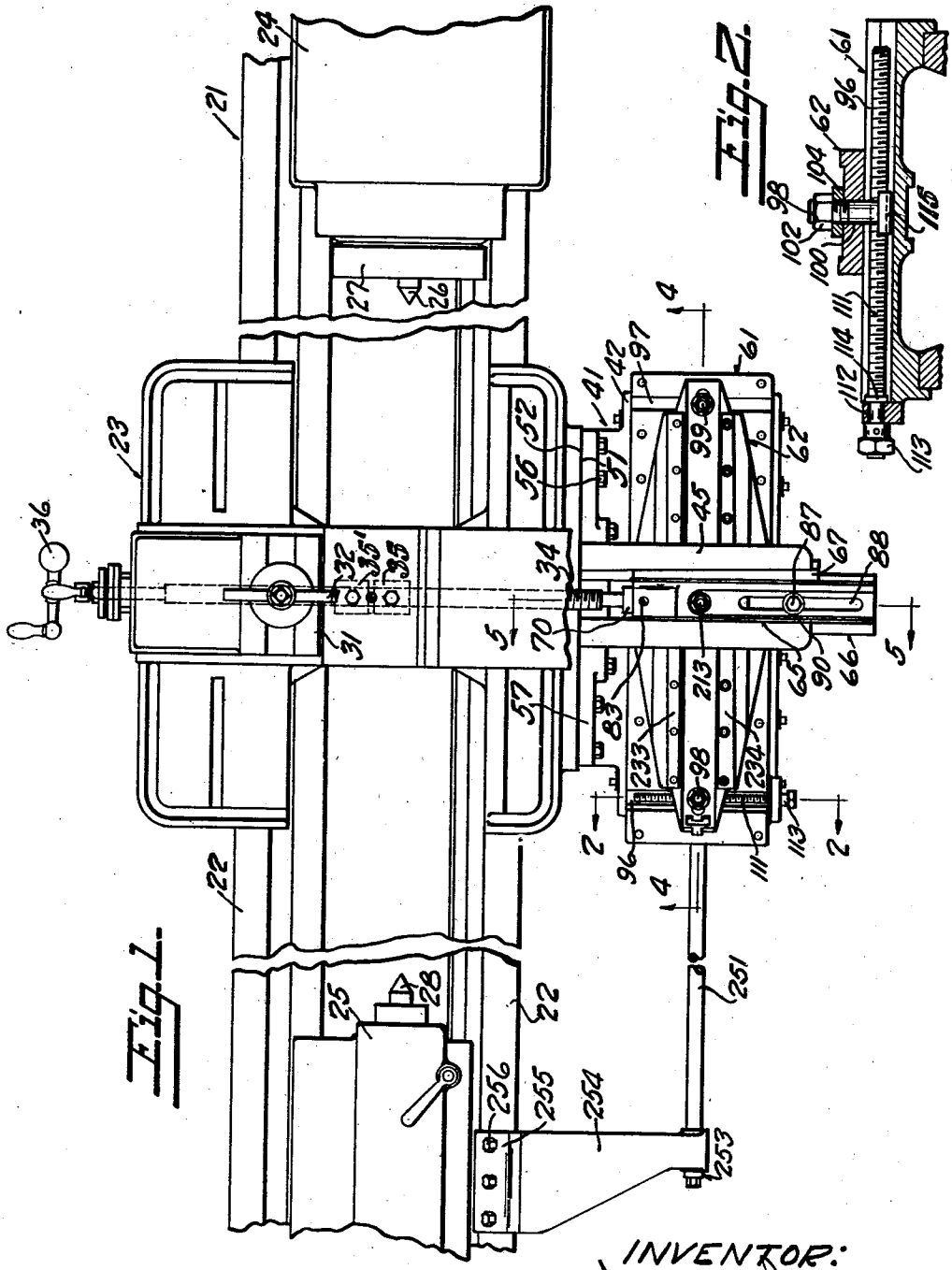
April 6, 1943. F. A. FRITZSCH 2,315,846

TAPER MECHANISM

Filed June 26, 1939 5 Sheets-Sheet 1



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TAPER MECHANISM

Filed June 26, 1939 5 Sheets-Sheet 2

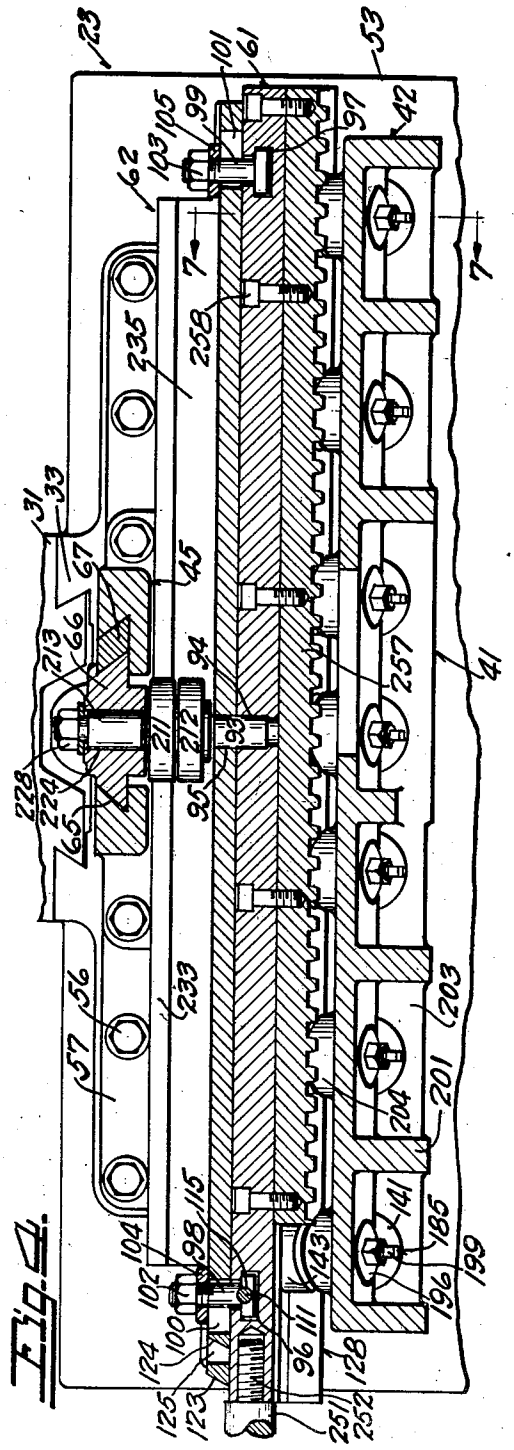

Fig. 4.

