

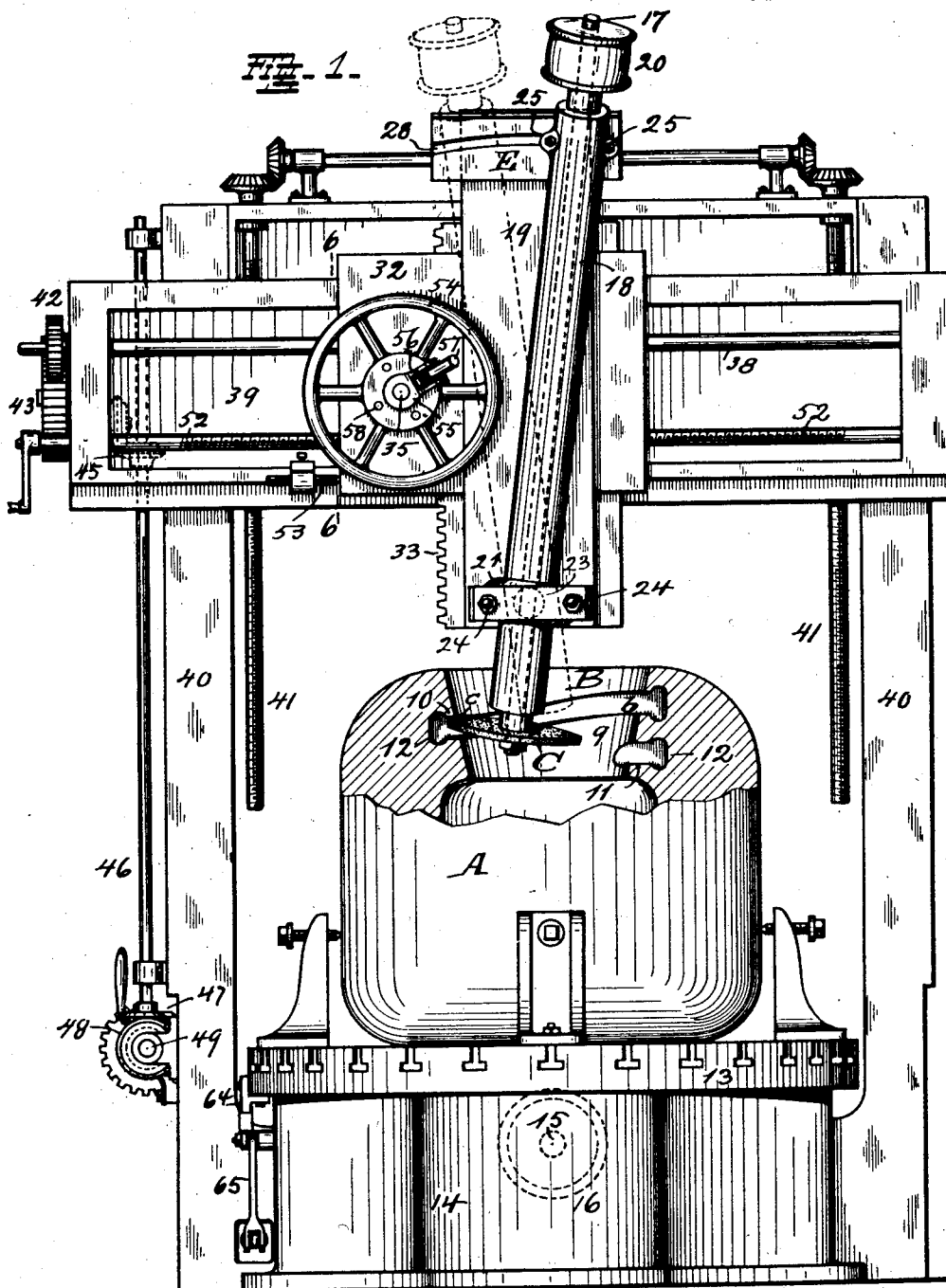
G. A. HATTERSLEY & L. KOENIG.
GRINDING MACHINE.

