ASRO JOURNAL
http://asrojournal-sttal.ac.id/index.php/ASRO

Volume 15, Number 04, pp.11-20
October-December 2024
ISSN: 2460-7037
E-ISSN: 2722-5763

THE DESIGN DRIVE MOTOR SYSTEM ON ASCENDER GRAPPLING HOOK GUNS

Pompy Pratisna[1], Anton Nugroho[2], Dueng Deriva[3], Satria Budi Harjo[4]

[1,2,3,4] D-3 Mechanical Engineering, Sekolah Tinggi Teknologi Angkatan Laut (STTAL), Jl. Moro Krembangan, Krembangan, Surabaya City, East Java 60178

satrianavy118@gmail.com

DOI: https://doi.org/10.37875/asro.v15i04.559

Manuscript received 8th October 2024, Revised 13th November 2024, Published 16th December 2024

ABSTRACT

The grappling hook gun provides KOPASKA with a major advantage in evacuation or reconnaissance routes in hard-to-reach areas, allowing the acquisition of advantageous tactical positions in combat, as well as the utilization of vertical dimensions in military operations. Nonetheless, challenges arise in electric control and ascender systems that still rely on members' physical exertion, which limits the efficiency and mobility of their operations in complex maritime environments. Therefore, this study focuses on improving the system to improve the performance and operational effectiveness of KOPASKA. In overcoming this problem, this research uses a design-based approach to develop more sophisticated solutions. First, in terms of the control system, the study used the 6pin 3 position Toggle Switch to redesign the controls on the grappling hook gun. This toggle switch allows work orders to be received without having to press buttons continuously, increasing the efficiency of using this weapon. Secondly, in optimizing the ascender, the study used a 2500Lb ATV Winch motor with 12VDC power and a ratio of 1:10. This motor is proven to be efficient and has enough lift to handle loads weighing 1133 Kg, providing a reliable solution to the lifting power problem of grappling hook guns. Finally, to ensure optimal power availability, this study applied a 12 VDC 7.0 Ah battery accu on the ascender tool. With a measured power consumption of 88.8 W per operation, the battery provides efficient usability, enabling up to five operations on a single charge. Thus, these solutions contribute positively to KOPASKA's mobility and performance in carrying out their tasks in a dynamic and diverse maritime environment.

Keywords: *Battray Accu, Grappling Hook Guns, Kopaska, Motor Winch 2500 Lb, Toggle Switch.*

1. INTRODUCTION

The Indonesian Navy, known as Tentara Nasional Indonesia Angkatan Laut (TNI-AL), is a crucial branch of the Indonesian National Armed Forces (TNI) responsible for safeguarding the country's maritime territory. The primary duties of TNI-AL are outlined in Law Number 34 of 2004 concerning the Indonesian National Army, which mandates the navy to protect the sovereignty of Indonesia's waters, enforce maritime laws, and conduct military operations at sea. With Indonesia's vast archipelagic nature, the navy plays a vital role in ensuring national security by maintaining control over territorial waters and Exclusive Economic Zones (EEZ).

One of the elite units within TNI-AL is Komando Pasukan Katak (KOPASKA), also known as the Frog Force Command. This specialized force is trained to execute high-risk missions, including amphibious operations, underwater demolition, and counter-terrorism. KOPASKA operates under strict military regulations and is guided by Law Number 34 of 2004, which ensures their operational effectiveness in supporting the broader objectives of the navy. Given the nature of their missions, KOPASKA requires advanced tactical capabilities, precise execution, and specialized equipment to successfully operate in challenging environments.

KOPASKA personnel undergo rigorous training to prepare for high-intensity combat scenarios, including sea landing operations, underwater infiltration, and hostage rescue missions. Their tasks demand physical endurance, mental resilience, and mastery of various tactical techniques. The difficulty

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

of these operations is further amplified by the dynamic and unpredictable nature of maritime conditions. To overcome these challenges, KOPASKA relies on cutting-edge technology and specialized equipment tailored to their unique operational needs. One such critical tool in their arsenal is the grappling hook gun, an essential device for maritime and urban warfare.

Grappling hook guns, also known as shooting hook guns, are used to deploy hooks or anchors attached to ropes or cables, enabling personnel to scale difficult terrains, board ships, or secure access to elevated positions. These tools enhance mobility and tactical versatility, allowing KOPASKA operatives to conduct covert infiltrations and rapid extractions with minimal exposure to enemy threats. The effectiveness of grappling hook guns makes them indispensable in naval special operations, particularly in missions that require swift and stealthy movements across complex environments.

