To all whom it may concern:

Be it known that I, Henry M. Norris, a citizen of the United States, and residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented a new and Improved Compensating Depth Gauge, of which the following specification is a full disclosure.

This invention contemplates an improvement upon the mechanism set forth in the United States patent to H. M. Norris No. 1,022,865 granted April 8, 1912; the mechanism being in the nature of a rotatable graduated dial combined with a clutch and automatic stops whereby it is possible so to adjust the power-feed for a drill-spindle that the advance into the work will be automatically arrested when the hole has been drilled to a predetermined depth.

When using the mechanism set forth in said patent for the purpose of drilling a hole of uniform diameter of a certain depth (not counting the conical bottom of the hole) the operator must, of course, resort to some measure for eliminating the conical tip of the drill as a source of error. For example, if he should simply move the drill towards the work until its tip touched the work, and then set the mechanism to drill a hole of predetermined depth, the drill-spindle would advance precisely that distance and would produce a hole which was of precisely that depth but the uniform diameter of the hole would cease somewhat short of that depth and would then taper downwardly for a slight additional distance corresponding to the extreme tip of the drill. Therefore, if the user should desire to have a hole of a uniform diameter for a definite length, he must make due allowance for the conical apex of the drill and the ordinary method of doing this is to cause the drill to drill its way into the work until the conical portion is precisely imbedded, then stop the drill, and then set the mechanism to make an automatic advance for whatever distance is desired. This is a somewhat bothersome operation and it involves care on the part of the user.

The object of this improvement is to provide a means for accomplishing that result without occasioning the user any trouble and without making it necessary for him to partially drill into the work in order to obtain a preliminary position of the drill to be used as a basis for setting the dial. In other words, this invention proposes an arrangement such that it is only necessary for the user to bring the tip of the drill against the work; whereupon he can at once set the dial to feed the drill as far as it is necessary (including the conical bottom) to produce a hole of full diameter for any desired depth.

This invention is predicated upon the observation that the height of the cone constituting the sharpened point of a drill is, under standard practice, directly proportional to the diameter of the drill. That is to say, under standard practice, a constant angle is employed for the tip of each of a given series of twist-drills irrespective of variations in diameter of the drills.

Therefore, the height of the cone of any given drill will be equal to one-half the diameter of the drill multiplied by the tangent of the angle which the cutting edge makes with the axis of the drill. In short, the preliminary additional feed in question is in all cases equal to the diameter of the drill to be used multiplied by the same constant. This property makes it possible to construct an auxiliary scale in which the graduations will be uniformly spaced apart and correspond directly to the variations in the height of the peaks of drills of various diameters.

This invention proposes the use of such an auxiliary scale in conjunction with the regular scale which gives direct readings as to the absolute distance of advance of the drill-spindle; the auxiliary scale being employed to add an increment to the regular scale of such magnitude as will precisely compensate for the portion of the advance required for the purpose of getting the point of the drill completely imbedded in the work preliminarily.

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 cor...
responding parts throughout all the views, of which:

Fig. 1 is a front elevation of a portion of a drill-head embodying the present invention. Fig. 2 is a central horizontal section through Fig. 1, the movable parts having been rotated counter-clockwise about 90°. Fig. 3 is a vertical section on the line 2–3 of Fig. 2 and Fig. 4 is a detail view showing the means for automatically rendering the clutch ineffective when the drill has entered the work a predetermined distance.

Referring more particularly to the drawings the invention is disclosed as embodied in a drill-head providing a frame portion 1, within which is slideably mounted the spindle sleeve 4 carrying the usual drill spindle 6. The portion 1 also affords a bearing for a shaft 2 which carries a pinion 8 meshing with a rack 7 secured upon the sleeve 4, whereby through rotation of the shaft 2 the drill spindle may be advanced or withdrawn at a rate proportional to the revolutions of the shaft 2.

A hand-lever 21 is pivoted, as by means of a pin B, to the end of the shaft 2 so that by turning the lever 21, the shaft may be rotated and the spindle advanced manually until the tip of the drill contacts with the work. The lever 21, when moved in or out of the plane of the paper as viewed in Fig. 1 operates a plunger 17 to which it is geared through rack teeth 17, and this plunger is arranged to connect or disconnect a suitable friction clutch C whereby the shaft may be rotated by the worm-wheel 9 (instead of manually) to accomplish the actual feed of the drill into the work. The worm-wheel 9 is journaled in the frame 1 coaxial with the shaft 2 and is rotated by a suitable power-driven worm not shown. The plunger 17 is slideably mounted in an opening in a member 14 keyed to the shaft 2, and is formed with a taper point 19.

Interposed between the worm-wheel 9 and the member 14 is a friction clutch comprising a contractile friction band 12 keyed to the member 14 and adapted upon endwise movement of the plunger in one direction to lock together the worm-wheel and the member 14. Means for expanding the band 12 may comprise twin cam levers 16 which movably engage with the corresponding ends of the friction band 12. The member 14 carries a taper pin 15 which extends between the levers 16 and serves as a fulcrum therefor. The tapered end 19 of the plunger 17 is adapted in its inward movement, to enter between the free ends of the levers 16 to separate them and thereby expand the friction band into frictional engagement with the worm-wheel to lock the worm-wheel 9 and member 14 together. Spring actuated plungers 25 mounted in a transverse opening formed in the member 14 and each formed with a taper point adapted to slideably engage an annular groove 18 formed in the plunger 17 to yieldingly maintain the plunger completely disengaged from the twin levers.