APPLICATION FILED FEB. 27, 1911.

Patented July 18, 1911.

3 SHEETS—SHEET 1.

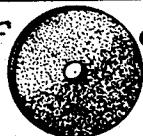
998,508.



Witnesses.

Chas. W. Smith.
T. Le Beau

FIG. 2.



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George A. Hattersley
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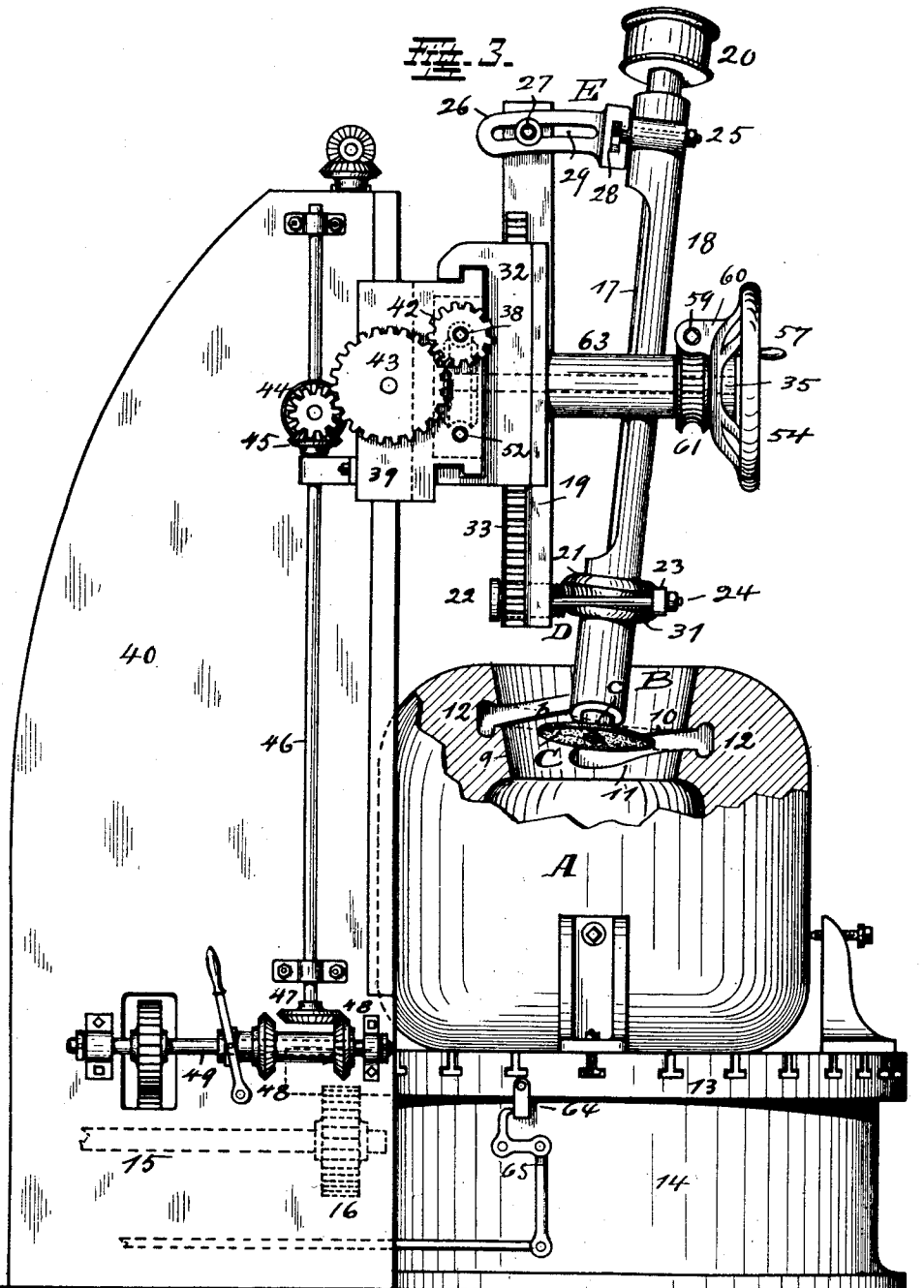
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3 SHEETS-SHEET 2.

