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Study and Manufacturing of DTH Bits

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Abstract: *As we, all know that bore wells are used to extract water from the earth. The earth is dug using a tool called BUTTON BITS. A button bit is a tool that blasts the rocks and breaks them into pieces, which are on their way during the drilling operation and make the operation easy. The material used for manufacturing the bits is EN 36 C. Especially this type of material is used because it possesses all the required qualities of the operation such as it gives a very hard surface and can be case hardened with a strong core and retaining a high degree of toughness to resist wear and tear while hitting the hard rock and penetration into the soil. The life of the bit is about 2000 feet and depending on the type of soil the life of the bit may vary. Depending upon the requirement different types of bits are used. Some of them are drifter bits, which are used for mining and blasting purposes, panther bits, and digger bits are used for water well drilling.*

Keywords: *Bits, Material Cutting, Annealing, Rough Turing, Finish Turing, Carburizing, Skin Cutting, Hardening, Tempering, Sand Blasting, Reaming, Buttons.*

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Preface: Water is considered the elixir of life. The most important resource for the very survival of living beings is becoming scarce in the world. We have been facing this problem for the last few decades. The main reason for this is the ever-increasing growth in population. This rapid increase in population and industrialization made the levels of waterfall down drastically. In the olden days to overcome this problem, people used to dig wells to extract water from the ground. This has become a very tedious and difficult process and requires a lot of manpower. Later on, hammers or bore wells came into existence. Bore wells are used according to topography. The bits, which are used to drill the ground, are designed depending on the landmasses and keeping in view, the problems faced during the drilling. Different types of bits depend on the type of soil and the working conditions. The different types of bits are concave, convex, and flat. The holes can be drilled ranging from 4 1/2 inches to 32 inches. The way to choose suitable drilling equipment is complicated and a lot of information is required to reach performance and economy in the operation. Aspects that have to be taken into consideration are the purpose of the borehole, geology, hydrogeology pump, method of drilling, flushing media, and so on.

Bits: Bits are the key part and may be called the cutting part of the hammer. This is to be made of strong metal for making a hole in the earth breaking the rocks and the solid masses of land in its way.

The function of the bit: It receives blows from the piston so it should be ready to absorb shock loads. And generally, any bit should be wear-resistant. Any low carbon steel is ready to absorb the shock loads and is wear-resistant. Coming to the case of high carbon steel it is strong but cannot receive shock loads and it is not worn resistant. So our low carbon steel is carburized to get all the qualities we require.

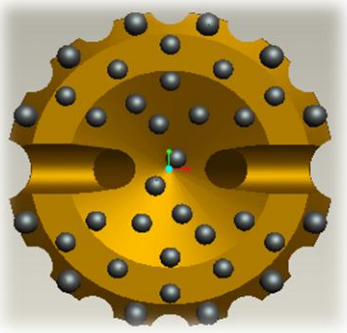
The material used in a bit: The material is EN-36-C alloy steel. It possesses all the required qualities

Types of Bits:

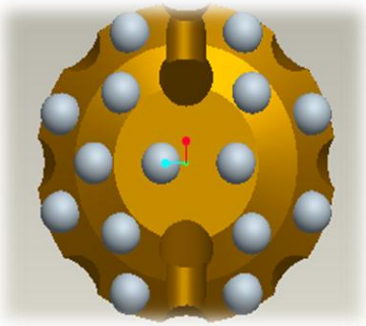
1. Concave: This is the common face style used in the market. Cone-shaped depression in the face has a centering effect for straighter holes. It gives excellent penetration in soft, medium, and hard formation.

2. Convex: This face has been utilized in very hard drilling formations. Face design allows for increased body support for gauge carbide. There are two gauges and the inner gauge row helps to protect the outer row from excessive wear.

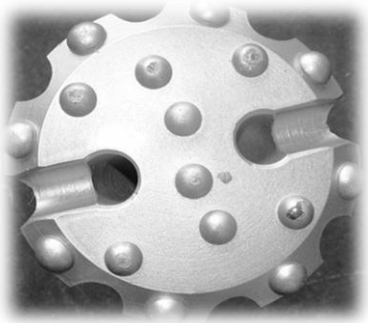
3. Flat: This bit is very aggressive in drilling applications and is suited best for very hard rock and broken formations. Face slots help eliminate bit plugging in softer Zones. More carbide to surface contact for better rock fracture. It is a simple and robust design Well suited for medium to hard rock formations.