In modern military operations, the continuous development and improvement of tactical gear, including grappling hook guns, remain essential for enhancing the operational readiness of KOPASKA. As threats evolve, so does the necessity for advanced and reliable equipment to ensure mission success. The integration of state-of-the-art weaponry and climbing tools reinforces KOPASKA's ability to execute high-risk assignments with precision and efficiency. With the increasing complexity of security challenges in maritime domains, equipping elite naval forces with the best available technology is a strategic priority for TNI-AL in safeguarding Indonesia's sovereignty at sea

1.2 Problem Statement

Based on the background that has been explained, several problems that need to be solved in this study can be formulated, namely:

a. How to design a precise, reliable and efficient control system for ascender grappling hook guns to ensure safety?

b. How to design a drive motor that meets the performance requirements of ascender grappling hook guns, including sufficient lifting power?

c. How to perform the calculation of the power required for the selection of batteries on the motor ascender grappling hook guns, as well as other equipment involved in this system?

1.3 Purpose of Writing

The objectives of the Drive Motor System Design on Ascender Grappling Hook Guns, are:

a. Designing a precise, reliable and efficient control system system for grappling hook guns. Its main focus includes developing customizable controls and including safeguards to prevent unwanted incidents.

b. Designing drive motors that meet the performance requirements of grappling hook guns, including lift. Steps are directed towards achieving a motor design that meets lifting power needs.

c. Perform proper battery removal to support the efficient operation of grappling hook guns, taking into account the power requirements of drive motors and other equipment in the system.

These steps are geared towards achieving an overall optimal and efficient operation across the board.

1.4 Benefits of Writing

With the status of research still in the form of prototypes, the benefits for it are still potential and involve a number of advantages in the development and implementation phases. Here are some of the anticipated benefits of using prototype grappling hook guns:

a. New Technology Development: The use of prototypes allows Kopaska to become early adopters of new technologies. This can spur the development of grappling hook guns technology to the next level based on practical experience and feedback from direct users.

b. Initial Performance Evaluation. The prototype provided an opportunity for Kopaska to evaluate the performance of grappling hook guns systems in real scenarios. This helps detect advantages and disadvantages of the technology that can be corrected before full implementation is carried out.

c. Operational Data Collection. Through the use of prototypes, Kopaska can collect valuable operational data related to circuit breakers, drive motors, and operational efficiency. This data can be used to improve design and performance in later iterations.

d. Training and Adaptation. The prototype allowed initial training for Kopaska personnel in the use of grappling hook guns. This allows their adaptation to new technologies and understanding firsthand the advantages and constraints that may arise during use.

e. Design Adjustments. With feedback from users, researchers can make adjustments to the prototype design to better meet Kopaska's needs and expectations. This opens up opportunities for iterative development focused on user needs.

f. Increased Security and Efficiency. Although still in prototype form, early implementation could bring early improvements to operational safety and efficient use of grappling hook guns, proving their potential benefits in real terms.

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

By utilizing prototypes wisely, Kopaska can be a pioneer in implementing this innovative technology, providing valuable input for further development, and ensuring that subsequent implementations will deliver maximum benefits in their operations.

1.5 Problem Limitation

In completing the writing of this Final Project, the author has set several limits that aim to focus the problem and prevent the scope of research from being too broad. The following are the limitations of the issue that apply:

a. It does not discuss the integration of advanced sensor technology in the needs of drive motors in ascender grappling hook guns.

b. This research is a prototype and does not include implementation for all members of the KOPASKA Unit.

c. The need for a drive motor in ascender grappling hook guns is built in the STTAL laboratory with a limited scope of trials in special training facilities.

d. Features on this prototype are the use of winch, automatic control, as well as ascender capabilities that can be set to support various mission scenarios.

2. LITERATURE REVIEW

2.1 Previous Research

This previous research became one of the author's references in conducting research so that the author could further explore and review the research carried out. From several previous studies reviewed, the author did not find research with the same title as the title that will be raised by the author in the final project. In enriching study materials in research, the author raises several studies as references. As for some previous research that we used as a reference in writing the final project including:

Andri Prasetyo Hermawan (2014) Design of machining systems and drive systems on Auger Cutter Suction Dredger (ACSD) as a dredging method in reservoirs.

