effecting coarse adjustments of said grinding-wheel and motor toward and from the surface of the work, and means, including a screw, for effecting fine adjustments of said grinding-wheel toward and from the surface of the work.

56. The combination with a frame or head, of a support thereon adjustable vertically to the surface of the work; a grinder-carrying device vertically adjustable upon said support independently of the latter; means for driving said frame to and fro in transverse horizontal directions over the work; and means for revolving said grinder during the movements of said frame.

57. The combination with a frame; of a support mounted to slide vertically upon said frame; a device mounted to slide vertically upon said support; a grinding-wheel and a motor upon said device; a belt connecting said motor to said grinding-wheel; means for driving said frame over the work in transverse directions; and a screw for effecting adjustment of said device together with said motor and said grinder.

58. The combination with a frame or head having means for supporting a grinding-wheel, of means for moving said frame over the work; means for revolving said grinding-wheel during the movement of said frame; means for changing the plane of rotation of said grinding-wheel to suit the direction in which the cut is being made; and means for enabling the adjustment of said grinding-wheel toward and from the surface of the work.

59. The combination with a frame or head having means for carrying a grinder, of means for driving said frame to and fro in transverse horizontal directions over the work, means for revolving said grinder during the movements of said frame, means for enabling said grinder to swivel, and means for effecting vertical adjustment of said grinder.

60. The combination with a frame or head of a fixed track along which said frame may move; means for driving said frame over the work in a direction at right angles to said

track; and a device swiveled on said frame and carrying both a grinder and means for rotating said grinder; said swiveled device being adjustable toward and from the work.

61. The combination with a frame of a device thereon adapted to carry a grinding-wheel, a horizontal track along which said frame may move, a motor upon said frame, a belt connecting said motor to said grinding-wheel, means for enabling both the vertical adjustment and the setting of said device in different positions upon said frame so as to change the plane of rotation of said grinding-wheel, and means for driving said frame over the work in a direction transversely of said track.

62. The combination with a frame of a device swiveled thereon carrying at its lower portion a grinding-wheel, means including a screw, for lowering and raising said device, an electric motor mounted upon said frame above said grinding-wheel, means for securing said device in any position to which it may be turned, a fixed track along which said frame may move, means for driving said frame to and fro along said track, and means for driving said frame to and fro over the work in a direction transversely of said track.

63. The combination with a frame or head of a support thereon adjustable toward and upon the surface of the work; a device swiveled upon said support for carrying a grinder; power-driven means for moving said frame in transverse directions over the work; means for revolving said grinder during the movement of said frame and in any position to which said device may be swiveled; and means for enabling the adjustment of said swiveled device toward and from the surface of the work independently of said adjustable support.

64. The combination with a frame of means for moving said frame over the surface of the work; a support mounted upon said frame for adjustment toward and from the surface of the work; a device having a cylindrical swiveling portion which is mounted upon said support so as to be independently adjustable axially toward and from the surface of the work; a grinding-wheel upon said device; and means for rotating said grinding-wheel.

65. The combination with a frame of means for moving said frame over the surface of the work; a support mounted upon said frame so as to slide vertically to the surface of the work; a device having a cylindrical swiveling and axially-adjustable portion; a screw for adjusting said device axially in a direction vertical to the work; and a grinding-wheel and motor therefor upon said device.

66. The combination with a frame of a way along which said frame may move over the work; a housing upon said frame; a cylindrical drum within said housing; means for adjusting said drum up and down within said housing; a grinding-wheel carried by said

drum below said housing; and a motor carried by said drum above said housing and connected to said grinding-wheel.

67. The combination with a frame of a way
5 along which said frame may move over the
work; a housing mounted to slide upon said
frame toward and from the surface of the
work; a cylindrical drum within said hous-
ing; means for adjusting said drum up and
10 down relatively to said housing; a grinding-
wheel carried by said drum below said hous-
ing; a motor carried by said drum above said
housing and connected to said grinding-wheel;
and a belt passing through said drum and
15 connecting said motor to said grinding-wheel.

68. The combination with a frame or head
having means for supporting a grinding-
wheel, of a way along which said head may
move, a screw extending parallel with said
20 way, power-driven means for turning said
screw constantly at speed in either direction,
and means automatically called into action
at the completion of the movement of said
head in either direction along said way, for
25 causing the movement of said screw to be re-
versed.

69. The combination of a bed; a track along
which said bed may move; a way upon said
bed extending transversely of said track; a
30 head upon said way; a prime motor upon said
bed; means for enabling said motor to drive
said head along said way; and a grinding-
wheel mounted upon said head and connected
to said prime motor.