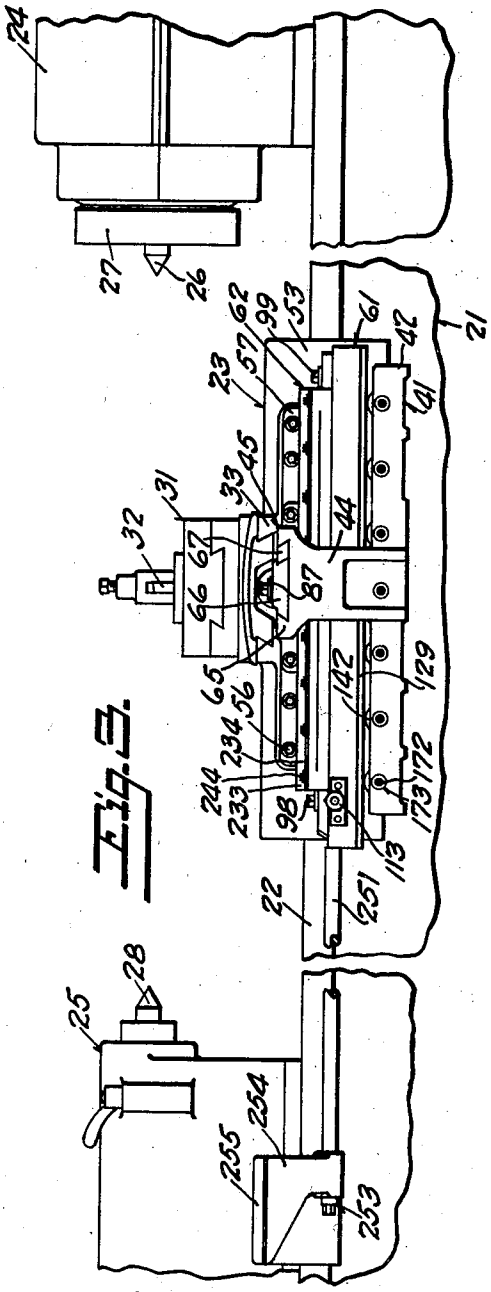

Fig. 5.

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TAPER MECHANISM

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Fig. 5.

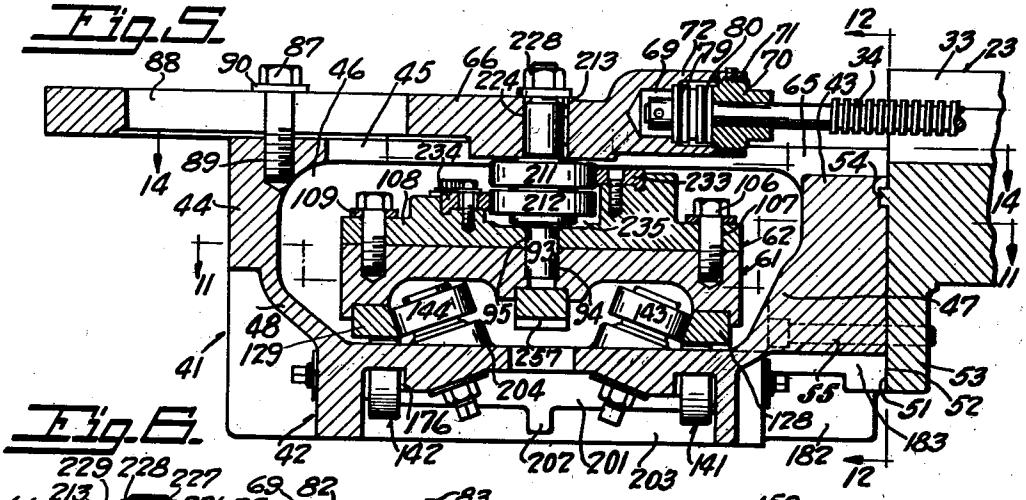


Fig. 6.

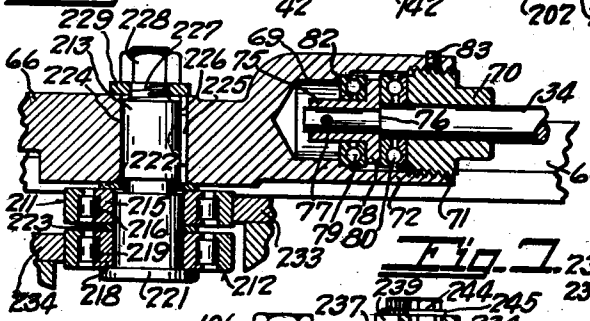


Fig. 8.

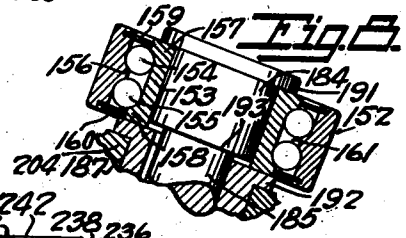


Fig. 7.

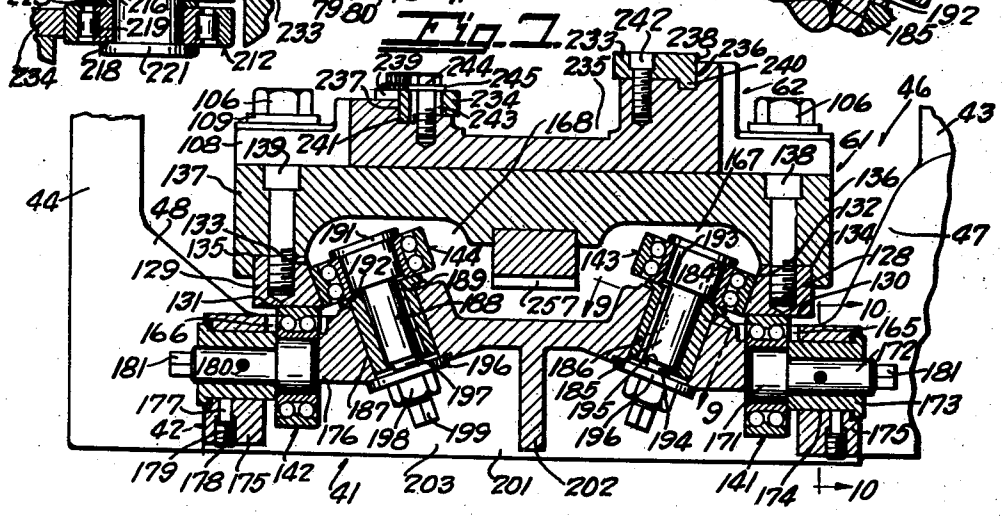


Fig. 9.

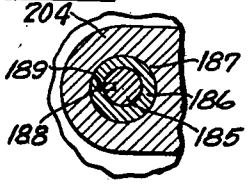
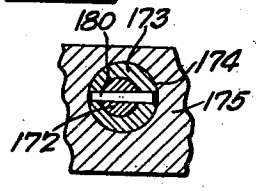


Fig. 10.



