MAST BORE CENTERING PROCESS

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ABSTRACT

The C600H is one of the models in the blast hole drilling process. Under the garage, the main frame, and mast are used to assemble the C600H machine. A head assembly, spindle hub, drill rod, and drill bit are all included in the mast. In this case, a hanger shaft is used to hold the drill rod during the drilling process, and it is powered by a swing cylinder (hydraulic cylinder). The drill rod is connected to the head assembly via the swing cylinder. The swing cylinder, however, is positioned in the Centre of the hanger shaft to regulate the movement of the barrel shaft. The barrel shaft will position the drill rod concerning the head assembly, causing some concentricity errors between the mast table, bull shaft, and head assembly. The manual process takes longer than usual to resolve it. To address this issue, a support fixture assembly is created and installed at the top and bottom of the mast (as same as the head assembly). In this case, the fixture assembly will reach the hypothetical Centre. The fixtureassembly is used to locate the imaginary Centre in the barrel shaft, hanger shaft,and bearing block. Now that the drill rod is connected to the mast's head assembly, we can easily achieve the bore Centre with a fixture at a straight angle. The drill rod will then be coupled with the spindle sub and drill bit for the drilling process.

Keywords: Mast, Hanger shaft, Fixture assembly, Drill rod.

1. INTRODUCTION

The world is endowed with a rich variety of mineral resources due to its varied geological structure. Mineral resources can be divided into two major categories: Metallic and Nonmetallic. Metallic resources are things like Gold, Silver, Tin, Copper, Lead, Zinc, Iron, Nickel, Chromium, and Aluminum. Nonmetallic resources are things like sand, gravel, gypsum, halite, Uranium, and dimension stone. Because different types of mineral deposits form in different environments, plate tectonics plays a critical role in the location of different geological environments. The process of taking out all those minerals from rocks buried under the earth's surface is called mining (Kaya 2006). They are presented with Coal, Iron ore, Copper, phosphate and Limestone. All these are the most commonly mined mineral resources for human resources. There are four main mining methods: underground, open surface (pit), placer, and insitu mining. Underground mines are more expensive and are often used to reach deeper deposits. Surface mines are typically used for more shallow and less valuable deposits. Placer mining is used to sift out valuable metals from sediments in river channels, beach sands, or other environments. In-situ mining, which is primarily used in mining uranium, involves dissolving the mineral resource in place and then processing it at the surface without moving rock from the ground. The method used depends on the type of mineral resource that is mined, its location at or beneath the surface, and whether the resource is worth enough money to justify extracting it. The blast hole drilling machine will be making a hole in the ground surface nearby near in distance of 5-10 feet. And some chemical explosives will be filled in that and they will be blasted at a critical temperature. And further, the natural minerals are taken. Extraction and processing have large environmental impacts in terms of such things as air quality, surface water quality, groundwater quality, soils.

2. BLAST HOLE

Blast Hole Drilling is a technique used in mining whereby a hole is drilled into the surface of the rock, packed with explosive material, and detonated. The aim of this technique is to induce cracks in the inner geology of the surrounding rock, in order to facilitate further drilling and associated mining activity. The word 'Blast' mean an explosion. Blast hole drills are productive solutions for all mine types. Blasting needs at the lowest cost per meter drilled, these powerful and reliable systems make P& H drills your best choice. Powerful and rugged rotary carriages are able to provide ample torque and bit loading through the toughest rock conditions in the world (Wardak et al., 2001). Difficult operating environments, such as arctic conditions, high altitude and weak power grids are no match for our drills. The initial hole into which the explosives are packed is known as the "blast hole". Blast hole drilling is one of the primary surface drilling techniques employed in mining operations today. Blast hole drilling is traditionally used wherever the mining company wants to explore the mineral composition or potential mineral yield of the area demarcated for their mining interests. Blast holes are thus a fundamental step in the exploratorion mining process, and can be employed in both surface mining operations and underground mining operations to varying degrees with varying effects or results. Blast hole drilling can also be employed in quarrying endeavours. Blast hole drilling is essentially carried out in order to break up rock and hard minerals in order to make it easier for the mining crew to get to the resources being mined. The basic blast hole drilling process can be explained in six major steps,