In research on Auger Cutter Suction Dredger (ACSD), the author performed various calculations, analyses, and designs related to machining systems, including the selection of suction pumps, Independent drive machines, cutter heads, ladder winch suction pipes, and planned ACSD dredge designs. This research covers important aspects to ensure the performance and operational efficiency of such dredges. (Hermawan, 2014)

Paulinus Frederikus Balubun, Eliza R de Fretes, Ruth Phetrosina Soumokil (2023) Analysis of Slipway Capacity Increase at Pt. Dok and Shipping Waiame (Persero) Ambon.

This study aims to determine the optimal specifications of ship launching systems and tug equipment to increase the capacity of PT. Waiame Docking and Shipping (Persero) Ambon. The calculation results show that the existing winch capacity and electro motor power are insufficient for dosing ships with a capacity of 3000 TLC. (R P Soumoki, 2023)

Rahmat (2021) Design an Aircraft Front Wheel Lift and Towing System Control System at the Indonesian Navy Air Base.

This circuit is a remote control circuit made using radio frequency signals to control various equipment related to electricity and DC motor selection. (Grace, 2021)

In enriching the study material in research, the author raises several studies and theoretical foundations as references, for improvements in making the design that the author will make. For the ascender tool that the author will make in the form of a prototype that can later be applied in the field, using a control system that can make it easier for users to operate it.

2.2 Theoretical Foundation

To support the design of the drive motor system on the Ascender Grappling Hook Guns, the author takes the theoretical foundation to be discussed as the basis for compiling a report on the planning and application of making the system on the tool that the author will build.

2.2.1 Grappling Hook Guns

Grappling hook guns The KOPASKA unit is designed and adapted to the needs of military tasks, especially in sea and underwater operations. This requires that the grappling hook guns meet the standards of durability, speed, precision and safety required in the special task environment faced by the Kopaska Unit. With grappling hook guns, this is very helpful for the KOPASKA Unit when carrying out special operations.

2.2.2 Body Armor

Body armor, also known as body armor or armor vest, is a type of personal protection designed to provide protection against various types of physical threats, such as firearm attacks, sharp weapon attacks, bullet attacks, or blunt object attacks. Body armor is commonly used by military personnel, security personnel, law enforcement officers and other individuals at high risk of physical harm. There are several different types of body

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

armor, which are suitable for different types of threats and situations.

2.2.3 Rise

Ascender is a mechanical device used to ascend or descend ropes more easily and efficiently than manual methods. This tool is often used in a variety of contexts, such as climbing, cave exploration, rescue and industrial work where it is necessary to move at high altitudes. The ascender works by biting and locking the strap when pulled in the desired direction, thus allowing the user to move safely.

2.2.4 Theory Winch

Application of winch technology in the design of drive motor system on ascender grappling hook guns Being a critical aspect that requires a deep understanding of winch theory as a foundation for designing and implementing optimal control systems and ascenders. The winch is an important device used to pull or lift loads in various conditions.

2.2.5 DC Motor Calculation

Identify Power Requirements. Determine the power requirements required to move the ascender grappling hook guns. These factors can include the desired lift, operational speed, and maximum workload the motor will face. (Personnel weight + Kopaska equipment weight + Grappling Hook equipment weight)

Calculate mechanical power. Use the basic formula to calculate the mechanical power required by ascender grappling hook guns. The formula is:

$P_{Mekanikal} = (W.d)/t$ .... (2.1)

Where:

P.mechanical is a mechanical force (in watts),

W is the workload (in newton),

d is the transfer distance (in meters),

t is the time required for such displacement (in seconds).

Here are the general steps to calculate motor efficiency:

a. Determine the input power. Calculate the input power (mains) given to the motor. It can be measured by measuring the input current (Iinput) and input voltage (Vinput) to the motor.
Power formula:

$P_{Masukan} = I_{Masukan} \times V_{Masukan}$....... (2.2)

b. Specify Output Power. Calculate the output power (mechanical) generated by the motor. It can be measured by measuring the torque (T) and angular velocity (ω) of the motor.

