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Pipe Cutting-A Different Approach

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Abstract—one problem which the present invention solves is the cutting of pipes located in trenches or other points similarly difficult of access. For example, in repairing or adding connections to installed gas mains it is frequently necessary to dig a trench around the pipe and cut out a section of it preparatory to inserting a new section. On the other hand, cutting of the pipe manually is not only an expensive and laborious job but is so slow that it may seriously impair public utility service if the pipe is, say, a gas or Water main. Also precluded, in the case of a gas main Same problems as discussed above are faced during the installation and maintenance of steam carrying pipelines of boilers in the industries, the current invention overcome all of the above problems, as it increases production rate, workers safety, accuracy of work and reduces labor cost, possible chances of accidents.

I. INTRODUCTION

It is essential, in the interest of strength and economy, to cut pipes cleanly and with a fair degree of accuracy. This has to be achieved, both in the workshop and on site, which means that a machine designed for such work requires to be light, portable and easy to maintain. The automatic portable gas pipe cutting machine has been designed to meet such requirements. It is simple mount, operate and maintain, and when operated at the correct cutting conditions, excellent finish is obtained on the cut faceIt is for use when pipes require to be square cut and the edges given square preparation. The smallest diameter pipe that can be dealt with is 380mm (15 inch). The largest diameter depends upon the length of the drive chain. The cutter has the capacity to cut thickness depends upon the concentration of the gas flame adjusted. It is recommended that the standard type machine is used on pipe in the horizontal position. Pipe in other positions can be dealt with if some means of support is provided, against which the wheel can run. In this instance a track band, made from mild steel strip, has been strapped firmly around the pipe, for the lower wheels of the machine to run against. Track band type machine to run against. Track band type machines can be used on pipe in any position. The accuracy of the automatic portable pipe gas cutting machine depends upon the care exercised by the operator and keeping the machine in a clean condition. Machine tool standards should be maintained at all times. Maintenance ofthe machine has been reduced to a minimum and most components which in times may require attention can be replaced at a fixed cost. Auto pipe cutting machine is a lightweight, portable chain type cutting machine. It can be used at large field jobs as well as in small workshop. The machine is designed with mild steel. The other parts of machine are of stainless steel making it rust free. Gas cutting machine is an automatically operated pipe cutting machine that uses a chain and gear drive system. The drive chain is comprised of durable, interlocking links that can easily be added or removed for quick change of pipe diameters. A graduated bevel collar ensures accurate bevel setting. The control valves for fuel, preheat and cutting oxygen are positioned from heat yet conveniently placed for easy operator use.

II. LITERATURE REVIEW

Plasma modelling, numerical simulation and diagnostics can be very useful tools for designing and optimizing plasma arc cutting torches and they should be used in conjunction in order to obtain significant added value from an integrated approach to design, but research is still in the making for finding a link between simulation of the plasma arc and a consistent prevision of cut quality. Diagnostics based on high speed imaging can play an important role for investigating significant phenomena, otherwise impossible to recognize. Schlieric photography can be very useful to better understand the interaction between the plasma discharge and the kerf front. Also, the behaviour of hafnium cathodes at high current levels at the beginning of theirservice life can be experimentally investigated, with the final aim of characterizing phenomena that take place during those initial piercing and cutting phases and optimizing the initial shape of the surface of the emissive insert exposed to plasma atmosphere. Experimental evidences can be integrated with simulative results in order to avoid a try & fail approach, often too expensive, to validate models and to identify innovative design solutions, addressing specific issues that cannot befully investigated through experimental tests. It is alsofrequently well-suited, and favoured, for fabricating some types of metal-based artwork. As well, oxy-fuel has an advantage over manual cutting and welding processes in situations where accessing would present difficulties; it is more self-contained, in this sense — hence "more portable". In oxy-fuel cutting, a cutting torch is used to cut pipes. In oxy-fuel cutting, a torch is used to heat metal to its kindling temperature. A stream of oxygen is then trained on the metal, burning it into a metal oxide that flows out of the kerf as slag .Sometimes called a "Gas Axe". Torches that do not

mix fuel with oxygen (combining, instead, atmospheric air) are not considered oxy-fuel torches and can typically be identified

by a single tank (Oxy-fuel cutting requires two isolated supplies, fuel and oxygen). Most metals cannot be melted with single-tank torch. As such, single-tank torches are typically used only for soldering and brazing, rather than welding. [1]