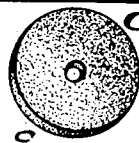
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Fig. 4.



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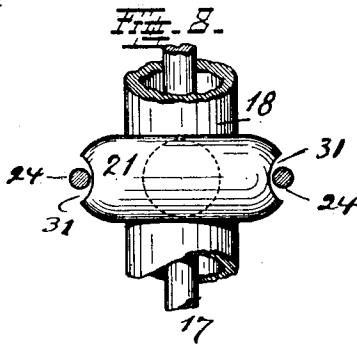
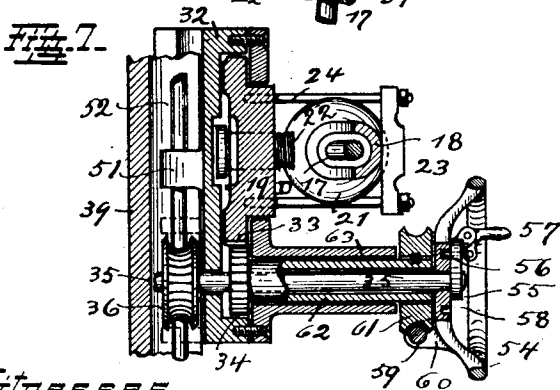
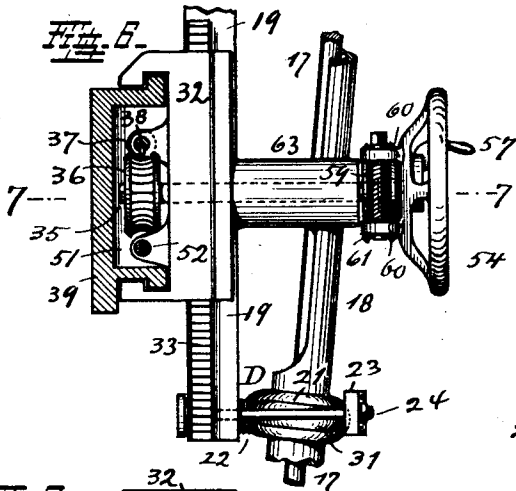
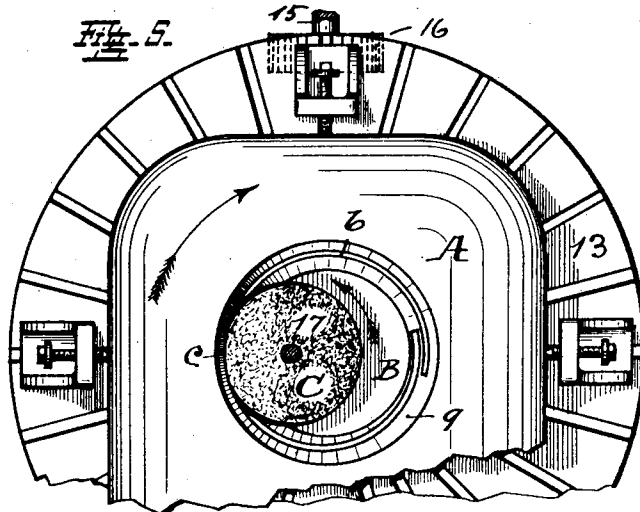
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3 SHEETS-SHEET 3.

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Witnesses.

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UNITED STATES PATENT OFFICE.

GEORGE A. HATTERSLEY, OF NORWOOD, AND LOUIS KOENIG, OF CINCINNATI, OHIO,
ASSIGNORS TO THE VICTOR SAFE & LOCK CO., OF CINCINNATI, OHIO, A CORPORATION OF OHIO.

GRINDING-MACHINE.

998,508.

Specification of Letters Patent.

Patented July 18, 1911.

Application filed February 27, 1911. Serial No. 611,167.