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TAPER MECHANISM

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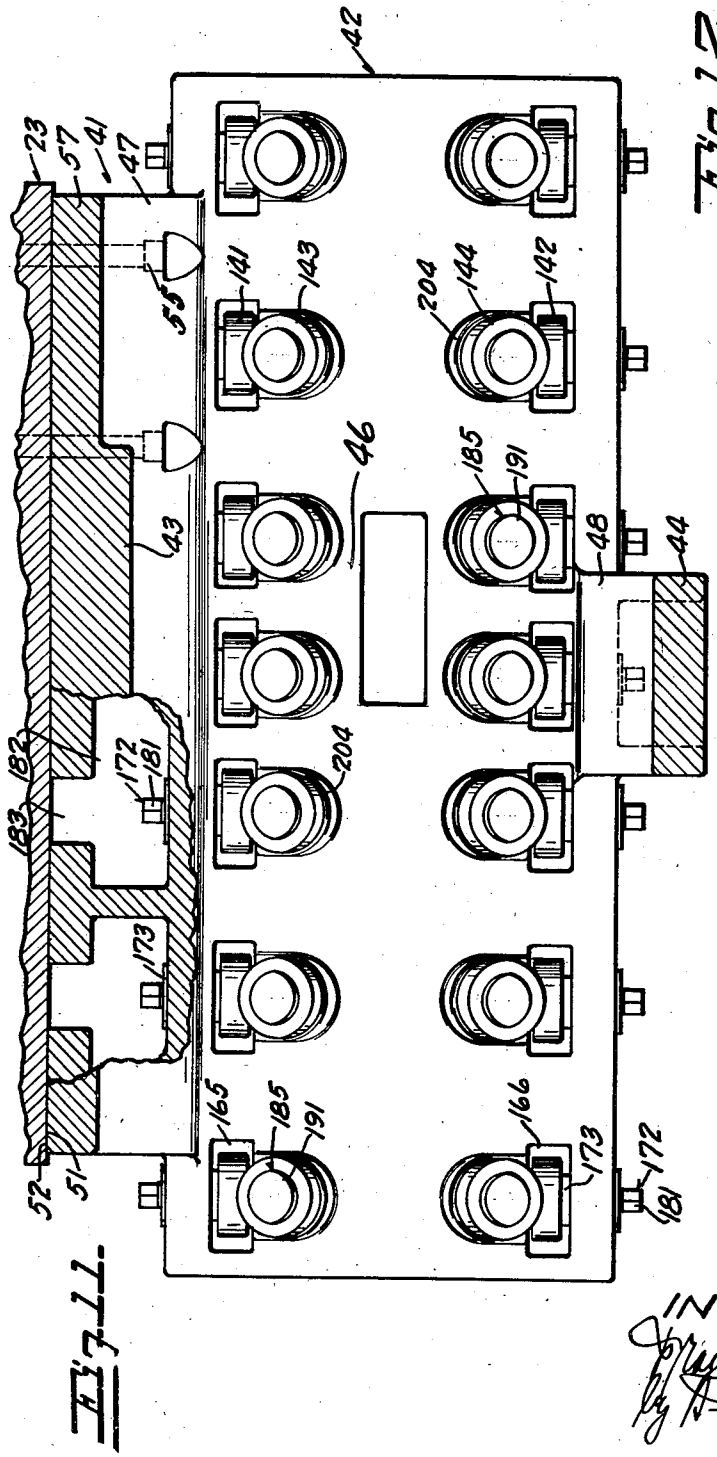

Fig. 11.

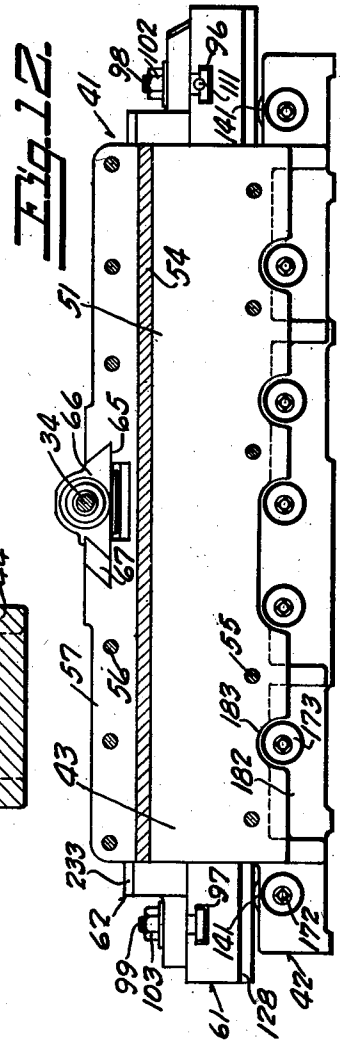

Fig. 12.

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Fig. 13.

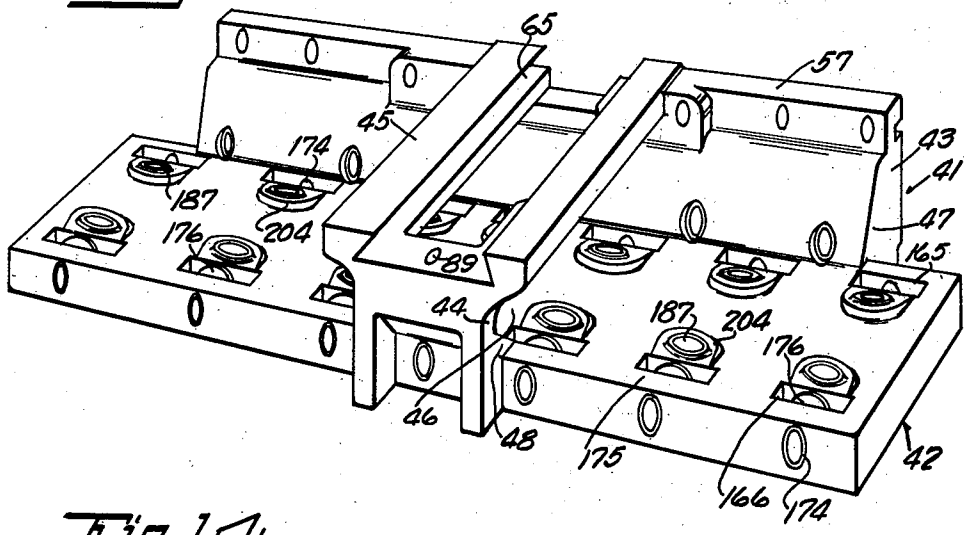
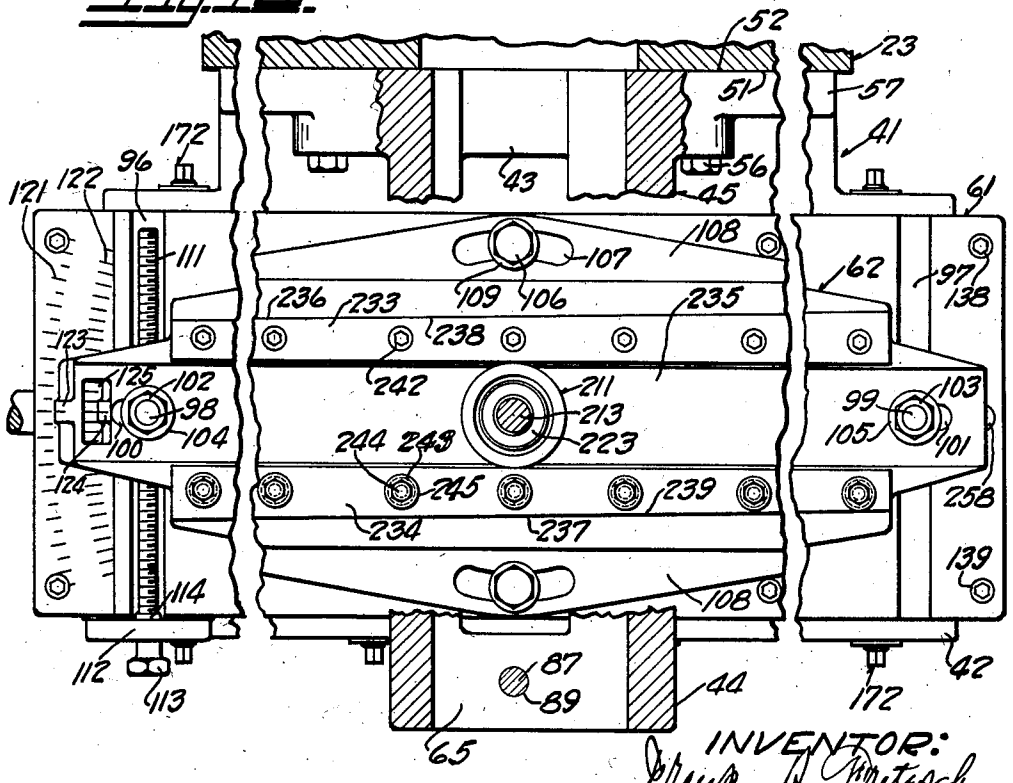


Fig. 14.