Laser beam machining (LBM) is one of the most widely used thermal energy based non-contact type advance machining process which can be applied for almost whole range of materials. This paper defines mathematical models for surface roughnessprediction (μm) and width of heat affected zone (mm) during laser cutting of alloy steels 1.4571 and 1.4828 with nitrogen as assist gas. For defining appropriate mathematical models multiple regression analysis is used with four independent variables. Following parameters are varied: cutting speed, focus position, nitrogen assist gas pressure and stand-off. Obtained mathematical models describe dependence of Ra and heat affected zone from varied process parameters. [2]

Now a day's optimization is essential process of an industry whether it is in form of process, cost, equipment, etc. In the welding cutting process according to various material various gas is utilized & gas is one of the energy producer (generator) material & it is our conventional energy source so to reduce gas utilization is our motto for full fill our motto in this research world we are 3 parameter of gas cutting is apply for the optimization MRR our research going on material M.S., C.I. C-45 sheet (thickness vary 6mm, 8mm 10mm). [3]

Fig.1 Gas cutting by LPG but good finishing not obtain [3]

Plasma arc cutting is a non-conventional manufacturing process capable of processing a variety of electrically conducting materials. Stainless steel, manganese steel, titanium alloys, copper, magnesium, aluminium and its alloys and cast iron can be processed. The plasma process for cutting was developed approximately thirty years ago, for metals difficult to be machined through conventional processes. It uses a high energy stream of dissociated, ionized gas, known as plasma, as the heat source (fig. 2.3) is characterized by an electric arc established between an electrode and the work piece. The electrode acts as the cathode, and the work piece material acts as the anode. PAC process is not a new process, however; state of the art knowledge in the process is characterized more by the huge amount of patents than by scientific publications. There is need for better understanding of process mechanics and physics. The challenge of today's research in PAC process is to increase the energy density generated by the system. In order to achieve higher cutting thickness without losing the quality of the cut, many parameters must be taken into consideration. Investigations on plasma cutting process on various materials have identified as dominant process parameters the following ones:1. cutting speed, 2. cutting current, 3. cutting height or standoff (i.e. the distance maintained between torch and work piece after piercing and while cutting), nature, pressure and flow of the plasma gas. [4]

III. SYSTEM DESIGN

A. Design Considerations

In system design we mainly concentrated on the following parameters:

1) System Selection Based On Physical Constraints: While selecting any machine it must be checked whether it is going to be used in a large-scale industry or a small-scale industry. In our case it is to be used by a small-scale industry. So space is a major constrain. The system is to be very compact so that it can be adjusted to corner of a room.The mechanical design has direct norms with the system design. Hence the foremost job is to control the physical parameters, so that the distinctions obtained after mechanical design can be well fitted into that.

2) Arrangement Of Various Components: Keeping into view the space restrictions the components should be laid such that their easy removal or servicing is possible. More over every component should be easily seen none should be hidden. Every possible space is utilized in component arrangements.

3) Components Of System: As already stated the system should be compact enough so that it can be accommodated at a corner of a room. All the moving parts should be well closed & compact. A compact system design gives a high weighted structure which is desired.

4) Man Machine Interaction: The friendliness of a machine with the operator that is operating is an important criteria of design. It is the application of anatomical & psychological principles to solve problems arising from Man – Machine relationship.

5) Chances Of Failure: The losses incurred by owner in case of any failure is an important criteria of design. Factor safety while doing mechanical design is kept high so that there are less chances of failure. Moreover periodic maintenance is required to keep unit healthy.