70. The combination of a bed; a track along
which said bed may move; a way upon said
bed extending transversely of said track; a
head upon said way; a prime motor upon said
bed; means for enabling said prime motor to
40 drive said head in opposite directions along
said way; a second prime motor upon said
bed; means for enabling said second prime
motor to drive said bed along said track; and
means upon said head for supporting a grind-
45 ing-wheel.

71. The combination of a bed; a track along
which said bed may move; a way upon said
bed extending transversely of said track; a
head upon said way; a motor upon said bed;
50 means for enabling said motor to drive said
head along said way; a second motor upon
said bed; means for enabling said second mo-
tor to drive said bed along said track; a third
motor upon said head; and a swiveled grind-
55 ing-wheel also mounted upon said head and
connected to said third motor.

72. The combination of a bed; a track along
which said bed may move; a way upon said
bed transverse to said track; a head movable
60 along said way; a grinding-wheel mounted
upon said head; a prime motor also mounted
upon said head and connected to said grind-
ing-wheel; a power-driven intermittently-
operative means for feeding said bed step by
65 step along said track.

73. The combination of a bed; a track along
which said bed may move; a way upon said

bed transverse to said track; a head movable
along said way; means upon said head for
supporting a grinding-wheel; means upon 70
said head for rotating said grinding-wheel;
and means operating automatically upon the
movement of said head along said way for
feeding said bed along said track.

74. The combination of a bed; a track along 75
which said bed may move; a way upon said
bed extending transversely of said track; a
head upon said way; a motor upon said bed;
means for enabling said motor to drive said
head in opposite directions along said way; 80
means upon said head for supporting a grind-
ing-wheel; and means automatically called
into action at the termination of the move-
ment of said head along said way in one di-
rection for advancing said bed along said 85
track.

75. The combination of a bed; a track along
which said bed may move; a way upon said
bed extending transversely of said track; a
head upon said way; means upon said head 90
for supporting a grinding-wheel; means also
upon said head for rotating said grinding-
wheel; and means called into action at the
termination of the movement of said head
along said way for advancing said bed along 95
said track in either direction.

76. The combination of a pair of tracks; a
bed bearing at its ends upon said tracks; a
way upon said bed at right angles to said
track; a head movable along said way; a 100
screw mounted upon said bed and connected
to said head; a motor upon said bed and con-
nected to said screw for operating the latter
in either direction; means called into action
at the movement of said head for advancing 105
said bed in either direction along said track;
means also called into action upon the move-
ment of said head along said way in either
direction for causing the direction of move-
ment of said screw to be reversed; and a grind- 110
ing-wheel mounted upon said head.

77. The combination of a track; a member
movable thereon; a grinding-wheel mounted
upon said member; a motor also mounted
upon said member for rotating said grinding- 115
wheel; and a second motor also mounted
upon said member and connected to means
for enabling it to advance said member along
said track in opposite directions.

78. The combination of a track; a bed mov- 120
able thereon; a head movable along said bed;
a motor mounted upon said bed and connect-
ed to means for moving the same along said
track in opposite directions; motor-driven
means upon said head for moving said head 125
to and fro transversely to said track either at
speed or step by step at will; a grinding-wheel
upon said head; and a motor upon said head
and operatively connected to said grinding-
wheel. 130

79. The combination of a pair of tracks; a
rack upon each of said tracks; a bed extend-
ing from track to track; a pinion upon each
end of said bed, said pinions meshing with

said racks; a shaft extending along said bed and connected to said pinions; a pinion provided upon said shaft about midway of the length of the latter; and a motor upon said bed and operatively connected to said midway pinion.

80. The combination of a pair of tracks; a rack upon each track; a bed extending from track to track; pinions upon said bed meshing with said racks; worm-wheels connected to said pinions; a shaft having worms engaging said worm-wheels; a pinion about midway of said shaft; a parallel shaft having a pinion meshing with said midway pinion; fast and loose pulleys upon said parallel shaft; a motor upon said bed and connected by belting to said fast and loose pulleys; belt-shifting means operable upon the movement of said bed along said tracks; and a grinder-head movable along said bed transversely to said tracks.

81. The combination of a pair of tracks; a bed extending from track to track; a prime motor upon said bed; means connected to said motor for advancing said bed along said tracks; means operating automatically for reversing the movement of said bed; a frame movable along said bed transversely of said tracks; a grinder mounted upon said frame, and an independent prime motor also mounted upon said frame and operatively connected to said grinder.