i. Surveying the location

ii. Researching the rock types and formations

iii. Plan drilling patterns

iv. Drilling the blast holes

v. Breaking up the rock

vi. Clean-up process

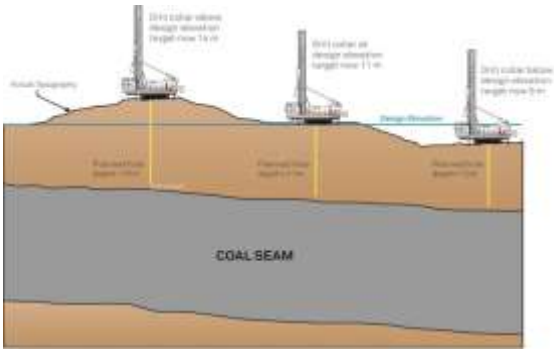

Fig 1.1: Design elevation of coal seam

3. DRILLING RIGS AND ITS TYPES

Mining drilling rigs are used for two main purposes, exploration drilling which aims to identify the location and quality of a mineral, and production drilling, used in the production-cycle for mining. Drilling rigs used for rock blasting for surface mines vary in size dependent on the size of the hole desired, and is typically classified into smaller pre-split and larger production holes (Tadic et al., 2014). The drill bit tends to come in two primary forms: firstly, roller-cone bits, and secondly, fixed cutter bits. Both drill bits see similarly high levels of use within the drilling industry (Pelinescu and Wang 2002). The DTH process is mainly used in hard rock drilling, especially for hardness over 200 MPa (Mega Pascal). It can be done on both hard and soft rock and is extensively used in the construction, oil and gas, and water well industries. DTH equipment consists of a drilling hammer and a piston-powered by compressed air.

The percussive force of the top hammer drilling produced by the piston of the pump in the hydraulic drilling rig, it is transmitted to the drill bit via shank adaptor and drill pipe, This is the difference between DTH drilling. Meanwhile, the percussion system drives the drilling system rotation (Dongre *et al*., 2014). This type of drilling equipment is used all over the world, especially in emerging markets, with some models being light.

Fig 1.2: Types of drilling

4. REVIEW OF LITERATURE

1. He et al., (2004) 'Protective door damaged by air shock wave and fragment arisen from explosion in prototype tunnel'. The blast explosion was carried out to study the coupled effect of protective door under combined loading fragments and blast wave.

2. Nystrom and Gylltoft (2009) 'Numerical studies of the combined effects of blast and fragment loading'. They investigated the combined action of blast and fragment loading on reinforced concrete wall through numerical simulation method.

3. Hou et al., (2015) 'Damage characteristics of sandwich bulkhead under the impact of shock and high-velocity fragments'. They conducted experiments adopting cast TNT and prefabricated fragments to study the damage characteristics, failure modes and the protective mechanism of sandwich bulkhead under the impact of shock and high-velocity fragments and pointed out that the main failure mode of the front plate is the combination of large deformation and large amounts of perforation holes while that of the back plate is only large deformation.

4. Aune et al., (2017) 'On the dynamic response of blast-loaded steel plates with and without pre-formed holes'. They studied the dynamic 210 response of the steel plates with and without pre-formed holes under the blast loading generated by a shock tube facility, the deformation is quantified and measured by 3D-DIC'which was used to compare the failure with numerical simulation results, in addition, the crack propagation was observed.

5. MAST BORE PROCESS

Drilling and blasting are the major unit operations in opencast mining. Inspite of the best efforts to introduce mechanization in the opencast mines, blasting continue to dominate the production.

Fig 1.3: Misangled drill bit

Explosives contribute currently about 5% of the direct cost of production and if the aggregate cost of drilling and blasting is taken together, this may go as high as 30% of direct cost of production. Therefore to cut down the cost of production optimal fragmentation from properly designed blasting pattern has to be achieved (de Leonardo et al., 2013).

6. ISSUE IN CENTERING

It is almost certain that problems will occur while drilling the blast hole, here the mast plays a vital role in drilling the hole. The operations are done by both hydraulic and pneumatic systems. If the inner through hole is not big enough to ensure the flow rate of high-pressure medium, the helicoids hydraulic motor will not be driven, the down whole motor will not work and thus the drilling process will not be completed. Therefore, big enough inner through hole for the rod is a necessary condition for ensuring the directional drilling process. Structure design of outer pipe In order to ensure the inner through hole of the rod, now designing an initial scheme according to which seamless steel tube is directly threaded, As the wall of the rod is relatively thin, the wall at the screw thread of the rod is even thinner after threading. Drilling is carried out by hand, hammer and chisel which tend to be tedious and slow processes in hard-rock mining. The limitations to hand-drilled holes do not exceed 400 mm in length. In modern day operations, mechanical rock drills are predominantly used. Blasting in a mine generally occurs in two phases, primary blasting and secondary blasting. Primary blasting involves breaking down of in-situ rock in development and stopping as well as by drilling holes in rocks. Secondary blasting is performed to get rid of overburden. Drill and blast design is a key component of mine planning and management. Its major impacts are on safety and efficiency. Calculation of charge density (kg of explosives per cubic meter or tone of 210 rock) for different applications, rock types and explosives is very theoretical. In practice, operation experience is beneficial for success in designing drilling and charging patterns for different conditions.

7. JIGS AND FIXTURES

Jigs and fixtures may be defined as devices used in the manufacture of duplicate parts of machines and intended to make possible interchangeable work at a reduced cost as compared with the cost of producing each machine detail individually. Jigs and fixtures serve the purpose of holding and properly locating a piece of work while machined, and are provided with necessary, appliances for guiding, supporting, setting and gagging the tools in such a manner that all the work produced in the same jig or fixture will be alike in all respects even with the employment of unskilled labour. When using the expression “alike, it implies, of course, simply that the pieces will be near enough alike for the purposes for which the work being machined is intended. When it is necessary to arrange points to act as on long cylindrical surface, it is good practice to make them so that they can be adjusted to take up wear. This can easily be done by means of headless set-screws with check-nuts to lock them securely in any position and it is a better construction to place one check-nut on the outside and another one inside, than to have both nuts on one side of the fixture wall. The construction of the fixture will not always permit of using this method, but, when it will, very satisfactory results are obtained.