6) Servicing Facility: The layout of components should be such that easy servicing is possible. Especially those components which require frequents servicing can be easily disassembled.

7) Scope Of Future Improvement: Arrangement should be provided to expand the scope of work in future. Such as to convert the machine motor operated; the system can be easily configured to required one. The die & punch can be changed if required for other shapes of notches etc.

8) Weight Of Machine: The total weight depends upon the selection of material components as well as the dimension of components. A higher weighted machine is difficult in transportation & in case of major breakdown; it is difficult to take it to workshop because of more weight.

9) *Mechanical Design*: Mechanical design phase is very important from the view of designer .as whole success of the project depends on the correct deign analysis of the problem. Many preliminary alternatives are eliminated during this phase. Designer should have adequate knowledge above physical properties of material, loads stresses, deformation, and failure. Theories and wear analysis, He should identify the external and internal forces acting on the machine parts.

These forces may be classified as:

1) Dead weight forces
2) Friction forces
3) Inertia forces
4) Centrifugal forces
5) Forces generated during power transmission etc.

Designer should estimate these forces very accurately by using design equations .If he does not have sufficient information to estimate them he should make certain practical assumptions based on similar conditions which will almost satisfy the functional needs. Assumptions must always be on the safer side.

Selection of factors of safety to find working or design stress is another important step in design of working dimensions of machine elements. The correction in the theoretical stress values are to be made according in the kind of loads, shape of parts & service requirements. Selection of material should be made according to the condition of loading shapes of products environment conditions & desirable properties of material.Provision should be made to minimize nearly adopting proper lubrications methods.

IV. OBJECTIVE

It will cut small diameter pipe.
It will increases production rate, workers safety, accuracy of work and reduces labour cost, possible chances of accidents.
It can be used at large field jobs as well as in small workshop.
This machine can be used almost in all types of industries.

V. CONSTRUCTION AND WORKING

A. Construction

∑ *Main Parts Of The Machine*

1) Drive Chain
2) Wing Nut
3) Spring
4) Guide Wheels
5) Lead Screw
6) Driving Motor

7) Sprocket
8) Base Plate
9) Saddle
10) Pillars

Automatic portable gas pipe cutting machine consist of chain driven four-wheeled carriage assembly which carries a cutter round the circumference of the pipe when the driving motor is turned on. The carriage assembly has a mild steel saddle which mounts the wheels and incorporates saddle guide posts. A mild steel saddle which mounts the chain sprocket and driving motor is adjustable up the guide posts to achieve the correct tension of the chain round the pipe. Adjustment of the saddle is by a large spring tension wing nut. Resistance to corrosion and anti-corrosion measures have been taken on all parts likely to be adversely affected by exposure to site work conditions.

1) Drive Chain: The chain is made up of separate links which can be readily added or subtracted to suit the pipe diameter. When set-up and use it is endless and perform two functions:-It holds the machine in position on the pipe by passing round the pipe and through the machine where it is tensioned by raising the saddle. It enables the machine to drive round the pipe by each link engaging progressively with the chain sprocket. Depending on the diameter of the pipe to be cut, links should be added or subtracted from the chain until it can be joined with the minimum of slack. Each link is grooved on one side only, so that the connecting hook on the joining link can be inserted from one side only.

2) Saddle: Saddle slides along the pillars. It carries driving motor. Lead screw is connected to the saddle.

3) *Wing Nut:* Wing nut is used for the adjustment of the length of the chain for fitting the machine on pipe by applying the tension on the spring provided on the top of the machine.