Output force formula (P output):

$(P\ output) = T \cdot \omega$................................ (2.3)

Where:

$V = S/t = \omega.r \rightarrow \omega = V/r$.........................(2.4)

So to find the RPM on the pully:

$\omega = 2\pi n/60 \rightarrow V/r = 2\pi n/60$ .... (2.5)

So:

$n_{(RPM)} = (60\ V)/2\pi r$(n pulley……… (2.6)

Calculate Motor Efficiency:

Use the motor efficiency formula (η):

$\eta = P_{Keluaran}/V_{Masukan} \times 100\%$.. (2.7)

a. Conversion of Mechanical Power to Electric Power:
Adjust the calculated mechanical power to the electrical power required by the motor taking into account the efficiency of the motor. The formula is:

$P_{Listrik} = P_{Mekanikal}/($Efficiency.... (2.8)

b. Consider additional factors:
Dynamic Load Factor: If ascender grappling hook guns experience varying dynamic loads, consider this factor in the calculation.

2.2.6 Calculations in battery selection

Calculate the Electric Power Required by the Motor. Use the pre-calculated electrical power calculation (step 3 in motor power calculation). Be sure to take into account the efficiency of the motor in this calculation.

Calculate Battery Capacity Required: The basic formula for calculating battery capacity (Q) is:

$Q = (P_{Listrik}.t_{Operation})/V_{Batra}$................ (2.9)

P/Electricity is the electrical power required by the motor (in watts),

t.operation is the desired operational time (in hours),

V,battery is the battery voltage (in volts).

Select Battery Type and Capacity. Choose the type of battery that suits the needs of the application, such as lithium-ion batteries which are generally used for applications that require high power and lightweight. Choose enough battery capacity to meet power needs and uptime.

Calculate the Battery Current Required. Use Ohm's law (I = P/V) to calculate the battery current required by the motor, where:

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

I is the current of the battery (in amperes),

P is the electrical power required by the motor (in watts),

V is the battery voltage (in volts).

2.2.7 Operating System

The control system is a device in the form of a circuit where the user does not have to hold or press constantly switches or control devices. The control system is the result of technological developments developed by humans to facilitate the work or operation of a tool.

3 RESEARCH METHODS

3.1 Research Design

This research design is an initial research by conducting which aims to make a tool that can be useful for the Kopaska unit. This final project also includes information systems research that applies science into information in order to obtain information as needed. The system is a design element that is combined with various methods into a system that meets a specific purpose. This research is carried out by carrying out development aimed at making new innovations with equipment that has been created previously in order to get more value.

3.2 Research Procedure

The research procedure is an explanation of the steps of a research process to be carried out, starting from the diagram of the design work system to the input and output of the system that will produce data that is as expected.

3.2.1 Time and Place of Research

The time of work and research is carried out after UAS where the author starts from the planning, data collection, analysis, and report writing stages. Meanwhile, the research was carried out in the workshop and integrated laboratory of STTAL Surabaya. The research time in writing this final project starts in July 2023 until December 2023.

3.2.2 Research Tools and Materials

In carrying out this research, several tools and materials are needed to facilitate system design and research trials. To facilitate the design, it is necessary to make a list of the tools and materials used for research. The following are the tools and materials used in this final project research in assisting the process of designing a driving motor on ascender grappling hook guns. Time and Place of Research The tools and materials needed in the implementation of research include:

Table 1. Tools and materials

NO	TOOL AND MATERIAL NAMES	INFORMATION
1	Tang Ampere	Nankai
2	Elektrik Speed Control	360 A
3	Motor DC	12 Volt 51.6 watt
4	Battery	12 Volt
5	Toggle Switch 6 pin	TUV
6	Battray Display	Peacefair
7	Solder	Opticcom 40 watt
8	Avo meter	Sanwa
9	Tool set	Tekiro
10	Obeng (set)	Tekiro
11	Combination pliers	Tekiro
12	Cutter	Kenko

(Source: Author's preparation)

The uses of the tools used in these 12 research tools and materials are as follows:

a. Ampere pliers are used to measure electric current on a conductor cable that is electrified using two clamping jaws (Clamp) without having to have direct contact with the electrical terminals.

b. Electronic Speed Control is used to regulate the speed of the DC motor.

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

c. DC motors are used to move Pully.

d. Accu is used to supply (provide) electricity to electrical systems and other electrical components.

and. Toggle Switch is used as a control to conduct electricity and drive the dc motor.

f. Battery Display is used to determine the current, voltage, power, time and remaining power on the battery.

g. Solder is used to assemble or disassemble electronic networks on networks found on PCB boards.

h. Avo meters are used to measure current (amperes), voltage (volts) and resistance (Ohms) in one tool.

i. The tool set is useful for opening and tightening bolts or nuts precisely.

j. A set of tools used to tighten or dormit bolts.

