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ARM MOUNT WITH ACCESSIBLE GEAR UNIT

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Fig. 1

Fig. 2

Fig. 3

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By Attorney

[Detail of patent drawing showing arm mount and accessible gear unit.]
This invention deals with machine-tools and it is concerned more especially with structures characterized by a column extending from another frame-element, such as a base, and interiorly containing a transmission that emerges at the free end of the column and which at the base is connected with a transmission shaft extending through the column. From another aspect, the invention also contemplates an arm vertically adjustable with respect to the column and suitably mounted thereon, as through the intervention of a sleeve, so as to admit of being swung about the axis of the column; said arm and column being especially formed and arranged to attain and preserve great precision in their relative positions, as well as ease in adjustment.

A so-called radial-drill is a good specific example of a machine-tool of the foregoing type and this invention will accordingly be disclosed as so embodied. Designers of such organizations have long recognized the need of extreme rigidity, precision of fit, smoothness of movement, compactness of parts, facility of assembly and the like. To attain these desiderata without creating shop and foundry difficulties, and at a moderate cost in labor and materials, has been the goal for which the art has long striven.

In a radial drill, the arm carrying the drill-head is supported at one end only and consequently exercises severe bending and cramping strains on the post or column as well as on the pivotal means (usually a large sleeve) employed to afford a swinging movement. This invention seeks to meet this difficulty: (A) by proposing an inexpensive internal system of reinforcements for the post fully compatible with limitations of foundry practice while providing a light yet rigid structure; (B) by providing a sleeve interiorly corrugated for the same purpose and having highly accurate upper and lower bearings on the exterior of the column for maintaining it truly concentric with the post without resorting to the expense of highly finishing the column throughout its entire length; (C) by utilizing a suspension bearing for the sleeve in connection with a stop enabling the cutting drill to be hoisted by the arm without liability of displacing the arm; (D) by interposing a travelling adjustable thrust-bearing between that portion of the arm and the post in the region where the bending moment creates the maximum pressure; and (E) by locating the clamp for the sleeve where it will not interfere with vertical travel of the arm and where it will not interfere with the maintenance of the essential accuracy of the co-axial relation between the sleeve and the column.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:

Fig. 1 is a plan of the bed and the detachable transmission unit assembled thereon; the post being omitted for the sake of clearness. Fig. 2 is a vertical longitudinal section (through line 2—2 of Fig. 1) showing how the unit is supported. Fig. 3 is a transverse vertical section (through line 3—3 of Fig. 1) showing how the unit is supported. Fig. 4 is a perspective of the isolated transmission unit. Fig. 5 is a perspective looking upwardly into the lower end of the post to show the reinforcements thereof and the cavity for accommodating the transmission unit. Fig. 6 is a transverse vertical section similar to that shown by Fig. 2 but including the complete post, sleeve and arm. Fig. 7 is a horizontal section through line 7—7 of Fig. 6 and Fig. 8 is a similar section through line 8—8 of Fig. 6.

The drawings represent a frame-element here shown as a base or bed A from which projects another frame-element indicated by B; said frame-element B being hollow and containing a transmission shaft which derives motion from a transverse shaft extending in parallelism with the base element. The element B is here shown in the form of a post which, by means of suitable bolts 1, is secured to the base; certain positioning pins 3 being preferably employed for the purpose of securing absolute alignment between parts. In machine-tools conforming to the above arrangement, no little difficulty has been experienced in connecting (usually
through suitable bevel gears) the two transmission shafts for the reason that their juncture occupies an inaccessible location. It is very troublesome to get at the bevel gears for the reason that it is first necessary to un-bolt and remove the frame element B, which is usually too heavy and ponderous to be easily handled. The bevel gears are, of course, likely to require inspection and repair from time to time and the difficulty of getting at them usually results in their becoming unduly deteriorated; to the detriment of the entire machine tool.

In order to overcome this difficulty, this invention proposes the use of a transmission unit (as exemplified by F) so mounted and arranged that it may readily be bodily removed and re-installed without requiring a preliminary separation of the post from the base; thereby not only maintaining the original accuracy of the assembly but also making an inspection or repair of this vital part a comparatively easy and simple operation. While, in the light of this disclosure, this proposition may be attained through more or less modified details, the construction herein illustrated will adequately set forth the characteristics of this invention.