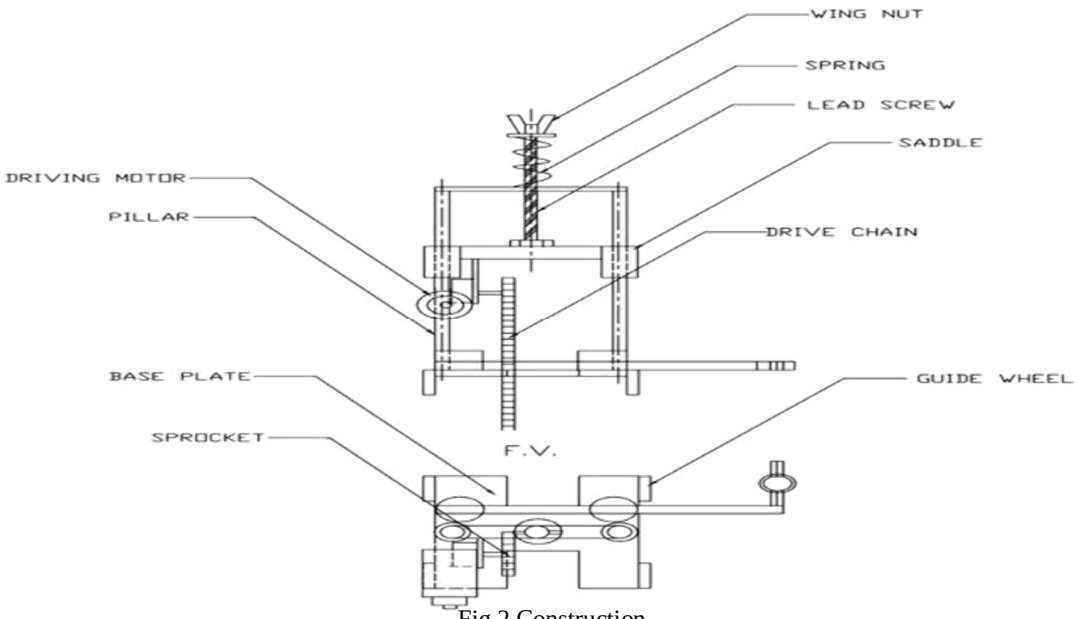


Fig.2 Construction

4) Spring: Spring sustaining the load and avoids the accidents, if sudden jerks are arrived during the operation by absorbing the jerks by compressing slightly.

5) Guide Wheels: Guide wheels are provided at the bottom of machine for smooth rotation of machine over the pipe during the operation. For this purpose use of roller bearings are best suited as they are easily available in market at cheap rate and they gives very smooth rolling movement with less friction also they are not affected by the heat generated while cutting the pipe.

6) Lead Screw: Lead screw is provided on the top of the machine for tightening of chain according to the diameter of after placing them machine over the pipe.

7) Electric Motor/Driving Motor(Geared DC Motor): Driving motor indexes the machine on the pipe outer diameter.

8) Sprocket: Sprocket is mounted on driving motor shaft and engaged with drive chain which helps the machine to index over pipe diameter by engaging and disengaging with chain links.

9) Base Plate: Guide rods are supported on the base plate and guide wheels are also connected to it.

10) Pillars: Pillars supports the saddle and also used for adjusting the length of chain along with the pipe.

B. Working

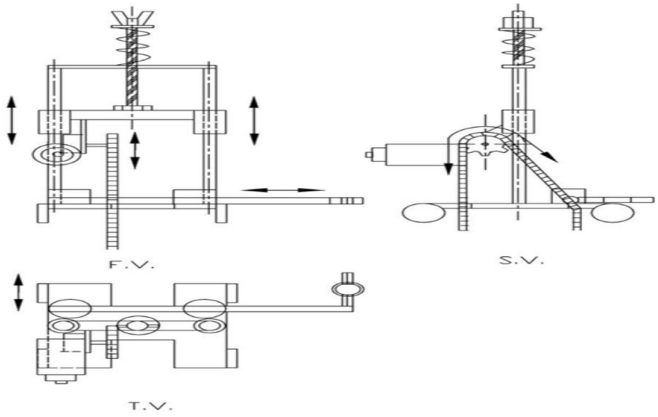
1) With the machine located correctly, raise the height of nozzle using the adjustment wheel and if possible rack it away from the line of cut until the conditions have been set.
2) Turn on gas supplies and set cutting pressure. It is essential for good cutting to move the machine with a steady motion along the line of cut.
3) As soon as the cut is completed, turn off the cutting stream and preheat flame
4) Open the fuel gas valve and ignites the gas; open the oxygen valve and adjust the flame condition with the cutting stream valve open.
5) Turn off the cutting stream with valve.