3.2.3 Research Design

This research design is implemented through a series of structured stages, beginning with the planning and design of the research framework. The process involves determining the research focus, setting the timeline, and identifying key variables to be examined. A well-defined research focus ensures that the study remains aligned with its objectives and contributes meaningful insights. Additionally, establishing a clear timeline allows for systematic data collection and analysis, ensuring that each phase progresses efficiently and effectively.

Following the initial planning, data collection is carried out using appropriate methodologies that align with the research objectives. Once the data is gathered, it undergoes a thorough analysis to identify patterns, relationships, and key findings. The results are then compiled and presented in a structured manner to ensure clarity and relevance. This systematic approach enhances the validity and reliability of the research, ultimately providing valuable contributions to the field of study..

3.3 System Analysis and Planning

System analysis can be defined as a complete description of components to identify and evaluate problems and needs desired by users. System analysis is the most important stage of the program because there is an initial stage to evaluate the problems encountered and that occur. After the assistance of the mechanical group carried out calculations to design and carried out testing, the following control group carried out system design to test, for testing both mechanical and control, planning until testing was carried out together.

3.4 Data Collection

Data collection method is an approach used to collect data needed in research, so that the final results of the study can present valid and reliable information. This method helps researchers or analysts to collect data that is accurate, reliable, and in accordance with the objectives of the research they do.

3.5 Data Processing

Data processing is a crucial stage in research, where the data that has been collected will be processed in order to produce useful information for users. In the process of data processing for research on the design of a drive motor system on ascender grappling hook guns using a winch, there are several important steps that need to be considered, including data preparation and data classification.

3.6 Operational Definition

Operational definitions in research variables refer to the process of breaking down or elaborating on concepts into measurable and concrete definitions. By defining variables operationally, researchers can ensure clarity and precision in their studies. These definitions allow abstract concepts to be translated into specific indicators that can be observed, measured, and analyzed systematically. This approach helps in minimizing ambiguity and ensures that all aspects of the research variables are clearly defined for accurate data collection.

Furthermore, operational definitions play a crucial role in maintaining consistency and uniformity in research. When variables are well-defined, researchers can collect data in a structured manner, making it easier to compare findings across different studies. This standardization is essential for achieving reliable and valid results. Additionally, clear operational definitions enhance the credibility of the research by ensuring that all stakeholders, including researchers, participants, and readers, have a common understanding of the variables being examined

4. ANALYSIS AND DISCUSSION

4.1 Planning

The system design that the author will discuss in this chapter is about the design of motor drive systems and ascender control. In designing this hardware, the author designed electronic equipment that supports the work of the ascender device using controls that can be controlled more efficiently. The hardware design includes the design of the toggle switch switch, battery indicator monitoring and electric range for the movement of the ascender drive motor.

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

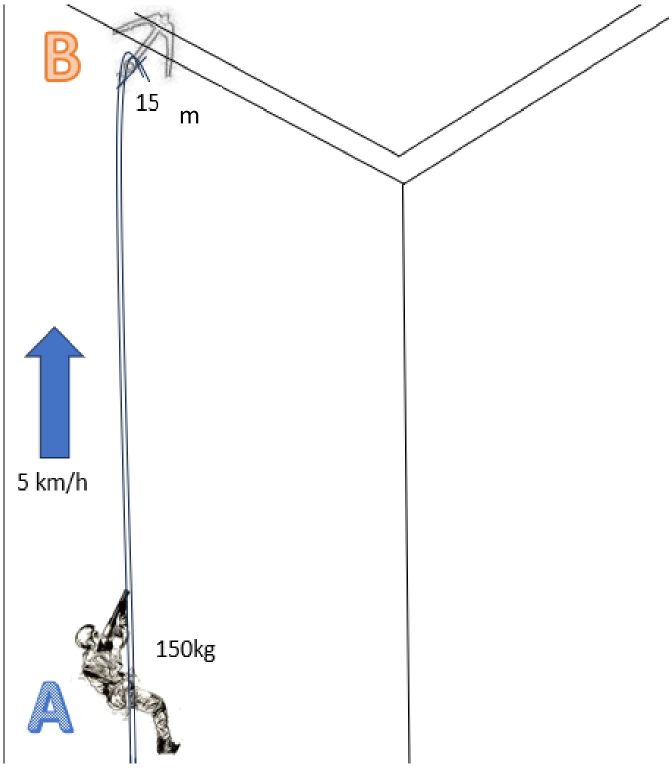

Figure 2. Phenomena that occur
(Source: Processed author)