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Patented Apr. 6, 1943

2,315,846

UNITED STATES PATENT OFFICE

2,315,846

TAPER MECHANISM

Frank A. Fritzsch, Cincinnati, Ohio, assignor to The Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, a corporation of Ohio

Application June 26, 1939, Serial No. 281,101

9 Claims. (Cl. 82—17)

My invention relates to taper mechanism, and is exemplified as a taper attachment for lathes employable in turning, boring or otherwise operating on metal and the like, and has for its object the provision of novel means for providing ease of movement between the parts; for enhancing rigidity; and for increasing efficiency, speed and accuracy of operations.

It has been the usual practice heretofore in taper attachments to employ an adjustable taper guide and a slide block sliding thereon, the taper guide being mounted on a supporting slide sliding in guideways on the carriage, and the slide block having operative connection with the cross tool slide on the carriage for moving the tool toward and from the axis of rotation of the work mounted and rotatable between the centers of the lathe. Such taper guide and slide block and such supporting slide and carriage have usually heretofore been provided with coacting plane guiding faces, the sliding between which, especially if the taper guide were set at a substantial angle with relation to the line of travel of the carriage, or if heavy duty were required of the taper attachment, produced considerable friction, binding stresses, and strain upon the coacting sliding faces between the guideways on the carriage and the slide block, and distortion in the mounting parts for the same, resulting in inaccuracies in the work, and in considerable expenditure of power in performing the work.

It is the object of my invention to provide novel means for removing these objections and to provide a novel taper mechanism which is easily operable, in which strains are materially reduced, and in which the support for the taper operating mechanism is rigid to resist such strains.

My invention consists in novel means for removing such objections; further, in providing series of rotary friction reducing members which are placed in angular relations to each other and coact with similar angularly related coacting faces to support and to hold down the taper guide carrier; further, in providing a novel arrangement of friction reducing means between the two coacting members, namely, the carriage and the supporting carrier for the taper guide comprising acutely angularly related guiding faces and coacting acutely angularly related rotary friction reducing members to guide the supporting carrier in a true path lengthwise of the ways of the bed with extreme ease and accuracy of movement between them; further, in providing opposing series of sets of such acutely angularly related guides and rotary friction reducing members so as to act in opposition to each other in maintaining accuracy and ease of movement of the supporting carrier; and, further, in novel means for mounting and adjusting such rotary friction reducing members.

My invention consists, further, in providing novel means for converting the linear movement of the taper guide into cross movement of the cross tool slide; further, in providing novel rotary friction reducing operative connection between the taper guide and the tool slide; further, in providing novel adjustments for the same; further, in providing novel adjusting means for the acutely angularly related rotary friction reducing members so as to adjust the respective members of the respective series with relation to each other and to adjust the lateral distance between the angles of the acutely angularly related rotary friction reducing members with relation to each other, and to adjust opposing series of said rotary friction reducing members for distance relation to each other; further, in providing a novel housing in which to mount such taper movement guiding means; further, in providing such a housing which has rigid enclosing walls about the taper movement guiding means; further, in providing an integral housing structure surrounding said taper movement guiding means in cross-sectional relation to the bed; and, further, in mounting such encompassing housing as an integral structure, and as a bracket extending from the rear of the carriage.

The invention will be further readily understood from the following description and claims, and from the drawings, in which latter:

Fig. 1 is a plan view of an exemplifying lathe embodying my invention, viewed from the rear of the lathe, partly broken away, and broken away at the respective sides of the carriage to indicate indefinite length of the lathe bed.

Fig. 2 is a cross-sectional detail view, taken on the line 2—2 of Fig. 1.

Fig. 3 is a rear elevation of the lathe, partly broken away.

Fig. 4 is a vertical longitudinal section of my improved device, taken on the line 4—4 of Fig. 1. and partly broken away.

Fig. 5 is a cross-section of the same, taken on the line 5—5 of Fig. 1, and partly broken away.

Fig. 6 is an enlarged cross-sectional detail view taken on the same section line.

Fig. 7 is a vertical cross-section of my improved

device, taken in the plane of the line 7—7 of Fig. 4, and partly broken away.

Fig. 8 is an enlarged axial sectional detail view of one of the angularly positioned rotary friction reducing members, and its mounting taken on the same line.

Fig. 9 is a cross-sectional detail view of the mounting for one of the angularly positioned rotary friction reducing members, taken in the plane of the line 9—9 of Fig. 7.

Fig. 10 is a similar cross-sectional detail view of the mounting means for one of the companion rotary friction reducing members, taken in the plane of the line 10—10 of Fig. 7.

Fig. 11 is a plan sectional view of my improved device, taken in the plane of the irregular line 11—11 of Fig. 5, and partly broken away, the supporting carrier for the taper guide being removed.

Fig. 12 is a vertical longitudinal section taken in the plane of the line 12—12 of Fig. 5, and showing a front view of the housing.

Fig. 13 is a perspective rear elevational view of the integral housing of my improved device; and,

Fig. 14 is a plan sectional view of my improved device, taken in the plane of the irregular line 14—14 of Fig. 5, and partly broken away.

The lathe exemplified (Figs. 1 and 3) comprises the bed 21 provided with ways 22 extending lengthwise thereof for supporting a carriage 23 slidingly on the bed between a headstock 24, mounted on one end of the bed, and a tailstock 25, mounted on the other end of the bed, the headstock having a suitable drive spindle supporting a head center 26 and a face plate 27 by means of which the work supported between the head center and the tail center 28 on the tailstock is rotated. The carriage has a suitable tool support 31 thereon, which has a suitable tool 32 secured thereto in suitable manner. The tool support is slidable crosswise of the carriage and of the bed on a cross guide 33 on the carriage, and is movable crosswise by means of a usual cross screw 34, having threaded connection with adjustable wear compensating nuts 35, 35' on the tool support and operated in the usual manner, either manually or by power, as by the hand wheel 36 or by the usual power feed rod or power feed screw extending lengthwise of the bed. The travel of the tool in a lathe thus far exemplified is usually in straight lines lengthwise of the bed, parallel with the axes of the head center and the tail center.

My invention relates primarily to means for imparting other than such parallel straight line movements to the tool, namely, movements which are slanting or tapering with relation to such parallel straight line movements for producing taper formations on the work. My invention, therefore, relates primarily to the taper mechanism of the lathe, usually known as a taper attachment and includes contour turning. This taper attachment is in the present exemplification located on the rear of the carriage and is exemplified as on a bracket which overhangs the rear of the bed, and has connection with the cross feed screw 34 for imparting its movements to the tool for effecting the taper cutting on the work.