82. The combination of a track; a bed thereon; a grinder-head upon said bed; means for moving said grinder-head along said bed; and means called into action at the movement of said grinder-head along said bed for moving the latter along said track.

83. A grinding-machine comprising a track; a bed thereon; a cutter-head movable upon said bed transversely of said track; means for moving said bed at speed along said track; means operating automatically at such movement of said bed for advancing said head along said bed; means for moving said head along said bed at speed; and means operating automatically upon such movement of said head for moving said bed along said track.

84. A grinding-machine comprising a track; a bed thereon; a grinder-head movable upon said bed transversely of said track; means for moving said bed to and fro automatically along said track; means called into action at the termination of the movement of said bed in one direction for advancing said head along said bed in either direction at will; power-driven means connected to said head-advancing means and operable at will for moving said head automatically to and fro along said bed; and means connected to said bed-moving means and called into action at the termination of the movement of said head in one direction for advancing said bed along said track.

85. A grinding-machine comprising a track; a bed thereon; a grinder-head upon said bed;

means, including a shaft, for driving said head along said bed; and means operable by the movement of said bed along said track for turning said shaft to effect an adjustment of said head upon said bed.

86. A grinding-machine comprising a track; a bed thereon; a grinder-head upon said bed; means, including a shaft, for driving said bed along said track; and means operable by a movement of said head along said bed for turning said shaft to effect an adjustment of said bed upon said track in either direction at will.

87. A grinding-machine comprising a pair of tracks; a bed bridging said tracks and movable therealong; two shafts extending along said bed; a grinder-head movable along said bed and operably connected to one of said shafts; a rack secured to each of said tracks and connected to the other of said shafts; an electric motor for turning each of said shafts; and means automatically operable upon the rotation of either shaft by its motor for turning the other shaft in either direction at will.

88. A grinding-machine comprising a pair of tracks; a bed bridging said tracks and movable therealong; two shafts extending along said bed; fast and loose pulleys upon each shaft; an electric motor connected by belting to each set of fast and loose pulleys; two sets of belt-shifting devices; a grinder-head operatively connected to one of said shafts and operating the set of belt-shifting devices associated therewith; the other shaft being connected to means for driving said bed along said tracks, and means being connected to said bed for operating the other set of belt-shifting devices; means operating automatically at the movement of said head along said bed for turning the bed-driving shaft; and means operating automatically at the movement of the bed along said tracks for turning the head-driving shaft.

89. A grinding-machine comprising a pair of tracks; a bed bridging said tracks and movable therealong; two shafts extending along said bed; fast and loose pulleys upon each of said shafts; an electric motor connected by belting to each set of fast and loose pulleys; two sets of belt-shifting devices; a grinding-head including a swiveled grinding-wheel and motor, movable upon said bed and operatively connected to one of said shafts and operating the set of belt-shifting devices associated therewith; the other shaft being connected to means for driving said bed along said tracks, and means being connected to said bed for operating the other set of belt-shifting devices; means operating automatically at the movement of said head along said bed for turning the bed-driving shaft in either direction at will; and means operating automatically at the movement of the bed along said tracks for turning the head-driving shaft in either direction at will.