Parts of the electrical system design and control control system of the tool made, from each part explained the arrangement of position placement to facilitate work and friction in the event of troubleshoot. Tool design is the most important part in making tools that will be designed in this final project. System design is designed with concepts based on theory and references related to tools that will be designed to facilitate the work and analysis of tools. The control system that the author will use is a toggle switch system without using a remote.

4.1.1 DC Motor Control Design and Selection

In designing this hardware, in the DC motor automatic control system, the author designed a control system that uses a switch / switch without using a remote control. The switch or switch the writer selects is a 6-pin and 3-position toggle switch that does not need to be pressed continuously so that the user only presses when rising, stopping and descending.

The user can focus on holding the weapon being carried and position the standby weapon against the enemy while the motor on the ascender will continue to move until the user presses or shifts the toggle switch position to off to stop and the opposite direction if the user wants to move down. The function of this toggle switch has the main function as a breaker or voltage connector in a circuit, in other words this switch functions as a power ON / OFF switch

a. Electrical System Scheme

The electrical scheme uses Direct Current (DC) current derived from a 12-volt accu, which supplies all electrical systems in the DC motor, one 12-volt accu is used to drive the DC motor. For Battery Meter this is an indicator of electricity usage such as power, voltage, ampere and time used by DC motors, while the toggle switch switch as a control up, down and stop to drive DC motors with electricity from accu as needed on DC motors

b. DC Motor Calculation

DC motors are the main driving component in ascender grappling hook guns. Therefore, it is necessary to analyze mechanical power requirements, convert mechanical power to electrical power, consider dynamic load factors and losses that may occur in the system in this DC motor. The calculation is carried out to obtain a motor that matches the existing load on the basis of the results of weighing the load (personnel + equipment weight + grappling hook equipment weight) which will be pulled by the motor assuming a weight of 150 kg with a motor rotation of 100 rpm and a pully diameter of 10 cm with the formula (2.1).

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

P_Mekanikal= (W.d)/t

Known:

W = 150 Kg x 10 = 1500 N

D = 15 meters

t = 90 Second

r = d/2 = 90 mm/2 =45mm = 0,045 Meter

Pin= 0,9 Kw

n Pully = 8.5 rpm

P_Mekanikal = (1500 N . 15 m)/(90 s)

= (22.056 Nm)/(90 s)

= 250 watts

So the value of the calculation above obtained mechanical power of 245 watts. then next calculate the RPM with the formula equation (2.4):

V =S/t=ω.r→ω=V/r

V =(15 m)/(90 s)

= 0.17 m/s

Then RPM (2.5):

ω=2πn/60→V/r=2πn/60

(0.17 m⁄s)/(0.045 m)=(2.3,14.n)/(60 s)

n=(2.3,14.0.17 m⁄s)/(60 s.0,045 m) n(pully)

=(2.3,14.0.17 m⁄s)/(60 s.0.045 m) 8.5 rpm

=36,09 rpm ×8,5 rpm

=306.765 rpm

Based on the motor output power reference above, the angular velocity ω motor (2.5) is calculated:

ω = (n.2π)/60 rad⁄s

= (306,8. 2 .3,14)/60

=32.11 rad⁄s

From the results obtained at angular speed of 10.5 rad / s can be determined the output power that works on the dc motor is (2.3):

Pout=W.r.V/r

= 1500 N x 0,045 m x (0,17 m⁄s)/(0,045 m)

= 249.75 watts

= 0.2498 Kw

With the calculation of angular speed and output power on the dc motor, the motor efficiency value can be calculated with the formula (2.7):

η= P_out/P_in ×100%

=(0.2498 Kw)/(0.9 Kw)×100%

=27.8 %

Based on the calculation above with a motor efficiency value of 86% including high efficiency, that the motor can produce more mechanical power by using less electrical power. Therefore the electrical power required by the motor can be calculated by the equation formula (2.8):

〖P_Listrik〗_(= P_Mekanikal/〖Effisiensi 〗_Motor)

=(250 watts)/(27.8 %)

=892.8 watts

=0.893 Kw

Referring to the calculation above, a mechanical power of 250 watts was obtained, the efficiency of the motor was high at 27.8% and the electric power was 0.893 Kw or 893 watts, then a DC electric motor with a capacity of 900 watts was selected from the Electric Winch catalog for planning an ascender system on grappling hook guns.