If the cut is to be from the edge of the pipe:

1) Adjust the nozzle height to 9 mm from pipe.
2) Preheat the edge of the pipe under the flame to bright red.
3) Turn on the cutting stream valve and make a cut by racking the cutter toward the line of cut.
4) As soon as the cut reaches the desired line of cut, commence rotating the machine around the pipe.

If the pipe valve has to be pierced to start the cut:

5) Rack the cutter over the line of cut and preheat the spot under the flame to bright red.
6) Just prior to turning the cutting stream, raise the height of the nozzle to approximately 12mm (1/2 in) from the pipe this should prevent any oxide slag fouling the tip of the nozzle.
7) As soon as the valve is pierced lower the nozzle to correct height, 6mm, and rotate the machine to move the machine around the pipe.
8) On completion of the cut turn off the cutting oxygen and finally the oxygen and fuel gas.
9) Remove machine and track band if this item has been used.



VI. ADVANTAGES, DISADVANTAGES& APPLICATION

A. Advantages

1) Fast Process: Due to the automation in operation the process time decreases and cutting process becomes faster
2) Reduced Fatigue Of Worker: Due to the automatic operation and easy setting of machine the workers fatigue gets reduced.
3) Less Skilled Required & Less Labour Cost: Due to the automatic operation of machine the workers involvement is negligible and due to which low skill workers are required which in terms reduces the labour cost.
4) Compact Size: Machine looks compact in size, so it can be carried from one place to another place.
5) Economical Process: Due to the less labour cost and faster process the cost is very economical compared to conventional process.

B. Disadvantages

1) Possibility Of Explosion: Due to the use of highly flammable gases i.e. LPG, Acetylene, Propane for cutting operation there is chance of explosion and hence dangerous to operate.

2) Care Required: Care should be taken in the mixing of Oxygen and Acetylene to require propositions

C. Applications

1) This machine can be used almost in all types of industries.
2) This machine is mainly used in fabrication oriented industries.
3) This machine can be used where cutting of large diameter metal pipes is required.

VII. RESULT AND DISCUSSION

We conducted cutting operation with the automatic portable gas pipe cutting machine. Our observations were as follows (for diameter = 1.75 feet):

Power Consumption = Current * Voltage (Watts).
= (7 Ampere) * (12
Volts) = 84 (Watts)

Table 1. Results of the Operation

Sr. No.	Task	Time required
1.	Machine Setting	10 min.
2.	Pipe Cutting	10 min.

Total 20 min

It is observed that,

- As the diameter of the pipe to be cut is increases, then the time required for the cutting is also increases.
- So that, diameter of the pipe is directly proportional to the time required for the cutting. • Electrical Power Consumption is 84 Watts in 1 minute for 1.75 feet diameter steel pipe.
- Time required to cut one pipe is 20 minutes.
- In the machine, requirement is 4 pillars on which all the assembly is mounted. Hence, Optimization is done, 2 pillars are used instead of 4 and also size of saddle get reduced, which causes reduce in the weight of machine.
- By using optimization machine becomes portable and easy to handle.

VIII. CONCLUSION

In this project a complete design of the gas pipe cutting machine is done and fabricated. The auto gas pipe cutting machine is designed taking in account of currently available components in the market. The designing and assembling of very large number of components was a tremendous task and was completed on time. However because of some parts couldn't be purchased the whole assembly was limited to welding operation. The project can go beyond its current position and capabilities by employing automation into it. This can be done by using Electrical Sensors. By using optimization, machine becomes portable and easy to handle. The use of this machine increases production rate, workers safety in gas pipe cutting operation.