To all whom it may concern:

Be it known that we, GEORGE A. HATTERSLEY and LOUIS KOENIG, citizens of the United States, the first residing at Norwood, the other in Cincinnati, both in Hamilton county, State of Ohio, have invented a certain new and useful Grinding-Machine; and we do declare the following to be a clear, full, and exact description thereof, attention being called to the three sheets of drawings which accompany this application and form a part of it.

This invention relates to a grinding machine which is particularly suitable for grinding screw-threads and may be used for forming, by grinding, a screw-thread complete, or for merely finishing one which has already been produced in the rough by a machine-tool for instance, or partly been formed in a casting.

The machine is shown and described as being used for grinding out and for finishing screw-threads formed in the rough in castings used in connection with safe-work of the screw-door type, in which type circular doors are held in closed position on the safe-body by means of a screw-connection.

Patents No. 905,180 and 916,704, show safes of this type, each involving a safe-body having a circular door-opening and a door fitted to this opening, each being made of a casting of non-machineable metal, requiring grinding in the fitting and finishing of the work. The threads used in the screw-connection whereby these doors are held in place are produced in the rough in these castings and the machine here in consideration is used to finish these threads and to shape them so that complementary threads fit to each other.

The leading feature in this grinding machine is a construction which permits possibility of obtaining various adjustments, particularly such which are necessary for the purpose of grinding screw-threads.

In the following specification and particularly pointed out in the claims at the end thereof, will be found a full description of our invention, together with its operation, parts and construction, which latter is also illustrated in the accompanying three sheets of drawings, in which:—

Figure 1, shows a front-view of the grinding machine, certain parts being shown in section. Fig. 2, shows a top-view of the

grinding-wheel as it appears in this view. Fig. 3, shows a side-elevation of the machine with certain parts shown in section. Fig. 4, shows a top-view of the grinding-wheel as it appears in this view. Fig. 5, is part of a top-view of the object upon which the grinding-wheel is operating. Fig. 6, is a vertical section on line 6—6 of Fig. 1. Fig. 7, is a horizontal section on line 7—7 of Fig. 6. Fig. 8, shows a detail of construction referred to hereinafter.

In the drawings, A indicates a cast-metal safe-body of which B is the door-opening and b a screw-thread provided in the jamb-surface 9 of this opening. A circular door, not shown, is fitted to this jamb and a complementary thread is provided to hold the door in place. The thread shown in the drawing is a female thread and in the position in which it appears 10 would be the upper side of it and 11 the lower one. This thread is roughly formed in the casting, to be completed by a finishing tool and at its bottom it is enlarged as shown at 12 to provide clearance for this tool, which clearance, being beyond the finished and fitted part of the thread, is not considered in the finishing work.

13 is a table upon which this casting is held in a manner customary in machine-tools, said table being mounted for rotation in a lower frame-part 14. It is rotated by means of a pinion 16 shown in dotted lines which meshes into a toothed ring or crown-gear provided on the underside of this table and not visible in the drawings. 15 is a power-driven shaft upon which this pinion is mounted.

A grinding-wheel C, supported for rotation is used for forming or for finishing the thread and for sizing it to a fit with reference to another complementary thread. The shape and pitch of the thread is produced by a compound feed-motion participated in by the grinding-wheel and by the table, which latter serves to rotate the casting supported upon it in a horizontal plane, while the rotating grinding-wheel, without changing its position horizontally, advanced at an angle to this plane. Thus by the motion of the table all parts of the thread to be formed are circumferentially subjected to the action of the rotating grinding-wheel, while the same moves at the same time to follow the changing pitch-line of the thread.