In this illustrative embodiment, two bevel gears 4 and 5 are suitably journaled (as by means of bushes 6 and 7) at right angles in a minor frame 8. The transmission shaft G (which conveys power to the arm and drill-point) is splined, as indicated by 9, to the gear 5 and, likewise, the shaft E (driven from the motor) is splined, as indicated by 10, to the gear 4. These shafts are consequently capable of being slipped into place when the transmission unit F has been located in its proper position. This unit F is of such a nature that it may be slipped into place through a port or opening in the base or preferably, partly in each. Thus, the foot of the post is enlarged box-like and provides an opening 11 in the nature of a portal; said opening registering with a recess 12 in the base; thereby affording a sufficient clearance for the bodily removal and insertion of the transmission unit. For the purpose of insuring positiveness in the seating of the minor frame 8, the side walls 13 of the recess provide shoulders or slide ways 14 and 15 adapted to carry rails 16 and 17 preferably integral with the minor frame 8. Suitable guides 18 and 19 are provided by the base A so as to hold the rails 16 and 17 against upward movement. This construction will insure coincidence of the longitudinal axis of the minor frame 8 with the vertical axis of the shaft G. In order, likewise, to ensure coincidence of the vertical axis of the bevel gear 5 with the axis of the transmission shaft G, the bed is provided with a suitable stop or shoulder 20 against which a part 21 of the minor frame 8 will abut when the unit F is being assembled in place; thereby definitely locating the unit. To render accessible the bolts employed for securing the unit in place, the minor frame 8 is extended (as by means of the strips 22 and 23) and these parts terminate in lugs or wings 24 and 25 having bolt-holes adapted to receive the bolts 26 and 27, as well as the pins 28 and 29, which are exteriorly located, as shown, adjacent the portal through which the transmission unit F is inserted and removed. The gear 5 is preferably positioned below the axis of the shaft E, as shown, (being held within a depending hub 30 of the minor frame 8) so that, by means of a plate 31, a well will be formed for containing lubricant and also so that it may serve the purpose of preventing the shaft G from being dropped too far when the parts are being assembled. The other gear 4 is arranged with its axis substantially horizontal; being mounted in a pillow block 32 having a pillow cap 33 held in place by bolts 34.

The post B is preferably interiorly ribbed to secure maximum rigidity and certain of these ribs, at their lowermost portions, are cut away sufficiently to avoid interference with the insertion and removal of the transmission unit; the foot of the post being of box-like form. The shaft G, in this instance, extends upwardly coaxially with the post and, at its upper end, is connected with the transmission-train.

In the case of a drilling machine embodying this invention, an arm D carries a drill-head; such arm being so mounted that it may be raised and lowered with respect to the post and also admit of being swung in a horizontal plane. This may be achieved by a species of pivot which, in this example is in the form of a sleeve C rotatably journaled on the post. The sleeve C is vertically adjustable on the sleeve and is raised and lowered by a lifting screw J actuated by power derived from the shaft G.

By reason of the fact that this arm D extends transversely to the axis of the post and is supported at one end only by the post, 115 and carries the drill head and point on its over-hanging portion, considerable bending strains are exerted on the post and sleeve and much difficulty has been experienced in securing and maintaining a high degree of precision in respect to the co-axial relation between the sleeve and the post. By means of the structural characteristics herein disclosed, this difficulty has in larger part been overcome, and the smooth adjustment of the sleeve about the post, even when carrying heavy loads, is ensured.

The post itself has a bi-tubular construction and consists of an outer shell 35 and an inner tube 36; the latter occupying substan-
ially the rear lower half portion of the post where the bending strains are the greatest. The outer shell 35 is substantially uniform in external diameter (allowing for certain bearing portions) from its top to the plane of the section line 8—8, where it enlarges to form a base-like drum or annulus 37 affording additional strength and also providing an enlarged periphery 38 adapted to serve as drum or friction surface around which the lower portion of the sleeve may be tightly clamped to lock these two parts against relative movement. The lower part of the drum 38, is, in turn, enlarged box-like to form a base or pedestal 39 providing an interior chamber adapted to contain certain unique reinforcements and also to receive the upper portion of the insertable gear unit described in the foregoing.

This box-like pedestal has an annular outside wall 40 which is of circular contour; except on the arm side of the post, where it runs straight across secant-like to permit the work on the bed to be arranged closer to the post and to afford a great working area on the bed. Passing vertically through this outer wall 40 is a series of spaced bolt-holes 42; whereby the post may be bolted, by means of bolts 1, rigidly to the bed.