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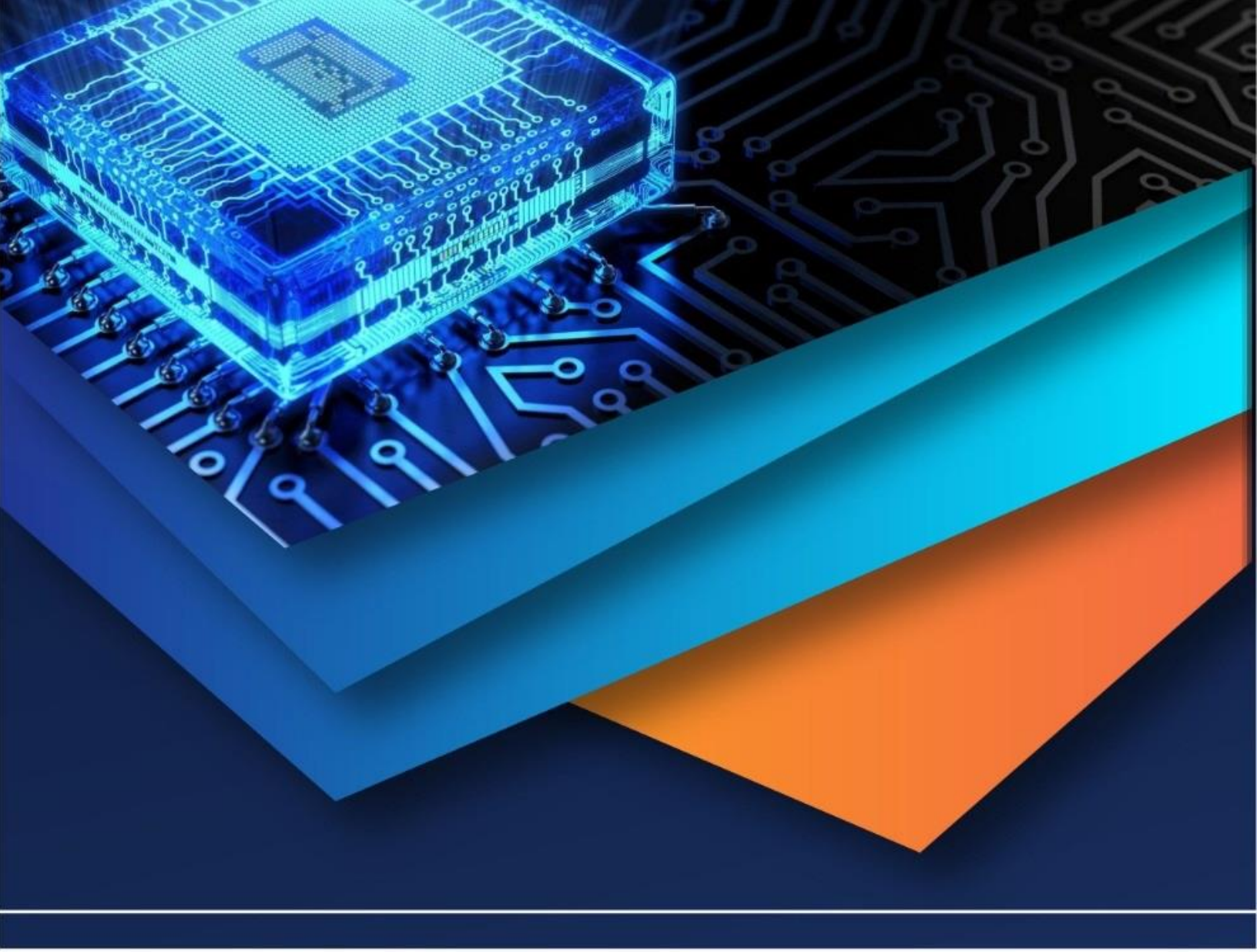

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