4.1.2 Battery/Accu Implementation with DC Motor

The purpose of implementing battery / accu with this DC motor is to move the DC motor through electricity that has a voltage of 12V so that it can be used as mechanical power in order to rotate the pully on the ascender with a load of 150 KG. With the toggle switch users can adjust the up, down and stop of the DC motor. The following will be discussed by the author in accordance with the results of mechanical electrical system trials according to the results of application. The results that the author reports are based on trials that the author conducts repeatedly so as to produce data as progress reports and tool application reports. In the test, the distance time was calculated when personnel from one of the D3 mechanical engineering students carried out the trial. Starting from the starting position, the start moves with the ascender pulling personnel up by 15 meters and descending by the same distance as when the test personnel carry out the start. After that, the travel time was taken in 5 attempts. Table 2 Ascender movement travel time.

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

Table 2. Ascender movement travel time

NO	TRAVEL TIME UP/DOWN	INFO
1	1.15 minutes/1.05 minutes	Succeed
2	1.12 minutes/1.02 minutes	Succeed
3	1.13 minutes/1.02 minutes	Succeed
4	1.16 minutes/1.01 minutes	Succeed
5	1.15 minutes/1.03 minutes	Succeed

(Source: Processed author)

The time difference that occurred in the experiment above was caused by several factors, namely, position placement, wind speed and field sitiuation with different time spans and differences when the ascender pulled the load up and returned to the starting position. From 5 times data retrieval, the average working time is up and down:

(1.15+1.12+1.13+1.16+1.15)/5 = 6.11/5 = 1.14 minutes (up)

(1.05+1.02+1.02+1.01+1.03)/5 = 5.13/5 = 1.03 minutes (down)

From the results of the calculation above, it can take 1.14 minutes to go up while down takes 1.03 minutes once the ascender operation process with a distance of 15 meters from start to finish rounded up to 2.30 minutes.

4.2 Current and Voltage Testing to Motors

In this test, the author measures the output of current and voltage on the motor using a battery meter. The positive current coming out of the accu is fed to the measuring instrument and forwarded to the drive motor. In measuring the voltage obtained by 12.2 V. in current measurement the author carried out two stages of testing as follows:

a. No-load current testing

In this testing section, the author conducted 2 tests with the right on position (up) and on left (down) position on the toggle switch. The results of the test obtained for the right on position (up) amounted to 4.22A and on the left (down) position amounted to 4.22A.

On right (up) = (4,22+4,22)/2 = 8,44/2 = 4,22 Amphere

On letter (turun) = (4.22+4.22)/2 = 8.44/2 = 4.22 Amphere

So it can be concluded that the average power coming out of the accu to the motor without load according to the position on the toggle switch is 4.22A.

b. Current testing with loads

In this testing section, the author conducted 2 tests with the right on position (up) and on left (down) position on the toggle switch. The results of the test obtained for the right on position (up) amounted to 7.4 A and on the left (down) position amounted to 7.2A.

On right (up) = (7,4+7,4)/2 = 7,4 Amphere

There is a letter (turun) = (7.4+7.4)/2 = 7.4 Amphere

So it can be concluded that the average power coming out of the accu to the DC motor with a load of 150 KG according to the position on the toggle switch, which is 7.4 A.

4.3 Results and Discussion

In this chapter will discuss the results of tests that have been carried out, the discussion carried out is by calculating the power needed to run up and down control on the ascender, and discuss the results of the DC drive motor used by the ascender.

4.3.1 Electric Power Discussion

In the discussion of electric power, the author uses 1 source of electric power, which is the power source in the driving motor on the ascender grappling hook guns. The author will calculate the amount of power needed in the tool that has been designed and in the electrical system of the motor.