As will be noted, this compound motion, rotary of the safe-body, and vertical of the grinding-wheel, changes the position of the grinding-contact of this latter constantly and causes it to follow in the line of a helical curve corresponding to the particular pitch of the screw-thread to be formed. That is to say, provided the grinding-wheel has been properly adjusted and the construction of the machine is so as to permit such adjustment and causes the parts to move in the intended manner. Since a line helically curved changes its formation and direction constantly as it progresses, no two points in it occupying the same plane, it follows that, in order to produce such a formation a grinding-tool and the surface upon which it acts must move accordingly with reference to each other and so as to maintain grinding contact with all points of this constantly changing line. This requires primarily that the grinding contact of the grinding medium be limited as much as possible, theoretically it should be limited to the geometrical point, because otherwise, if the wheel grinds at more than one point, that is if a considerable area of it is at once in grinding contact, flat places result which destroy the true line of the helical pitch curve. For this reason the grinding-wheel is presented to the surface on which it is to grind in a tilted position and if grinding for instance the upper side 10 of the thread, it would be in a position as shown in Fig. 1, so that as to the wheel, grinding-contact takes place only with a point in the periphery of its upper edge, said point being indicated at *c* in Figs. 1, 2, 3, 4 and 5. This limited contact can however be had only when this point of grinding contact lies also at the same time in a plane which is radial to both the grinding-wheel and surface 9 which contains the screw-thread (observe Fig. 5) and provided further that this plane is vertical to the pitchline of the screw as shown in Fig. 3, (dotted lines) which show the grinding-wheel in the same position as it is shown in Fig. 1, the parts of the safe shown there (Fig. 3) and on which it is grinding being removed.

While the grinding contact has been described as being confined to a point in the periphery of the wheel, such a condition can be maintained in reality only for a limited time on account of the wear of the grinding-wheel which latter assumes a tapering edge. Therefore this point soon assumes the form of a line which extends from it inwardly and increases in length as the width of the zone of wear increases, said line lying within the radial plane above mentioned. Observe Figs. 2, 4 and 5.

The particular positional relation between the point of grinding contact on the grinding-wheel and the pitch line of the screw is

maintained by reason of the rotation of the safe-body in one plane and the simultaneously proceeding movement of the grinding-wheel in a direction at an angle to this plane, both motions proceeding in properly proportioned ratio and by means and mechanism to be presently described and comprising a machine which is the subject of our invention.

The grinding-wheel C is mounted upon a spindle 17 supported in two bearings, one at each of its ends, which bearings, in order to assure perfect alinement, are by preference contained in a substantially tubular frame-structure 18, which is supported on a carrier 19.

20 is a belt-pulley at the upper end of the grinding-spindle whereby this latter is rotated. The lower connection of frame 18 to this carrier is by a universal joint D, which permits the grinding wheel to assume the various tilted positions described when its spindle is adjusted accordingly. The principal movement for this adjustment is had at the upper end of frame 18 where this frame may be moved in or out with reference to its carrier 19, or laterally with respect thereto, the lower part of the frame simply following by turning at universal joint D which acts as a pivot. This latter joint is substantially a ball and socket-joint, the ball being formed by a spherical projection 21, fitted to a socket which is formed at one end of a screw 22, seated in the lower end of carrier 19. The ball is held in this socket by a bar 23 extending across it on the outer side and held to carrier 19 by screws 24. At its upper end frame 18 is connected to a frame E by bolts 25, said frame being connected to the carrier by two rearwardly extending wings 26 and by screws 27 engaging these wings.

Bolts 25 are T-bolts and their heads occupy a T-slot 28 in the front-side of frame E, said slot being curved on a radius which has its center in universal joint D. Screws 27 are seated in carrier 19 and extend into slots 29 in wings 26, said slots being also formed on a radius, the center of which is likewise in universal joint D. It will now be seen that the tilted position of the grinding-wheel shown in Fig. 1 and required to cause it to grind at a point in its edge, on the upper side 10 of the screw-thread may be obtained by swinging the spindle-frame with the grinding-spindle to the right on frame E, after which bolts 25 are tightened in slots 28. If the wheel is to grind on the lower side 11 of the screw-thread, the spindle would be swung to the opposite side as shown in dotted lines. To obtain the tilted position shown in Fig. 3, to cause the grinding-wheel to meet the inclination of the pitch-line of the screw, frame E with the upper end of spindle-frame 18, both forming at this time a rigidly connected struc-