In this embodiment, the inner tube 36 has its lowermost end 43 terminating a sufficient distance above the floor to accommodate the insertable transmission unit F. A series of similar radial vanes 44, 45 and 46 integrally connect the inner tube 36 with the outer shell 35; the lower edge portions of these vanes being curved downwardly and outwardly from the lower end of the inner tube to the lower end-edge of the inner periphery of the wall 40, as indicated by 47. A somewhat similar vane 48 likewise connects the inner tube 36 to the outer shell 35 by its lower end-edge terminates flush, as indicated by 49, with the lower end of the tube so as not to interfere with the insertion of the transmission unit F. These vanes preferably continue upwardly beyond the top of the inner tube, as indicated by 48, 46, and 45; thereby forming inner ribs integral with the inner periphery of the outer shell 35 and sufficiently reinforcing its upper half portion to enable it to resist effectively such strains as will ordinarily occur at that point. Where the strains are greatest, i.e., at the pedestal and drum, additional ribs 50, 51, 52 and 53, which are uniformly and radially distribute from the inner face of the pedestal and drum; the innermost edges of said vanes being preferably spaced somewhat away from the inner tube, as indicated by 54. These supplementary vanes occupy substantially the region of the enlargement below the plane of the section line 8—8 (where the sleeve exercises its lower fulcrum point on the column) and co-operate with the other features of construction to produce an extremely rigid base for the post, and yet without employing an excessive amount of metal, and without introducing great difficulties in respect to foundry practice. The outer wall 40 is preferably also provided with short side walls 55 reinforcing the opening or portal 11 through which the transmission unit is inserted, as has been explained.

It will be noted that certain of these ribs (44, 45, 46 and 55) are so shaped and arranged that their lowermost portions serve as struts extending from the roof 59 of the pedestal into contact with the floor (provided by the base) and that, in the region underlying such roof, these vanes rest flush on the floor; they being provided with radial flats all arranged in the same plane for that purpose. The object of this particular formation (which may be utilized either as to each or many of the vanes) is effectively to resist the tendency of the roof 59 to buckle under the severe bending strains to which the column is necessarily subject. In the region underlying the central inner tube, the vanes are distant from the plane of the floor so as to provide for a central chamber within which the transmission gears may be located. In the form shown by the drawings, the ribs 50, 51, 52 and 53 (which do not extend to the inner tube) are flush with with the floor in the region only of the annular wall 40; inasmuch as the other vanes will adequately answer the requirements of struts and the last-mentioned vanes will serve adequately to brace the roof and the side-wall together without having such an extensive bearing surface on the floor; thereby eliminating any unnecessary machining of the flats. Such ribs, however, preferably extend, as indicated by Fig. 6, along a curve quite closely to the floor, so as to obtain the benefit of a full width or height in the vane and afford a great resistance to any bending thereto.

It will be seen that this arrangement affords a complete system of reinforcements very effectively responding successively to the stress-gradations and producing a column perfectly adapted at all points to answer the local requirement; this being attained without the use of excess metal. Thus, at its upper portion, the outer shell is merely interiorly ribbed. These ribs enlarge as the middle of the post is approached and then the inner edges of these ribs are in turn stiffened and braced by merging into the inner tube. Still lower, where the post swells, this formation is continued and is supplemented by additional ribs interiorly stiffening the enlarged periphery of the shell. Finally, these ribs extend to brace the roof of the box-like pedestal and provide struts directly and vertically connecting the roof.
with the base; thereby providing reinforcements in full proportion to the degree of the strains.