A bracket 41 (Figs. 5, 11, 12 and 13) extends rearwardly from the carriage and comprises a shelf 42, a front upwardly extending substantial wall 43 extending throughout a substantial portion of the front of the shelf, a rear upright substantial wall 44 and an upper connecting bridge 45, rigidly connecting the upper portions of the front wall and the rear wall to provide a lengthwise extending cavity 46, and forming a housing, which I prefer to form as an integral structure for exceptional rigidity, as by casting the same in one piece of metal, such as gray cast iron, cast steel or other substance to produce a unistructure, the relative parts of which are unyielding under great strains.

The front wall comprises a bracing portion 47 and the rear wall comprises a bracing portion 48, such bracing portions connecting said walls with the shelf. The front wall is provided with a front face 51 of substantial area and coacts with a rear face 52 at the rear end of the carriage, the rear end of the carriage being provided with a downwardly extending rear apron 53, on which the rear face 52 is continued. A positioning formation 54 is located between the rear wall of the carriage and the front wall of the housing to relatively locate the parts, and the housing is clamped to the carriage by means of bolts 55 extending through the base portion of said wall 43 and bolts 56 extending through flanges 57 at the upper margin of said wall, said bolts being respectively threaded into the rear apron 53 of the carriage and into the rear end of the body of the carriage to rigidly connect the housing with the carriage.

Movement lengthwise of the bed is imparted between a supporting carrier 61 and the carriage. The carrier has thereon a taper guide 62 (Figs. 1, 4, 5 and 14) arranged to be placed in various angular positions on the supporting carrier. This angle or taper guide has operative connection with the cross feed tool support for translating the inclined movements between the taper guide and said operative connections into cross movements of the tool.

The housing is provided with a cross guide 65, shown in the bridge 45 (Figs. 1, 4, 5, 6 and 13) in which a translating member of the taper attachment is accurately guided crosswise of the carriage and bed. This translating member is exemplified as a cross slide 66. An adjustable tapered gib 67 is located between said cross slide and said cross guide. This cross slide is attached to the cross feed screw 34, as by having the rear end of the latter journaled thereto in a cavity 69 in the front end of the cross slide, closed by a plug 70, having threaded connection 71 with the outer end of the wall 72 of the cavity 69. The rear end of the cross feed screw has a collar 75 fixed thereto between a shoulder 76 on the screw and a pin 77 fixed in said collar and in the rear end of the cross feed screw. This collar is provided with an annular flange 78, forming a separating wall between end thrust ball bearings 79, 80, the outer races of which are held between an annular shoulder 82 in the wall 72 and the rear end of the plug bearing 70. The ball bearings are adjusted by the threading of the plug 70 and are held in adjusted positions by a set screw 83, threaded in said wall and bearing upon said plug to hold the parts in adjusted relations.

A clamp bolt 87 is located in a slot 88 extending lengthwise in the cross slide 66, and is threaded into the housing at 89, a washer 90 spanning said slot and clamping upon the walls at the respective sides thereof for clamping the taper cross slide to the housing when the taper attachment is out of use, and thereby axially locating the cross feed screw 34 during the usual

manual or power feed of the cross feed screw. When the taper attachment is being used the clamp bolt **87** is unscrewed for unclamping the cross slide **66** and permitting it to be cross fed by the taper attachment. The cross feed screw may be rotated when the taper attachment is in use and when it is out of use for feeding the tool support.

The taper guide **62** (Figs. 1, 2, 4, 5, 12 and 14) is pivoted to its supporting carrier on a pivot stud **93** located in a central pivot hole **94** in the carrier and a registering central pivot hole **95** in the taper guide, so constructed that the taper guide may be adjusted into angular positions in both directions to a line parallel with the bed and intersecting the pivotal axis of said pivot stud. Dovetailed grooves **96**, **97** are located in the respective ends of the carrier and extend crosswise of the same, the heads of T bolts **98**, **99** being shiftable lengthwise in said grooves, the bolts extending through slots **100**, **101**, extending lengthwise of the taper guide, nuts **102**, **103** being threaded over said bolts and having washers **104**, **105** thereunder for clamping the respective ends of the taper guide in adjusted positions to its carrier.

The taper guide may be further clamped to its carrier by clamp bolts **106** passing through arcuate slots **107** in side wings **108** of the taper guide and threaded into the carrier, the arc of the arcuate slots being described from the pivotal axis of the taper guide as a center. Washers **109** are located under the heads of the bolts.

An adjusting screw **111** (Figs. 2, 4 and 14) is journaled in a bearing **112** in the carrier, the adjusting screw having an operating head **113** secured thereto, and being held endwise in said bearing between said head and a collar **114** on the screw. The threaded portion of said screw is located in the groove **96**. The screw is threaded in a threaded bearing **115** in the T bolt **98** for moving the T bolt in its groove **96** crosswise of the carrier when the taper guide is released for setting the taper guide in desired angular position, the T bolts and the clamp bolts **106** being clamped when said desired angular position is obtained.

There are suitable gages **121**, **122** on one of the ends of the carrier, one of said gages indicating degrees of angular adjustment of the taper guide, and the other indicating inches of taper per foot of linear movement of the carriage on the bed, the said gages having zero at their respective middles and increasing in values at the respective sides of said zero indications. A line marker in the middle of each of the inclined faces **123**, **124** on the taper guide registers with the markings of said respective gages, there being an opening **125** between said inclined faces through which one of the gages therebelow is viewed, the other gage being at the extreme end of said taper guide.

Taper attachments have heretofore been usually made with plane guide and slide faces between the taper guide supporting slide and its support and between the taper guide and its slide block connection with the tool post, with the result that great lateral, cramping and torsional strains have been exerted between the sliding faces, which are especially noticeable and detrimental in modern machine tool practice in which high speed work is performed and heavy cuts are made.

In order to overcome these objections I have provided my improved device in which resistances to such heavy strains are minimized, in which the moving parts are held in their true paths, in which the resisting strains are met in all directions by rotary friction reducing members, and in which the positions of the rotary friction reducing members are rigid with relation to each other in novel manner, in which adjustments are provided for such rotary friction reducing members in novel manner for compelling the translatable members to maintain their true paths, and in which the rotary friction reducing members are mounted in novel manner, in a novel housing, for extreme rigidity and in which means are provided thereby the coacting guiding contacts are provided in accurate relation to each other with extreme accuracy and economy in manufacture.

The housing for the supporting carrier and the operative connection between the taper guide and the tool support is, as heretofore stated, an integral casting for extreme rigidity, the housing being provided with the lengthwise cavity **46**, in which the supporting carrier moves linearly and in which the operative connection between the taper guide and the tool support for imparting taper movements to the latter, is located. The taper guide carrier is located and moves, lengthwise of the bed, at both sides of the connection between the taper guide and the cross slide therefor. In machining structures in which plane guide and slide faces are located between a taper slide and its support, the guide faces on the support have heretofore been machined in a continuous passage between such guide faces and the tool.

In applicant's structure, however, in which the housing supporting the carrier is integral, such machining would be impracticable because a portion of the guideways for the taper guide supporting slide would be surrounded by the casting. This is one of the reasons why I have dispensed with such plane guideways on the support. Furthermore, a more rigid and accurate structure is provided in my improved device.