ture to maintain the previous adjustment of the spindle-frame, are swung with reference to the upper end of carrier 19, and after adjustment, secured thereto by the 5 tightening of screws 27. The grinding-wheel without changing its tilted position due to the first adjustment and as shown in Fig. 1, has now been subjected to a second tilting adjustment as shown in Fig. 3, this 10 being in a plane at right angles to the plane of the first adjustment. While this adjustment is being had at the upper end of the spindle-frame, screws 24 at its lower end are sufficiently eased to permit a free move- 15 ment of the members of the ball-and-socket-joint. These screws although closely fitted against opposite sides of ball 21, do not interfere with the limited movement of the same as screw 22, because round-bottomed 20 notches 31 are provided in said ball. (See Fig. 8.)

The adjustment had at the upper end of the spindle-frame may be aided and corrected if necessary, by moving screw 22 25 whereby the lower end of the spindle may be moved in or out with reference to carrier 19. After all adjustments are completed screws 24, are also tightened, so that the spindle-supporting frame 18 and carrier 19 30 become now a rigidly connected structure which is supported to be movable to and from table 13 which carries the object A. For the purpose of such movement carrier 19 is slidably fitted to a cross-head 32 and 35 provided with a rack 33 which is engaged by a pinion 34, see Fig. 7, whereby said carrier is caused to move either up or down to follow the inclination of the pitch-line of screw-thread *b*. The actuation of this pin- 40 ion is obtained by intermediate means from a shaft 35 which carries a worm-wheel 36, rotated by a worm 37. This latter is connected to a shaft 38, mounted on a rail 39 which is supported on upright frame-mem- 45 bers 40. This support may be one vertically adjustable by means of screws 41 in a manner customary in machine-tools. Shaft 38 is rotated by means of gears 42, 43 and 44, the latter rotated by a set of bevel-wheels 50 45 from an upright shaft 46. This latter carries a bevel-wheel 47 and may be rotated in either direction by either one of two bevel-wheels 48, 48, shiftably mounted upon a power-driven shaft 49. By chang- 55 ing the direction of rotation of shaft 46, worm 37 is caused to rotate accordingly and carrier 19 may be directed to move either up or down with reference to table 13. Cross-head 32 is slidably mounted on rail 39 and 60 provided with a nut 51, engaged by a screw 52 mounted in rail 39, so that, when said screw is rotated, which may be by means of a crank-handle, the head is caused to move transversely on rail 39. Worm 37 follows 65 the head so as to maintain engagement with

worm-wheel 36, its engagement with shaft 38 being by a customary spline.

The parts for positioning are handled as follows: The grinding-wheel, having been raised by means of carrier 19 to permit 70 placing of object A, and moved laterally by head 32 on rail 39 to be in proper position above the object, is lowered again by moving the carrier, until it is opposite one end of thread *b*. Next the two tilted positions 75 of the grinding-wheel, shown respectively in Figs. 1 and 3, are obtained by adjusting the grinding-spindle on said carrier in two planes and in the manner described and by adjustment of frame E. This adjustment 80 having been determined, the grinding-wheel is moved into thread *b* as shown in Fig. 1, by moving cross-head 32, which is done by rotating screw 52. A cut circumferentially all around through the thread is taken, after 85 which rotation of table 13 and angular movement of the grinding-wheel with reference to the table are both stopped, and the grinding-wheel is moved out of the thread 90 by shifting of cross-head 32. Since one cut is rarely sufficient to cover the surface to be ground, additional cuts are taken, the wheel for each subsequent cut and while maintain- 95 ing its tilted position being set deeper into the thread, this being done after the wheel has each time been brought opposite one of the ends of the thread. We prefer to grind while the grinding-wheel follows the pitch- 100 line with a downward movement and therefore, for each re-setting, the wheel must first be raised to be opposite the high end of the thread, after which it is set into the same and the compound feed-motion by table and carrier is caused to resume. A 105 gage 53 adjustably mounted on the rail, aids the determination of the extent of these successive re-settings.