4.3.2 DC Drive Motor Discussion

With a rotation of 307.765 rpm from the calculation of pully which has a rotation of 8.5 rpm, the DC motor has a power of 12 V, 7.4 A and 223.2 W. For propulsion, researchers use shafts from the motor to the pully. Researchers use a DC motor used to rotate the pully on the ascender device, the rotation of the dynamo is continued by continuing the rotation to the gearbox after which it is flowed through the shaft to rotate the pully both up and down. Researchers arrange the motor and shaft so that they can rotate the gearbox as a drive, then the rotation of the gearbox is forwarded to the pully using

Volume 15, Number 4, pp.1-10
ISSN: 2460-7037
E-ISSN: 2722-5763

the shaft as a successor to the rotation of the motor. The researcher's power source uses a 12-volt battery. On the ascender, researchers used an 88.8-watt motor to qualify for use on the ascender.

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

Based on the results of design, testing, and analysis during the preparation and making of this final project, the following conclusions were obtained:

a. In designing the control system, the author adopts a series of 6pin 3 position Toggle Switch. This circuit changes the built-in control system on the winch while maintaining the use of cables. By pressing the toggle switch, work orders can be received, and the flow of electricity to the DC motor moves without having to be pressed continuously. Unlike the original control system of the winch motor which requires continuous suppression, this change increases the effectiveness of use.

b. The Ascender uses a 2500Lb ATV Winch motor with 12VDC power which is highly efficient and minimalist. Even so, this motorbike has enough power to lift a load weighing 1133 kg with a ratio of 1:10 from human weight. This motor has a braking system which when the motor stops, the motor will stop without being able to rotate by itself. Therefore, this motorbike is very efficient to support military operational tasks, especially for the Kopaska TNI Navy unit.

c. On the Ascender, an accu battery with a capacity of 12 VDC 7.0Ah is used. For power consumed in one operation reaches 88.8 W, and with an operating time of 6 minutes, this tool can be used up to 9 times operation.

5.2 Suggestion

Based on the conclusions above, some suggestions for future research are as follows:

a. First, research can focus on developing more efficient and ergonomic control system designs, taking into account the integration of automation or remote control technologies to improve user responsiveness and comfort.

b. Secondly, follow-up studies need to be conducted to optimize the power efficiency on the 2500Lb ATV Winch motor and ascender, while exploring more efficient or environmentally friendly power source alternatives.

ACKNOWLEDGEMENT

The authors greatly acknowledge the support from Indonesia Naval Technology College STTAL Surabaya Indonesia for providing the necessary resources to carry out this research work. The authors are also grateful to the anonymous reviewers and journal editorial board for their many insightful comments, which have significantly improved this article.

REFERENCES

Encyclopedia, W. (2023, November 29). History of the Indonesian National Army. Navy.

Hermawan, A. P. (2014, 2 13). Planning of machining systems and actuator systems on Auger Cutter Suction Dredger (ACSD) as a dredging method in the duct. Tehnik ITS, 3, 1.

http://digilib.unhas.ac.id/uploaded_files/temporary/DigitalCollection/.pdf (Retrieved June 1, 2023, at 08:00 WIB).

http://ejurnal.its.ac.id/index.php/teknik/article/view/5821 (Retrieved June 1, 2023, at 08:00 WIB).

http://eprints.itn.ac.id/4323/8/Jurnal%20Skripsi.pdf (Retrieved June 1, 2023, at 08:00 WIB).

https://ojs3.unpatti.ac.id/index.php/metiks/article/view/7243 (Retrieved June 1, 2023, at 08:00 WIB).

https://ny.web.id/pengertian-prinsip-kerja-dan-jenis-jenis-motor-dc._info (Retrieved November 15, 2023, at 08.00 WIB).

https://www.yuasabattery.co.id/produk/detail/91(Retrieved November 17, 2023, at 08:00 WIB).

R P Soumoki, P. E. (2023, 6 12). Analysis of the addition of slipway capacity to Pt. Dock and shipping Waiame (Persero) Ambon. Tehnik electro-engine marine informatics and science.

Grace. (2021). Design an Aircraft Front Wheel Lift and Towing System Control System at the Indonesian Navy Air Base. Surabaya.

TNI, P. (2007, March 7). THE DUTIES OF THE TNI ARE IN ACCORDANCE WITH ARTICLE 7 PARAGRAPH (1) OF LAW NO. 34 OF 2004. Retrieved from www.tni.mil.id.

Wikipedia. (2023, November 27). Frog Squad Commando. Retrieved from https://id.wikipedia.org/wiki/Pusat_Komando_Pasukan_Katak.

Wikipedia. (2023). Kopaska. Retrieved from https://id.wikipedia.org/wiki/Pusat_Komando_Pasukan_Katak.