Upon the frame 1 is secured a member 11 upon which is rotatably secured a dial 28 provided with a main graduated scale A and carrying a cam-member 29. This cam member is adapted at a certain station in the rotation of the parts to engage a pin 29 projecting from the plunger 17 and thereby automatically move the plunger out of engagement with the twin levers for disengaging the friction clutch. The point at which this trip mechanism comes into action is determined by the position of the dial 28. A clamp 27 is provided for securing the dial to the member 11 at any desired position of adjustment.

The relation between the adjustable graduated ring 28 and the part 14, on which is secured an auxiliary scale plate 31, is such that when the zero of the main scale A coincides with the zero of the small auxiliary scale a the clutch will be thrown out of action and the power thus rendered ineffective further to advance the drill spindle.

The main scale A is so constructed that when the spindle has fed a distance equal to one inch, the zero-line on the auxiliary scale will travel a circumferential distance equal to that between the line 1 on the main scale and the zero-line of that scale. The graduations, on the auxiliary scale, however, indicate distances proportional to the diameters of different drills; those distances being determined, as aforesaid, by the ratio between the tangent of the angle of each drill-point and its diameter. That is to say, if H be the height of the peak on any drill, and A be the angle of its cutting edge to its axis, and D be its diameter, then: \[ H = D \tan \alpha = DK \] where K represents the constant \( \frac{1}{\tan \alpha} \).

Now, since the auxiliary scale is to be used in conjunction with the main scale, and since the latter is directly proportional to the actual travel of the spindle, the spacing of the graduations of the auxiliary scale is to be determined by using also the same constant used in evaluating the main scale. Thus if the length of the main scale equals the travel of the spindle multiplied by a constant C, then for the length of the auxiliary scale, we have: \[ H = DKC \]. In other words K and C are both constants and D is the variable representing the various diameters of drills and hence the graduations of the auxiliary scale A will be uniformly spaced; just as are those of the main scale A but, of course, in a different ratio. This is necessary because the scale A of gradu-
tions represent, so to speak, a magnification of the actual distance of advance of the spindle, and the same rate of magnification will be applied to the auxiliary scale which denotes the height of the peak of the drill-point.

The mode of operation of this arrangement is very simple. If the user should desire to drill a hole through a plate 1 1/4 inches thick with a drill 2 3/4 inches in diameter, he will grasp the lever 21 and first swing it in a plane perpendicular to the paper, as viewed in Fig. 1, (to release the clutch) and will then rotate it in a transverse plane to bring the drill-point against the upper surface of the plate to be drilled. He will then release the graduated dial 26 and swing it until the 1 1/4 inch-mark on its scale of graduations coincides with the 2 3/4 inch-mark on the small scale which represents the diameter of the drill. He will then re-clamp the dial 26 and move the lever 21 to throw in the clutch and the power-feed will thereupon function to advance the spindle through a distance equal to 1 1/4 inches plus the height of the peak on a 2 3/4 inch drill: in other words, drill a full diameter hole for a distance of 1 1/4 inches which is the thickness of the plate.

This device is specially available for moving the spindle any desired distance without making any allowance for the peak of the drill. Thus, should he desire to drill a hole 1 1/4 inches deep from its lowermost point to the surface (counting the conical bottom of the hole) he will simply set the graduation-line representing 1 1/4 inches on the dial 26 to the zero-line on the auxiliary dial; his other operations being the same as before described.

It will thus be seen that this invention is well adapted to eliminate a source of confusion and trouble which operators of drilling-machinery have heretofore experienced in respect to obtaining full depth holes.

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 the 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 and elements, or equivalents thereof, by Letters Patent of the United States:

1. A machine for drilling holes of various diameters comprising a main scale graduated proportionally to the advance of the drill-spindle; an auxiliary cooperating scale graduated proportionally to various diameters of drills, the ratio between the auxiliary scale and the main scale being in proportion to a function of the angle made by the cutting edge of the drill with its axis; a clutch; manual means for opening said clutch to advance the drill-point into contact with the work; means for shifting the said scales into any desired coincidence; and an automatic throw-out for the clutch having its action determined by the adjusted relation of the said scales.

2. A depth gauge for drilling-machines combining a main scale indicating the extent of advance of the drill-spindle and an auxiliary scale cooperating therewith, the spacing of the auxiliary scale being equal to the spacing of the main scale multiplied both by the diameter of the drill and one-half the tangent of the angle made by the cutting edge of the drill with its axis.

3. A depth gauge for determining the length of advance of the drill-spindle relative to its work, said depth gauge comprising a main scale denoting the actual travel of the spindle and an auxiliary scale cooperating therewith denoting an increment to said travel corresponding to the height of the peak of the cone constituting the cutting extremity of a drill of any selected diameter.

4. A drilling-machine combining means for feeding a drill-spindle; a member movable in a predetermined ratio to said spindle; an element; a main scale for indicating the movement between said member and said element, said scale being shiftable to prescribe a termination of said relative movement, an automatic stop controlled by said shiftable scale; and an auxiliary scale for adding an increment to the indications of said main scale, the graduations on said auxiliary scale being directly proportional to the diameter of the drill and to the tangent of the angle between the cutting-edge of a drill and its axis.

In witness whereof, I hereto subscribe my name, as attested by the two subscribing witnesses.

HENRY M. NORRIS.

Witnesses:
C. C. SLETE,
NANCY McKEE.