The vertical movement of carrier 19 described before being obtained from worm-wheel 36 and worm 37 and whereby the 110 grinding-wheel is caused to follow the pitch of the screw, is rather slow and therefore means have been provided whereby, for merely setting the grinding-wheel and for moving it vertically with respect to the 115 work on table 13, carrier 19 may be moved more quickly by hand and at which time worm 37, worm-wheel 36 and shaft 35 are not used to rotate the rack-moving pinion 34. Instead, the intermediate means before 120 referred to are used and which means consist of a hand-wheel 54 and a hollow shaft 62 to which it is connected and on which pinion 34 in engagement with the rack on carrier 19 is mounted. This hollow shaft is 125 sleeved upon shaft 35 and supported in a suitable bearing 63 which may form a part of cross-head 32. The connection of this hand-wheel 54 to the hollow shaft is one permitting adjustment of it in a rotary di- 130

recession for reasons to be presently explained and is by a worm-wheel 61 rigidly mounted upon the shaft and in engagement with a worm 59 carried on the rear-side of the hand-wheel 54 and in bearings 60 thereon between which it is endwise confined. When the hand-wheel is thus used for quickly raising or lowering carrier 19, the rotation of power-operated shaft 35, which is not used at this time, may be preferably stopped by use of a conveniently located clutch stopping rotation of shaft 38. A customary balancing weight used in connection with related machine-tools having movable tool-carriers, boring mills for instance, is used to sustain the weight of carrier 19 at this time and prevents the carrier from dropping, said weight being connected to the carrier by a chain passing over suitable guide-pulleys. The end of shaft 35 projects beyond hand-wheel 54 and has rigidly mounted upon it an arm 55 which carries a locking pin 56 and a handle 57 whereby this pin may be manipulated with respect to the hub of the hand-wheel and to a number of openings 58 therein, any one of which said pin may occupy. It will now be seen that the rack-engaging pinion 34 which moves carrier 19 of the grinding-spindle vertically may be rotated directly by hand when its shaft 62 is rotated by means of hand-wheel 54. It may also be rotated by the power-driven means when said shaft 62, by means of locking pin 56 is connected to rotate with shaft 35 which is operated by power-driven worm-shaft 38. This latter mode of rotation constitutes the automatic machine-operated change of position of the grinding wheel while in action and whereby it is caused to grind in line with and to follow the pitch line of the thread to be formed.

The direct manipulation by the hand-wheel, when shaft 62 is disconnected from shaft 35, is merely to permit quick, preliminary adjustment of the position of the grinding-wheel with respect to the object before the grinding-wheel starts to grind. As soon as the grinding-wheel has been approximately moved to the desired position, locking-pin 56 is turned again into any of openings 58 nearest it at the time, to re-connect shaft 62 to power-driven shaft 35 so as to be ready to be driven thereby as soon as grinding is resumed after this adjustment is entirely completed. Final adjustment necessary to set the grinding-wheel exactly to the point of grinding contact and not obtainable by use of the hand-wheel by reason of the space between openings 58, which limits the points of engagement of the locking pin, is had by further rotation of hollow shaft 62 independently of shaft 35 and of the hand-wheel and obtained by manipulation of worm 59, by means of a

suitable wrench, whereby, by means of worm-wheel 61 on said shaft 62, additional movement of carrier 19 is had until the grinding-wheel is in the exact position desired for grinding when its rotation may be started. When as in the case shown, the screw-thread to be ground does not run out to the open, that is extend to the edges of surface 9 in which it is contained, rotation of table 13 as well as the movement of carrier 19 must stop each time as soon as the end of the thread and the grinding-wheel come together. This is preferably done automatically and by means well known in the art of machine-tool building, as for instance by a stop 64 adjusted to proper position on table 13 and which by means of a trip-lever mechanism 65 acts upon a clutch adapted to control operation of a general driving-shaft from which the operation of shafts 15 and 49 proceeds.