Circumscribing the post is a sleeve C which, as indicated by Fig. 7, is interiorly provided with a plurality of shallow ribs 56 in the nature of corrugations. These reinforcements preferably are substantially co-extensive in length with the sleeve except as to such portions thereof as constitute the bearings N and M. The weight of the sleeve is suspended from its upper end which has a thrust bearing on the top of the post. A block 57 of high-grade metal in the nature of a hub is interlitted with the upper end of the post and is secured in place by means of bolts 58 and lock screws 59 accurately in co-axial relation with the post. Near its upper end, this hub provides a horizontal seat 60 on which rests a thrust bearing 61 which, in turn, carries the pressure of a bearing ring 62 which is secured to cap 63 that, by means of bolts 64, is firmly affixed to the upper end of the sleeve C so as to support the weight thereof. In this manner, the weight of the sleeve (and its various parts) is supported from the upper end of the post. It occasionally happens that, in the course of the transportation of a drill, it is hoisted by means of ropes around the arm and sleeve. In previous constructions, this has resulted in trouble because there was nothing to prevent the sleeve from slipping upwardly off of the post. To avoid this untoward condition, an auxiliary normally-idle thrust bearing K is employed and is so arranged that the tube cannot slip upwardly except perhaps for a very slight distance. This thrust-bearing may, very conveniently, be combined with the annular bearing which maintains the upper extremity of the sleeve accurately in co-axial relation with the post. The hub 57 has an annular surface 65 formed concentrically with its axis, very accurately, and this surface supports an annular ball-bearing 66 which closely fits in an aperture 67 in a dish-like member 68 which, by means of screws 69 and a shoulder 70 is accurately secured to the upper end of the sleeve. A collar K, in the nature of a normally-idle thrust-bearing is screwed to the upper end of the hub 57 and is adapted to contact (during a hoisting operation) with the seat 71 of the member 68 in case an attempt is made to lift the drill by the sleeve; these portions being made sufficiently strong and massive to carry safely the entire weight of the drilling-machine.

In order effectively to offset the tendency of the upper end of the sleeve to be bent or deflected under the weight of the arm, this invention contemplates an accurately fitted bearing at M, whereby the inner periphery of the sleeve may turn around the outer periphery of the post with a close margin of clearance therewith. This bearing is preferably made by providing the post with a slightly enlarged annular seat 72 and providing the sleeve with a complementary annular seat 73; these seats not necessarily being of very great width. The parts, while of very considerable diameter, are fitted very accurately allowing a clearance of say about .002 of an inch.

A similar bearing N is arranged at the lower portion of the sleeve (in the region of the lower fulcrum of the sleeve on the post) say slightly above the plane of the section 8—8, so that the sleeve, accordingly, has a very accurate bearing on the post at two widely spaced points corresponding substantially to its fulcrums. By reason of the rigid formation of the post and of the sleeve respectively, it is entirely practical to employ these two widely spaced bearings instead of giving the sleeve a uniform bearing throughout the length of the post and this construction has the advantage that the parts may be given a much closer fit than otherwise and the excess strains are taken up by these bearings and not imposed on the ball bearings at the top of the post and it also avoids the necessity of machining the intermediate portions since a clearance space is permissible.

The thrust on the bearing N is quite considerable and the friction created thereby materially diminishes the ease with which the user can rotate the sleeve about the post in giving the arm various pressures of angular adjustment. For the purpose of taking up some of this pressure and to facilitate the adjustment of the sleeve, this invention proposes a cooperating travelling thrust bearing of the anti-friction type which is adjustable within close limits so that it can be set to take as much or as little of the strain as will conform to the condition in hand. This thrust-bearing may have a simple formation and may comprise a hardened and ground annular track 75 accurately seated in shoulders 76 on the post in the vicinity of the main bearing N. A pair of rollers 77 and 78 are mounted on the side of the sleeve underlying the arm and these rollers ride on the track 75. Preferably, two rollers are employed and are spaced apart and are located at each side of the center line of the arm, as shown by Fig. 8, so as to somewhat balance the tendency of the sleeve to shift to one side or the other of its true concentric position. To provide for the mounting of these rollers and to reinforce the sleeve at this point against local distortion, the sleeve will preferably be provided with a flange or ledge 79 eccentrically disposed with relation to the normal section of the sleeve. This ledge is provided with two recesses 80 and 81 in which the rollers 77 and 78 are located and pivot pins 82 and 83 are journaled in
the said ledges; these pivot pins having slightly eccentric portions 84 carrying suitable anti-friction bearings 85 which may be regarded as a part of the rollers 77 and 78. It is preferable to use the ring 75 in tight fitting relation with the outer ball-race of an ordinary ball-bearing in order to avoid any distortion under the rather heavy pressures used. By slightly turning the pivot pins by means of an implement applied to a squared socket in their upper ends, the rollers may be urged against the track 75 to ease the pressure more or less on the bearing N. A set-screw 86 serves to hold the pivot pin 82 in its adjusted post, as will be understood.

While, of course, the user of this machine may adjust the bearing 77 to receive as much or as little of the strain as is desired, it is highly preferable so to make the adjustment that the normal or non-working load (created by the weights of the parts only of the mechanism) will be carried entirely, or substantially so, by the bearings 75, 61, and 66; leaving the bearings M and N dutyless, or substantially so, during the period of adjusting the drill to the work. Such adjustments may consequently be made with great ease, notwithstanding the weight and massiveness of the elements of the machine.