Convex



Concave



Flat

Some of the commonly used bits are:

Panther/DH-4 **Cop-42/QL-40** **Mach 44/DHD-30**	**4",4 ½",4 ¼",5",5 ½",6",6 ½",7"**
DHD-340	**5",5 ½",6"**
DHD-360 **Mega/QL 60** **Mission-6**	**6",6 ½",7",8",9",10"**
DHD-17	**8",9",10",11",12",13"**
DHD-380	**14"**

Material Cutting: In the process, the material in the form of cylinders of square blocks is cut as per the required dimensions say 35kg. The diameter of the material will be in the range specified by the customer. The material is cut by a Band saw with a conveyor the cutting of material is fast in the process. The pieces will be then weighed and the pieces that are less than the given weight specified and its tolerance are rejected and the remaining are sent for further machining. The supplier itself cuts these so this is not included in the manufacturing process carried out by the company. However, this is the Basic process for the bit.

Forging: Forging is defined as the shaping of a heated metal by hammering or pressing. In forging the metals are made plastic by heating them and then deformed by hammering when they are red-hot. This process is usually carried out above re-crystallization temperature. Therefore, it is called a hot working process. For our raw materials selected, the piece is kept in the furnace and heated to a temperature of 900^0 c -1200^0 c. Then the piece is forged into steps. The piece will be red hot even in these conditions. Then the piece in the form of steps is placed in the mold and they drop forged. Then the piece attains the shape of the die finally the piece is kept in the air for cooling. Next, the piece will be sent for further machining. After forging, the metal will be 34.5kg in mass.

Annealing: Annealing generally refers to any heating and cooling operation that is usually applied to induce softening.Our piece from forging reaches annealing. Here the piece is heated to 980^0 c and left for 10 hrs. Then it is cooled in the atmosphere air for 3hrs. Then the pieces are again heated for about 8hrs. It is left in the furnace for 2hrs and then taken out for cooling. After annealing, the metal becomes soft for machining. Then it is sent for further machining. Then sent for further machining, the Mass of the piece after annealing is 32kg.

Rough Turning: The metal from forging and annealing will be brought to roughing. The piece will be covered will slag-like material. The piece is then sent for facing and turning and the dimensions are not to be that accurate. It is the process of metal removal in the form of chips when the tool is fed against the rotating piece. The process is suitable for cylindrical jobs only. The turning is carried out by carbide tipped tool. This turning needs no accuracy i.e., the dimensions may vary up to 1mm. The mass of the piece after roughing will be 30kg. The main aim of this roughing will be the removal of the top layer. After this, the dimensions are to be perfectly maintained.

Finish Turning: The piece from rough turning comes to C.N.C (Computer Numerical Control) to prepare a semi-finished bit. The bit is placed in the jaws are operated pneumatically and by leg pedals. Then the pneumatically operated tailstock holds the workpiece using a revolving center.
The C.N.C. is equipped with eight tools. Tool, in this case, consists of two parts 1. **Tool and 2. Insert**
While working on C.N.C. the coolant is necessary, as the piece will be rotating at a high speed to prevent the tool from spoiling. The circuits of the machine will be provided with air-conditions as the accuracy is to be maintained up to 1um. After C.N.C., the piece will be 27½ kgs.

Deep Hole Drilling: In the process, the top surface of the bit is drilled 30 mm to a distance of 254.8 mm from the top surface. This is done by using a deep hole drilling machine operated hydraulically. The tool is fitted to the moving end of the machine tailstock. The oil is pumped continuously into and out of the machine for the tail; stock movement first drilling and then boring is done in the drilled hole. This is a hole used to take the air into the hole to remove sand in the way of boring it. The process is short and takes about 10 minutes. The piece is held in the four jaws as in the conventional lathe. The weight of the workpiece at the end of this will be 25.8 kg.

Milling: In this process mainly two operations are carried out on our workpiece
1. Spline cutting
2. Slot cutting
Splines are cut on the body of the workpiece about 12 splines are cut and the tool used for these splines are square milling cutter. Slots are cut at the bottom surface of the bit about 10 slots are cut at regular intervals. The distance between slots is 29mm and the size of the slot is 24mm from the cutter used here . A conventional horizontal milling machine is used for this purpose. After milling, the weight of the workpiece will be 25 kg and it is a move to the heat-treatment process.

Annealing: This is the second time the piece is moved to annealed and will be carried out after carburizing. The piece will be heated to a temperature of 660^0C and kept at the

temperature of 660^0C and kept at that for 5 hours and then finally cooled. This process is done for making the metal soft for further machining

Carburizing: Carburizing involves the diffusion of carbon into the surface layers of low carbon steel by heating it in contact with carbonaceous materials. It is carried out at a temperature range of 920^0-950^0 c. It is the process of increasing carbon percentage in the outer surface of L.C.S. Here the point to be noted is that L.C.S. can absorb shock loads. It is carburized to make the core hard and wear-resistant. The carburizing adopted is gas carburizing using gases like (Iso Propanol, methanol, acetone), etc the temperature of the gas carburizing is 920^0 c.

The process is split into 2 parts they are 1. Boosting and 2. Diffusion

Skin Cutting: This is a process used to remove the metal at the end part of the bottom surface after which the milling slots are cut. This is just like a turning operation carried on the conventional lathe. This process is done to make a drill easy on the top surface. This process is an easy and less time taking process.