The carrier is at its respective sides (Figs. 5 and 7) provided with guides **128**, **129**, respectively having lower plane faces **130**, **131**, and angular plane faces **132**, **133**, sloping in opposite directions with relation to said lower faces. The guides are located in rabbets **134**, **135**, presented toward each other in the lower ends of the side walls **136**, **137** of the carrier **61**. The guides or bars are secured in said rabbets by bolts **138**, **139**, countersunk in the carrier and threaded into said guides for securely fastening the guides to the carrier. These guides extend lengthwise of the carrier, substantially throughout the length of the latter and, with the carrier, move lengthwise in the cavity **46** in the housing **41**.

The carrier is supported and guided lengthwise and held to its true line of movement by means of rotary friction reducing members **141**, **142** (Figs. 4, 5, 7 and 11), arranged in series lengthwise of the carrier at the respective sides of the carrier for supporting the same and coacting with the lower plane faces **130**, **131**, and by rotary friction reducing members **143**, **144**, inclined relatively to each other and to the rotary friction reducing members **141**, **142**, and coacting with the sloping plane faces **132**, **133**, for holding the carrier downwardly upon the rotary friction reducing members **141**, **142**, there being a pair of series of these rotary slanting friction reducing members at the respective sides of the carrier to compel movement of the carrier in its

true linear path to hold the carrier downwardly toward the rotary friction reducing members 141, 142, and to prevent lifting, lateral tilting and shifting of said carrier out of its true linear path. With this improved guiding and supporting means for the carrier, the use of tracks, guides, gibs and the like coacting with other plane surfaces for maintaining the carrier in its true path of movement are avoided, thereby eliminating a source of friction present in previous structures.

These rotary friction reducing members are respectively exemplified as rollers (Figs. 8, 9 and 10), which are the outer races of friction reducing or rolling bearings 152, exemplified as ball bearings, the inner races 153 of which are adjustably positioned, forming radial and end thrust ball bearings, each having two rows of balls 154, 155, respectively located between an intermediate annular rib 156 extending inwardly from the outer race and radially outwardly extending ribs 157, 158 at the outer ends of the inner race, for definitely locating the races in axial direction. The ball bearings may be provided with end closures 159, 160, suitably held in place for closing the ends of the annular cavity 161 between said races, which cavity may be filled with a suitable lubricating grease for maintaining the ball bearings lubricated, and forming sealed bearings.

The lower supporting rollers are located in slots 165, 166, in the shelf 42 (Figs. 4, 5, 7 and 11), and extend upwardly above said shelf into supporting coaction with the carrier 61, and the sloping rollers are located in cavities 167, 168 in the lower portion of the carrier, these cavities extending lengthwise of the carrier. The lower friction reducing members and the sloping friction reducing members are preferably arranged in pairs at the respective sides of the carrier with the contact lines between them and the carrier preferably located in concident vertical planes perpendicular to the path of the carrier so as to place their resistance stresses directly counter to each other crosswise of the carrier.

Each of the supporting rolling bearings is located on a head 171 of a shank 172, eccentrically located in a bushing 173 rotatively adjustable and slidable endwise for endwise adjustment in a bearing 174 in the outer wall 175 of one of the slots 165, 166 in the housing 41. The inner wall of each slot is provided with a boss 176, against which the inner race of the ball bearing may be clamped by endwise pressure on the bushing 173, the bushing being clamped in place by a clamping plug 177, clamped endwise against the bushing by a clamp screw 178 threaded in a hole 179 in the shelf. The shank is fixed to the bushing by a pin 180 in registering holes in said bushing and said shank (Fig. 10). The outer end of the shank is provided with a formation 181 by means of which the shank and the bushing in which it is eccentrically mounted, may be rotated for positioning the axis of rotation of the ball bearing. Access thereto is readily obtained through cavities 182, 183 in the front lower portion of the housing, and from the rear of the housing.

Each of the sloping rolling bearings is located on the head 184 of a shank 185 eccentrically located in a bushing 186 in a bearing 187 of the shelf, a spline key 188 in the shank extending into a slot 189, formed lengthwise in the wall of the bore of said bushing (Fig. 9). The head of the shank is provided with an outer flange 191, which bears upon the outer end of the inner race of its ball bearing, the inner end of said race bearing upon the inner end of the bushing 186, which is provided with an outwardly radiating annular flange 192 coacting with the inner end of the bearing 187. The head of the shank forms a shoulder 193, normally spaced from the inner end of the bushing. The shank has a reduced threaded end 194 forming a shoulder 195 spaced from a washer 196 received over said reduced end and engaging the outer end of the bearing 187. There is a space 197 between the outer end of the bushing and said washer. A nut 198 threaded over said reduced end clamps the inner race between the flange 191 and the bushing 186 and clamps the bushing to the bearing. The outer end of the shank is provided with a formation 199 by means of which the shank and the bushing may be rotated for adjusting the position of the axis of the ball bearing.

The lower face of the housing 41 is provided with cross ribs 201 and a longitudinal rib 202 merging therewith, to form pockets 203 in which the lower portions of the supporting ball bearings and the lower ends of the sloping shanks and the clamping connections for the sloping ball bearings are located, and to enhance rigidity of the housing structure.

The bores for the bearings 174, 187 may be readily provided in the housing from the outside of the housing, as by boring holes of suitable diameters and finishing the same from the outside of the housing or integral casting, all of which may be done with accuracy, with free access to various parts of the housing from the outside thereof and in definite, accurate registry with relation to each other, so that the contact lines of the lower rotary friction reducing members are in the same supporting plane and the contact lines for the respective series of sloping rotary friction reducing members are in similar planes for proper coaction with the respective series of lower friction reducing members. Adjustments of the respective rotary friction reducing members are readily obtained by rotations of the respective bushings in which their shanks are respectively eccentrically located, the bushings being reclamped in adjusted positions after the adjustments have been made.

The parts are so constructed and related that the same may be readily assembled and so that desired finishing of suitable surfaces may be made from the outside of the housing. Thus the boss 176 on the inner wall of each of the slots 165, 166 is no greater in diameter in any direction than the diameter of the bearing 174 in the outer wall of said slot, and which boss is in line with said bearing and may be readily finished by an end milling tool inserted in said slot and connected with a shaft inserted into said tool through the bearing in line with said boss. The respective ends of the sloping bearings 187 may also be readily finished from the outside of the housing, the inner end of the bearing having a boss 204 around the same, the inner end of which is readily finished by an end milling tool having its cutting face presented toward said boss and rotated by a shaft extending thereinto through said bearing. The outer end of the said bearing is also suitably finished by an end milling cutter presented thereagainst from the outside of the housing.

The supporting ball bearings may be inserted in their slots, and the assembled shanks and bushings may be inserted from the outside of the housing into their encompassing bearings and the heads of said shanks inserted into said

ball bearings. The assembled sloping ball bearings and their shanks and bushings may be inserted into their respective bearings in the housing from the inside of the housing, the reduced outer ends of said shanks being inserted slantingly into said bearings followed by the insertion of the bushings in axial directions into said bearings, the washers and nuts being placed over the outer projecting ends of said shanks after such insertions. The carrier may then be moved endwise into the cavity in the housing into coactive relation with said rollers.