When, now, the actual drilling operation is proceeded with, the strains will be reversed in direction and greatly increased due to the starting pressures of the drill, and they may also be greatly increased in the other direction due to the pull of the drill when it is emerging through the work. These excess plus and minus strains are severe and frequently beyond the reasonable capacity of ordinary roller bearings. Furthermore, these strains tend to deflect or distort the sleeve, but any such distortion is immediately and effectively resisted by the bearings M and N by reason of their close clearances and locations. By reason of the intimate co-operation of the travelling thrust-bearing 77, it is feasible to machine the bearings M and N to within .005 inch or less without creating a cramp interfering with the free adjustment of the parts during a non-drilling period; whereas, a clearance of at least about .020 would have to be provided between the sleeve and the column with any of the constructions heretofore proposed and especially in the absence of the thrust bearing 77 or its equivalent. It will be seen that, irrespective of the degree of rigidity of either the column or the sleeve, such prior structures permitted distortion to a materially greater extent, and such deflection was accentuated by the materially less rigidity of both the post and the sleeve; the result being that the ultimate accuracy at the drill point was necessarily materially less than is the case with the present arrangement.

Furthermore, in the prior machines, when the reverse working pressures were insufficient to distort the sleeve sufficiently to take up the .020 inch clearance, aforesaid, the rigidity of the post was not adequately utilized and the drill had to work against the resiliency of the intermediate portions of the comparatively thin and non-reinforced old type of sleeve. In that case, the drill was not supported as rigidly as was desirable, and this defect has completely been overcome by the present invention.

The lower end of the sleeve is enlarged to circumscribe the drum 37 of the post and such portion is split as indicated by 87 and carries a lug 88 in which an eccentric bolt 89 is journaled; said bolt being connected with a draw bolt passing through the lugs 90 and 91 for the purpose of constricting the split end of the sleeve and clamping it tightly about the brake surface 88 so as to hug the sleeve against rotation. The transmission shaft G passes upwardly through the inner tube 96 and, at its upper end, is accurately positioned by means of a ball bearing 92 and a roller-bearing 93. The upper end of this shaft is, in turn, connected with certain gearing (not shown) whereby the elevating screw for the arm D may be rotated to effect a raising and lowering of said arm or whereby the motion of the shaft G may be transmitted to the drill point, as will be understood.

It will thus be seen that this invention is well adapted to achieve the objects enumerated in the foregoing in a simple, inexpensive and essentially practical manner; thereby materially promoting the accuracy, ease of manipulation and serviceability of a drilling machine.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the essential characteristics of either generic or specific aspects of this invention, and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new and desire to secure the following combinations elements, or equivalents thereof, by Letters Patent of the United States.

1. A radial drill combining a base; an arm extending horizontally therewith; an upright post carried by said base and arranged to support one end of said arm, said post being formed of nested tubular portions in egrally connected by radial vanes, certain of said vanes having their lowermost ends flat and radiating inwardly flush with the lowermost end of the outer tubular portion;
and means for effecting a relative adjustment between said arm and said base.

2. A radial drill combining a base; a bi-tubular post upstanding therefrom and formed of concentrically spaced tubular-portions integrally connected by intervening vanes, the inner tubular-portions occupying the lower half only of the outer tubular-portion; said outer tubular portion being formed at its lower end with a series of strengthening ribs independent of said vanes; an arm supported at one end by said post; and means for vertically moving said arm.

3. A radial drill combining a base; a tubular post upstanding therefrom consisting of a plurality of co-axial tubular portions spaced peripherally apart, the outer portion extending continuously from top to bottom and having its lower end enlarged to form a box-like supporting-foot, the inner wall-surface of said hollow foot being integrally connected by a plurality of continuous intervening vanes with the lower end of the inner tubular portion to form a reinforced spider-like base against bending strains; a series of strengthening ribs integral with the outer portion of said tubular post and located entirely within said enlarged lower end thereof, said strengthening ribs radiating inwardly toward the inner tubular portion of the post and having their innermost edges spaced therefrom; an arm extending radially to the axis of said post; and means for effecting a relative vertical adjustment between said base and said arm.

4. A radial drill combining a base; a bi-tubular post consisting of an outer and an inner tubular shell, said shells being continuous and arranged co-axially, and being integrally connected by a plurality of vanes, some of which vanes being converging directly to the lowermost inner edge of the outer shell and other of said vanes extending downwardly to provide radial flats coincident with the plane of the lowermost end of the outer shell; an arm extending radially to the common axis of said shells; and means for elevating said arm.