The use of customary means for changing speeds and for reversing motions, analogous to similar constructions in machine-tools is presumed, but since such means may be applied in various ways they are not shown in detail. The complementary thread on the door which is fitted to the opening in the safe-body A, is ground in a similar way, the grinding-wheel being adjusted accordingly. While as shown the thread to be finished is located in an annular surface, tapering inwardly; that is conically disposed, the same procedure is followed if the thread were to be ground in a cylindrical surface. In other words the thread is ground as if it were contained in a cylindrical surface and taper is not considered. A true screw-line results nevertheless in the surface in either case with this difference merely, that in a tapering surface the thread becomes deeper toward one of its ends, which however is not objectionable provided the thread is started deep enough at the largest diameter of the taper to afford proper engagement with its complementary thread.

Having described our invention, we claim as new:

1. In a grinding-machine, the combination of rotary object-supporting means, a grinding-wheel provided opposite these means, a spindle on one end of which it is mounted and which extends away from the supporting means, a frame whereby this spindle is supported and means for supporting this frame in a manner to permit the spindle to assume and occupy positions in planes inclined to various angles to the plane in which the object supporting means rotate and also to various additional angular positions in any of these planes and in planes disposed at right angles to the plane of the first adjustment.

2. In a grinding-machine, the combination of rotary object-holding means, a car-

rier, means for supporting it in a manner rendering it movable to and from these means, a spindle-supporting frame connected at one of its ends to this carrier by means of a universal joint, means to hold its other end adjustably to this carrier, a grinding-spindle mounted on this frame, a grinding-wheel seated on this spindle and near that end of its frame which is connected by means of the universal joint, means to lock the adjustable end of this frame to the carrier after adjustment and means to feed the carrier with the spindle-frame locked to it, to cause the grinding-wheel to move in a direction at right angles to the plane in which the object-holding means rotate and parallel to the axis of this rotation.

3. In a grinding-machine, the combination of object-holding means mounted for rotation, a carrier supported to be movable in a direction at right angles to the plane of rotation of these means, a spindle-supporting frame adjustably held on the carrier, a grinding-spindle mounted in this frame, devices to rotate the object-holding means, devices to feed the carrier in a linear direction with reference to these holding means and parallel to the axis of rotation of these holding means and general mechanism to actuate these devices and to cause the object-holding means to rotate at a certain ratio of speed with reference to the movement of the carrier.

4. In a grinding-machine, the combination of object-holding means mounted for rotation, a carrier, a spindle-supporting frame adjustably held thereon, a grinding-spindle mounted on this frame, devices to rotate the object-holding means, devices to move the carrier in a linear direction with reference to these holding-means and parallel to the axis of rotation of these holding means, general mechanism to actuate these

devices to cause the object-holding means and the carrier to operate in a certain related ratio of speed and a stop-device adapted to be automatically actuated by the object-holding means for the purpose of stopping the operation of the general mechanism to terminate simultaneously rotation of the object-holding means and movement of the carrier.

5. In a grinding-machine, the combination of rotary object-holding means, a carrier, means for supporting it in a manner rendering it movable to and from these means, a spindle-supporting frame connected at one of its ends to this carrier by means of a universal joint, an intermediate frame to which its other end is adjustably connected, means whereby this intermediate frame is adjustably connected to the carrier and a grinding-spindle mounted in the spindle-supporting-frame.

6. In a machine for grinding screw-threads, the combination of rotary object-supporting means, a grinding-wheel, a spindle on which it is mounted, a carrier on which the spindle is supported, means to adjust the position of the spindle on its carrier in a manner to tilt the grinding-wheel with reference to the work so as to limit its grinding contact therewith, and additional means for adjusting the spindle in this adjusted position and whereby the grinding-wheel, while remaining in the tilted position mentioned, is tilted in a different direction so as to grind in line with the pitch of the screw-thread to be ground.

In testimony whereof, we hereunto affix our signatures in the presence of two witnesses.

GEORGE A. HATTERSLEY.
LOUIS KOENIG.

Witnesses:

C. SPENGLER,
T. LE BEAU.