8. FIXTURE ASSEMBLY

Fixtures are usually named after the type of machining operation for which they are designed and employed. The function of these fixtures is to hold different components together in their proper relative position at the time of assembling them. A fixture holds and positions the work but does not guide the tool, whereas a jig holds, locate and as well as guide the tool. The fixtures are heavier in construction and are bolted rigidly on the machine table, whereas the jigs are made lighter for quicker handling and clamping with the table is often unnecessary. It increases the machining accuracy because the work piece is automatically located and the tool is guided without making any manual adjustment. It enables the production of identical parts which are interchangeable.

9. ISSUE IN CENTERING

Centering operation also called center drilling; this operation drills a starting hole to establish its location for subsequent drilling accurately. The tool is known as a center drill. Clamping pressure can be exerted by means of hydraulic fluid and work piece can be clamped. By using hydraulic fixture manufacturer get flexibility in clamping pressure as per job specification and material. So, the imaginary center can't be achieved. The manual correction takes longer time to correct it. The guide fixture assemble is used to overcome the issue. Problems Occurring are:

i. Fixture setup is done manually due to this cycle time is more.

ii. Overnighting or loosening of screw leads to machining defects.

iii. Product quality is not obtained as per specification.

iv. Sometimes rejection rate is observed.

v. Manual clamping leads to accidents.

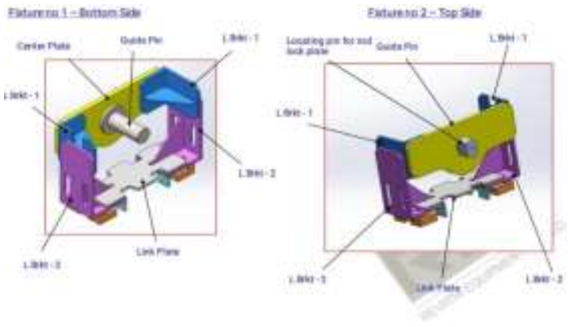

Fig 1.4: Assembly fixture in CAD modelling

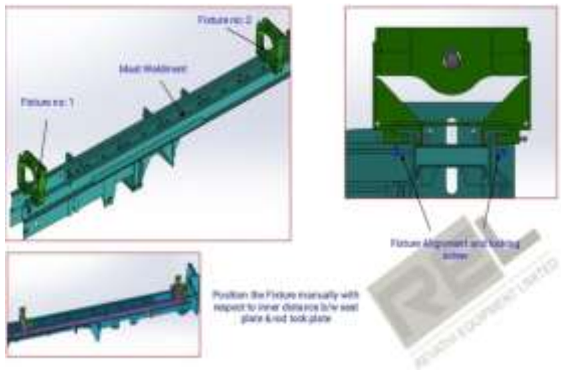

Fig 1.5: CAD model fixture mast

Fig 1.6: Blast hole drilling machine (C625H)

10. SEQUENCE AND TIMING

Table consisting of Fixture assembly Components

SL.NO	ACTIVITY	ASSY DAYS
1	Mast piping	4
2	Head Assembly	8
3	Pull down assy	4
4	Thermal valve assy	24
5	Mast piping	12
6	Pivot bearing	8
7	Mast crown	10
8	Assy fixture	88
9	Main frame	194
10	Under garage	97
11	Setting	32
12	Testing	8
13	Total hours to assy	364 (42 Days)
14	No. of parts for C600H	

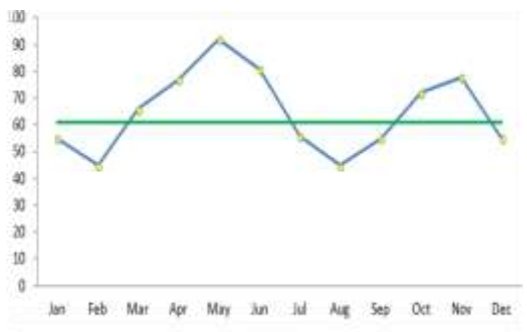

Fig 1.7: Engineers work flow chart

11. CONCLUSION

This project mainly focuses on the assembly Fixture and to achieve the imaginary center during the drilling operations. The assembly fixture was mounted in the Mast and made to achieve the imaginary center during the assembly of drill rod from hanger shaft to mast and further it will be coupled with drill bit. A smart drilling system is one that is capable of sensing and adapting to conditions around and ahead of the drill bit to reach desired targets. This system may be guided from the surface, or it may be self-guided, utilizing a remote guidance system that modifies the trajectory of the drill when the parameters measured by the sensing system deviate from expectations.

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