5. A radial drill combining a base; an arm extending horizontally therewith; an upright post carried by said base and arranged to support one end of said arm, said post being formed of nested tubular portions integrally connected by radial vanes, certain of said vanes having their lowermost ends flat and radiating inwardly flush with the lowermost end of the tubular portion; a gear unit removably secured within the lower end of said post; a portal formed in the lower end of said post between two of said certain vanes for permitting insertion and removal of said gear unit; and means deriving motion from said gear-unit for elevating and lowering said arm.

6. A radial drill combining a base; a bi-tubular post upstanding therefrom and formed of concentrically spaced tubular portions integrally connected by intervening vanes; a sleeve rotatably carried by said post, said base having a channel under said post to permit the insertion of a transmission unit without disturbing said post; an arm radiating from said sleeve; and means embodying a transmission within said post and connected with said unit for vertically having said arm.

7. A radial drill combining a base; a bi-tubular post consisting of an outer and an inner tubular shell, said shells being continuous and arranged co-axially, and being integrally connected by a plurality of vanes; an elongated sleeve enveloping said post to rotate about the axis thereof; an arm extending radially to the common axis of said shells; an adjustable roller-bearing intervening between the post and the lower portion of said sleeve and located in the vertical plane of the arm to receive the leverage thrust thereof; and means for elevating said arm.

8. A radial-drill combining a base; a post; a thrust-bearing in the upper end of said post; a sleeve suspended therefrom and journaled adjacent its upper and lower ends to the external periphery of said post; a second thrust-bearing, independent of the first-mentioned thrust-bearing, intermediate the upper ends of said post and sleeve, constructed and arranged to prevent upward movement of said sleeve on said post; and an arm slidably carried by said sleeve.

9. A radial-drill combining a base; a post; a thrust-bearing in the upper end of said post; a sleeve supported solely by said thrust-bearing and journaled adjacent its upper and lower ends to the external periphery of said post; a radial arm slidably carried by said sleeve; and a roller-bearing located beneath said arm at the side of the post to which the arm extends and arranged to relieve the lower bearing of excess lateral thrust caused by the weight of the arm.

10. A radial drill combining a base; a post; a thrust-bearing in the upper end of said post; a sleeve suspended therefrom, said sleeve being interiorly ribbed and exteriorly having a truly cylindrical surface; co-acting annular bearing surfaces formed respectively on the outer surface of the post and inner surface of the sleeve, the bearing surfaces of the sleeve projecting beyond the ribs and being connected thereby; and an arm slidably carried by said sleeve.

11. A radial-drill combining a base; a hollow post; a thrust bearing at its top; a sleeve suspended by said bearing; a second thrust-bearing between the upper end of said sleeve and said post for restraining a material displacement of said sleeve when
said drill is being hoisted, said sleeve being journaled to the outer surface of said post; and means independent of said thrust-bearing for clamping said sleeve to said post during a drilling operation.

12. A radial-drill combining a base; a hollow post supported thereby; a thrust-bearing at the top of said post; a sleeve rotatably secured to said post and supported solely by said thrust-bearing; a second thrust-bearing between said post and sleeve for restraining a material displacement of said sleeve when said drill is being hoisted; an arm slidably mounted upon said sleeve and extending laterally to one side thereof; a roller-bearing between said sleeve and post located at the arm side of the center of said sleeve and acting in a horizontal plane to resist the lateral thrust caused by the weight of said arm; and means independent of said thrust-bearing for clamping said sleeve to said post during a drilling operation.

13. A radial-drill combining a base; an arm extending horizontally therewith; an upright post carried by said base and arranged to support one end of said arm, said post being formed of nested tubular portions, the inner tubular portion having its lower end terminating materially above the lower end of the outer tubular portion, said portions being integrally connected by radial vanes, certain of said vanes having their lowest end flat and radially inwardly flush with the lowermost end of the outer tubular portion; and means for effecting a relative adjustment between said arm and said base.

14. A radial drill combining a base; a bi-tubular post upstanding therefrom and formed of concentrically spaced tubular portions integrally connected by intervening vanes, the inner tubular portion occupying the lower half only of the outer tubular portion, and said vanes extending upwardly as ribs for the upper inner surface of the outer tubular portion; an arm supported at one end by said post; and means for vertically moving said arm.