Rough Drills: Making holes into metal for an assembly or design is called drilling. These are made at the bottom surface of the drilling bit for buttons in rough drilling total of 21 holes are made.
10 – 10 slots
11 – Base of bit
The rough drills of about 15.8 mm are made on the surfaces. The drilling is done on a raider drilling machine. No perfect accuracy is to be maintained.

Hardening: Hardening may be defined as the process of heating steel to the austenite phase followed by rapid cooling in a liquid bath such as water or oil.
To develop hardness, wear resistance to cut other materials.
To improve strength and toughness.
For our taken piece, the metal is heated to 820^0 c and sometimes above then it is kept at that temperature for two hrs to make the metal hard.

Tempering: Tempering is the process of heating hardened steel to a temperature below the critical temperature followed by cooling the tempering renders the steel tough and ductile.

- ⇨ **It reduces thermal stresses**
- ⇨ **To stabilize the structure of the metal**
- ⇨ **To reduce the brittleness**

⇨ **To increase the toughness and ductility.**

Here the tempering carried is called Low- Tempering and the temperature is 180^0 c, maintained for four hrs, and then cooled (at atmospheric air).

Sand Blasting: In this process, the pieces are placed in the sandblasting machine the particles of sand hit the piece at a (greater) higher velocity. Thereby a good surface finish is obtained for the boring bit. This is one of the modern finishing processes generally used after heat treatment. The machines will be robust in structure and can accommodate many pieces in a single-use.

Inspection: After sandblasting the piece is sent for inspection i.e., hardness testing on a rock well-testing machine. The hardness should be in the range of 35 to 40 HRC.

Reaming: Reaming generally refers to the enlargement of original holes or of finishing the already drilled holes. The holes, which are drilled roughly, are reamed using reamers on conventional drilling machines. The dimension of the hole will be less than the dimension of the button. The time taken is less for this process. The hole and button assembly should be an interference fit

Buttons: These are cutting parts in the hammer. Button and bit assembly makes the cutting tool for the hammer. Buttons are inserted in the holes of the bit. These are plenty in number. This number depends on the hole that is to be made by the hammer.

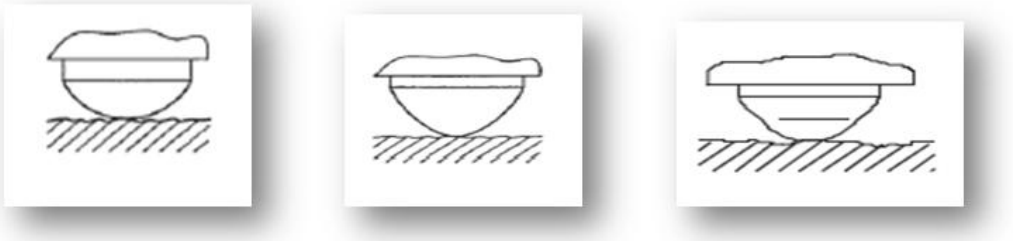
For Example:
For the bit selected for our project
6 ½" inch diggers modified
21 buttons are used
10 on 10 sides (angle)
11 on the base (straight)
These are generally made of tungsten carbide, which is imported from West Germany. These are pressed into the holes of the bit. As this is an interference fit. The buttons once cant is removed.

Types of buttons

1. Domed (spherical): This button is the most common shape utilized in DTH Bits. This type of shape is the strongest and most resistant to breakage. The domed shape provides excellent penetration in medium rock, hard rock, and hard rock broken formations, in all types of drilling.

2. Ballistic: Normally this button is used in less hard-consolidated drilling formations. This type of button is very aggressive and drills faster than domed. However, because the ballistic tip protrudes out farther than the domed, the ballistic is prone to breakage if used in the wrong formations. Care should be taken when drilling with this type of button. Ballistic buttons yield high penetration rates and efficient rock breakage.

3. Double–Domed: This is a domed button with an additional, smaller dome on top of it. The 2nd dome provides additional carbide thus extending the life of the button. The 2nd dome also keeps the button sharp longer thus providing better penetration and an extended drilling distance before the first sharpening is required.



Button Pressing: This is the last manufacturing process in boring bit making. The indentation made by the drill is covered with scrap and then covered with two or three circular sheets and then the buttons are placed in the

hole and are pressed using a hydraulic press of capacity 20 tones. Thus, the buttons once pressed cannot be taken out

Applications:

1. Used for water well drilling.
2. Used for mining and quarry.
3. Used for short hole drilling.
4. Used for mineral exploration.
5. Used for civil constructions.

Conclusion: I have a study of manufacturing of bore bit this improves our not only practical knowledge but also helps to know about the various process that is involved in the designing such as planning the project schedule designing, collection of data with to project work Etc ..,

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