The operative connection between the cross slide 66 and the taper guide (Figs. 4, 5 and 6) is exemplified as comprising a pair of rotary friction reducing members 211, 212, shown as rollers about a depending shank 213, secured to said cross slide. The rotary friction reducing member 211 is shown as the outer race of a rolling bearing, the inner race 215 of which is mounted on the shank 213, intermediate balls or rollers 216 being located between said races. The rotary friction reducing member 212 is shown as the outer race of a rolling bearing, the inner race 218 of which is mounted on the shank 213, intermediate friction reducing rollers or balls 219 being located between said races.

The lower end of the shank 213 is provided with an annular flange 221. Separating washers 222, 223 are located about the shank respectively between the inner races and between the upper inner race and the bearing 224, in which the shank 213 is located. The shank is positioned in its bearing by a spline key 225 in the shank projecting into a slot 226, extending lengthwise in said bearing. The shank has a threaded reduced end 227, over which a clamp nut 228 is threaded, a washer 229 being located between the clamp nut and the cross slide 66. Clamping of the shank clamps the flange 221, the inner races and their washers and the shank to the cross slide.

Guide bars 233, 234 on the taper guide (Figs. 5, 7 and 14) coact respectively with the respective rotary friction reducing members 211, 212. These respective rotary friction reducing members and their respective guide bars are in different horizontal planes and act independently of each other so that there may be no friction or interference in action between them.

Adjustment is provided between the guide bars and the rollers for relatively locating the parts and for taking up any wear between them. The taper guide is provided with a recess 235 extending lengthwise thereof. Guideways 236, 237 extend lengthwise in the taper guide at the opposite sides of the rollers and have outer guide walls which are inclined in opposite directions. The guide bars have outer inclined edges 238, 239 inclined in opposite directions to coact with said inclined guide walls. They are located in said guideways and coact with said guideways, there being preferably coacting tongues 240 and grooves 241 between said guide bars and the bottom walls of said guideways parallel with the coacting inclined faces of said guideways and guide bars for locating the guide bars laterally with relation to said guideways.

The guide bar 233 is adjusted lengthwise on the taper guide for desired lateral relation of its contact edge with the roller 211, such lengthwise movement of the guide bar adjusting it laterally due to its inclined connection with the taper guide. When in adjusted position the guide bar is fastened to the taper guide by means of countersunk screws 242. This adjustment is preferably a permanent adjustment. The opposing guide bar 234 is provided with holes 243, of greater diameter than the diameter of the clamping bolts 244 therein to permit lengthwise and lateral movement between said guide bar and the taper guide when adjusting said guide bar lengthwise, so as to adjust the guide bar laterally with relation to the opposing guide bar for proper contact relations between the friction reducing rollers 211, 212 and said guide bars. Upon such adjustment having been made, the bolts 244 are tightened in the taper guide, clamping the guide bar between the heads of the bolts and their washers 245 and said taper guide. The inner edge of the guide bars project inwardly beyond the side walls of the recess 235, extending lengthwise of the taper guide, for proper coaction between the rollers and said guide bars.

When it is desired to cut tapers, the clamp bolt 87 is released and the taper guide is angularly adjusted on its carrier to conform to the taper and the direction of taper desired on the work, and movement is caused lengthwise of the bed between the carriage and the carrier. In cutting tapers determined by the movement of the carriage lengthwise of the bed at the speed of such movement, the carrier is held stationary with relation to the bed, as by means of a rod 251 fixed to the carrier by a threaded connection 252, the other end of said rod being fixed, as at 253, to a bracket 254, extending from the bed, and arranged to be clamped to one of the guideways thereon, as by means of a clamp 255, arranged to be clamped to said guideway by clamp bolts 256 and released from said guideway so as to slide thereon by unclamping said bolts. This bracket during normal operation of the lathe when the taper attachment is not employed may be removed or may be permitted to slide idle on the bedway.

If it is desired to move the taper guide supporting carrier at a speed different from that of the travel of the carriage so as to cut long tapers greater than the length of supported movement between the carrier and the carriage, or short high pitch tapers, a suitable differential gearing may be employed for imparting less speed or greater speed to the carrier than the speed of feeding movement of the carriage, said differential gearing employing suitable speed changing mechanism and a power delivering gear suitably operated and meshing with a rack 257 extending lengthwise of the carrier and secured thereto by suitable clamp bolts 258.

The supporting rollers 141, 142 and the angularly positioned rollers 143, 144 having been adjusted so that their respective lines of contact are in similar planes lengthwise of the bed and so that they coact to support the carrier and hold the carrier down to the supporting rollers, and prevent lateral shifting of the carrier, and the angle or taper guide having been angularly adjusted on its carrier to conform to the taper desired on the work, and feeding movement having been imparted lengthwise of the bed between the carriage and the carrier, transverse movement is imparted to the tool through the operative connection between the taper guide and the rollers 211, 212 respectively contacted at their opposite sides by the guide bars 233, 234. The guide bars have adjustment between them for insuring proper contact relations between said respective rollers and the respective sides of the angle or taper guide, so as to impart accuracy to the tool movement.

It will be noted that the coacting contacts in all directions between the taper bracket and the carrier, and the operative connections between the taper guide and the cross slide, are produced by rolling contacts, thereby providing ease of motion and relieving the operating parts from the excessive strains which heretofore have been due to relative movement between plane coacting faces on said respective parts which created excessive friction and caused tilting, cramping and binding between the plane coacting surfaces, which are avoided by my improved construction. My improved construction insures accurate linear movement between the parts and prevents excess friction and holds the parts in their desired predetermined paths. The acute angular relation between the supporting rollers and the hold-down rollers insures correct linear movement of the carrier and prevents tilting and tipping of the same, without the employment of coacting plane slide surfaces, and my invention insures that one of the coacting guide surfaces in each direction is on a rotary friction reducing member.

These features are especially useful in resisting unusual strains due to high speeds of feeding movements between the tool and the work and to heavy cuts taken off the work by the tool and when the tool is operating upon especially tough materials, as is usual in modern machine tool practice.

The supporting rollers and hold-down rollers are furthermore acutely angularly positioned with relation to each other, and are adjustable for lateral movement between them to insure proper contact relation between said respective rollers and their respective coacting guides so as to adjust the pressure between said rollers according to the resistance encountered in the cutting operation. The rollers are arranged in pairs at the respective sides of the carrier and the axes of the rollers of said respective pairs are preferably located in identical planes transverse to said carrier, the axes of the pairs of rollers at said respective sides being also preferably in such identical planes, for resisting the distorting stresses upon the taper guide and carrier in identical planes for greatest efficiency in their resistances.

The rotary friction reducing members between the carrier support or bracket and the carrier and between the taper guide and the cross slide are located within a channel of an integral casting so that the integral casting surrounds the same to prevent reflex movements between the parts and to insure stability of coactive relation between the parts.

The contact lines between the supporting rollers and the hold-down rollers respectively and the carrier are located in the acute angle of the axes of rotation of said rollers, the axes of rotation extended of the respective series of rollers being located in planes lengthwise of the bedways and parallel with said axes, which intersect each other at such acute angle.

The adjustments for pressure contact between the respective rollers and their guide faces between the carriage and the carrier and between the taper guide and the taper cross slide are such as to permit preloading pressures between said rollers and guide faces, that is, pressures which are active in the directions produced by cutting stresses before these stresses are actually applied, insuring extreme accuracy in the work, not possible with coacting guide and slide faces heretofore usually employed in such structures, as such pressures applied to the latter would jam the faces together and prevent sliding action between them. The friction reducing members and their coacting guide faces may be hardened, and suitable covers may be provided to protect the operating mechanisms.