15. A radial drill combining a base having an elongated well; a tubular post upstanding therefrom constituted of a plurality of co-axial tubular portions spaced peripherally apart, the outer portion extending continuously from top to bottom and having its lower end enlarged to form a box-like supporting-foot, the inner wall-surface of said hollow foot being integrally connected by a plurality of continuous intervening vanes with the lower end of the inner tubular portion to form a reinforced spider-like base against bending strains, certain of said vanes having their lowest end flat and radiating inwardly flush with the lowest end of the tubular portion, said post-base having an entrance to the well in the main base; said entrance being formed between an adjacent two of said certain vanes; a gear-unit adapted to be inserted there through; an arm extending radially to the axis of said post; and means extending from said unit through the axis of said post for effecting a relative vertical adjustment between said base and said arm.

16. A radial drill combining a base; a bi-tubular post consisting of an outer and inner tubular shell, said shells being continuous and arranged co-axially, and being integrally connected by a plurality of vanes, some of said vanes being converged directly to the lowermost inner edge of the outer shell and other of said vanes extending downwardly to provide radial flats coincident with the plane of the lowermost end of the outer shell; a detachable gear-unit located in the lower extremity of the outer shell; a shaft in said inner shell detachably connected with said unit; an arm extending radially to the common axis of said shells; and means connected with said shaft for elevating said arm.

17. A radial drill combining a base having a horizontally disposed well; an arm; an upright post carried by said base and arranged to support one end of said arm, said post being formed of nested tubular portions integrally connected by radial vanes, the lower portion of said post providing a portal between two of said vanes and in register with said well for the insertion of a gear-unit; a tubular sleeve rotatably carried by said post, said sleeve having its intermediate portion clear of said post and adjacent its upper end-portion having a bearing against the outer periphery of said post; an arm extending horizontally therewith; and means deriving motion from said gear-unit for elevating and lowering said arm.

18. A radial drill combining a base; a bi-tubular post consisting of an outer and an inner tubular shell, said shells being continuous and arranged co-axially, and being integrally connected by a plurality of vanes; an elongated sleeve enveloping said post and journaled directly thereon adjacent its upper and lower ends to rotate about the axis thereof; an arm extending radially to the common axis of said shells; means located between the lower bearing and the lower end of the sleeve for relieving the lateral thrust on said bearing caused by the weight of said arm, said means comprising an adjustable roller-bearing carried by said sleeve wholly at the side thereof to which the arm extends; and an annular track carried by said post against which the roller-bearing acts; and means for elevating said arm.

19. A radial-drill combining a base and a bi-tubular post consisting of outer and inner tubular shells upstanding from said base, said outer shell having, at its lower end, an
enlarged drum-like portion; radial vanes connecting said shells; and a series of ribs radiating inwardly from the inner periphery of said drum for strengthening the drum, said ribs being independent of the inner tubular shell and said vanes.

20. A radial drill combining a base and a post consisting of an outer shell and a shorter inner tube and providing a first series of longitudinal vanes extending above and below said tube and joined thereto, and a second series of vanes in the lower portion of said shell and radiating inwardly therefrom, the inner vertical edges of said vanes being clear of said tube.

21. A radial drill combining a base provided with a recess (12); a tubular post secured thereto and extending upwardly therefrom, said post being provided with an enlarged lower portion adjacent said base, within which is formed a portal (11) in registry with said recess and forming therewith a continuous opening; a series of radially-projecting strengthening ribs formed integrally with said post; a plurality of non-radial strengthening ribs (55) formed in the enlarged lower portion of the post and located adjacent said portal to strengthen said post about said portal; a shaft journaled lengthwise of said base; a second shaft journaled lengthwise of said post; a detachable gear-unit insertable through said opening for operatively connecting said shafts; and means located externally of said column for removably securing said gear-unit in operative position.

22. A radial drill combining a post; a sleeve supported upon the upper end of said post and a plurality of complemental internal and external cylindrical bearing surfaces formed on said sleeve and post; respectively, adjacent their opposite ends, said bearing cooperating to maintain said post and sleeve truly coaxial and permitting free rotation of the sleeve on the post.

23. In a machine tool of the class described, in combination, a post provided with an enlarged base; a thrust bearing carried by the upper end of the post; a sleeve surrounding the post and supported upon the thrust bearing; said sleeve having its lower end adjacent the enlarged portion of said post; means to clamp the lower end of the sleeve to the enlarged portion of said post; and a plurality of complemental internal and external cylindrical bearings provided by said sleeve and post respectively, intermediate the thrust bearing and the lower end of the sleeve supporting and clamping means, to maintain the sleeve coaxial with the post.