90. A grinding-machine comprising a pair of tracks; a bed bridging said tracks and mov-

- able therealong; two shafts extending along said bed; fast and loose pulleys upon each shaft; an electric motor connected by belting to each set of fast and loose pulleys; two sets of belt-shifting devices; a grinder-head operatively connected to one of said shafts and operating the set of belt-shifting devices associated therewith; the other shaft being connected to means for driving said bed along said tracks, and means being connected to said bed for operating the other set of belt-shifting devices; means operating automatically at the movement of said head along said bed for turning the bed-driving shaft in either direction at will, said means including a ratchet upon said shaft, a pair of pawls associated with said ratchet, and means for holding either or both of said pawls out of action; and means operating automatically at the movement of the bed along said tracks for turning the head-driving shaft in either direction at will, said means including a ratchet upon said shaft, a pair of pawls associated with said ratchet, and means for holding either or both of said pawls out of action.
91. The combination of a track of a bed thereon; a grinder-head upon said bed; means for moving said bed along said track; an adjustable device operated by said bed for causing the direction of movement of the latter to be reversed; and means also controlled by said adjustable device for feeding said grinder-head step by step along said bed in a direction transverse to said track.
92. The combination of a track of a bed thereon; a grinder-head upon said bed; means for moving said grinder-head along said bed transversely to said track; an adjustable device operated by said head for causing the direction of movement of the latter upon said bed to be reversed; and means also controlled by said adjustable device for feeding said bed step by step along said track.
93. A grinding-machine comprising a track; a bed thereon; a grinding-head upon said bed; means for moving said bed at speed along said track; an adjustable device operated by said head for causing the direction of movement of the latter to be reversed; means also controlled by said adjustable device for feeding said grinding-head step by step along said bed in a direction transverse to said track in either direction at will; means for moving said grinding-head at speed along said bed; a second adjustable device operated by said head for causing the direction of movement of the latter upon said bed to be reversed; and means also controlled by said second adjustable device for feeding said bed step by step along said track in either direction at will.
94. In a grinding-machine, the combination of a pair of tracks; a bed bridging said tracks; means for moving said bed along said tracks; a saddle-like head mounted upon said bed; a grinding-wheel upon said head at each side of said bed; means for moving said head along said bed; and a motor upon said head for each of said grinding-wheels.
95. In a grinding-machine, the combination with a head of a pair of grinding-wheels thereon; a prime motor for each grinding-wheel; means for adjusting each of said wheels independently of the other toward and from the surface of the work; and means for driving said head to and fro over the surface of the work.
96. In a grinding-machine, the combination of a pair of tracks; a bed bridging said tracks; means for moving said bed along said tracks; a saddle-like head upon said bed; a plurality of driving mechanisms carried by said head; a shaft extending longitudinally of said bed; means upon said head and engaging said shaft, for enabling the latter when rotated to propel said head; and means for rotating said shaft.
97. In a grinding-machine, the combination of a pair of tracks; a bed bridging said tracks; a saddle-like head upon said bed; a plurality of driving mechanisms carried by said head; a shaft extending longitudinally of said bed and arranged interiorly thereof; means upon said head and engaging said shaft, for enabling the latter when rotated to propel said head; means for rotating said shaft; a second shaft upon said bed; a rack parallel with said tracks; a pinion upon said second shaft meshing with said rack so as to propel said bed along said tracks; and a motor for each of said shafts.
98. In a grinding-machine, the combination with a track of a bed thereon; means for moving said bed along said track; a head on said bed; a grinding-wheel on said head; means for moving said head to and fro along said bed; a second head upon said bed; and a device adjustably coupling said heads together.
99. In a grinding-machine, the combination with a track of a bed thereon; means for moving said bed along said track; a head on said bed; a grinding-wheel on said head; means for moving said head to and fro along said bed; a second head upon said bed; a device adjustably coupling said heads together; a plurality of grinding-wheels on each of said heads; and means for independently adjusting each of said grinding-wheels toward and from the surface of the work.
100. The combination of a pair of tracks; a bed bridging said tracks; means for moving said bed along said tracks; a plurality of independent heads upon said bed; said heads being adjustable relatively one to the other; means for moving said heads along said bed; a plurality of grinding-wheels upon each of said heads; and means for adjusting each of said grinding-wheels independently toward and from the surface of the work.
101. The combination of a track; a bed thereon; means for driving said bed along said track; a head movable along said bed and carrying a grinder; a second bed upon

said track; a head movable along said second bed and carrying a grinder; and means for adjustably coupling said beds together.

102. The combination of a pair of tracks; a plurality of beds bridging said tracks; means for moving said beds along said tracks; a plurality of heads upon each bed, each head carrying a grinding-wheel; and means for moving said heads along said beds.

103. The combination of a pair of tracks; a plurality of beds bridging said tracks; means for moving said beds together to and fro along said tracks; a head upon each bed carrying a plurality of grinding-wheels each of which is independently adjustable toward and from the work; means for moving said heads along said beds; and a second head upon each bed adjustably connected to the first head and also carrying a plurality of grinding-wheels each whereof is independently adjustable toward and from the work.

104. The combination of a pair of tracks; a bed bridging said tracks; a grinding-head upon said bed; a prime motor mounted upon one end of said bed and connected to means

for driving said bed along said tracks; and a prime motor mounted upon the other end of said bed and connected to means for moving said head along said bed.

105. The combination of a pair of tracks; a bed bridging said tracks; a grinding-head upon said bed; an electric motor mounted upon one end of said bed and connected to means for driving said bed along said tracks; and an electric motor mounted upon the other end of said bed and connected to means for moving said head along said bed; and an electric motor upon said head and connected to said grinding-wheel.

106. A grinding-machine comprising a pit; a track on each side thereof; a plurality of beds bridging said tracks; a plurality of grinding-heads upon each of said beds; means for moving said beds to and fro along said tracks; and means for moving said grinding-heads to and fro along said beds.

HENRY DEMING HIBBARD.

Witnesses:

B. C. STICKNEY,
JOHN O. SEIFERT.