It is obvious that changes in structures, relations and arrangements of parts from what is herein particularly shown and described may be made without departing from the spirit of my invention or the scope of the accompanying claims.

I claim:

1. In taper mechanism, the combination with the bed, the carriage movable lengthwise thereon and the tool holder movable crosswise on the carriage, of a housing movable with said carriage, said housing provided with encompassing walls to form a cavity in said housing extending lengthwise of said bed, a carrier, a taper guide adjustable thereon and having operative connection through said housing with the tool holder to move said tool holder crosswise on the carriage, means for lengthwise supporting and lateral and hold down movements between said carriage and said carrier comprising opposing supporting and lateral and hold down guides and opposing supporting and lateral and hold down rotary friction reducing members coacting therewith, mounting means for the latter comprising bearings in said housing having bores open at the outer periphery of said housing, bushings in said bores, said rotary friction reducing members eccentrically mounted in said bushings, means at the outer ends of said mountings wherewith to relatively laterally adjust the distance relation between the axes of rotation of said opposing supporting and lateral and hold down rotary friction reducing members from the outside of said housing, and means to fixedly position said bushings in said bores to retain such adjustments.

2. In taper mechanism, the combination with the carriage and the cross tool support thereon, of an integral housing movable with said carriage and comprising a shelf, front and rear walls extending upwardly therefrom and an upper wall between the latter to form a cavity extending lengthwise of the carriage, a carrier in said cavity separate from said housing and having taper operative connection with said cross tool support, and supporting and guiding means between said carriage and said carrier comprising a plurality of oppositely presented acutely angularly related plane guide faces extending lengthwise on said carrier, series of friction reducing rollers on said housing respectively having peripheral contact faces which are acutely angularly related and coact with said plurality of oppositely presented acutely angularly related plane guide faces, the plane guide faces being located solely on said carrier and said rollers being located solely on said housing, and individual securing means for said respective rollers whereby to rotatively connect the same with said housing and whereby the plane guide faces of said guiding means are located solely on a member separate from said housing.

3. In taper mechanism, the combination of a crosswise movable member for operative connection with a tool support, a carrier, a taper guide and a coacting part between said carrier and said crosswise movable member, an integral casting comprising a bottom wall, front and rear walls and an upper wall connecting the latter to form

a cavity lengthwise in said integral casting, said carrier being separate from said housing and located lengthwise in said cavity, said carrier provided with supporting guideways and combined lateral and hold down plane guideways extending lengthwise thereof, rotary friction reducing supporting members and rotary friction reducing combined lateral and hold down members respectively having rolling contacts with said supporting guideways and said lateral and hold down guideways to support and laterally guide and hold down said carrier, said integral casting provided with holes extending therethrough, and mountings for said rotary friction reducing members in said holes, and all the guideways located solely on said separate carrier, whereby the cavity in said integral casting between said walls is free of all lengthwise extending guiding and supporting facs on said casting.

4. In taper mechanism, the combination of a crosswise movable member for operative connection with a tool support, a carrier, a taper guide and a coacting part between said carrier and said crosswise movable member, an integral casting comprising a bottom wall, front and rear walls and an upper wall connecting the latter to form a cavity lengthwise in said integral casting, said carrier being separate from said casting and located lengthwise in said cavity, and supporting and guiding means between said casting and said carrier comprising plane guideways located solely on said carrier and including supporting guideways and combined lateral and hold down guideways extending solely lengthwise on said carrier, rotary friction reducing supporting members and rotary friction reducing combined lateral and hold down members respectively having rolling contacts with said supporting guideways and said combined lateral and hold down guideways to support and laterally guide and hold down said carrier, said integral casting provided with holes extending therethrough, and mountings for said rotary friction reducing members in said holes, said rotary members located on the inner ends of said mountings and the outer ends of said mountings provided with means wherewith to adjust said rotary members from the outside of said casting.

5. In taper mechanism, the combination of a carriage, a tool support feedable crosswise on said carriage, a carrier, a taper guide angularly adjustable thereon, a housing fixed to said carriage and formed as an integral casting comprising a bottom wall, front and rear walls and a top wall integral with each other about a cavity extending lengthwise of the carriage, said carrier being separate from said casting and insertible into said cavity, a crosswise moving member guided crosswise on said upper wall, operative connecting means between said taper guide and said crosswise moving member, operative connecting means between said crosswise moving member and said tool support, guiding means between said integral casting and said carrier comprising rollers and plane guideways, the latter extending lengthwise of said carriage and located solely on said carrier for forming the sole plane lengthwise extending guiding faces between said carriage and said carrier, said lower wall having holes therethrough open at the outside of said integral casting for access through said holes into said cavity, and mounting means for said rollers located in said holes and provided with means wherewith to adjust said mounting means, said integral casting about said cavity resisting the operative strains between said casting and said carrier, between said tool support, said crosswise moving member and said taper guide and carrier, and between said tool support, said carriage and said integral casting.

6. In taper mechanism, the combination of a bed, a carriage movable thereon lengthwise of said bed, a tool support on the carriage, a crosswise translatable member for the taper mechanism on said carriage having operative connection with said tool support for moving said tool support crosswise on the carriage, a carrier on said carriage, guiding means for guiding movement between said carrier and said carriage, a taper guide on said carrier having alined guideways, and operative connecting means beteween said alined guideways and said crosswise translatable member comprising superposed friction reducing rollers having substantially coincident axes and coacting with said respective alined guideways in opposite directions and forming the sole pivots between said taper guide and said crosswise translatable member.

7. In taper mechanism, the combination of a bed, a carriage thereon movable lengthwise of said bed, a tool support on the carriage, a crosswise translatable member on said carriage having operative connection with said tool support for moving said tool support crosswise on said carriage by the taper mechanism, a carrier on said carriage, guiding means for guiding movement between said carrier and said carriage lengthwise of said bed, a taper guide on said carrier provided with opposed alined guides, friction reducing rollers having pressure coaction with said opposed alined guides, and pivot connection between said superposed rollers and said crosswise translatable member, the pivotal axis of said pivot connection and the axes of said rotation of said rollers between said taper guide and said crosswise translatable member extended being substantially coincident throughout coactive movement between said taper guide and said crosswise translatable member throughout taper movement between said taper guide and said rollers.

8. In taper mechanism, the combination of a bed, a carriage movable thereon lengthwise of said bed, a tool support on the carriage feedable crosswise of said carriage, a cross member on said carriage movable crosswise thereof, a cross feed screw having journal connection therewith and operative connection with said tool support, a taper guide on said carriage provided with alined guide faces, superposed friction reducing rollers coacting with said alined guide faces, and pivotal connections between the latter and said cross member, the axes of rotation of said superposed rollers and the pivotal axes of said pivotal connections being substantially coincident.

9. In taper mechanism, the combination with a bed, a carriage movable lengthwise on said bed, a tool support on said carriage movable crosswise of said carriage, a cross feed screw having operative connection with said tool support to so move the same, a cross member on said carriage having journal connection with said cross feed screw, a taper guide, and superposed rollers coacting with the latter and having pivotal and journal connections with said cross member, and said pivotal and journal connections having substantially coincident axes located substantially in the vertical plane extended in which the axis of rotation of said cross-feed screw is located.

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