24. A radial drill combining a horizontally disposed base formed with a recess; an upright column secured to said base; a driven shaft journaled lengthwise within said column; a driving shaft arranged transverse to the driven shaft; mating gears rotatable with said two shafts to transmit power from the driving shaft to the driven shaft; a minor frame removably secured to said base and located mainly within the recess therein; and bearings carried by said minor frame rotatably to support said gears independent of the driving and driven shafts.

25. A radial drill combining a horizontally disposed base formed with a recess; an upright column secured to said base and provided with a portal extending upwardly from its lower edge and located above said recess; a driving shaft arranged transverse to the driven shaft; a minor frame removably secured to said base and located mainly within the recess therein; a bearing carried by said minor frame at its upper side; a bevel gear rotatably journaled within said bearing and fixed to turn with said driving shaft; a second bearing provided by said minor frame at its lower side; and a bevel gear rotatably journaled in said second bearing and having a non-rotatable connection with said driven shaft; said two bevel gears co-operating to transmit power from the driving shaft to the driven shaft, said portal and recess being so constructed and arranged as to permit insertion of said minor frame and its attached gears into the recess in the base beneath said column.

26. In a machine of the class described in combination, a base formed with a recess providing vertically disposed walls; a column secured to said base partly above said recess; a gear-unit removably secured to said base and held against lateral displacement by the walls of said recess; mating gears rotatably journaled in said gear-unit; and driving and driven shafts each having a splined connection with one of said gears and each adapted to be inserted within its gear after said gear-unit and gears have been secured in their operative position.

27. A radial drill combining a base provided with a recess; a column secured to said base partly above said recess; a removable gear-unit within said recess; fixed retaining surfaces provided by said base to prevent vertical movement of said gear-unit; fixed retaining surfaces provided by said base to prevent horizontal movement of said gear-unit in all except one direction; and means accessible from without said column to secure said gear-unit against movement in said one direction.

28. A radial drill combining a base provided with a recess affording vertically and horizontally disposed guiding and retaining surfaces; a column secured to said base partly above said recess; members secured to said base beneath said column and overlying said surfaces; a minor frame insertible
into said recess between said surfaces and beneath said members; a shaft journaled in said column; intermeshing gears rotatably journaled in said minor frame; means to locate said minor frame in said recess with the axis of one of said gears in alignment with the axis of said shaft whereby the shaft may be moved lengthwise into engagement with said gear; and means to secure said minor frame to said base.

29. In a radial drill, in combination, a base provided with a recess; a column secured to said base and partly overlying said recess; a gear unit removably secured to said base and located within said recess; transverse bearings carried by said gear unit; mating bevel gears journaled within said bearings; a substantially horizontal driving shaft operatively connected with one of said gears; a driven shaft journaled within said column and having a splined connection with the other of said gears, each of said shafts being adapted to be inserted into its complementary gear after the gear-unit and gears have been secured in their operative positions; and a plate secured beneath one of said bearings to close said bearing thereby to provide an oil-well to lubricate the bearing of that gear, said plate also serving as a stop to limit the downward movement of the driven shaft when the parts are being assembled.

30. A machine-tool combining a post; a sleeve rotatably journaled upon said post; a substantially heavy member projecting radially from said sleeve and normally exerting a lateral pressure on one side of said post; and an anti-friction bearing intermediate the sleeve and post, beneath said member at the side of said sleeve only where it exerts its lateral pressure on said post, said anti-friction bearing serving to prevent binding between the post and sleeve due to said lateral pressure, thereby maintaining said sleeve freely rotatable on the post. 31. A radial drill combining a post; a sleeve rotatably journaled on said post; an arm projecting from said sleeve and normally exerting a lateral pressure on one side of said post; an anti-friction bearing interposed between said sleeve and post beneath said arm and at the point where the sleeve exerts the lateral pressure on said post, said anti-friction bearing serving to prevent binding between the sleeve and post thereby maintaining the sleeve freely rotatable on the post; and clamping means located at the side of said sleeve opposite to said bearing, where the lateral pressure of the sleeve produces slack, to cause said sleeve to grip said post to prevent relative rotation between the two.

In witness whereof, I hereunto subscribe my name.

DAVID C. KLAUSMEYER.