their radial position, with the longer dimension of the elipse tangential to the slots cut. Alternatively, the nozzle means positioned progressively more radially outwardly may be made of progressively increasing diameter to emit a larger diameter jet. A further alternative is to supply a multiplicity of individual fluid cutting jets at the radial position where more fluid jet energy is required.

If, during operation of the drill bit, the drill bit encounters extremely hard rock or earth material, the slots and center core opening may not extend axially as far as in softer rock or earth material. Upon encountering hard rock or earth material, the rotational speed of the drill bit can be decreased to allow more time for application of the fluid jet energy to the hard rock or earth material, thereby increasing the depth of the cuts. This result is easily achieved and allows use of the drill bit in a wide variety of different rock formations merely by regulating its rotational speed. However, even if the rotational speed is not regulated, the removal of the drill face material essentially proceeds only as deep as the slot cuts extend. In either case, the expected rate of advancement is generally two to three times more than the rate of advancement obtained by typical prior art rotary drill bits.

By the present invention, it is apparent that the means for emitting fluid cutting jets are greatly beneficial in rapidly advancing the bore hole. The center jet completely removes material to open the center core while jets **J1** through **J6** cut slots to define annular rings of material. The rings are easily and advantageously removed by breaking the rings in sequence by applying tensional force in distinction to compression force typically employed in prior art drill bits. By breaking the rings only after the adjacent radially inward ring has been broken, the bending movement is directly applied only to the ring to break it without interference or restraining force from other rings radially inwardly positioned therefrom. By breaking the rings radially toward the center of the bore hole, the material from the rings is easily and conveniently removed by the wash fluid from the bore hole. The tendency for downhole deviation is reduced due to cutting the drill face material on the different axial levels and cutting the slots in the drill face material. The slots tend to funnel or confine the advancement of the drill bit along its anticipated axis. The breaker wheels supplying radially inwardly directed force to the annular rings at the three cones equally spaced at radial positions around the axis of the bore hole, tends to confine the drill bit to the desired bore hole axis by following a predetermined helical path defined by the slots formed by the cutting jets.

The absence of large axial forces on the drill bit increases bearing life since the bearings supporting the breaker wheels are not required to withstand the high axial force. Increasing bearing life increases the life of the bit. By positioning the nozzle means of each cone radially outwardly adjacent a breaker wheel, the standoff distance or distance between the drill face material and the nozzle means is kept at a minimum. It is apparent from FIGS. **12**-A through **12**-O that as the breaker wheels remove an annular ring at one axial level, the nozzle means radially outward positioned from that breaker wheel is in close contact with the drill face material at a less axially advanced level, thereby causing the jets to be highly effective in cutting the drill face material.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made by way of example and that changes in details in structure may be made without departing from the spirit and scope of the invention expressed in the appended claims.

I claim:

1. A rotary drill bit for cutting an axially advancing bore hole by rotation at a drill face of the bore hole, comprising:

a drill bit body, said drill bit body comprising a plurality of axle shafts extending radially toward the axis of rotation of said drill bit;

at least one breaking wheel attached for rotation on each axle shaft to traverse a path concentric with the axis of rotation of said drill bit when rotated in contact with the drill face of the bore hole, at least a few of said breaking wheels are positioned to traverse essentially different paths concentric with the axis of rotation, and

fluid jet means, positioned on said drill bit body radially adjacent at least one breaking wheel, for cutting a plurality of different concentric slots concentric with the axis of rotation when said drill bit is rotated, each pair of radially adjacent concentric slots defining edges of one concentric path traversed by at least one breaking wheel.

2. A rotary drill bit as recited in claim **1** wherein:

the concentric path least radially spaced from the axis of rotation is more axially spaced in the axial direction of advancement of the bore hole than the concentric path most radially spaced from the axis of rotation.

3. A rotary drill bit as recited in claim **1** wherein:

said breaking wheels are positioned to contact the drill face of said bore hole at a plurality of different axially spaced levels.

4. A rotary drill bit as recited in claim **1** wherein:

each pair of radially adjacent concentric slots cut in the drill face material define one ring of material, and

each breaking wheel primarily initially contacts one ring at an edge thereof.

5. A rotary drill bit as recited in claim **4** wherein:

each breaking wheel applies a tensional force to the material of the ring.

6. A rotary drill bit as recited in claim **1** further comprising:

additional fluid jet means positioned on said drill bit body for cutting a center core opening in the drill face of said bore hole when said drill bit is rotated.

7. A rotary drill bit as recited in claim **6** wherein:

said drill bit body comprises at least one axle shaft for receiving at least one breaking wheel thereon for rotation, and

said additional fluid jet means is positioned on one of said axle shafts.

8. A rotary drill bit as recited in claim **7** wherein:

said additional fluid jet means comprises a nozzle means for emitting a jet of fluid; and

said nozzle means is positioned essentially in said axle shaft to emit the jet of fluid crossing the axis of rotation of said drill bit at a predetermined angle.

9. In a rotary drill bit for cutting an axially advancing bore hole in material when rotated, said drill bit including rotatable rock breaking means rotationally connected to said drill bit for breaking material, an improvement comprising, in combination: